

Team LiB

Excel 2002 Power Programming with VBA

John Walkenbach

Author of *Excel 2002 Bible*

"An outstanding reference. . . . If you use Excel, you need this book."

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John Walkenbach



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About the Author

John Walkenbach is a leading authority on spreadsheet software and is principal of JWalk and Associates Inc., a small, San Diego-based consulting firm that specializes in spreadsheet application development. John is the author of more than two dozen spreadsheet books and has written more than 300 articles and reviews for a variety of publications, including *PC World*, *InfoWorld*, *Windows*, and *PC/Computing*. He also maintains *The Spreadsheet Page*, a popular Internet Web site (www.j-walk.com/ss), and is the developer of Power Utility Pak, an award-winning add-in for Microsoft Excel. John graduated from the University of Missouri and earned a master's and a Ph.D. from the University of Montana.

In addition to computers and spreadsheet software, John's other interests include guitar, music, novels, digital photography, and puttering around in the garden.

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This one's for Michelle.

Preface

Welcome to *Excel 2002 Power Programming with VBA*. If your job involves developing spreadsheets that others will use — or if you simply want to get the most out of Excel — you’ve come to the right place.

Why I Wrote This Book

Quite a few advanced Excel books are available, but this book is still the only one that deals with spreadsheet application development from a larger perspective. VBA is just one component (albeit a fairly large component) of application development. Excel is an extremely deep software product: It has many interesting features that lurk in the background, unbeknownst to the typical user. And you can use some of the well-known features in novel ways.

Millions of people throughout the world use Excel. I monitor the spreadsheet-related newsgroups on the Internet, and it’s very clear to me that people need (and want) help in the areas that this book covers. My guess is that only five percent of Excel users really understand what the product is capable of. In this book, I attempt to nudge you into that elite company. Are you up to it?

What You Need to Know

This is not a book for beginning Excel users. If you have no experience with Excel, I recommend that you read either of the following books:

- ◆ *Excel 2002 for Windows For Dummies*, by Greg Harvey, is written for users who want to know just enough to get by, and want to be entertained in the process.
- ◆ *Excel 2002 Bible* (by yours truly) provides comprehensive coverage of all the features of Excel. It is meant for users of all levels.

To get the most out of this book, you should be a relatively experienced Excel user. I didn’t spend much time writing basic how-to information. In fact, I assume that you know the following:

- ◆ How to create workbooks, insert sheets, save files, and so on
- ◆ How to navigate through a workbook
- ◆ How to use the menus and shortcut menus

- ◆ How to manage Excel's toolbars
- ◆ How to enter formulas
- ◆ How to use Excel's worksheet functions
- ◆ How to name cells and ranges
- ◆ How to use basic Windows features, such as file management techniques and the clipboard

If you don't know how to perform the preceding tasks, you may find some of this material over your head, so consider yourself warned. If you're an experienced spreadsheet user who hasn't used Excel 2002, Chapter 2 presents a short overview of what this product offers.

What You Need to Have

To make the best use of this book, you need a copy of Excel. Although the book was written with Excel 2002 in mind, most of the material also applies to Excel 2000 and Excel 97. If you use an earlier version of Excel, you're reading the wrong book. Most of the material in this book also applies to Excel for Macintosh. However, I did no compatibility testing with the Mac version, so you're on your own.

Any computer system that can run Windows will suffice, but you'll be much better off with a fast Pentium-based machine with plenty of memory. Excel is a large program, and using it on a slower system or a system with minimal memory can be extremely frustrating.

I recommend using a high-resolution video driver (800 × 600 is okay, 1024 × 768 is excellent, and 1600 × 1024 is sheer heaven). A standard VGA resolution will do in a pinch, but it just doesn't let you see enough on-screen.

To make use of the examples on the companion CD, you will also need a CD-ROM drive.

Conventions in This Book

Take a minute to skim this section and learn some of the typographic conventions used throughout this book.

Keyboard conventions

You need to use the keyboard to enter data. In addition, you can work with menus and dialog boxes directly from the keyboard—a method you may find easier if your hands are already positioned over the keys.

Input

Input that you type from the keyboard appears in boldface—for example, enter **=SUM(B2: B50)** into cell B51.

More lengthy input usually appears on a separate line in a monospace font. For example, I may instruct you to enter the following formula:

```
=VLOOKUP(STOCKNUMBER,PRICELIST,2)
```

VBA code

This book contains many snippets of VBA code, as well as complete procedure listings. Each listing appears in a monospace font; each line of code occupies a separate line. (I copied these listings directly from the VBA module and pasted them into my word processor.) To make the code easier to read, I often use one or more tabs to create indentations. Indentation is optional, but it does help to delineate statements that go together.

If a line of code doesn't fit on a single line in this book, I use the standard VBA line continuation sequence: At the end of a line, a space followed by an underscore character indicates that the line of code extends to the next line. For example, the following two lines are a single line of code:

```
    If Right(ActiveCell, 1) = "!" Then ActiveCell _  
        = Left(ActiveCell, Len(ActiveCell) - 1)
```

You can enter this code either on two lines, exactly as shown, or on a single line without the underscore character.

Functions, filenames, and named ranges

Excel's worksheet functions appear in uppercase monospace font, like so: "Enter a SUM formula in cell C20." VBA procedure names, properties, methods, and objects appear in monospace font: "Execute the GetTotals procedure." I often use mixed upper- and lowercase to make these names easier to read.

Mouse conventions

If you're reading this book, you're well versed in mouse usage. The mouse terminology I use is all standard fare: pointing, clicking, right-clicking, dragging, and so on.

What the Icons Mean

Throughout the book, I've used icons in the left margin to call your attention to points that are particularly important.



I use this icon to indicate that the material discussed is new to Excel 2002. If you're developing an application that will be used for earlier versions of Excel, pay particular attention to these icons.



I use Note icons to tell you that something is important—perhaps a concept that may help you master the task at hand or something fundamental for understanding subsequent material.



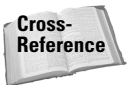
Tip icons indicate a more efficient way of doing something or a technique that may not be obvious.



These icons indicate that an example file is on the companion CD-ROM (see "About the Companion CD-ROM," later in the introduction). This CD holds many of the examples that I cover in the book, as well as a trial copy of my popular Power Utility Pak software.



I use Caution icons when the operation that I'm describing can cause problems if you're not careful.



I use the Cross Reference icon to refer you to other chapters that have more to say on a subject.

How This Book Is Organized

The chapters of this book are grouped into seven main parts. In addition, I've included a few appendixes that provide supplemental information.

Part I: Some Essential Background

In this part, I set the stage for the rest of the book. Chapter 1 presents a brief history of spreadsheets so that you can see how Excel fits into the big picture. In Chapter 2, I offer a conceptual overview of Excel 2002—quite useful for experienced spreadsheet users who are switching to Excel. In Chapter 3, I cover the essentials of formulas, including some clever techniques that may be new to you. Chapter 4 covers the ins and outs of the various files used and generated by Excel.

Part II: Excel Application Development

This part consists of just two chapters. In Chapter 5, I broadly discuss the concept of a spreadsheet application. Chapter 6 goes into more detail and covers the steps typically involved in a spreadsheet application development project.

Part III: Understanding Visual Basic for Applications

Chapters 7 through 11 make up Part III, and these chapters include everything you need to know to learn VBA. In this part, I introduce you to VBA, provide programming fundamentals, and detail how to develop VBA subroutines and functions. Chapter 11 contains tons of useful VBA examples.

Part IV: Working with UserForms

The four chapters in this part cover custom dialog boxes (also known as UserForms). Chapter 12 presents some built-in alternatives to creating custom UserForms. Chapter 13 provides an introduction to UserForms and the various controls you can use. Chapters 14 and 15 present many examples of custom dialog boxes, ranging from basic to advanced.

Part V: Advanced Programming Techniques

Part V covers additional techniques that are often considered advanced. The first three chapters discuss how to develop utilities and how to use VBA to work with pivot tables and charts. Chapter 19 covers the topic of event-handling, which enables you to execute procedures automatically when certain events occur. Chapter 20 discusses various techniques that you can use to interact with other applications (such as Word). Chapter 21 concludes Part V with an in-depth discussion of creating add-ins.

Part VI: Developing Applications

The chapters in Part VI deal with important elements of creating user-oriented applications. Chapters 22 and 23 provide information on creating custom toolbars and menus. Chapter 24 presents several different ways to provide online help for your applications. In Chapter 25, I present some basic information about developing user-oriented applications, and I describe such an application in detail.

Part VII: Other Topics

The five chapters in Part VII cover additional topics that you may find helpful. Chapter 26 presents information regarding compatibility. In Chapter 27, I discuss various ways to use VBA to work with files. In Chapter 28, I explain how to use VBA

to manipulate Visual Basic components such as UserForms and modules. Chapter 29 covers the topic of class modules. I finish the part with a useful chapter that answers many common questions about Excel programming.

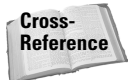
Appendixes

Five appendixes round out the book. Appendix A contains useful information about Excel resources online. Appendix B is a reference guide to all of VBA's keywords (statements and functions). I explain VBA error codes in Appendix C, and Appendix D is a handy ANSI code reference chart. The final appendix describes the files available on the companion CD-ROM.

About the Companion CD-ROM

The inside back cover of this book contains a CD-ROM that holds many useful examples that I discuss in the text. When I write about computer-related material, I emphasize learning by example. I know that I learn more from a well-thought-out example than from reading a dozen pages in a book. I assume that this is true for many other people. Consequently, I spent more time developing the examples on the CD-ROM than I did writing chapters.

The files on the companion CD-ROM are not compressed, so you can access them directly from the CD.



Refer to Appendix E for a description of each file on the CD-ROM.



All CD-ROM files are read-only files. Therefore, if you open a file from the CD-ROM and make any changes to it, you need to save it to your hard drive. In addition, if you copy a file from the CD-ROM to your hard drive, the file retains its read-only attribute. To change this attribute after copying a file, right-click the filename or icon and select Properties from the shortcut menu. In the Properties dialog box, click the General tab and remove the check mark from the Read-only checkbox.

About the Power Utility Pak Offer

Toward the back of the book, you'll find a coupon that you can redeem for a free copy of my popular Power Utility Pak software (normally \$39.95). PUP is an award-winning collection of useful Excel utilities and many new worksheet functions. I developed this package exclusively with VBA.

I think you'll find this product useful in your day-to-day work with Excel, and I urge you to take advantage of this free offer. You can also purchase the complete VBA source code for a nominal fee. Studying the code is an excellent way to pick up some useful programming techniques.

You can take Power Utility Pak for a test drive by installing the 30-day trial version from the companion CD-ROM.

How to Use This Book

You can use this book any way you please. If you choose to read it cover to cover, be my guest. But because I'm dealing with intermediate-to-advanced subject matter, the chapter order is often immaterial. I suspect that most readers will skip around, picking up useful tidbits here and there. If you're faced with a challenging task, you might try the index first to see whether the book specifically addresses your problem.

Reach Out

The publisher and I want your feedback. After you have had a chance to use this book, please take a moment to visit the Hungry Minds, Inc. Web site to register your book and give us your comments. (See the "my2cents.hungryminds.com" page at the back of this book for more details.) Please be honest in your evaluation. If you thought a particular chapter didn't tell you enough, let me know. Of course, I would prefer to receive comments like "This is the best book I've ever read," or "Thanks to this book, I was promoted and now make \$90,000 a year."

I get at least a dozen questions every day, via e-mail, from people who have read my books. I appreciate the feedback. Unfortunately, I simply don't have the time to reply to questions. Appendix A provides a good list of sources that *can* answer your questions.

I also invite you to visit my Web site, which contains lots of Excel-related material. Despite the massive attempts to make this book completely accurate, a few errors have probably crept into its pages. My Web site includes a list of any such errors. The URL is

<http://www.j-walk.com/ss/>

Acknowledgments

First of all, thanks to everyone around the world who purchased the previous editions of this book. The daily positive feedback from readers continues to astound and encourage me.

Many of the ideas for the topics in this book came from postings to the Excel Internet newsgroups. Thanks to all who frequent these services; your problems and questions were the inspiration for many of the examples I present in this book.

This book would not be in your hands if it weren't for the talented people at Hungry Minds, Inc., including Susan Christophersen, my project editor. Special thanks to Bill Manville, my technical editor. Bill provided lots of great feedback and suggestions, and set me straight on more than a few issues.

Finally, thanks to Katlyn, my wonderful daughter and the joy of my life.

John Walkenbach

La Jolla, California

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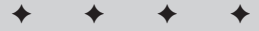
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Some Essential Background

The four chapters in this section provide some useful background information about Excel 2002 and spreadsheets in general. In Chapter 1, you get a brief history of spreadsheets, with insights about why Excel is the superior product for developers. Chapter 2 provides a quick-and-dirty overview of using Excel, complete with lots of tips and helpful suggestions. In Chapter 3, I present some of the formula tricks I've accumulated over the years. Chapter 4 provides many details about the files used and generated by Excel—important information for developers.



In This Part

Chapter 1

Excel 2002: Where It Came From

Chapter 2

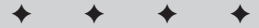
Excel in a Nutshell

Chapter 3

Formula Tricks and Techniques

Chapter 4

Understanding Excel's Files



Excel 2002: Where It Came From

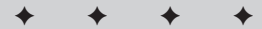
To fully appreciate the application development features available in Excel 2002, it's important to understand where this product came from and how it fits into the overall scheme of things. If you've worked with personal computers and spreadsheets over the past decade, this information may be old hat. If you're a trivia buff, this chapter is a gold mine. Study this chapter and you'll be a hit at the next computer geek party you attend.

A Brief History of Spreadsheets

Most of us tend to take spreadsheet software for granted. In fact, it may be hard to fathom, but there really was a time when electronic spreadsheets were not available. Back then, people relied instead on clumsy mainframes or calculators and spent hours doing what now takes minutes.

It all started with VisiCalc

The world's first electronic spreadsheet, VisiCalc, was conjured up by Dan Bricklin and Bob Frankston back in 1978, when personal computers were pretty much unheard of in the office environment. VisiCalc was written for the Apple II computer, an interesting little machine that is something of a toy by today's standards. But in its day, the Apple II kept me mesmerized for days at a time. VisiCalc essentially laid the foundation for future spreadsheets, and its row-and-column-based layout and formula syntax are still found in modern spreadsheet products. VisiCalc caught on quickly, and many forward-looking companies purchased the Apple II for the sole purpose of developing their budgets with VisiCalc. Consequently, VisiCalc is often credited for much of the Apple II's initial success.

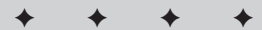


In This Chapter

A history of spreadsheets — where they came from, who makes them, and what differentiates them

A discussion of Excel's evolution

An analysis of why Excel is the best spreadsheet available for developers



In the meantime, another class of personal computers was evolving; these PCs ran the CP/M operating system. A company called Sorcim developed SuperCalc, a spreadsheet that also attracted a legion of followers.

When the IBM PC arrived on the scene in 1981, legitimizing personal computers, VisiCorp wasted no time porting VisiCalc to this new hardware environment, and Sorcim soon followed with a PC version of SuperCalc.

By current standards, both VisiCalc and SuperCalc were extremely crude. For example, text entered into a cell could not extend beyond the cell—a lengthy title had to be entered into multiple cells. Nevertheless, the capability to automate the budgeting tedium was enough to lure thousands of accountants from paper ledger sheets to floppy disks.

Lotus 1-2-3

Envious of VisiCalc's success, a small group of computer freaks at a start-up company in Cambridge, Massachusetts, refined the spreadsheet concept. Headed by Mitch Kapor and Jonathan Sachs, the company designed a new product and launched the software industry's first full-fledged marketing blitz. I remember seeing a large display ad for 1-2-3 in *The Wall Street Journal*. It was the first time that I'd ever seen software advertised in a general interest publication. Released in January 1983, Lotus Development Corporation's 1-2-3 was an instant success. Despite its \$495 price tag (yes, people really paid that much for software), it quickly outsold VisiCalc, rocketing to the top of the sales charts, where it remained for many years.

Lotus 1-2-3 not only improved on all the basics embodied in VisiCalc and SuperCalc but also was the first program to take advantage of the new and unique features found in the powerful 16-bit IBM PC AT. For example, 1-2-3 bypassed the slower DOS calls and wrote text directly to display memory, giving it a snappy and responsive feel that was unusual for the time. The online help system was a breakthrough, and the ingenious “moving bar” menu style set the standard for many years. One feature that really set 1-2-3 apart, though, was its macro capability, a powerful tool that enabled spreadsheet users to record their keystrokes to automate many procedures. When such a macro was “played back,” the original keystrokes were sent to the application. Although this was a far cry from today's macro capability, 1-2-3 macros were definitely a step in the right direction.

1-2-3 was not the first *integrated* package, but it was the first successful one. It combined (1) a powerful electronic spreadsheet with (2) elementary graphics and (3) some limited but handy database features. Easy as 1, 2, 3—get it?

Lotus followed up the original 1-2-3 Release 1 with Release 1A in April 1983. This product enjoyed tremendous success and put Lotus in the enviable position of virtually owning the spreadsheet market. In September 1985, Release 1A was replaced

by Release 2, a major upgrade that was superseded by the bug-fixed Release 2.01 the following July. Release 2 introduced *add-ins*, special-purpose programs that could be attached to give an application new features and extend the application's useful life. Release 2 also had improved memory management, more @ functions (pronounced "at functions"), four times as many rows as its predecessor, and added support for a math coprocessor. It also enhanced the macro language, whose popularity exceeded the developers' wildest dreams.

Not surprisingly, the success of 1-2-3 spawned many *clones* — work-alike products that usually offered a few additional features and sold at a much lower price. Among the more notable were Paperback Software's VP Planner series and Mosaic Software's Twin. Lotus eventually took legal action against Paperback Software for copyright infringement (for copying the "look and feel" of 1-2-3); the successful suit essentially put Paperback out of business.

In the summer of 1989, Lotus shipped DOS and OS/2 versions of the long-delayed 1-2-3 Release 3. This product literally added a dimension to the familiar row-and-column-based spreadsheet; it extended the paradigm by adding multiple spreadsheet pages. The idea wasn't really new, however; a relatively obscure product called Boeing Calc originated the 3D spreadsheet concept, and SuperCalc 5 and CubeCalc also incorporated it.

1-2-3 Release 3 offered features that users wanted, features that ultimately became standard fare: multilayered worksheets, the capability to work with multiple files simultaneously, file linking, improved graphics, and direct access to external database files. But it still lacked an important feature that users were begging for: a way to produce high-quality output.

Release 3 began life with a reduced market potential because it required an 80286-based PC and a minimum of 1MB of RAM — fairly hefty requirements in 1989. But Lotus had an ace up its corporate sleeve. Concurrent with the shipping of Release 3, the company surprised nearly everyone by announcing an upgrade of Release 2.01 (the product materialized a few months later as 1-2-3 Release 2.2). Release 3 was *not* a replacement for Release 2, as most analysts had expected. Rather, Lotus made the brilliant move of splitting the spreadsheet market into two segments: those with high-end hardware and those with more mundane equipment.

1-2-3 Release 2.2 wasn't a panacea for spreadsheet buffs, but it was a significant improvement. The most important Release 2.2 feature was Allways, an add-in that gave users the ability to churn out attractive reports, complete with multiple typefaces, borders, and shading. In addition, users could view the results on-screen in a WYSIWYG (What You See Is What You Get) manner. Allways didn't, however, let users issue any worksheet commands while they viewed and formatted their work in WYSIWYG mode. Despite this rather severe limitation, most 1-2-3 users were overjoyed with this new capability, for they could finally produce near-typeset-quality output.

A Few Words about Copy Protection

In the early days of personal computing, copy-protected software was the rule rather than the exception. Most analysts agree that copy protection makes life more difficult for legitimate users and does very little to actually prevent software piracy.

As you probably know, Microsoft Office XP incorporates “product activation” technology. This technology is targeted to consumers and is designed to prevent “casual copying.” It does not address the vastly more serious problem of real pirates who create and sell counterfeit software.

Ironically, one of the reasons Microsoft Office initially gained prominence in the market place was because it was not copy protected. The competing products at the time (1-2-3 and WordPerfect) were. Other companies realized that copy protection doesn’t work, and it soon became history.

Personally, I think the return to copy-protected software is a bad trend for the software industry; it will only make product installation more complex and frustrate legitimate customers when things go wrong. The success of Microsoft’s new copy-protection method remains to be seen. Will it result in increased sales? I doubt it. Will it cause people to avoid upgrading from a previous version? I think so. Will it cause people to seek out another product? Possibly. Will it be “cracked” and be rendered completely useless? Without a doubt.

In May 1990, Microsoft released Windows 3.0. As you probably know, Windows changed the way people used personal computers. Apparently, the decision makers at Lotus weren’t convinced that Windows was a significant product, and the company was slow getting out of the gate with its first Windows spreadsheet, 1-2-3 for Windows, which wasn’t introduced until late 1991. Worse, this product was, in short, a dud. It didn’t really capitalize on the Windows environment and disappointed many users. Consequently, Excel, which had already established itself as the premier Windows spreadsheet, became the overwhelming Windows spreadsheet market leader (and has never left that position). Lotus came back with 1-2-3 Release 4 for Windows in June 1993, a vast improvement over the original. Release 5 for Windows appeared in mid-1994.

In mid-1994, Lotus unveiled 1-2-3 Release 4.0 for DOS. Many analysts (including myself) expected a product more compatible with the Windows product. But we were wrong; DOS Release 4.0 is simply an upgraded version of Release 3.4. Because of the widespread acceptance of Windows, this should be the last DOS version of 1-2-3 to see the light of day.

Over the years, spreadsheets became less important to Lotus (its flagship product turns out to be Notes). In mid-1995, IBM purchased Lotus Development Corporation. Two more versions of 1-2-3 became available, but it seems to be a case of too little, too late. Excel clearly dominates the spreadsheet market, and 1-2-3 continues to lose market share.

The most recent versions of 1-2-3 feature LotusScript, a scripting language similar to VBA (see Figure 1-1). Spreadsheet developers haven't exactly embraced this language with open arms. In retrospect, Lotus probably should have licensed VBA from Microsoft.

Quattro Pro

The other significant player in the spreadsheet world is (or, I should say, *was*) Borland International. In 1994, Novell purchased both WordPerfect International and Borland's entire spreadsheet business. In 1996, WordPerfect and Quattro Pro were both purchased by Corel Corporation.

Borland started out in spreadsheets in 1987 with a product called Quattro. Essentially a clone of 1-2-3, Quattro offered a few additional features and an arguably better menu system. And it was also much cheaper. Importantly, users could opt for a 1-2-3-like menu system that let them use familiar commands and also ensured compatibility with 1-2-3 macros.

In the fall of 1989, Borland began shipping Quattro Pro, a more powerful product that built upon the original Quattro and trumped 1-2-3 in just about every area. For example, the first Quattro Pro let you work with multiple worksheets in movable and resizable windows — although it did *not* have a graphical user interface (GUI). More trivia: Quattro Pro was based on an obscure product called Surpass, which Borland acquired.

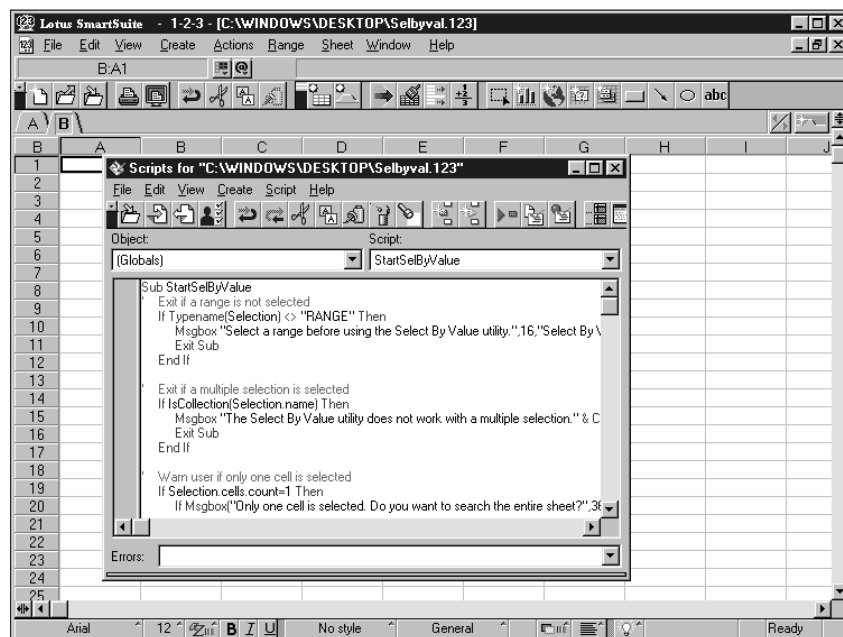


Figure 1-1: Currently, Lotus 1-2-3 includes LotusScript, a VBA-like scripting language.

Released in late 1990, Quattro Pro Version 2.0 added 3D graphs and a link to Borland's Paradox database. A mere six months later — much to the chagrin of Quattro Pro book authors — Version 3.0 appeared, featuring an optional graphical user interface and a slide show feature. In the spring of 1992, Version 4 appeared, having customizable SpeedBars and an innovative analytical graphics feature. Version 5, which came out in 1994, had only one significant new feature: worksheet notebooks (that is, 3D worksheets).

Like Lotus, Borland was slow to jump on the Windows bandwagon. When Quattro Pro for Windows finally shipped in the fall of 1992, however, it provided some tough competition for the other two Windows spreadsheets, Excel 4.0 and 1-2-3 Release 1.1 for Windows. Importantly, Quattro Pro for Windows had an innovative feature, known as the UI Builder, that let developers and advanced users easily create custom user interfaces.

Also worth noting is a lawsuit between Lotus and Borland. Lotus won the suit, forcing Borland to remove the 1-2-3 macro compatibility and 1-2-3 menu option from Quattro Pro. This ruling was eventually overturned in late 1994, however, and Quattro Pro can now include 1-2-3 compatibility features (as if anyone really cares). Both sides spent millions of dollars on this lengthy legal fight, and when the dust cleared, no real winner emerged.

Borland followed up the original Quattro Pro for Windows with Version 5, which was upgraded to Version 6 after Novell took over Borland's spreadsheet business (see Figure 1-2). As I write this, the current version of Quattro Pro is Version 9, which is part of WordPerfect Office 2000. This product boasts some impressive specs, including support for 1 million rows and 18,278 columns (something many Excel users would kill for). In the spreadsheet market, Quattro Pro ranks a distant third.

For a while, Quattro Pro seemed the ultimate solution for spreadsheet developers. But then Excel 5 arrived.

Microsoft Excel

And now on to the good stuff.

Most people don't realize that Microsoft's experience with spreadsheets extends back to the early '80s. Over the years, Microsoft's spreadsheet offerings have come a long way, from the barely adequate MultiPlan to the state-of-the-art Excel 2002.

In 1982, Microsoft released its first spreadsheet, MultiPlan. Designed for computers running the CP/M operating system, the product was subsequently ported to several other platforms, including Apple II, Apple III, XENIX, and MS-DOS.

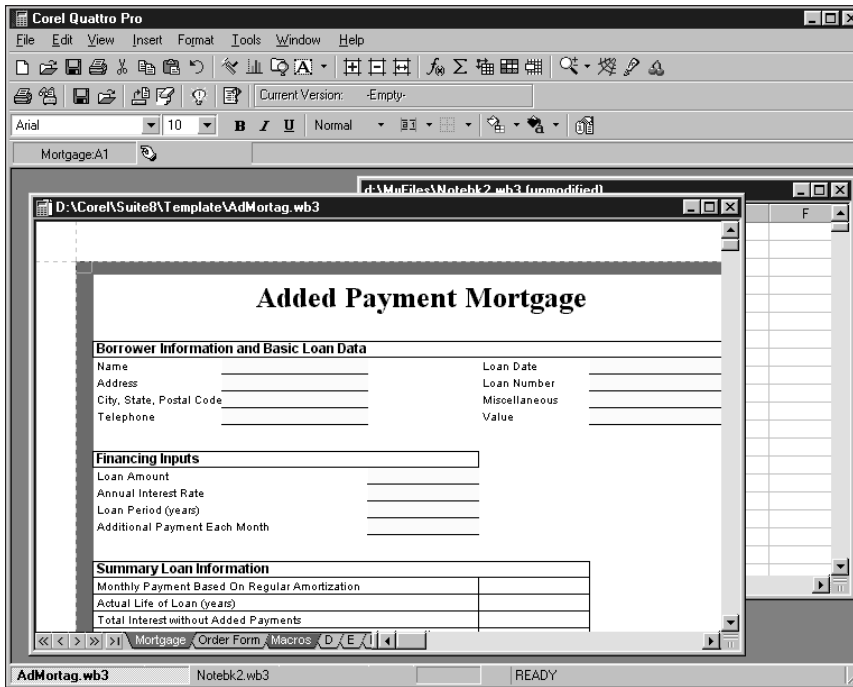


Figure 1-2: Corel's Quattro Pro

MultiPlan essentially ignored existing software user-interface standards. Difficult to learn and use, it never earned much of a following in the United States. Not surprisingly, Lotus 1-2-3 pretty much left MultiPlan in the dust.

Excel sort of evolved from MultiPlan, first surfacing in 1985 on the Macintosh. Like all Mac applications, Excel was a graphics-based program (unlike the character-based MultiPlan). In November 1987, Microsoft released the first version of Excel for Windows (labeled Excel 2.0 to correspond with the Macintosh version). Because Windows was not in widespread use at the time, this version included a runtime version of Windows — a special version that had just enough features to run Excel and nothing else. Less than a year later, Microsoft released Excel Version 2.1. In July 1990, Microsoft released a minor upgrade (2.1d) that was compatible with Windows 3.0. Although these 2.x versions were quite rudimentary by current standards (see Figure 1-3) and didn't have the attractive, sculpted look of later versions, they attracted a small but loyal group of supporters and provided an excellent foundation for future development. The macro language (XLM) consisted of functions that were evaluated in sequence. It was quite powerful, but very difficult to learn and use. As you'll see, the XLM macro language was replaced by VBA, which is the topic of this book.

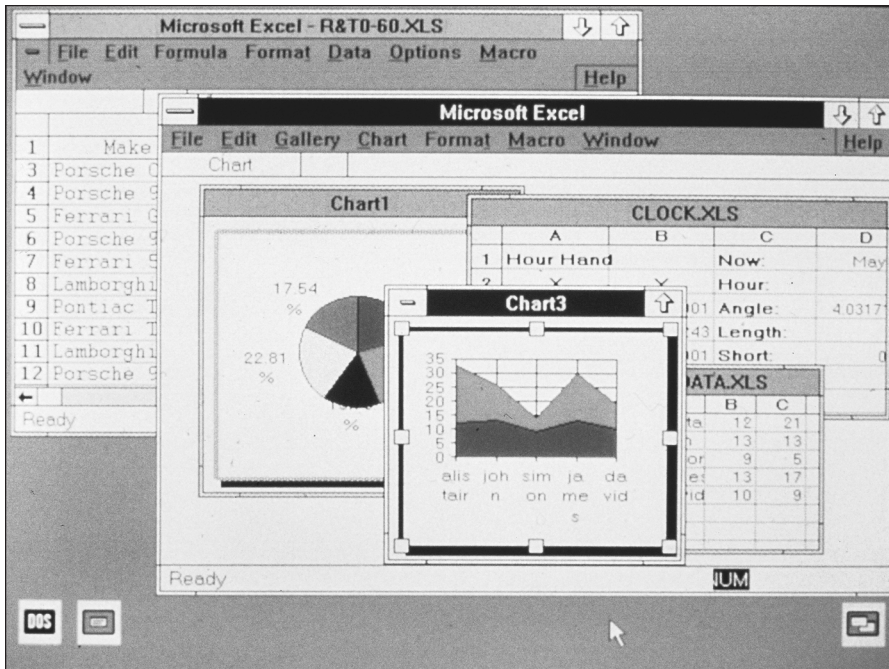


Figure 1-3: The original Excel 2.1 for Windows. This product has come a long way, no? (Photo courtesy of Microsoft)

Meanwhile, Microsoft developed a version of Excel (numbered 2.20) for OS/2 Presentation Manager, released in September 1989 and upgraded to Version 2.21 about ten months later. OS/2 never quite caught on, despite continued efforts by IBM.

In December 1990, Microsoft released Excel 3 for Windows, a significant improvement in both appearance and features (see Figure 1-4). The upgrade included a toolbar, drawing capabilities, a powerful optimization feature (Solver), add-in support, Object Linking and Embedding (OLE) support, 3D charts, macro buttons, simplified file consolidation, workgroup editing, and wordwrap text in a cell. Excel 3 also had the capability to work with external databases (via the Q+E program). The OS/2 version upgrade appeared five months later.

Version 4, released in the spring of 1992, not only was easier to use, but also had more power and sophistication for advanced users (see Figure 1-5). Excel 4 took top honors in virtually every spreadsheet product comparison published in the trade magazines. In the meantime, the relationship between Microsoft and IBM became increasingly strained; Excel 4 was never released for OS/2, and Microsoft has stopped making versions of Excel for OS/2.

Pro Forma Income Statement - Five-year Projection					
Revenues (in thousands)	1991	1992	1993	1994	1995
Canada	184,845	203,330	223,663	246,029	270,632
Mexico	49,292	49,785	50,283	50,786	51,294
United States	1,232,300	1,355,530	1,219,977	1,341,975	1,476,173
North America	1,466,437	1,608,645	1,493,923	1,638,790	1,798,099
France	184,845	194,087	203,791	213,981	224,680
Germany	308,075	369,690	373,387	410,726	414,833
Other European	61,615	92,423	184,846	258,784	362,298
United Kingdom	61,615	67,777	74,555	82,011	90,212
Europe	616,150	723,977	<i>Great increase from 1991</i>	965,502	1,092,023
Australia	48,392	53,231		64,409	70,850
Japan	439,931	879,862		2,287,641	2,973,933
Korea	43,993	65,990		148,478	222,717
Taiwan	65,990	82,488	103,110	128,988	161,110
Far East	598,306	1,081,571	2,020,373	2,629,416	3,428,610
Total Revenue	2,680,893	3,414,193	4,350,875	5,233,708	6,318,732
Cost of Goods Sold	1,340,447	1,474,492	1,621,941	1,784,135	1,962,549

Figure 1-4: Excel 3 was a vast improvement over the original release. (Photo courtesy of Microsoft)

Excel 5 hit the streets in early 1994 and immediately earned rave reviews. Like its predecessor, it finished at the top of every spreadsheet comparison published in the leading trade magazines. Despite stiff competition from 1-2-3 Release 5 for Windows and Quattro Pro for Windows 5—both were fine products that could handle just about any spreadsheet task thrown their way—Excel 5 continued to rule the roost. This version, by the way, was the first to feature VBA.

Excel 95 (also known as Excel 7) was released concurrently with Microsoft Windows 95. Microsoft skipped over Version 6 to make the version numbers consistent across its Office products. On the surface, Excel 95 didn't appear to be much different from Excel 5. Much of the core code was rewritten, however, and speed improvements were apparent in many areas. Importantly, Excel 95 used the same file format as Excel 5, which is the first time an Excel upgrade didn't use a new file format. This compatibility wasn't perfect, however, because Excel 95 included a few enhancements in the VBA language. Consequently, it was possible to develop an application using Excel 95 that would load (but not run properly) in Excel 5.

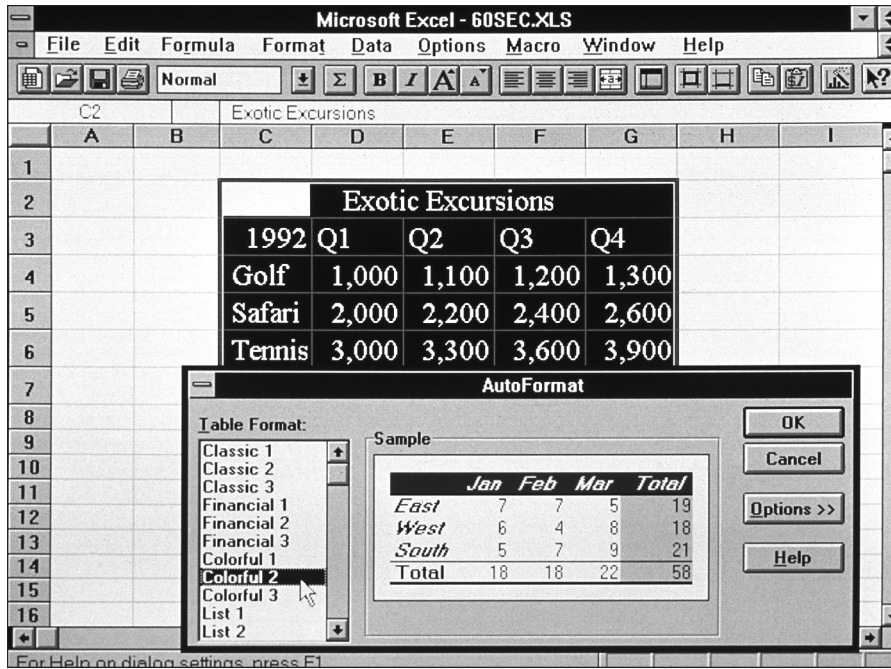
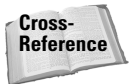


Figure 1-5: Excel 4 was another significant step forward, although still far from Excel 5. (Photo courtesy of Microsoft)

In early 1997, Microsoft released Office 97, which included Excel 97. Excel 97 is also known as Excel 8. This version included dozens of general enhancements plus a completely new interface for developing VBA-based applications. In addition, the product offered a new way of developing custom dialog boxes (called UserForms rather than dialog sheets). Microsoft tried to make Excel 97 compatible with previous versions, but the compatibility is far from perfect. Many applications that were developed using Excel 5 or Excel 95 require some tweaking before they will work with Excel 97 or later versions.



I discuss compatibility issues in Chapter 26.

Excel 2000 was released in early 1999 and is also sold as part of Office 2000. The enhancements in Excel 2000 deal primarily with Internet capabilities, although a few significant changes are apparent in the area of programming.

Excel 2002 hit the market in mid-2001. Like its predecessor, it doesn't offer a raft of significant new features. Rather, it has a number of minor new features and several refinements of existing features. Perhaps the most compelling new feature is the ability to repair damaged files and save your work when Excel crashes. Excel will continue its market dominance and will remain the standard for users of all levels.

Spreadsheets Today

As I've watched the various spreadsheet products come and go over the years, I've seen some dramatic changes and some astounding shifts in the market. With each version of each product, the designers show a willingness to "borrow" their competitors' successful features. As a result, the three major spreadsheets are now, by and large, virtually identical from the standpoint of the typical user. Excel has, however, continued to gain market share and now dominates the spreadsheet world. In fact, competition in the spreadsheet market has virtually disappeared — which may explain why we haven't seen many significant new features in Excel in the past few upgrades.

How do you decide which product to use? Consider these factors:

- ♦ *Corporate policy.* Of course, most users end up using a particular spreadsheet because of corporate policy. Most companies choose a spreadsheet and stick with it. So, most end users are stuck with a spreadsheet.
- ♦ *Inertia.* Users tend to stick with a product, upgrading when possible, even if a better product is available. The phrase *If it ain't broke, don't fix it* comes to mind.
- ♦ *Familiarity.* In the past, 1-2-3 users often found Excel difficult to adapt to, and vice versa. Although the user interfaces of the latest versions are strikingly similar, each product has its own distinct look and feel. Users tend to use products that just "feel" right.
- ♦ *Standout features.* A standout feature or two can catch a user's fancy. Although today's spreadsheets possess similar features, not all implement these features equally well. For example, all three of the leading spreadsheets offer scenario management, but 1-2-3 far surpasses its competition in this area.
- ♦ *Recommendations.* Unless they're intimately involved with the spreadsheet industry, most people really don't have the foggiest idea where to start when evaluating spreadsheet products. Consequently, most rely heavily on recommendations from friends, associates, and the media.
- ♦ *Compatibility.* This is a broad term that covers an application's file formats and menu structures as well as how the application works with other software and operating environments (hardware and software).
- ♦ *Manufacturer stability.* Nobody wants to buy a spreadsheet from a company that may go out of business in six months. That would mean no support and no upgrades.
- ♦ *Programmability.* All spreadsheets have some sort of macro capability. But as you'll see, Excel is clearly the winner in this area. VBA is a significant step forward that makes competing macro features pale in comparison.

- ♦ *Peer support.* A primary source for spreadsheet help is the Internet. Web sites, newsgroups, and online “knowledge bases” provide answers to just about any spreadsheet question that may arise. The amount of material available for the popular spreadsheets varies quite a bit. I estimate that 95 percent of all spreadsheet information on the Internet deals with Excel.
- ♦ *Cost.* Unlike with most products, *price* is not usually a major issue.
- ♦ *Bundling.* When consumers purchase a new computer, it is usually bundled with an operating system and software (which often includes a spreadsheet product).

Given these factors, it’s no wonder that Excel remains the leading Windows spreadsheet. It was first on the scene, and I doubt that many original Excel users have switched. It has several standout features (pivot tables, data filtering, and add-ins, to name a few). It almost always comes out on top in head-to-head reviews. Its file format makes it quite compatible with other spreadsheets, and it’s also extremely compatible with other Microsoft applications.

For application development, Excel is without peer. In addition, many individuals and corporations alike choose Excel because it and Windows come from the same company, Microsoft, which happens to be the world’s most successful software company and isn’t going to disappear any time in the near future (although its corporate structure may change). If you’re looking for spreadsheet information on the Internet, you’ll have dozens of Web sites and newsgroups to choose from. Finally, when you buy Excel as part of the Microsoft Office package, it’s dirt cheap. And it’s even cheaper if it comes bundled with a new computer.

Why Excel Is Great for Developers

Spreadsheet-based application development will become increasingly important over the next few years. Excel 2002, a highly programmable product, is easily the best choice for developing spreadsheet-based applications because it supports the VBA language, which is now in widespread use.

For developers, Excel’s key features include the following:

- ♦ *File structure.* The multisheet orientation makes it easy to organize elements of an application and store it in a single file. For example, a single workbook file can hold any number of worksheets and chart sheets. UserForms and VBA modules are stored with a workbook but are invisible to the end user.
- ♦ *Visual Basic for Applications.* This macro language lets you create structured programs directly in Excel. Excel isn’t the only spreadsheet to include a structured scripting language (1-2-3 offers LotusScript, for example), but it’s certainly the best implementation.

- ♦ *Easy access to controls.* Excel makes it very easy to add controls such as buttons, list boxes, and option buttons to a worksheet. Implementing these controls often requires little or no macro programming.
- ♦ *Custom dialog boxes.* You can easily create professional-looking dialog boxes. Excel 2000's UserForm feature (introduced in Excel 97) is a vast improvement over the old dialog sheets.
- ♦ *Custom worksheet functions.* Using VBA, you can create custom worksheet functions to simplify formulas and calculations.
- ♦ *Customizable menus.* You can change menu elements, add to existing menus, or create entirely new menus. Other products enable you to do this as well, but Excel makes it extremely easy.
- ♦ *Customizable shortcut menus.* Excel is the only spreadsheet that lets you customize the right-click, context-sensitive shortcut menus.
- ♦ *Customizable toolbars.* It's easy to create new toolbars as another user interface option. Again, other spreadsheets let you do this as well, but Excel out-muscles them all.
- ♦ *Powerful data analysis options.* Excel's pivot table feature makes it very easy to summarize large amounts of data with very little effort.
- ♦ *Microsoft Query.* You can access important data directly from the spreadsheet environment. Data sources include standard database file formats, text files, and Web pages.
- ♦ *Data Access Objects (DAO) and ActiveX Data Objects (ADO).* These features make it easy to work with external databases using VBA.
- ♦ *Extensive protection options.* Your applications can be kept confidential and protected from changes. Again, pretty standard fare, but Excel has some advantages.
- ♦ *Ability to create "compiled" add-ins.* With a single command, you can create XLA add-in files that install seamlessly.
- ♦ *Support for automation.* Using VBA, you can control other applications that support automation. For example, you can generate a report in Microsoft Word.
- ♦ *Ability to create Web pages.* It's very easy to create an HTML document from an Excel workbook.

Excel's Role in Microsoft's Strategy

Currently, most copies of Excel are sold as part of Microsoft Office — a *suite* of products that includes a variety of other programs (the exact programs you get depend on which version of Office you buy). Obviously, it helps if the programs can communicate well with each other. Microsoft is at the forefront of this trend. All the Office products have extremely similar user interfaces, and all support VBA.

Therefore, after you hone your VBA skills in Excel, you'll be able to put them to good use in other applications — you just need to learn the object mode for the other applications.

Summary

In this chapter, I sketched the evolution of spreadsheets. I provided an overview of the various versions of the major spreadsheet product lines, and I explained why Excel is so successful and is an excellent choice for application development. I hope that you gained a new appreciation of Excel while preparing for your next spreadsheet trivia contest.

In the next chapter, I provide a quick-and-dirty overview of Excel for newcomers.



Excel in a Nutshell

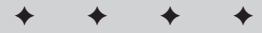
In this chapter, I provide a broad overview of the major components of Excel 2002. This chapter will prove especially useful for readers who have experience with another spreadsheet and are moving up to Excel. Veteran 1-2-3 users, for example, usually need help thinking in Excel's terms. But even experienced Excel users still may learn a thing or two by skimming through this chapter.

Thinking in Terms of Objects

When you are developing applications with Excel (especially when you are dabbling with VBA), it's helpful to think in terms of *objects*, or Excel elements that you can manipulate manually or via a macro. Some examples of Excel objects are:

- ◆ The Excel application itself
- ◆ An Excel workbook
- ◆ A worksheet in a workbook
- ◆ A range in a worksheet
- ◆ A ListBox control on a UserForm (a custom dialog box)
- ◆ A chart sheet
- ◆ A chart on a chart sheet
- ◆ A chart series on a chart

Notice that something of an *object hierarchy* exists here: The Excel object contains workbook objects, which contain worksheet objects, which contain range objects. This hierarchy comprises Excel's *object model*. Excel has approximately 200 classes of objects that you can control directly or by using VBA. Other Office 2002 products have their own object models, and Office itself even has an object model.

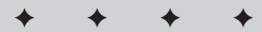


In This Chapter

An introduction to Excel's "object orientation"

A conceptual overview of Excel 2002, including a description of its major features

Some tips and techniques that even advanced users may find helpful



Where Are the VBA Module Sheets?

VBA first appeared in Excel 5. In this version (as well as in Excel 95), a VBA module appeared in a workbook as a separate sheet. A VBA module, as you may know, holds VBA code. Beginning with Excel 97, VBA modules no longer appear as separate sheets. Rather, you work with VBA modules in the Visual Basic Editor (VBE). To view or edit a VBA module, activate the VBE by pressing Alt+F11. Subsequent chapters discuss VBA modules in depth.



Note

Controlling objects is fundamental to developing applications. Throughout this book, you learn how to automate tasks by controlling Excel's objects, and you do so using VBA. This concept becomes clearer in subsequent chapters.

Workbooks

One of the most common Excel objects is a *workbook*. Everything you do in Excel takes place in a workbook, which is stored in a file that, by default, has an XLS extension.

An Excel workbook can hold any number of sheets (limited only by memory). There are four types of sheets:

- ♦ Worksheets
- ♦ Chart sheets
- ♦ XLM macro sheets (obsolete, but still supported)
- ♦ Dialog sheets (obsolete, but still supported)

You can open as many workbooks as you like (each in its own window), but at any given time, only one workbook is the *active workbook*. Similarly, only one sheet in a workbook is the *active sheet*. To activate a sheet, click its sheet tab, which is located at the bottom of the screen. To change a sheet's name, double-click the tab and enter the new text. Right-clicking a tab brings up a shortcut menu.



New Feature

Excel 2002 also lets you color-code your sheet tabs. To do so, choose Format ⇨ Sheet ⇨ Tab Color. Color-coding sheet tabs may help identify a particular sheet, especially when the workbook has many sheets.

You can also hide the window that contains a workbook by using the Window ⇨ Hide command. A hidden workbook window remains open, but it is not visible.

How Big Is a Worksheet?

It's interesting to stop and think about how big a worksheet really is. Do the arithmetic ($256 \times 65,536$), and you'll see that a worksheet has 16,777,216 cells. Remember, this is in just one worksheet. A single workbook can hold more than one worksheet.

If you're using the standard VGA video mode with the default row heights and column widths, you can see 9 columns and 18 rows (or 162 cells) at a time. This works out to less than 0.001 percent of the entire worksheet. Put another way, a single worksheet contains nearly 104,000 VGA screens of information.

If you started entering a single digit into each cell at a relatively rapid clip of one cell per second, it would take you about 194 days, nonstop, to fill up a worksheet. Printing the results of your efforts would require more than 36,000 sheets of paper—a stack about six feet tall.

Filling an entire workbook with values is not recommended. Such a file would be huge and extremely slow to work with because Windows would be continually paging information to disk. As you may have surmised, Excel does not allocate memory for each cell; only cells that are actually used take up memory.

Worksheets

The most common type of sheet is a worksheet, which is what people normally think of when they think of a spreadsheet. Every Excel worksheet has 256 columns and 65,536 rows. And, to answer a common question, the number of rows and columns cannot be changed. You can hide unneeded rows and columns to keep them out of view, but you cannot increase the number of rows or columns. The ability to increase the number of columns is easily one of the top five requests from Excel users, but (for whatever reason) Microsoft continues to ignore such requests.

**Note**

Versions prior to Excel 97 had only 16,384 rows.

The real value of using multiple worksheets in a workbook is not access to more cells. Rather, multiple worksheets enable you to organize your work better. Back in the old days, when a file comprised a single worksheet, developers wasted a lot of time trying to organize the worksheet to hold their information efficiently. Now you can store information on any number of worksheets and still access it instantly by clicking a sheet tab.

As you know, a worksheet cell can hold a constant value or the result of a formula. The value may be a number, a date, a Boolean value (True or False), or text. Every worksheet also has an invisible draw layer, which lets you insert graphic objects, such as charts, diagrams, drawing objects, UserForm controls, pictures, and embedded objects.



The geographic mapping feature, found in previous versions of Excel, is no longer available in Excel 2002. If you relied on this feature in the past, upgrading to Excel 2002 is not recommended.

You have complete control over the column widths and row heights—in fact, you can even hide rows and columns (as well as entire worksheets). Text in a cell can be displayed vertically (or at an angle) and even wrap around to occupy multiple lines.

Chart sheets

A chart sheet normally holds a single chart. Many users ignore chart sheets, preferring to store charts on the worksheet's draw layer. Using chart sheets is optional, but they make it a bit easier to print a chart on a page by itself, and they are especially useful for presentations.

XLM macro sheets

An XLM macro sheet (also known as an MS Excel 4 macro sheet) is essentially a worksheet, but it has some different defaults. More specifically, an XLM macro sheet displays formulas rather than the results of formulas. In addition, the default column width is larger than in a normal worksheet.

As the name suggests, an XLM macro sheet is designed to hold XLM macros. As you may know, the XLM macro system is a holdover from previous versions of Excel (version 4.0 and earlier). Excel 2002 continues, however, to support XLM macros for compatibility reasons—although it no longer provides the option of recording an XLM macro. This book does not cover the XLM macro system; instead, it focuses on the more powerful VBA macro system.

Excel 5/95 dialog sheets

In Excel 5 and Excel 95, you created a custom dialog box by inserting a special dialog sheet. Excel 97 and later versions still support these dialog sheets, but a much better alternative is available: UserForms. You work with UserForms in the Visual Basic Editor.

When you open a workbook that contains an Excel 5/95 dialog sheet, the dialog sheet appears as a sheet in the workbook.



If, for compatibility purposes, you need to insert an Excel 5/95 dialog sheet, you won't find the command to do so on the Insert menu. The only way to add an Excel 5/95 dialog sheet is to right-click any sheet tab and select Insert from the shortcut menu. Then, in the Insert dialog box, click the MS Excel 5.0 Dialog icon.

Be aware that I do not discuss Excel 5/95 dialog sheets in this book (refer to my *Excel for Windows 95 Power Programming with VBA*, IDG Books Worldwide, Inc.).

Excel's User Interface

The *user interface* (UI) is the means by which an end user communicates with a computer program. A UI includes elements such as menus, toolbars, dialog boxes, keystroke combinations, and so on. For the most part, Excel uses the standard Windows UI to accept commands, but it deviates from the standard Windows UI in at least one area—Excel's menus are not “standard” Windows menus.

Menus

Beginning with Excel 97, the menus are actually toolbars in disguise. The icons that accompany some menu items are a dead giveaway.

Excel's menu system is relatively straightforward. Two different menu bars exist (one when a worksheet is active; the other when a chart sheet is active or when a chart object in a worksheet is selected). Consistent with Windows conventions, inappropriate menu commands are dimmed and commands that open a dialog box are followed by an ellipsis. Where appropriate, the menus list any available shortcut key combinations (for example, the Edit menu lists Ctrl+Z as the shortcut key for Edit ⇨ Undo).

Several menu items are *cascading menus*. Clicking such a menu item leads to a submenu that has additional commands (Edit ⇨ Fill is a cascading menu, for example). Cascading menus are indicated by a small right-pointing arrow.

The entire menu system can be customized by the end user or developer. To do so, choose the View ⇨ Toolbars ⇨ Customize command. It's important to understand that menu changes made by using this technique are “permanent.” In other words, the menu changes remain in effect even if you close Excel and restart it. This is *very* different from the Menu Editor found in Excel 5 and Excel 95—and is no longer available in Excel 2002.

**Note**

If you need to modify a menu created with the menu editor found in Excel 5 or Excel 95, you'll need to use Excel 5 or Excel 95 to make the change. Or, seek out a utility program that can do the job.

Excel also features context-sensitive shortcut menus, which appear when the user right-clicks after selecting one or more objects. Importantly, the end user or developer can customize any of the shortcut menus.

**Cross-Reference**

Refer to Chapter 23 for more information about customizing menus.

Dialog boxes

Most of the menu commands in Excel display a dialog box. These dialog boxes are quite consistent in terms of how they operate, except for some subtle differences found in the dialog boxes produced by the Analysis ToolPak add-in (which was written by a third party).

Some of Excel's dialog boxes use a notebook tab metaphor, which makes a single dialog box function as several different dialog boxes. The Options dialog box (choose Tools ⇨ Options) is an example of a tabbed dialog box (see Figure 2-1). This dialog box has 13 tabs.

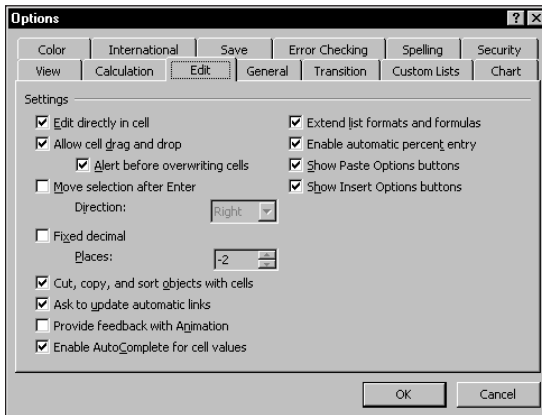
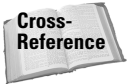


Figure 2-1: Tabbed dialog boxes make many options accessible without overwhelming the user.

The UserForm feature (which debuted in Excel 97) is a significant advancement because it enables the developer to create more robust dialog boxes, including tabbed dialog boxes (using the MultiPage control).



Refer to Part IV for information about creating and working with UserForms.

Toolbars

Excel 2002 ships with dozens of predefined toolbars (including the two toolbars that function as menus), and you can create as many new toolbars as you like. Use the View ⇨ Toolbars ⇨ Customize command to customize toolbars or create new ones. You can distribute customized toolbars by attaching them to workbooks.

You can *dock* toolbars (position them along any edge of the screen) or make them *float*. By default, Excel displays the Standard and Formatting toolbars directly below the menu bar.

The toolbar buttons can be displayed in either of two sizes — although the large size buttons are simply too large in my opinion. A crude but effective toolbar button editor is built into Excel (see Figure 2-2). Excel provides a huge assortment of toolbar button images, however, so you probably won't need to use the button editor.

New Toolbars

Excel 2002 features a number of new toolbars.

- ♦ *Task Pane*. Although this doesn't look like a toolbar, technically it is one. The Task Pane varies, depending on what you are doing. It can display tools to open or create new files, comprehensive search tools, or a list of items currently on the clipboard.
- ♦ *Watch Window*. Enables you to monitor the values in any number of cells, even if the cells are not visible on-screen.
- ♦ *Text To Speech*. Reads the contents of cells (useful for proofreading).
- ♦ *Organization Chart*. Contains tools to customize organization charts.
- ♦ *Protection*. Contains tools to help you with various types of protection.
- ♦ *Diagram*. Contains tools for manipulating diagrams created with the Insert Diagram command.
- ♦ *Drawing Canvas*. Contains tools to change the size of diagrams.
- ♦ *Borders*. Contains tools to let you "draw" borders around cells.



I discuss toolbars in detail in Chapter 22.

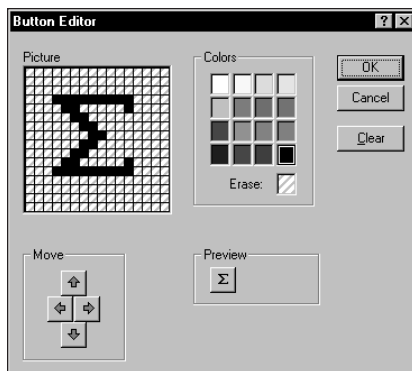


Figure 2-2: Excel's toolbar button editor is nothing to write home about, but it does the job.

Drag-and-drop

Excel's drag-and-drop UI feature enables you to freely drag objects that reside on the draw layer to change their position. Pressing Ctrl while dragging duplicates the selected objects.

Excel also allows drag-and-drop actions on cells and ranges: You can easily drag a cell or range to a different position. And pressing Ctrl while dragging copies the selected range.

**Note**

Drag-and-drop is optional; you can disable it in the Edit tab of the Options dialog box.

You can also drag a range to the Windows desktop, creating a “scrap” object. You can then drag this object to another workbook (or to another application) and insert it as an OLE object.

Keyboard shortcuts

Excel has many keyboard shortcuts. For example, you can press Ctrl+C to copy a selection. If you’re a newcomer to Excel—or you just want to improve your efficiency—I urge you to check out the online help (access the *Keyboard Shortcuts* index and go from there). Learning these shortcuts is key to becoming proficient in Excel. The help file has tables that summarize useful keyboard commands and shortcuts.

Customizing the Display

Excel offers a great deal of flexibility regarding what is displayed on-screen (status bar, formula bar, toolbars, and so on). For example, by choosing View ⇨ Full Screen, you can get rid of everything except the menu bar, thereby maximizing the amount of information visible. In addition, by using the View tab in the Options dialog box, you can customize what is displayed in a worksheet window (you can even hide scroll bars and grid lines).

In fact, Excel makes it possible to develop an application that doesn’t even look like a spreadsheet.

Data Entry

Data entry in Excel is quite straightforward. Excel interprets each cell entry as one of the following:

- ♦ A numeric value (including date and time values)
- ♦ Text
- ♦ A formula
- ♦ A Boolean value (True or False)

Data Entry Tips

The following data entry tips are especially useful for those who are moving up to Excel from another spreadsheet:

- ♦ If you select a range of cells before entering data, you can press Enter to end a cell entry and move to the next cell in the selected range. Similarly, use Shift+Enter to move up, Tab to move to the right, and Shift+Tab to move to the left.
- ♦ To enter data without pressing the arrow keys, enable the Move Selection after Enter option in the Edit tab of the Options dialog box (which you access from the Tools ⇨ Options command). You can also choose the direction in which you want to go.
- ♦ To enter the same data into each cell of a range, select the range, enter the information into the active cell, and then press Ctrl+Enter.
- ♦ To copy the contents of the active cell to all other cells in a selected range, press F2 and then Ctrl+Enter.
- ♦ To fill a range with increments of a single value, press Ctrl while you drag the fill handle at the bottom-right corner of the selection.
- ♦ To create a custom AutoFill list, use the Custom Lists tab of the Options dialog box.
- ♦ To copy a cell without incrementing, drag the fill handle at the corner of the selection. Or press Ctrl+D to copy down or Ctrl+R to copy to the right.
- ♦ You can enter tabs and carriage returns in a cell to make the text easier to read. To enter a tab, press Ctrl+Alt+Tab. To enter a carriage return, press Alt+Enter. Carriage returns cause a cell's contents to wrap within the cell.
- ♦ To enter a fraction, press 0, a space, and then the fraction (using a slash). Excel formats the cell using the Fraction number format.
- ♦ To automatically format a cell with the Currency format, type the currency symbol (a dollar sign in the U.S.) before the value. To enter a value in Percent format, type a percent sign after the value. You can also include thousand separator symbols to separate thousands (for example, use commas in the U.S.: 4,123,434).
- ♦ Press Ctrl+; to insert the current date and Ctrl+Shift+; to enter the current time into a cell.
- ♦ To set up a cell or range so it only accepts entries of a certain type (or within a certain value range), use the Data ⇨ Validation command.

Formulas always begin with an equals sign (=). Excel is accommodating to habitual 1-2-3 users, however, and accepts an ampersand (&), a plus sign (+), or a minus sign (-) as the first character in a formula. It automatically adjusts the entry after you press Enter.

Selecting Objects

Generally, selecting objects conforms to standard Windows practices. You can select a range of cells by clicking and dragging. Clicking an object that has been placed on the draw layer selects the object. To select multiple objects or noncontiguous cells, press Ctrl while you select the objects or cells. To select a large range, click a cell at any corner of the range, scroll to the opposite corner of the range, and press Shift while you click the opposite corner cell.

Note

In versions prior to Excel 97, clicking an embedded chart selected the chart. In Excel 97 and later, clicking a chart selects a specific object within the chart. To select the chart object itself, press Ctrl while you click the chart.

Formatting

Excel provides two types of formatting: numeric formatting and “stylistic” formatting.

Numeric formatting

Numeric formatting refers to how a value appears in the cell. In addition to choosing from an extensive list of predefined formats, you can create your own formats (see Figure 2-3). The procedure is thoroughly explained in the online help system.

Excel applies some numeric formatting automatically, based on the entry. For example, if you precede a value with your currency symbol (a dollar sign in the U.S.), Excel applies Currency number formatting.

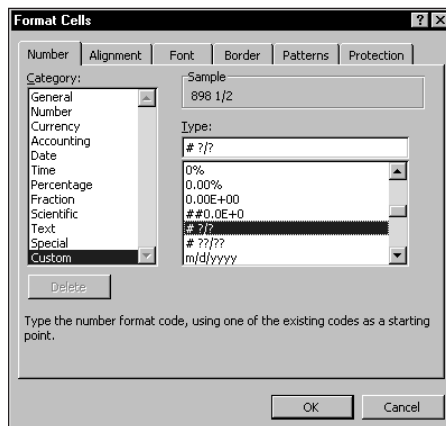


Figure 2-3: Excel’s numeric formatting options are very flexible.

Stylistic formatting

Stylistic formatting refers to the formatting that you apply to make your work look good. Many toolbar buttons offer direct access to common formatting options, regardless of whether you're working with cells, drawn objects, or charts. For example, you can use the Fill Color toolbar button to change the background color of a cell, change the fill color of a drawn text box, or change the color of a bar in a chart. But you'll want to access the Format dialog box for the full range of formatting options.

The easiest way to get to the correct dialog box and format an object is to select the object and press Ctrl+1. Or, right-click the object and choose Format *xxx* (where *xxx* is the selected object) from the shortcut menu. This action leads to a tabbed dialog box that holds all the formatting options for the selected object.

Excel's conditional formatting feature is particularly useful. This feature, accessed by selecting Format ⇨ Conditional Formatting, allows you to specify formatting that will be applied only if certain conditions are met. For example, you can make cells that exceed a specified value appear in a different color.

Formulas

Formulas are what make a spreadsheet a spreadsheet. Excel has some important formula-related features that are worth knowing. They enable you to write array formulas, use an intersection operator, include links, and create megaformulas (my term for a lengthy and incomprehensible — but very efficient — formula).



Chapter 3 covers formulas and presents lots of tricks and tips.

Names

All spreadsheets let you use names for cells and ranges, but Excel handles names in some unique ways.

A *name* is an identifier that enables you to refer to a cell, range, value, formula, or graphic object. Formulas that use names are much easier to read than formulas using cell references, and it's much easier to create formulas that use named references.



I discuss names in Chapter 3.

Functions

Worksheet functions enable you to perform calculations or operations that would otherwise be impossible. Excel provides a huge number of built-in functions, and you can access even more functions (many of them quite esoteric) by attaching the Analysis ToolPak add-in.

The easiest way to locate the function you need is to use the Insert Function dialog box, shown in Figure 2-4. Access this dialog box by clicking the Insert Function button on the formula bar (or by selecting Insert ⇨ Function or pressing Shift+F3). If you're not familiar with this feature, I encourage you to check it out. It's very handy.

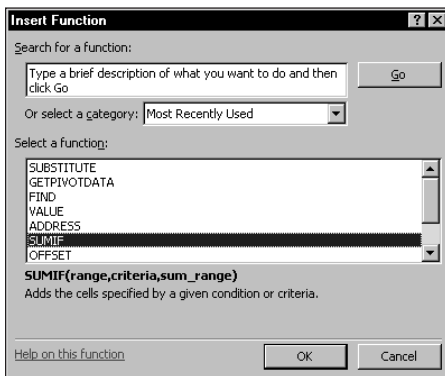


Figure 2-4: The Insert Function dialog box is the best way to insert a function into a formula.



New Feature

A new feature in Excel 2002 lets you identify a function by searching for a key word. This is useful if you can't remember the name of the function. For example, if you're looking for the function that converts text to its ASCII code, you can search for "code" and click Go. Excel will propose three functions: CODE, CELL, and CHAR.



Cross-Reference

Excel also lets you create your own worksheet functions using VBA. For details about this powerful feature, see Chapter 10.

Shapes

As I mentioned earlier in this chapter, each worksheet has an invisible draw layer, which holds charts, maps, pictures, controls (such as buttons and list boxes), and shapes.

Excel enables you to easily draw a wide variety of geometric shapes directly on your worksheet, thanks to buttons on the Drawing toolbar. In addition, you should be aware that you can group objects into a single object, which is easier to size or position.

Several drawing objects are worthy of additional discussion:

- ♦ You can insert AutoShapes from the Drawing toolbar. You can choose from a huge assortment of shapes. Once a shape is placed on your worksheet, you can modify the shape by selecting it and dragging its handles. In addition, you can apply drop shadows, text, or 3D effects to the shape.
- ♦ The *text box* provides a way to display text that's independent of row and column boundaries — a good way to label rows in a table (see Figure 2-5). Although you can display text vertically in a cell, doing so changes the row height and messes up the table.

The screenshot shows an Excel spreadsheet window titled 'Book1'. The spreadsheet has columns A through G and rows 1 through 13. A table is centered in the grid, starting at row 5, column B and ending at row 9, column F. The table has a title 'Quarter' centered above the columns. The columns are labeled 'Qtr-1', 'Qtr-2', 'Qtr-3', and 'Qtr-4'. The rows are labeled 'North', 'South', 'East', and 'West'. A vertical text box containing the word 'Region' is positioned to the left of the table, spanning rows 6 through 9. The text box is oriented vertically, reading from bottom to top.

		Quarter			
		Qtr-1	Qtr-2	Qtr-3	Qtr-4
Region	North	854	832	903	784
	South	897	440	873	983
	East	109	98	281	211
	West	87	98	110	89

Figure 2-5: The text box drawing object is useful for displaying text vertically.

- ♦ For some reason, the designers of Excel made the *linked picture object* rather difficult to generate. Copy a range and then select the Edit ⇨ Paste Picture Link command (which appears on the Edit menu only when you press Shift). The Paste Picture Link command is useful for printing a noncontiguous selection of ranges. For example, you can “take pictures” of the ranges and then paste the pictures together in a single area, which can then be printed.
- ♦ Finally, many of the controls used in custom dialog boxes can be placed directly on a worksheet. Doing so can greatly enhance the usability of some worksheets and eliminate the need to create custom dialog boxes.



Excel 2002 provides you with a new object type: Diagrams. Use Insert ⇨ Diagram to select one of six diagram types (see Figure 2-6). After the diagram is inserted, you can use the Diagram toolbar to make basic modifications to it.

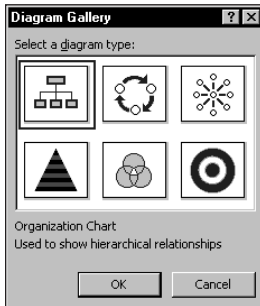


Figure 2-6: A new feature in Excel 2002 lets you add diagrams to a worksheet.

Charts

Excel, of course, has excellent charting capabilities. As I mentioned earlier in this chapter, you can store charts on a chart sheet or float them on a worksheet.

Note

Beginning with Excel 2000, you can also create pivot charts. A pivot chart is linked to a pivot table, and you can view various graphical summaries of your data using the same techniques used in a pivot table.

Excel offers extensive chart customization options. If a chart is free-floating, just click a chart element to select it (or double-click it to display its formatting dialog box). Right-clicking a chart element displays a shortcut menu.

The easiest way to create a chart is to select the data to be charted and then use the Chart Wizard (you can choose the corresponding button on the Standard toolbar). The Chart Wizard walks you through the steps to create a chart that meets your needs.

Excel uses a `SERIES` function to specify data for the chart (one `SERIES` formula for each data series). When you select a series in a chart, the `SERIES` function is displayed in the formula bar (see Figure 2-7). You can modify the `SERIES` function manually if you like. Often, this is the most efficient way to change the data range used in a chart.

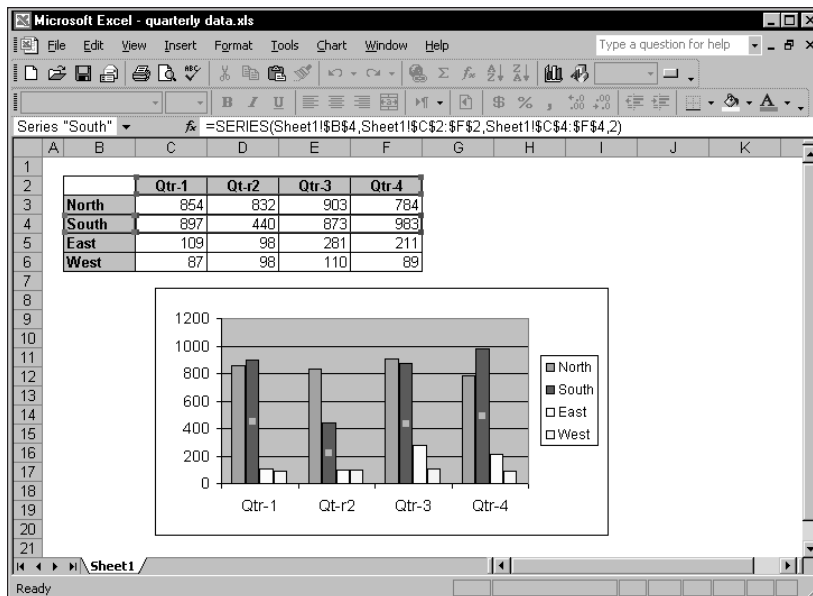


Figure 2-7: Data for a chart series is specified in a SERIES function.

Macros

All the major spreadsheet products have a macro language. Excel has two: XLM and VBA. The original XLM macro language is obsolete and has been replaced with VBA. Excel 2002 can still execute any XLM macro you may run across, but you cannot record such macros. You'll want to use VBA to develop new macros.



Part III of this book is devoted to the VBA language.

Database Access

Over the years, most spreadsheets have enabled users to work with simple flat database tables (even the original version of 1-2-3 contained this feature). Excel has some slick tools.

Using databases from a spreadsheet falls into two categories:

- ♦ **Worksheet databases.** *The entire database is stored in a worksheet, limiting the size of the database. In Excel, a worksheet database can have no more than 65,535 records (the top row holds the field names) and 256 fields.*
- ♦ **External databases.** *The data is stored in one or more disk files and accessed as needed.*

Worksheet databases

Generally, when the cell pointer is located within a database, Excel recognizes it and displays the field names whenever possible. For example, if you move the cell pointer within a worksheet database and choose the Data ⇨ Sort command, Excel lets you select the sort keys by choosing field names from a drop-down list.

Particularly useful is Excel's AutoFilter feature, which enables you to display only the records that you want to see. When AutoFilter mode is on, you can filter the data by selecting values from pull-down lists (which appear in place of the field names when you choose the Data ⇨ Filter ⇨ AutoFilter command). Rows that don't qualify are temporarily hidden. See Figure 2-8 for an example.

	A	B	C	D	E	F	G	H
1	ListPrice	Date Listed	Area	BRs	Bath	SqFt	Type	Pool
5	\$379,000	11/11/2000	N. Cour	4	3	3,000	Single Family	FALSE
6	\$248,500	11/21/2000	?	4	2.5	2,101	Single Family	TRUE
7	\$297,500	11/23/2000	S. Cour	2	3.5	2,170	Single Family	FALSE
8	\$259,900	11/27/2000	N. Cour	3	3	1,734	Condo	FALSE
9	\$325,000	12/1/2000	S. Cour	3	3	2,800	Condo	TRUE
10	\$208,750	12/3/2000	S. Cour	5	3	2,207	Single Family	TRUE
11	\$227,500	12/3/2000	S. Cour	6	3	1,905	Condo	FALSE
16	\$304,900	12/9/2000	S. County	4	3	2,350	Single Family	FALSE
17	\$349,900	12/13/2000	N. County	4	3	2,290	Single Family	TRUE
18	\$249,000	12/21/2000	Central	4	3	1,940	Single Family	TRUE
19	\$229,500	12/24/2000	Central	4	3	2,041	Single Family	FALSE
23	\$349,000	1/5/2001	N. County	4	2.5	2,730	Condo	TRUE
25	\$309,950	1/9/2001	Central	4	3	2,800	Single Family	FALSE
28	\$375,000	1/26/2001	Central	4	3	2,368	Single Family	TRUE
29	\$369,900	1/29/2001	N. County	4	3	1,988	Condo	FALSE
36	\$354,000	2/21/2001	Central	4	2	2,088	Single Family	FALSE
40	\$269,900	2/28/2001	S. County	4	2.5	1,911	Single Family	FALSE
41	\$338,876	3/4/2001	S. County	4	2.5	2,612	Single Family	FALSE
43	\$229,900	3/9/2001	Central	4	3	2,006	Single Family	FALSE
45	\$364,900	3/15/2001	Central	4	2.5	2,507	Single Family	FALSE
46	\$235,910	3/17/2001	Central	4	3	2,265	Single Family	TRUE
48	\$325,000	3/24/2001	S. County	4	3	2,770	Single Family	FALSE
49	\$398,000	3/25/2001	N. County	4	2.5	2,620	Single Family	FALSE
50	\$247,500	3/27/2001	S. County	4	3	2,000	Single Family	FALSE
54	\$319,000	4/12/2001	Central	4	2	1,690	Condo	TRUE
56	\$375,000	4/22/2001	Central	4	3	2,467	Single Family	TRUE
58	\$238,000	4/23/2001	N. County	4	2.5	1,590	Condo	FALSE

Figure 2-8: Excel's AutoFilter enables you to view database records that meet your criteria.

If you prefer to use the traditional spreadsheet database techniques that involve criteria ranges, choose the Data ⇨ Filter ⇨ Advanced Filter command.

External databases

To work with external database tables, use the Data ⇨ Get External Data command, which executes Microsoft Query and enables you to choose your databases and define queries. The results of a query can be directed back to your worksheet.

Beginning with Excel 97, you can also create Web queries to bring in data stored in a corporate intranet or on the Internet.

Excel also lets you work with data objects independent of Excel through both Data Access Objects (DAO) and ActiveX Data Objects (ADO). Both systems allow you to access external databases from VBA, and ADO lets you make changes to the database.

Internet Features

Excel includes a number of features that relate to the Internet. For example, you can save a worksheet or an entire workbook in HTML format, accessible in a Web browser. In addition, you can insert clickable hyperlinks (including e-mail addresses) directly in cells.

Excel files can be saved as HTML files “with interactivity.” This feature, which makes use of the Office Web Components, allows you to post interactive workbooks to a Web server and allow others (who have a license for the Office Web Components) to work with the workbook.

Analysis Tools

Excel is certainly no slouch when it comes to analysis. After all, that’s what most people use a spreadsheet for. Most analysis tasks can be handled with formulas, but Excel offers many other options.

Outlines

A worksheet outline is often an excellent way to work with hierarchical data such as budgets. Excel can create an outline (either horizontal, vertical, or both) automatically, or you can do so manually. Once created, you can collapse or expand the outline to display various levels of detail.

Automatic subtotals

Excel can automatically insert (or remove) subtotal formulas in a table set up as a database. It also creates an outline from the data so that you can view only the subtotals or any level of detail you desire. Figure 2-9 shows some automatic subtotals and the accompanying outline.

1	State	Jan	Feb	Mar	Q1 Total	Q2 Total	Q3 Total	Q4 Total	Grand Total
6	West Total	5,170	6,527	5,081	16,778	18,242	18,314	19,138	72
7	New York	1,429	1,316	1,993	4,738	4,763	3,915	4,289	17
8	New Jersey	1,735	1,406	1,224	4,365	4,316	4,051	4,526	17
9	Massachusetts	1,099	1,233	1,110	3,442	4,155	4,882	5,376	17
10	Florida	1,705	1,792	1,225	4,722	4,630	5,062	4,734	19
11	East Total	5,968	5,747	5,552	17,267	17,864	17,910	18,925	71
12	Kentucky	1,109	1,078	1,155	3,342	4,626	4,306	4,526	16
13	Oklahoma	1,309	1,045	1,641	3,995	5,364	4,338	4,449	18
14	Missouri	1,511	1,744	1,414	4,669	4,556	4,203	4,279	17
15	Illinois	1,539	1,493	1,211	4,243	3,623	4,889	4,330	17
16	Kansas	1,973	1,560	1,243	4,776	4,007	4,322	4,299	17
17	Central Total	7,441	6,920	6,664	17,683	17,550	17,752	17,357	70
18	Grand Total	18,579	19,194	17,297	51,728	53,656	53,976	55,420	214

Figure 2-9: Excel can automatically insert subtotal formulas and create outlines.

Scenario management

If you're seeking the ultimate in scenario-management features, 1-2-3's Version Manager is probably your best bet. Excel's scenario manager is quite weak in comparison, but it can handle simple scenario-management tasks, and it's definitely easier than trying to keep track of different scenarios manually.

Analysis ToolPak

The Analysis ToolPak add-in provides 19 special-purpose analysis tools (primarily statistical in nature) and many specialized worksheet functions. These tools make Excel suitable for casual statistical analysis.



Be aware that some of the statistical tools in the Analysis ToolPak are known to have some accuracy problems. Missing values are handled inconsistently and the exact algorithms used are not documented. For critical statistical analyses, you will probably want to use a standalone statistical analysis program.

Pivot tables

One of Excel's most powerful tools is its *pivot tables*. A pivot table is capable of summarizing data in a handy table, and this table can be arranged in many ways simply by dragging your mouse. In addition, a pivot table can be manipulated entirely by VBA. Data for a pivot table comes from a worksheet database or an external database and is stored in a special cache, which enables Excel to recalculate rapidly after a pivot table is altered. Figure 2-10 shows a pivot table.



See Chapter 17 for information about manipulating pivot tables with VBA.

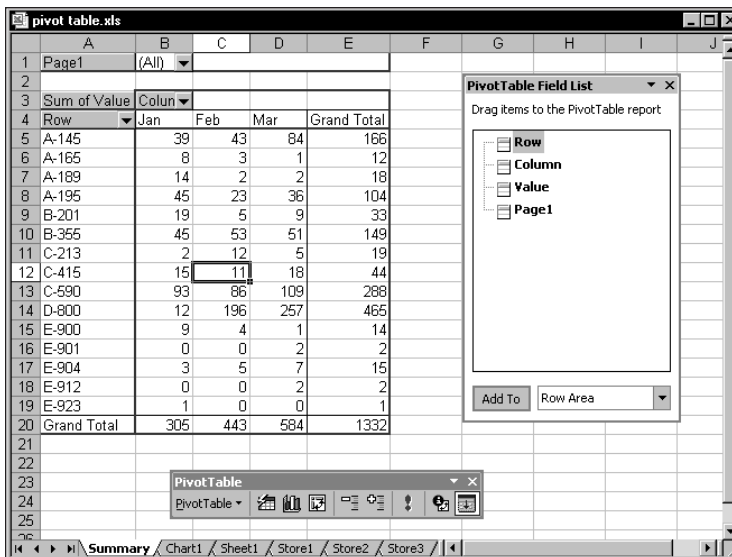


Figure 2-10: Excel's pivot table feature has many applications.

Auditing

Excel also has some useful auditing capabilities that help you identify errors or track the logic in an unfamiliar spreadsheet. To access these features, select Tools ⇨ Formula Auditing.



Solver

For specialized linear and nonlinear problems, Excel's Solver add-in calculates solutions to what-if scenarios based on adjustable cells, constraint cells, and, optionally, cells that must be maximized or minimized. Excel's Solver is very similar to the feature found in 1-2-3 for Windows and Quattro Pro for Windows. (This similarity is not surprising when you know that a single company, Frontline Systems, was largely responsible for the feature in all three products.)

Add-Ins

An *add-in* is a program that's attached to Excel to give it additional functionality. To attach an add-in, use the Tools ⇨ Add-Ins command.

In addition to the add-ins that ship with Excel, you can download additional add-ins from Microsoft's Web site. And there are many third-party add-ins that you can purchase or download from online services. You can use the coupon in the back of the book to acquire a free copy of the Power Utility Pak add-in. And, as I detail in Chapter 21, it's *very* easy to create your own add-ins.

Compatibility

An Excel workbook file is generally specific to the version of Excel that created it. Excel can read workbook files generated by previous versions of Excel, but earlier versions may or may not be able to read files produced by later versions. For example, Excel 97, Excel 2000, and Excel 2000 all use the same file format, so file compatibility is not a problem for these three versions. Excel does give you the option of saving a workbook using an earlier file format.

Excel can import a variety of files generated by other spreadsheet and database products (see Chapter 4 for details).

If you're an experienced 1-2-3 for DOS user, Excel provides detailed online help that's designed to get you to think in terms of Excel. Check out the Help ⇨ Lotus 1-2-3 Help command for more information.



Another aspect of compatibility is compatibility with previous versions of Excel. Developers should be aware of a number of issues. I discuss these in Chapter 26.

Summary

In this chapter, I provided a conceptual overview of Excel 2002 for newcomers to the fold.

Chapter 3 continues the saga with a discussion of formulas.



Formula Tricks and Techniques

Virtually every successful spreadsheet application uses formulas. In fact, constructing formulas can certainly be construed as a type of “programming.” This chapter provides an overview of Excel’s formula-related features and describes some techniques that may be new to you.

About Formulas

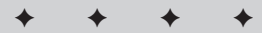
Formulas, of course, are what make a spreadsheet a spreadsheet. If it weren’t for formulas, your worksheet would just be a static document — something that could be produced by a word processor with great support for tables.

Excel has a huge assortment of built-in functions, has excellent support for names, and even supports array formulas (a special type of formula that can perform magic).

A formula entered into a cell can consist of any of the following elements:

- ◆ Operators such as + (for addition) and × (for multiplication)
- ◆ Cell references (including named cells and ranges)
- ◆ Values or strings
- ◆ Worksheet functions (such as SUM or AVERAGE)

A formula can consist of up to 1,024 characters. After you enter a formula into a cell, the cell displays the result of the formula. The formula itself appears in the formula bar when the cell is activated, however.



In This Chapter

An overview of Excel formulas

Differentiating between absolute and relative references in formulas

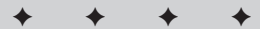
Understanding and using names

Introducing array formulas

Counting and summing cells

Working with dates and times

Creating “megaformulas”





Excel 2000 includes several new features related to formulas. Perhaps the most useful is the ability to flag potentially erroneous formulas. This can be done automatically in the background, or upon request. To set the options for this feature, use the Error Checking tab of the Options dialog box. Another new feature is the Evaluate Formula dialog box. This dialog box lets you see the intermediate results of individual parts of a complex formula. Access this feature from the Formula Auditing toolbar.

Calculating Formulas

You've probably noticed that the formulas in your worksheet get calculated immediately. If you change a cell that a formula uses, the formula displays a new result with no effort on your part. This is what happens when Excel's Calculation mode is set to Automatic. In this mode (which is the default mode), Excel uses the following rules when calculating your worksheet:

- ♦ When you make a change — enter or edit data or formulas, for example — Excel immediately calculates those formulas that depend on the new or edited data.
- ♦ If it's in the middle of a lengthy calculation, Excel temporarily suspends calculation when you need to perform other worksheet tasks; it resumes when you're finished.
- ♦ Formulas are evaluated in a natural sequence. In other words, if a formula in cell D12 depends on the result of a formula in cell D11, cell D11 is calculated before D12.

Sometimes, however, you may want to control when Excel calculates formulas. For example, if you create a worksheet with thousands of complex formulas, you'll find that operations can slow to a snail's pace while Excel does its thing. In such a case, you should set Excel's calculation mode to Manual. You can do this in the Calculation panel of the Options dialog box.

When you're working in Manual calculation mode, Excel displays *Calculate* in the status bar when you have any uncalculated formulas. You can use the following shortcut keys to recalculate the formulas:

- ♦ *F9* calculates the formulas in all open workbooks.
- ♦ *Shift+F9* calculates only the formulas in the active worksheet. Other worksheets in the same workbook won't be calculated.
- ♦ *Ctrl+Alt+F9* forces a recalculation of everything. This is an undocumented key sequence. Use it if Excel (for some reason) doesn't seem to be calculating correctly, or if you want to force a recalculation of formulas that use custom functions created with VBA.

Note

Excel's Calculation mode isn't specific to a particular worksheet. When you change Excel's Calculation mode, it affects all open workbooks, not just the active workbook.

Cell and Range References

Most formulas reference one or more cells. This reference can be made by using the cell's or range's address or name (if it has one). Cell references come in four styles:

- ♦ *Relative*. The reference is fully relative. When the formula is copied, the cell reference adjusts to its new location. Example: A1.
- ♦ *Absolute*. The reference is fully absolute. When the formula is copied, the cell reference does not change. Example: \$A\$1.
- ♦ *Row Absolute*. The reference is partially absolute. When the formula is copied, the column part adjusts, but the row part does not change. Example: A\$1.
- ♦ *Column Absolute*. The reference is partially absolute. When the formula is copied, the row part adjusts, but the column part does not change. Example: \$A1.

By default, all cell and range references are relative. To change a reference, you must manually add the dollar signs. Or, when editing a cell in the formula bar, move the cursor to a cell address and press F4 repeatedly to cycle through all four types of cell referencing.

Why use references that aren't relative?

If you think about it, you'll realize that the only reason you would ever need to change a reference is if you plan to copy the formula. Figure 3-1 demonstrates why this is so. The formula in cell C4 is:

```
=C$3×$B4
```

This formula calculates the area for various widths (listed in column B) and lengths (listed in row 3). After the formula is entered, it can then be copied down to C8 and across to F8. Because the formula uses absolute references to row 3 and column B and relative references for other rows and columns, each copied formula produces the correct result. If the formula used only relative references, then copying the formula would cause all the references to adjust, and produce incorrect results.

	A	B	C	D	E	F	G
1							
2			Length				
3			12	13	16	18	
4		3	36	39	48	54	
5		4	48	52	64	72	
6		5	60	65	80	90	
7		6	72	78	96	108	
8		7	84	91	112	126	
9							
10							

Figure 3-1: An example of using nonrelative references in a formula

About R1C1 notation

Normally, Excel uses what's known as A1 notation. Each cell address consists of a column letter and a row number. However, Excel also supports R1C1 notation. In this system, cell A1 is referred to as cell R1C1, cell A2 as R2C1, and so on.

To change to R1C1 notation, select Tools ⇨ Options, click the General tab, and place a check mark next to R1C1 reference style. After you do so, you'll notice that the column letters all change to numbers. All the cell and range references in your formulas are also adjusted.

Table 3-1 presents some examples of formulas using standard notation and R1C1 notation. The formula is assumed to be in cell B1 (also known as R1C2).

Table 3-1
Simple Formulas in Two Notations Compared

<i>Standard</i>	<i>R1C1</i>
=A1+1	=RC[-1]+1
=\$A\$1+1	=R1C1+1
=\$A1+1	=RC1+1
=A\$1+1	=R1C[-1]+1
=SUM(A1:A10)	=SUM(RC[-1]:R[9]C[-1])
=SUM(\$A\$1:\$A\$10)	=SUM(R1C1:R10C1)

If you find R1C1 notation confusing, you're not alone. R1C1 notation isn't too bad when you're dealing with absolute references. But when relative references are involved, the brackets can drive you nuts.

The numbers in brackets refer to the relative position of the references. For example, R[-5]C[-3] specifies the cell that's five rows above and three columns to the left. On the other hand, R[5]C[3] references the cell that's five rows below and three columns to the right. If the brackets are omitted, the notation specifies the same row or column. For example, R[5]C refers to the cell five rows below in the same column.

Although you probably won't use R1C1 notation as your standard system, it *does* have at least one good use. Using R1C1 notation makes it very easy to spot an erroneous formula. When you copy a formula, every copied formula is exactly the same in R1C1 notation. This is true regardless of the types of cell references you use (relative, absolute, or mixed). Therefore, you can switch to R1C1 notation and check your copied formulas. If one looks different from its surrounding formulas, there's a good chance that it may be incorrect.

In addition, if you write VBA code to create worksheet formulas, you may find it easier to create the formulas using R1C1 notation.

Referencing other sheets or workbooks

References to cells and ranges need not be in the same sheet as the formula. To refer to a cell in a different worksheet, precede the cell reference with the sheet name followed by an exclamation point. Here's an example of a formula that uses a cell reference in a different worksheet:

```
=Sheet2!A1+1
```

You can also create link formulas that refer to a cell in a different workbook. To do so, precede the cell reference with the workbook name (in square brackets), the worksheet name, and an exclamation point. Here's an example:

```
=[Budget.xls]Sheet1!A1+1
```

If the workbook name in the reference includes one or more spaces, you must enclose it (and the sheet name) in single quotation marks. For example,

```
='[Budget For 2002]Sheet1'!A1+A1
```

If the linked workbook is closed, you must add the complete path to the workbook reference. Here's an example:

```
='C:\MSOffice\Excel\[Budget For 2002]Sheet1'!A1+A1
```

Although you can enter link formulas directly, you can also create the reference by using normal pointing methods. To do so, the source file must be open. When you do so, Excel creates absolute cell references (if you plan to copy the formula to other cells, make the references relative).

Using Links to Recover Data in a Corrupt File

Excel 2002 includes a new “detect and repair” feature that will attempt to fix damaged or corrupt files. If this feature doesn’t work for you (or if you use an earlier version of Excel), you can try the technique described here.

If you are unable to load a corrupted Excel workbook, you can write a link formula to recover all or part of the data (but not the formulas). You can do so because the source file in a link formula does not need to be open. If your corrupt file is named *Badfile.xls*, for example, open a blank workbook and enter the following formula into cell A1 of Sheet1 to attempt to recover the data from Sheet1 of the corrupt workbook file:

```
=[C:\Files\Badfile.xls]Sheet1!A1
```

In your new workbook, copy this formula down and to the right to recover as much information as you can. A better approach, however, is to maintain a backup of your important files.

Working with links can be tricky. For example, if you use the File ⇨ Save As command to make a backup copy of the source worksheet, you automatically change the link formulas to refer to the new file (not usually what you want to do). Another way to mess up your links is to rename the source workbook when the dependent workbook is not open.

Using Names

One of the most useful features in Excel is its ability to provide meaningful names for various items. For example, you can name cells, ranges, rows, columns, charts, and other objects. An advantage unique to Excel is that you can name values or formulas that don’t even appear in cells in your worksheet (see the “Naming constants” section later in this chapter).

Naming cells and ranges

You create names for cells or ranges by using the Insert ⇨ Name ⇨ Define command (or by pressing Ctrl+F3). An even faster way to create names is to use the Name Box (the drop-down list at the left side of the formula bar). When using the Name Box, just select the cell or range, type the name into the Name Box, and press Enter.

You can choose the Insert ⇨ Name ⇨ Create command to create names automatically for cells or ranges based on row or column titles on your worksheet. In Figure 3-2, for example, C3:F3 is named *North*, C4:F4 is named *South*, and so on. Vertically, C3:C6 is named *Qtr1*, D3:D6 is named *Qtr2*, and so on.

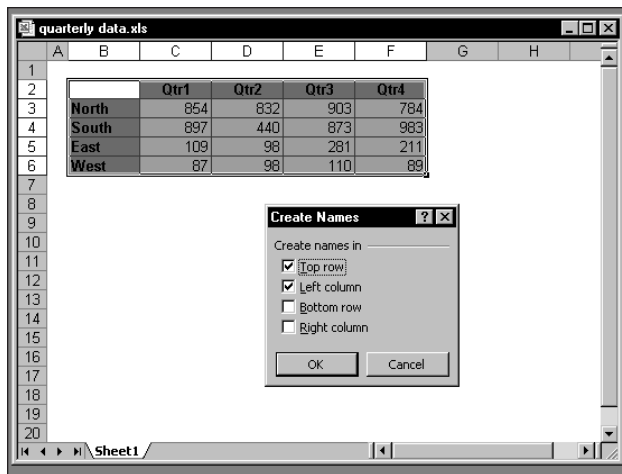


Figure 3-2: Excel makes it easy to create names that use descriptive text in your worksheet.

Using names is especially important if you write VBA code that uses cell or range references. The reason? VBA does not automatically update its references if you move a cell or range that's referred to in a VBA statement. For example, if your VBA code writes a value to `Range("C4")`, the data will be written to the wrong cell if the user inserts a new row above or a new column to the left of cell C4. Using a reference to a name cell such as `Range("InterestRate")` avoids these potential problems.

Applying names to existing references

When you create a new name for a cell or a range, Excel doesn't automatically use the name in place of existing references in your formulas. For example, assume that you have the following formula in cell F10:

```
=A1-A2
```

If you define a name *Income* for A1 and *Expenses* for A2, Excel won't automatically change your formula to `=Income-Expenses`. It's fairly easy to replace cell or range references with their corresponding names, however. Start by selecting the range that you want to modify. Then choose the `Insert > Name > Apply` command. In the Apply Names dialog box, select the names that you want to apply and then click OK. Excel replaces the range references with the names in the selected cells.

Note

Unfortunately, there is no way to "unapply" names. In other words, if a formula uses a name, you can't convert the name to an actual cell or range reference. Even worse, if you delete a name that is used in a formula, the formula does not revert to the cell or range address—it simply returns a `#NAME?` error.

Hidden Names

Some Excel macros and add-ins create hidden names. These are names that exist in a workbook, but don't appear in the Define Name dialog box. For example, the Solver add-in creates a number of hidden names. Normally, you can just ignore these hidden names. However, sometimes these hidden names create a problem. If you copy a sheet to another workbook, the hidden names are also copied, and they may create a link that is very difficult to track down.

You can use the following VBA procedure to delete all hidden names in a workbook:

```
Sub DeleteHiddenNames()  
    Dim n As Name  
    Dim Count As Integer  
    For Each n In ActiveWorkbook.Names  
        If Not n.Visible Then  
            n.Delete  
            Count = Count + 1  
        End If  
    Next n  
    MsgBox Count & " hidden names were deleted."  
End Sub
```



My Power Utility Pak add-in (available on the companion CD-ROM) includes a utility that scans all formulas in a selection and automatically replaces names with their references.

Intersecting names

Excel has a special operator, called the *intersection operator*, that comes into play when you're dealing with ranges. This operator is a space character. Using names with the intersection operator makes it very easy to create meaningful formulas. For this example, refer once again to Figure 3-2. If you enter the following formula into a cell:

```
=Qtr2 South
```

the result is 183—the intersection of the *Qtr2* range and the *South* range. To get the total for the West region, you can use this formula:

```
=SUM(West)
```

“Natural Language” References

Beginning with Excel 97, you can write “natural language” formulas that use row and column headers. It’s not necessary to actually define these names—Excel figures them out automatically. You connect these pseudo names by using the intersection operator (that is, a space character). For example, you might create a formula like this:

```
=January Sales
```

Excel would display the value at the intersection of the column header (Sales) and the row header (January).

While this type of thing may be convenient, I suggest that you avoid this feature like the plague. Using these pseudo names is unreliable and difficult to document, and you cannot use these names in your VBA code. When this feature first became available, Microsoft touted it as a significant ease-of-use feature. Microsoft now downplays this feature, and it is turned off by default. You can check the value of this setting in the Calculation panel of the Options dialog box.

Naming columns and rows

With Excel, you can also name complete rows and columns. In the preceding example, the name *Qtr1* is assigned to the range B2:B5. Alternatively, *Qtr1* could be assigned to all of column B, *Qtr2* to column C, and so on. You also can do the same horizontally so that *North* refers to row 2, *South* to row 3, and so on.

The intersection operator works exactly as before, but now you can add more regions or quarters without having to change the existing names.

When naming columns and rows, make sure that you don’t store any extraneous information in named rows or columns. For example, remember that if you insert a value in cell B7, it is included in the *Qtr1* range.

Scoping names

A named cell or range normally has a workbook-level *scope*—in other words, you can use the name in any worksheet in the workbook.

Another option is to create names that have a worksheet-level scope. To create a worksheet-level name, define the name by preceding it with the worksheet name followed by an exclamation point; for example, *Sheet1!Sales*. If the name is used on the sheet in which it is designed, you can omit the sheet qualifier when you reference the name. The Define Name dialog box lists worksheet-level names only if the sheet on which they are defined is active. You can, however, reference a worksheet-level on a different sheet if you precede the name with the sheet qualifier.

If you decide to use a combination of workbook-level and worksheet-level names, make sure you understand how this works, or you may be in for some surprises.

Naming constants

Virtually every experienced Excel user knows how to create cell and range names (although not all Excel users actually do so). But most Excel users do not know that you can use names to refer to values that don't appear in your worksheet (that is, *constants*).

Suppose that many formulas in your worksheet need to use a particular interest rate. Some people would type the interest rate into a cell and give it a name, such as *RATE*, so that they could use the name in their formulas. For example, the following formula uses the name *RATE*:

```
=RATE×A3
```

The other alternative is to call up the Define Name dialog box and enter the interest rate directly into the Refers to box (see Figure 3-3). Then you can use the name in your formulas just as if the value is stored in a cell. If the interest rate changes, just change the definition for *RATE*, and Excel updates all the cells that contain this name.

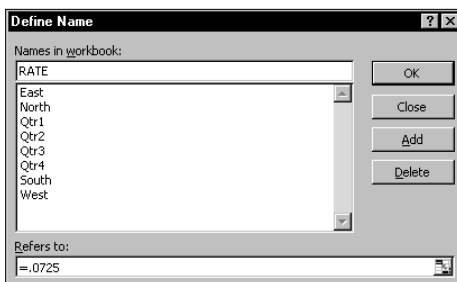


Figure 3-3: Excel lets you name constants that don't appear in worksheet cells.

Tip

By the way, this technique also works for text. For example, you can define the name *IWC* to stand for *International Widget Corporation*. Then, you can enter **=IWC** into a cell and the cell displays the full name.

Naming formulas

Besides naming cells, ranges, and constants, you can also enter a formula directly into the Refers to box in the Define Name dialog box to create a named formula. The formula that you enter uses cell references relative to the active cell—the cell that receives the formula. If you use the mouse to indicate related cells in the act of building a formula, however, the references will be absolute.

Figure 3-4 shows a formula ($=A1^B1$) entered directly in the Refers to box in the Define Name dialog box. In this case, the active cell is C1, so the formula refers to the two cells to its left (notice that the cell references are relative). After this name is defined, entering $=\text{Power}$ into a cell raises the value two cells to the left to the power represented by the cell directly to the left. For example, if B10 contains 3 and C10 contains 4, entering the following formula into cell D10 will return a value of 81 (3 to the 4th power):

$=\text{Power}$

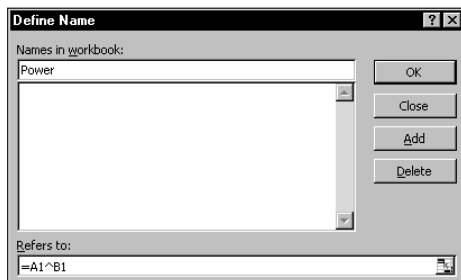


Figure 3-4: You can name a formula that doesn't appear in any worksheet cell.

When you call up the Define Name dialog box after creating the named formula, you'll find that the Refers to box displays a formula that is relative to the active cell. For example, if cell D32 is active, the Refers to dialog box will display:

$=\text{Sheet1!B32}^{\text{Sheet1!C32}}$

Notice that Excel appends the worksheet name to the cells references used in your formula. This, of course, will cause the named formula to produce incorrect results if you use it on a worksheet other than the one in which it was defined. If you would like to use this named formula on a sheet other than Sheet1, you'll need to remove the sheet references from the formula (but keep the exclamation points). For example:

$=!A1^!B1$

After you understand the concept, you may discover some new uses for named formulas. One distinct advantage is apparent if you need to modify the formula. You can just change the definition in the Name Box rather than edit each occurrence of the formula.



The companion CD-ROM contains a workbook with several examples of named formulas.

The Secret to Understanding Cell and Range Names

Excel users often refer to *named ranges* and *named cells*. In fact, I've used these terms frequently throughout this chapter. Actually, this terminology is not quite accurate.

Here's the secret to understanding names:

When you create a name for a cell or a range in Excel, you're actually creating a named formula—a formula that doesn't exist in a cell. Rather, these named formulas exist in Excel's memory.

When you work with the Define Name dialog box, the Refers to field contains the formula, and the Names in workbook field contains the formula's name. You'll find that the contents of the Refers to field always begins with an equals sign.—which makes it a formula.

This is not exactly an earth-shaking revelation, but keeping this “secret” in mind may help you understand what's going on behind the scenes when you create and use names in your workbooks.

Naming objects

In addition to providing names for cells and ranges, you can give more meaningful names to objects such as charts and shapes. This can make it easier to refer to such objects, especially when you refer to them in your VBA code.

Contrary to what you might think, the Insert ⇄ Name ⇄ Define command doesn't enable you to name objects (it works only for cells and ranges). The only way to change the name of a nonrange object is to use the Name box. Just select the item, type the new name in the Name box, and press Enter.

**Note**

If you simply click elsewhere in your workbook after typing the name in the Name box, the name won't stick. You *must* press Enter.

Formula Errors

It's not uncommon to enter a formula and receive an error in return. Formulas may return an error value if a cell that they refer to has an error value. This is known as the ripple effect—a single error value can make its way to lots of other cells that contain formulas that depend on the cell. Excel's Formula Auditing toolbar contains tools that can help you trace the source of formula errors.

Table 3-2 lists the types of error values that may appear in a cell that has a formula.

Table 3-2
Excel Error Values

Error Value	Explanation
#DIV/0!	The formula is trying to divide by zero (an operation that's not allowed on this planet). This error also occurs when the formula attempts to divide by a cell that is empty.
#N/A	The formula is referring (directly or indirectly) to a cell that uses the NA worksheet function to signal the fact that data is not available. A LOOKUP function that can't locate a value also returns #NA.
#NAME?	The formula uses a name that Excel doesn't recognize. This can happen if you delete a name that's used in the formula or if you have unmatched quotes when using text.
#NULL!	The formula uses an intersection of two ranges that don't intersect (this concept is described later in the chapter).
#NUM!	There is a problem with a value; for example, you specified a negative number where a positive number is expected.
#REF!	The formula refers to a cell that isn't valid. This can happen if the cell has been deleted from the worksheet.
#VALUE!	The formula includes an argument or operand of the wrong type. An operand is a value or cell reference that a formula uses to calculate a result. This error also occurs if your formula uses a custom VBA worksheet function that contains an error.

Array Formulas

An *array* is simply a collection of cells or values that is operated on as a group. An *array formula* is a special type of formula that works with arrays. An array formula can produce a single result, or it can produce multiple results — with each result displayed in a separate cell (because Excel can fit only one value in a cell).

For example, when you multiply a 1×5 array by another 1×5 array, the result is a third 1×5 array. In other words, the result of this kind of operation occupies five cells; each element in the first array is multiplied by each corresponding element in the second array to create five new values, each getting its own cell. The array formula that follows multiplies the values in A1:A5 by the corresponding values in B1:B5. This array formula is entered into five cells simultaneously:

```
=A1:A5×B1:B5
```

Note

You enter an array formula by pressing Ctrl+Shift+Enter. To remind you that a formula is an array formula, Excel surrounds it with brackets ({ }) in the formula bar. Don't enter the brackets yourself.

An array formula example

Excel's array formulas enable you to perform individual operations on each cell in a range in much the same way that a program language's looping feature enables you to work with elements of an array. If you've never used array formulas before, this section will get your feet wet with a hands-on example.

Figure 3-5 shows a worksheet with text in A1:A5. The goal of this exercise is to create a *single formula* that returns the sum of the total number of characters in the range. Without the single formula requirement, you would write a formula using the LEN function, copy it down the column, and then use the SUM function to add up the results of the intermediate formulas.

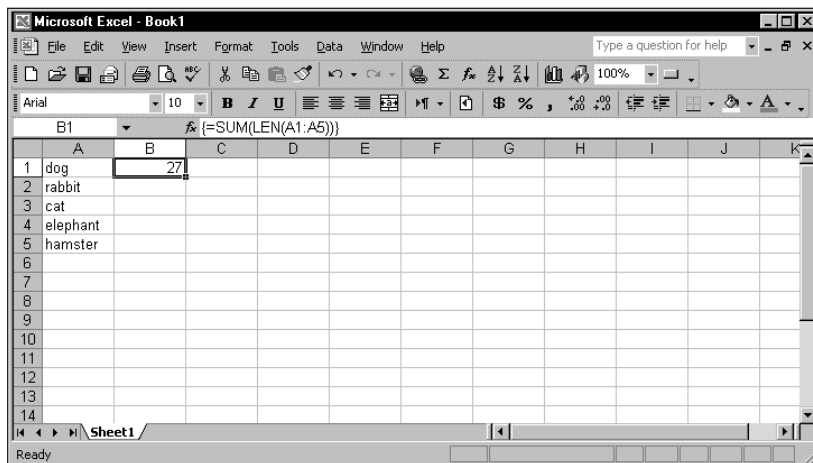


Figure 3-5: Cell B1 contains an array formula that returns the total number of characters contained in range A1:A5.

To demonstrate how an array formula can occupy more than one cell, create the worksheet shown in Figure 3-5, and then try this:

1. Select the range B1:B5.
2. Type the following formula:
=LEN(A1:A5)
3. Press Ctrl+Shift+Enter.

The preceding steps enter a single array formula into five cells. Enter a SUM formula that adds the values in B1:B5, and you'll see that the total number of characters in A1:A5 is 27.

Here's the key point: It's not necessary to actually *display* those five array elements. Rather, Excel can store the array in memory. Knowing this, you can type the following single formula in any blank cell (make sure you enter it using Ctrl+Shift+Enter):

```
=SUM(LEN(A1:A5))
```

This formula is displayed surrounded by brackets:

```
{=SUM(LEN(A1:A5))}
```

This formula essentially creates a five-element array (in memory) that consists of the length of each string in A1:A5. The SUM function uses this array as its argument, and the formula returns 27.

An array formula calendar

Figure 3-6 shows a worksheet set up to display a calendar for any month. Believe it or not, the calendar is created with a single array formula that occupies 42 cells.



November 2001						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Figure 3-6: One array formula is all it takes to make a calendar for any month in any year.



The companion CD-ROM contains a workbook with the calendar example as well as several additional array formula examples.

Array formula pros and cons

The advantages of using array formulas rather than single-cell formulas include the following:

- ♦ They can sometimes use less memory.
- ♦ They can make your work much more efficient.
- ♦ They can eliminate the need for intermediate formulas.
- ♦ They can enable you to do things that would be difficult or impossible otherwise.

A few disadvantages of using array formulas are the following:

- ♦ Some can slow your spreadsheet recalculation time to a crawl.
- ♦ They can make your worksheet more difficult for others to understand.
- ♦ You must remember to enter an array formula with a special key sequence (Ctrl+Shift+Enter).

Counting and Summing Techniques

I spend quite a bit of time reading the Excel newsgroups on the Internet. Many of the questions posed in these groups deal with counting or summing various types of cells. In an attempt to answer most of these questions, I present a number of formula examples that deal with counting various things on a worksheet. You can probably adapt these formulas to your own needs.

Using the COUNTIF or SUMIF function

Excel's SUM, COUNT, COUNTA, and COUNTBLANK functions are very straightforward, so I'll skip them and get straight to the more useful COUNTIF and SUMIF functions. COUNTIF takes two arguments: the range that holds the data to be counted and the criteria used to determine whether the cell is included in the count. SUMIF takes three arguments: the range to be evaluated, the criteria used to determine whether the cell is included in the count, and the range that holds the data to be summed.

Table 3-3 demonstrates a variety of uses for the COUNTIF function. The formulas assume that you have a range named *data* (you'll need to substitute the actual range name or address in these formulas). Also, be aware that the second argument for the COUNTIF function can be a reference to a cell that contains the search criteria.

Table 3-3
Examples of Common Uses for the COUNTIF Function

<i>Formula</i>	<i>Return Value</i>
=COUNTIF(data,12)	The number of cells that contain the value 12
=COUNTIF(data,1)+ COUNTIF(data,12)	The number of cells that contain 1 or 12
=COUNTIF(data,"<0")	The number of cells that contain a negative number
=COUNTIF(data,">0")	The number of nonzero values
=COUNTIF(data,">=1")- COUNTIF(data,">10")	The number of cells that contain a value between 1 and 10
=COUNTIF(data,"yes")	The number of cells that contain the word yes (not case-sensitive)
=COUNTIF(data,"x")	The number of cells that contain any text
=COUNTIF(data,"xsx")	The number of cells that contain the letter s (not case-sensitive)
=COUNTIF(data,"??")	The number of three-letter words

Using array formulas to count and sum

If none of the standard counting techniques fits the bill, you may be able to construct an array formula (see “Array Formulas” earlier in this chapter). Don’t forget: When you enter an array formula, press Ctrl+Shift+Enter.

To count the number of numerical values (skipping text and blanks), use this array formula:

```
=SUM(IF(ISNUMBER(data),1,0))
```

To count the number of cells that contain an error value, use this array formula:

```
=SUM(IF(ISERR(data),1,0))
```

To count the number of unique numeric values (skipping text, blanks not allowed), use this array formula:

```
=SUM(IF(FREQUENCY(data,data)>0,1,0))
```

Table 3-4 shows a number of array formula examples based on the worksheet shown in Figure 3-7.

	A	B	C	D
1	Month	Region	Sales	
2	Jan	North	100	
3	Jan	South	200	
4	Jan	West	300	
5	Feb	North	150	
6	Feb	South	250	
7	Feb	West	350	
8	Mar	North	200	
9	Mar	South	300	
10	Mar	West	400	
11				

Figure 3-7: This simple database demonstrates some useful array formulas for counting and summing.

Table 3-4
Complex Array Formulas Using the SUM Function

Array Formula	Returns
=SUM((A2:A10="Jan")×(B2:B10="North")×C2:C10)	Sum of Sales where Month="Jan" AND Region="North"
=SUM((A2:A10="Jan")×(B2:B10<>"North")×C2:C10)	Sum of Sales where Month="Jan" AND Region<>"North"
=SUM((A2:A10="Jan")×(B2:B10="North"))	Count of Sales where Month="Jan" AND Region="North"
=SUM((A2:A10="Jan")×((B2:B10="North")+ (B2:B10="South")))	Count of Sales where Region="North" or "South" and Month="Jan"
=SUM((A2:A10="Jan")×(C2:C10>=200)×(C2:C10))	Sum of Sales where Month="Jan" and Sales>= 200
=SUM((C2:C10>=300)×(C2:C10<=400)×(C2:C10))	Sum of Sales between 300 and 400
=SUM((C2:C10>=300)×(C2:C10<=400))	Count of Sales between 300 and 400

Other counting tools

The COUNTIF function is useful when you have a single counting criterion. For more complex comparisons, you can use the DCOUNT function. To use the DCOUNT function, you must set your data up as a database (with field names in the first row), and you also need to create a separate criteria range to specify the counting criteria. The criteria range can also handle logical OR operations by using additional rows. Consult the online help for details.

Excel's `SUBTOTAL` function can be very useful when you need to get a count of rows that have been filtered using the AutoFilter feature. The first argument for the subtotal figure determines the type of subtotaling. An argument of 3 represents the `COUNTA` function, and it returns the number of visible cells in a range.

For the ultimate in counting, consider using a pivot table. If you're not familiar with pivot tables, you're missing out on one of the most powerful tools around.

Working with Dates and Times

Excel uses a serial number system to store dates. The earliest date that Excel can understand is January 1, 1900. This date has a serial number of 1. January 2, 1900, has a serial number of 2, and so on.

Most of the time, you don't have to be concerned with Excel's serial number date system. You simply enter a date in a familiar date format, and Excel takes care of the details behind the scenes. For example, if you need to enter June 1, 1999, you can simply enter the date by typing **June 1, 1999** (or use any of a number of different date formats). Excel interprets your entry and stores the value 36312, which is the serial number for that date.

Entering dates and times

When working with times, you simply enter the time into a cell in a recognized format. Excel's system for representing dates as individual values is extended to include decimals that represent portions or fractions of days. In other words, Excel perceives all time using the same system whether that time is a particular day, a certain hour, or a specific second. For example, the date serial number for June 1, 1999, is 36312. Noon (halfway through the day) is represented internally as 36312.5. Again, you normally don't have to be concerned with these fractional serial numbers.

Because dates and times are stored as serial numbers, it stands to reason that you can add and subtract dates and times. For example, you can enter a formula to calculate the number of days between two dates.

**Tip**

When performing calculations with time, things get a bit trickier. When you enter a time without an associated date, the date is assumed to be January 0, 1900. This is not a problem—unless your calculation produces a negative time value. When this happens, Excel displays an error (displayed as #####). The solution? Switch to the 1904 date system. Select **Tools** ⇨ **Options**, click the **Calculation** tab, and place a check mark next to the 1904 date system check box. Be aware that switching to the 1904 date system can cause problems with dates already entered in your file, or dates in workbooks that are linked to your file.



Tip

When you add time values, you'll find that you can't display more than 24 hours. For each 24-hour period, Excel simply adds another day to the total. The solution is to change the number formatting to use brackets around the hour part of the format. The following number format, for example, displays more than 24 hours:

[hh]:mm

Using pre-1900 dates

The world, of course, didn't begin on January 1, 1900. People who work with historical information using Excel often need to work with dates before January 1, 1900. Unfortunately, the only way to work with pre-1900 dates is to enter the date into a cell as text. For example, you can enter the following into a cell and Excel won't complain:

July 4, 1776

You can't, however, perform any manipulation on dates that are actually text. For example, you can't change its formatting, you can't determine which day of the week this date occurred on, and you can't calculate the date that occurs seven days later.

On the
CD-ROM

The companion CD-ROM contains an add-in that I developed called Extended Date Functions. When this add-in is installed, you'll have access to eight new worksheet functions that let you work with any date in the years 0100 through 9999. Figure 3-8 shows a worksheet that uses these functions to calculate the number of days between various pre-1900 dates.

	A	B	C	D	E
1	President	Born	Died	Age	
2	William McKinley	1/29/1843	9/14/1901	58	
3	Franklin D. Roosevelt	1/30/1882	4/12/1945	63	
4	William Henry Harrison	2/9/1773	4/4/1841	68	
5	Abraham Lincoln	2/12/1809	4/15/1865	56	
6	Zachary Taylor	3/29/1790	7/9/1850	60	
7	Warren G. Harding	11/2/1865	8/2/1923	57	
8	James A. Garfield	11/19/1831	9/19/1881	49	
9					
10					
11					

Figure 3-8: The Extended Date Functions add-in lets you work with pre-1900 dates.

Creating Megaformulas

Often, spreadsheets require intermediate formulas to produce a desired result. In other words, a formula may depend on other formulas, which in turn depend on other formulas. After you get all these formulas working correctly, it's often

possible to eliminate the intermediate formulas and use what I refer to as a single *megaformula* instead. The advantages? You use fewer cells (less clutter), and recalculation may be faster. Besides, people in the know will be impressed with your formula-building abilities. The disadvantages? The formula may be impossible to decipher or modify.

Here's an example: Imagine a worksheet with a column of people's names. And suppose that you've been asked to remove all the middle names and middle initials from the names — but not all the names have a middle name or initial. Editing the cells manually would take hours, so you opt for a formula-based solution. Although this is not a difficult task, it normally involves several intermediate formulas.

Figure 3-9 shows the results of the more conventional solution, which requires six intermediate formulas shown in Table 3-5. The names are in column A; the end result goes in column H. Columns B through G hold the intermediate formulas.

	A	B	C	D	E	F	G	H
1	Bob Smith	Bob Smith	4	#VALUE!	4	Bob Smith	Bob Smith	
2	Mike A. Jones	Mike A. Jones	5	8	8	Mike Jones	Mike Jones	
3	Jim Ray Johnson	Jim Ray Johnson	4	8	8	Jim Johnson	Jim Johnson	
4	Tom Alvin Jacobs	Tom Alvin Jacobs	4	10	10	Tom Jacobs	Tom Jacobs	
5	John Q. Public	John Q. Public	5	8	8	John Public	John Public	
6	R.J Smith	R.J Smith	4	#VALUE!	4	R.J Smith	R.J Smith	
7	R. Jay Smith	R. Jay Smith	3	7	7	R. Smith	R. Smith	
8	Tim Jones	Tim Jones	4	#VALUE!	4	Tim Jones	Tim Jones	
9								
10								

Figure 3-9: Removing the middle names and initials requires six intermediate formulas.

Table 3-5
Intermediate Formulas Written in the
First Row of Sheet1 in Figure 3-9

Cell	Intermediate Formula	What It Does
B1	=TRIM(A1)	Removes excess spaces
C1	=FIND(" ",B1,1)	Locates the first space
D1	=FIND(" ",B1,C1+1)	Locates the second space
E1	=IF(ISERROR(D1),C1,D1)	Uses the first space if no second space exists
F1	=LEFT(B1,C1)	Extracts the first name
G1	=RIGHT(B1,LEN(B1)-E1)	Extracts the last name
H1	=F1&G1	Concatenates the two names

You can eliminate all the intermediate formulas by creating a megaformula. You do so by creating all the intermediate formulas and then going back into the final result formula and replacing each cell reference with a copy of the formula in the cell referred to (without the equals sign). Fortunately, you can use the clipboard to copy and paste. Keep repeating this process until cell H1 contains nothing but references to cell A1. You end up with the following megaformula in one cell:

```
=LEFT(TRIM(A1),FIND
(" ",TRIM(A1),1))&RIGHT(TRIM(A1),LEN(TRIM(A1))-
IF(ISERROR(FIND(" ",TRIM(A1),FIND(" ",TRIM(A1),1)+1)),
FIND(" ",TRIM(A1),1),FIND(" ",TRIM(A1),FIND
(" ",TRIM(A1),1)+1)))
```

When you're satisfied that the megaformula is working, you can delete the columns that hold the intermediate formulas because they are no longer used.

The megaformula performs exactly the same tasks as all the intermediate formulas — although it's virtually impossible for anyone to figure out, even the author. If you decide to use megaformulas, make sure that the intermediate formulas are performing correctly before you start building a megaformula. Even better, keep a single copy of the intermediate formulas somewhere in case you discover an error or need to make a change.


Note

The only limitation to the megaformula technique is that Excel formulas can contain no more than 1,024 characters. Another way to approach this problem is to create a custom worksheet function in VBA. Then you could replace the megaformula with a simple formula, such as:

```
=NOMIDDLE(A1)
```

In fact, I wrote such a function to compare it with intermediate formulas and megaformulas.

Because a megaformula is so complex, you may think that using one would slow down recalculation. Actually, that's not the case. As a test, I created a worksheet that used a megaformula 65,536 times. Then I created another worksheet that used six intermediate formulas. I compared the results with the VBA function I wrote. Statistics regarding the two methodologies were recorded and are shown in Table 3-6.

Table 3-6
Intermediate Formulas vs. Megaformula vs. VBA Function

<i>Method</i>	<i>Recalculation Time (Seconds)</i>	<i>File Size</i>
Intermediate formulas	10.8	24.4MB
Megaformula	6.2	8.9MB
VBA function	106.7	8.6MB

The actual results will vary significantly, depending on system speed and amount of memory installed.

As you can see, using the megaformula resulted in faster recalculations as well as a *much* smaller workbook. The VBA function was much slower — in fact, it wasn't even in the same ballpark. This is fairly typical of VBA functions; they are always slower than built-in Excel functions.



The three files used in this time test are available on the companion CD-ROM.

Summary

In this chapter, I examined Excel formulas and related issues such as names and calculation techniques. I also provided a few examples of array formulas, counting and summing techniques, and even “megaformulas.”

In the next chapter, I explain how Excel maintains and organizes its many types and formats of files.



Understanding Excel's Files

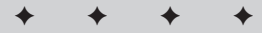
If you plan to do any advanced work with Excel, it's critical that you become familiar with the various ways to start Excel, and understand what happens when the application is launched. It's also a good idea to have an understanding of the various files used and generated by Excel. These topics are covered in this chapter.

Starting Excel

Excel can be started various ways (depending on how it's installed). All methods ultimately execute the Excel.exe executable file.

When Excel starts, it reads its settings from the Windows Registry and opens any add-ins that are installed (that is, those that are checked in the Add-Ins dialog box). It then displays an empty workbook; the number of sheets in the workbook is determined by a user-defined setting that is stored in the Windows Registry. You can change this number by editing the Sheets in the New Workbook setting located in the General tab of the Options dialog box (select Tools ⇨ Options).

If your Xlstart folder contains any workbooks, they are opened automatically — and a blank workbook does not appear. If your Xlstart folder includes a workspace file, multiple workbooks are opened in a customized workspace. You can also define an alternate startup directory to hold other worksheet or workspace files you want opened automatically. You can set up this alternate startup directory by specifying a path in the *At startup, open all files in* setting located in the General tab of the Options dialog box. In previous versions of Excel, this field was labeled *Alternate startup file location*.

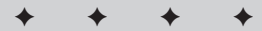


In This Chapter

A description of the various ways to start Excel

A discussion of the files used and produced by Excel — including the new HTML file format

Details about how Excel uses the Windows Registry



**Tip**

If you want to change the default formats (or content) of blank workbooks that you create, create a default workbook and save it as a template with the name *Book.xlt* in your *Xlstart* folder. For details on creating and using template files, refer to the online help.

Excel recognizes several command line switches. These are listed in Table 4-1.

Table 4-1
Excel Command Line Switches

Switch	What It Does
<i>/automation</i>	Forces Excel to start without loading add-ins and templates or processing files in the <i>Xlstart</i> directory or the alternate startup file location. Use this switch to perform a “clean-boot” of Excel.
<i>/e</i>	Forces Excel to start in “embedded” mode. Use this switch when you want to start Excel without creating a new workbook and without displaying its splash screen.
<i>/embedded</i>	Starts an invisible instance of Excel (not recommended).
<i>/m</i>	Forces Excel to create a new workbook that contains a single Microsoft Excel 4.0 macro sheet (obsolete).
<i>/o</i>	Causes Excel to register itself in the Windows Registry. It replaces missing Registry entries; it does not correct invalid entries (see <i>/regserver</i> , later in this table).
<i>/p directory</i>	Sets the active path to a directory other than the default directory.
<i>/r filename</i>	Forces Excel to open the specified file in read-only mode.
<i>/s</i>	Forces Excel to start in “safe” mode, and does not load any add-ins or files in the <i>Xlstart</i> or alternate startup file directories.
<i>/regserver</i>	Forces Excel to reregister itself in the Windows Registry and then quit. Use this switch when you want Excel to rewrite all its Registry keys and reassociate itself with Excel files, such as workbooks and charts.
<i>/unregserver</i>	Forces Excel to unregister itself in the Windows Registry and then quit.

One way to specify any of these switches is to edit the properties of the shortcut that starts Excel. For example, if you want Excel to use a folder named *Xlfiles* as its default folder, you can use the */p* switch and specify this in the Target field in the Properties dialog box for the Excel shortcut. To access the Properties dialog box, right-click the shortcut icon and click the Shortcut tab. For example, you can change the Target to:

```
"C:\Program Files\Microsoft Office\Office\EXCEL.EXE" /p
C:\Xlfiles
```


Note

You can run multiple instances of Excel on a single system. Each instance is treated as a separate task. And, most people have pretty good success running multiple versions of Excel on a single system. For best results, install the versions in the order of their release dates.

Excel's File Extensions

As Excel goes about its business, it uses many files in addition to the Excel.exe executable. These other files are loaded into memory as needed. Table 4-2 presents a summary of the file types that Excel may write to your hard disk during installation, or files that you may encounter when working with Excel.

Table 4-2
File Types Installed by Excel

<i>File Type</i>	<i>Description</i>
CHM	A compiled HTML help file.
DLL	A Dynamic Link Library file. DLLs are used by Windows applications to store program code.
EXE	An executable file. Excel.exe is the executable file that runs Excel.
OLB	An object type library file.
TXT	A plain ASCII text file, readable from any text editor (such as NotePad). These files often contain late-breaking information not found in the manuals.
XLA	An Excel add-in file. Several are supplied with Excel, and you can also download other add-ins or create your own.
XLB	An Excel toolbar configuration file. The current toolbar configuration is stored in the Windows directory in a file named Excel10.xlb (the filename is different in a network environment).
XLC	An Excel 4 chart file (obsolete beginning with Excel 5).
XLL	An Excel link library file. For example, the Analysis ToolPak add-in uses this type of file.
XLM	An Excel 4 macro file (obsolete beginning with Excel 5).
XLS	An Excel workbook file. Unfortunately, there is no way to tell from the extension which version of Excel produced the file.

Continued

Table 4-2 (continued)

<i>File Type</i>	<i>Description</i>
XLT	An Excel template file.
XLW	A workspace file that contains information about the windows and positions in a workspace. This extension was also used for Excel 4 workbook files (obsolete beginning with Excel 5 because all files are workbooks).
XLK	A backup file.



Excel versions prior to Excel 2000 used standard Windows Help files (*.hlp). Excel 2000 and later use HTML Help. This system uses compiled HTML files with a *.chm extension.

Spreadsheet File Formats Supported

Although Excel's default file format is an XLS workbook file, it can also open and save a wide variety of files generated by several other applications.

An important consideration is whether a particular file type can survive a “round trip.” In other words, do you lose any information if you save a file in a particular format and then reopen it in the same application? As you might expect, using Excel's native file format (XLS files) ensures that you'll lose absolutely nothing — as long as you use the latest version of XLS.



If you save and retrieve a file using a format other than the current XLS format, you run the risk of losing some types of information — typically formatting and macros, but sometimes formulas and charts.

In the sections that follow, I discuss the various types of files you can and cannot use with Excel.

Lotus 1-2-3 spreadsheet files

Lotus spreadsheets come in several flavors:

- ♦ *WKS files* are single-sheet files used by 1-2-3 Release 1.x for DOS. Excel can read and write these files.



Excel can also open Microsoft Works files, which also have a WKS extension.

- ♦ *WK1 files* are single-sheet files used by 1-2-3 Release 2.x for DOS. The formatting for these files is stored in *.all files (produced by the Allways add-in) or FM1 files (produced by the WYSIWYG add-in). Excel can read and write all these files. When you save a file to the *.wk1 format, you can choose which (if any) type of formatting file to generate.
- ♦ *WK3 files* are generated by 1-2-3 Release 3.x for DOS, 1-2-3 Release 4.x for DOS, and 1-2-3 Release 1.x for Windows. These files may contain more than one sheet. The formatting for these files is stored in *.fm3 files (produced by the WYSIWYG add-in). Excel can read and write WK3 files with or without the accompanying FM3 file.
- ♦ *WK4 files* are generated by 1-2-3 Release 4.x for Windows and 1-2-3 Release 5.x for Windows (Lotus finally got its act together and eliminated the separate formatting file). These files may contain more than one sheet. Excel can neither read nor write these files. If you need to read a WK4 file into Excel, your only option is to use 1-2-3 Release 4 for Windows (or later) and save the file in WK3 format, which Excel can read.
- ♦ *123 files* are generated by 1-2-3 97 and 1-2-3 Millennium Edition. These files may contain more than one sheet. Excel can neither read nor write these files. If you need to read a 123 file into Excel, your only option is to use 1-2-3 and save the file in WK3 format, which Excel can read.

Quattro Pro spreadsheet files

Quattro Pro files also exist in several versions:

- ♦ *WQ1 files are the single-sheet files generated by Quattro Pro for DOS Versions 1, 2, 3, and 4. Excel can read and write these files.*
- ♦ *WQ2 files are generated by Quattro Pro for DOS Version 5. Excel can neither read nor write this file format.*
- ♦ *WB1 files are generated by Quattro Pro for Windows Versions 1 and 5 (there are no Versions 2 through 4). Excel can read, but not write, this file format.*
- ♦ *WB2 files are generated by Quattro Pro for Windows Version 6. Excel can neither read nor write this file format.*
- ♦ *WB3 files are generated by Quattro Pro for Windows Versions 7 and 8. Excel can neither read nor write this file format.*

**Note**

You can download a Quattro Pro file converter from Microsoft's Web site. This converter enables you to import Quattro Pro 97's WB3 files. The URL for download is

<http://officeupdate.microsoft.com/downloadDetails/quatt97.htm>

Database file formats

DBF files are single-table database files generated by dBASE and several other database programs. Excel can read and write DBF files up to and including dBASE 4.

Excel cannot read or write any other database file formats directly. You can, however, use Microsoft Query to access many other database file formats and then copy or link the data into an Excel worksheet. You can run Microsoft Query directly from Excel by using the Data ⇨ Get External Data ⇨ New Database Query command.

Text file formats

Text files simply contain data with no formatting. There are several relatively standard text file formats, but there are no standard file extensions.

- ♦ Each line in *tab-delimited files* consists of fields separated by tabs. Excel can read these files, converting each line to a row and each field to a column. Excel also can write these files, using TXT as the default extension.
- ♦ Each line in *comma-separated files* consists of fields usually separated by commas (countries that use a comma as a decimal symbol will use semicolons in CSV files). Sometimes text appears in quotes. Excel can read these files, converting each line to a row and each field to a column. Excel can also write these files, using CSV as the default extension.
- ♦ Each line in *space-delimited files* consists of fields separated by spaces. Excel can read these files, converting each line to a row and each field to a column. Excel also can write these files, using PRN as the default extension.

When you attempt to load a text file into Excel, the Text Import Wizard may kick in to help you specify how you want the file retrieved.



Tip

To bypass the Text Import Wizard, press Shift when you click OK in the Open dialog box.



Note

You can also perform queries using text files. Use the Data ⇨ Get External Data ⇨ Import Text File command.

Other file formats

Other formats supported are the following:

- ♦ DIF (Data Interchange Format) file format was used by VisiCalc. I haven't seen a DIF file in ages. Excel can read and write these files.
- ♦ SYLK (SYmbolic LinK) file format was used by MultiPlan. SYLK files, too, are quite rare these days. Excel can read and write these files.

Files Written by Excel

Excel can write several types of files, which I discuss in this section.

XLS files

The XLS workbook files produced by Excel 2002 use the same file format as Excel 2000 and Excel 97. These files cannot be opened by any version of Excel prior to Excel 97. You can, however, save a workbook using any of the older Excel file formats. You may lose some information that is specific to the later file format.


Note

An Excel workbook or add-in file can have any extension you like. In other words, these files need not be stored using an XLS or XLA extension.

Which Version Created That XLS File?

Unfortunately, there is no direct way to determine which version of Excel created a particular XLS file. If you have an earlier version of Excel and attempt to open an XLS file that was created in a later version, you'll probably get an error message or a screenful of garbage characters. But if you can open the file successfully, you can use a simple VBA statement to determine the Excel version of the file.

Open the workbook, and make sure it's the active workbook. Press Alt+F11 to activate the Visual Basic Editor, and then press Ctrl+G to activate the Immediate window. Type the following statement, and press Enter:

```
Print ActiveWorkbook.FileFormat
```

The Immediate window displays a value that corresponds to the version of the active workbook. This value is one of those shown in the following table:

<i>Value</i>	<i>Excel Version</i>
16	Excel 2
29	Excel 3
33	Excel 4
39	Excel 5, 95
-4143	Excel 97, 2000, 2002

Workspace files

A *workspace file* is a special file that contains information about an Excel workspace. For example, if you have a project that uses two workbooks and you like to have the workbook windows arranged in a particular way, you can save an XLW file (use the File ⇨ Save Workspace command) to save this window configuration. Then, whenever you open the XLW file, Excel restores the desired workspace.



It's important to understand that a workspace file does *not* include the workbooks — only the configuration information that makes those workbooks visible in your Excel workspace. So if you need to distribute a workspace to someone else, make sure that you include the workbook files as well as the XLW file. In addition, the File ⇨ Save Workspace command does not save the workbooks themselves.

Template files

You can save any workbook as a template file (XLT extension). Doing so is useful if you tend to create similar files on a regular basis. For example, you may need to generate a monthly sales report. You can save some time by creating a template that holds the necessary formulas and charts for your report. When you start new files based on the template, you need only plug in the values.

To create a new workbook that's based on an existing template, use the File ⇨ New command, and select the template from the New dialog box.



Excel 2002 requires an extra step, because the preceding commands display the New Workbook toolbar. From the toolbar, you can choose a source for the template, including templates that you can download from Microsoft's Web site.



Clicking the New toolbar button or pressing Ctrl+N does not enable you to select a template. Rather, a default workbook is created.

If you create a template named Book.xlt, that template will be used as the basis for new workbooks. In addition, you can create a template named Sheet.xlt, which is used as the basis for new worksheets that you add to a workbook. Note that it is not possible to create a template for chart sheets because Excel handles chart templates differently.

Templates can be stored in two locations on your local computer:

- ♦ *Your Xlstart folder.* This is where you store autotemplates named Book.xlt and Sheet.xlt. You can also put workbook templates in this folder.
- ♦ *Your Templates folder.* Workbook templates stored here appear in the New dialog box.

**Tip**

The location of the Templates folder varies, depending on the version of Excel. To find the location of your Templates folder, execute the following VBA statement:

```
MsgBox Application.TemplatesPath
```

Toolbar files

Excel stores toolbar and menu bar configurations in an XLB file. When you exit Excel 2002, the current toolbar configuration is saved in a file named Excel10.xlb. The exact location and name of this file varies with the version of Excel, so search your hard drive for *.xlb and you'll find it. This file contains information regarding the position and visibility of all custom toolbars and custom menu bars, plus modifications that you've made to built-in toolbars or menu bars.

Excel 2002's online help lists the various names and locations of the XLB files for various versions of Excel. Do a search for "xlb" to find this information.

Add-in files

An *add-in* is essentially a workbook file with a few important differences:

- ♦ The workbook's `IsAddin` property is `True`—which means that it can be loaded using the Tools ⇨ Add-Ins command.
- ♦ The workbook is hidden and cannot be unhidden by the user. Consequently, an add-in is never the active workbook.
- ♦ The workbook is not part of the `Workbooks` collection.

Many add-ins provide new features or functions to Excel. You can access these new features as if they were built into the product.

You can create your own add-ins from XLS workbook files. In fact, creating add-ins is the preferred method of distributing some types of Excel applications. Add-ins have an XLA extension by default, but you can use any extension you like.

**Note**

Besides XLA add-ins, Excel supports XLL add-ins and (beginning with Excel 2000) COM add-ins. These types of add-ins are created using software other than Excel. This book discusses only XLA add-ins.

**Cross-Reference**

Chapter 21 covers the topic of add-ins in detail.

Excel and HTML

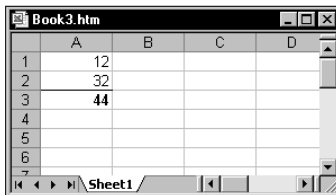
HTML is the language of the World Wide Web. When you browse the Web, the documents that are retrieved and displayed by your browser are usually in HTML format. An HTML file consists of text information plus special tags that describe how the text is to be formatted. The browser interprets the tags, applies formatting, and displays the information.

Excel 2000 and later can use HTML as a native file format. In other words, you can save a workbook in HTML format and then reopen the HTML file, and it will look exactly as it did before you first saved it. All the Excel-specific information (such as macros, charts, pivot tables, and worksheet settings) remains intact. HTML is a relatively simple file format. The fact that an Excel workbook can survive the “round trip” is just short of amazing.

Using HTML as a native file format may be amazing, but I think Microsoft may have overemphasized the importance of this feature. In real life, this simply isn't very useful except in a small number of situations.

So how does it work?

The best way to understand how Excel can use HTML as a native file format is to perform some simple experiments. Start with a new workbook, and make sure it has only one worksheet. Enter a few values and a formula, do some simple formatting, and then save the workbook in HTML format. Use the File ⇨ Save As Web Page command, and make sure you select the Entire Workbook option. Figure 4-1 shows a very simple workbook consisting of two values and a formula, with the formula cell formatted bold. This is a good candidate for learning about the HTML files saved by Excel.



	A	B	C	D
1	12			
2	32			
3	44			
4				
5				
6				
7				

Figure 4-1: Try saving a simple workbook like this in HTML format.

**Note**

The remainder of the material in this section assumes that you're familiar with HTML.

Next, open the HTML file in your browser. It will, of course, look pretty much like the original workbook. However, it is a “dead” non-interactive document. Use the browser’s View ⇨ Source command to view the HTML code. You might be surprised by what you see. Even HTML gurus might be overwhelmed by the complexity of this “simple” Web document.

Following are a few observations about the HTML file:

- ♦ The entire Excel workbook can be represented by a single HTML file. In other words, all the information needed to create an exact replica of the original workbook is contained in the HTML file. This isn’t always the case, however. Keep reading to find out when a simple HTML file no longer suffices.
- ♦ Most of the document is contained within the `<head>` and `</head>` tags.
- ♦ A large portion consists of style definitions. This is the information between the `<style>` and `</style>` tags — which is embedded between the `<head>` and `</head>` tags.
- ♦ The actual text that’s displayed in the browser is contained in a table (between the `<table>` and `</table>` tags).
- ♦ The formula is preserved by using a proprietary argument for the `<td>` tag. The proprietary argument is ignored by browsers, but Excel uses this information when the file is reopened.

The HTML file produced for the simple workbook is more than 4,000 bytes in size, which is quite large considering the simplicity of the displayed page. The extra information, of course, is what Excel uses to create a workbook when the HTML file is reopened.

Adding some complexity

The example workbook used in the preceding section is about as simple as it gets. Now let’s add a small bit of complexity to the workbook and see what happens to the HTML file.

Using the simple example file, select A1:A3 and press F11 to create a new chart sheet. Save the file again and load it in your browser. You’ll find that it closely resembles the Excel workbook, even down to the sheet tabs and navigation arrows at the bottom!

The HTML file has more than doubled in size (it’s now up to about 10,000 bytes). More importantly, you’ll find that the directory in which you saved the file has a new subdirectory that contains additional files (six extra files using my simple workbook). The files in this directory are necessary to display a replica of the workbook in a browser and to re-create the workbook when the HTML file is reopened in Excel.

If you examine the HTML file, you'll see that it's much more complicated than the original one and contains quite a bit of complex JavaScript code (JavaScript is a scripting language supported by Internet Explorer and Netscape Navigator). At this point, the HTML file has gotten well beyond the grasp of your average HTML author. And that's not even taking into account the other files dumped into the subdirectory. The files are:

- ♦ Three HTML files (one for each sheet, plus a file that displays the tab strip).
- ♦ A GIF file (the chart).
- ♦ A CSS file (a cascading style sheet that holds formatting and display information).
- ♦ An XML file. This is an “eXtensible Markup Language” file. XML is well beyond the scope of this book. (Hey, I told you this stuff was getting complicated!)

You might want to open some other Excel workbooks and save them as HTML files. You'll soon discover another type of file that's created in the subdirectory, an MSO (for Microsoft Office) file. This is a binary file that holds the information necessary to re-create Excel-specific features such as macros, pivot tables, conditional formatting, and so on.

**Caution**

As you may have surmised by now, saving an Excel workbook in HTML format introduces lots of potential problems. For example, if you need to transfer your file to another location, it's imperative that you include all the supporting files as well. If any of the supporting files are damaged, Excel cannot re-create the workbook. And opening and saving HTML files is much slower than opening and saving normal XLS files. To make a long story short, don't save your workbooks in HTML format unless you have a very good reason to do so.

What about interactivity?

If you're still with me at this point, it's time to introduce yet another level of complexity. Excel can save HTML files that include spreadsheet interactivity. In other words, when the HTML file is displayed in a browser, the user can actually interact with the document as a spreadsheet — enter data, change formulas, adjust cell formatting, see “live” charts, and even drag data around in pivot tables. This feature, which is called *publishing* (as opposed to *saving*), is limited in that you can only save one sheet (not an entire workbook).

To get a feel for how this works, activate a sheet that contains formulas. Use the File ⇨ Save As Web Page command. In the Save As dialog box, choose the Selection: Sheet option, and place a check mark next to Add interactivity. Click the Publish button. You'll get another dialog box (Publish as Web Page). Accept the defaults, and click Publish.

When you open the HTML file in your browser, you'll find that it displays a spreadsheet-like object that is, in fact, interactive. Figure 4-2 shows an example, using Microsoft's Internet Explorer browser.

What about the Script Editor?

You'll find that this book ignores a complete aspect of Excel: the Microsoft Script Editor, which you access by pressing Alt+Shift+F11. The Script Editor is used to edit the JavaScript (or VBScript) code in an HTML document. I consider this topic to be beyond the scope of this book, and useful to only a very small number of readers. In fact, I have never been in contact with anyone who had any interest at all in this topic. Consequently, I focus on the real meat of Excel: non-Web-based application development using VBA.

You might expect that the HTML file generated for an interactive worksheet would be much more complex than the example in the previous section. You'd be wrong. Such a worksheet occupies a single HTML file. Since only one sheet is involved when you publish, there's no need to get involved with the tab strip stuff. The complexity is handled by an ActiveX control. Because of this, the end user must have Office 2000 or later installed (or have a license for the Microsoft Web Components ActiveX control) to view an interactive Excel file in his or her browser.

Note

This section was intended to provide a brief overview of the HTML feature in Excel 2000 and 2002. This topic is definitely fodder for a complete book—one that I don't choose to write, thank you.

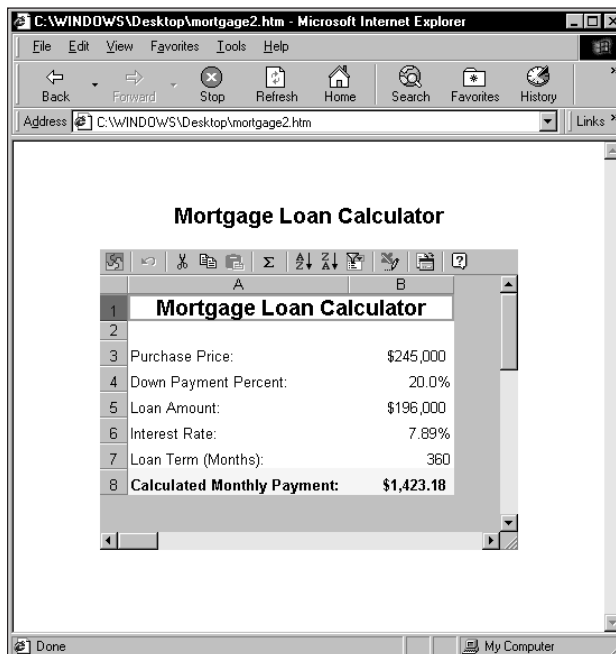


Figure 4-2: An example of an interactive Excel worksheet displayed in a browser

Excel Settings in the Registry

In this section, I provide some background information about the Windows Registry and discuss how Excel uses the Registry to store its settings.

About the Registry

Windows 3.1 used a Registration Database to store information about file association and OLE registration. The Windows 95 (or later) Registry extends this concept by storing configuration information for all types of applications, as well as computer-specific information.

The Registry is essentially a hierarchical database that can be accessed by application software. This information is stored in two data files: System.dat (for system-specific information) and User.dat (for user-specific information). Both of these files are located in the Windows folder. In addition, the Registry may use a file named Policy.pol—a file that contains system policies that override the information in the other files.

You can use the Registry Editor program (Regedit.exe, in the Windows folder) to browse the Registry—and even edit its contents if you know what you’re doing. Before beginning your explorations, take a minute to read the sidebar titled “Before You Edit the Registry . . .” Figure 4-3 shows what the Registry Editor looks like.

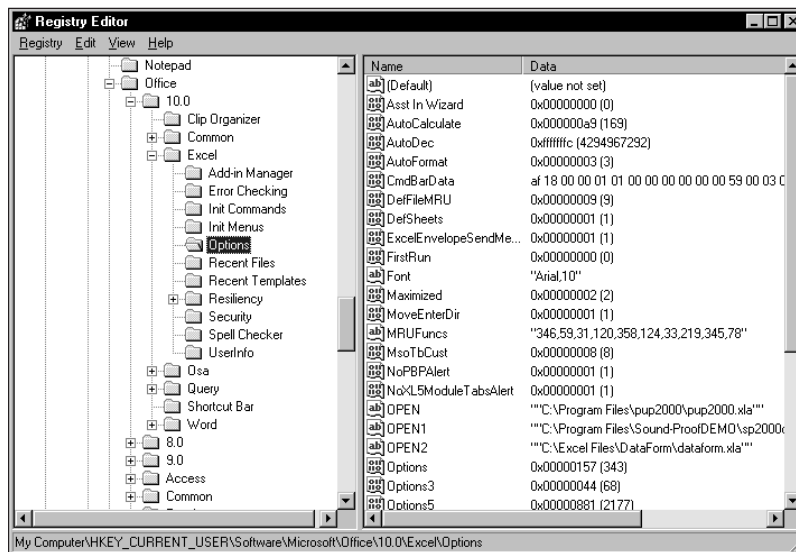


Figure 4-3: The Registry Editor lets you browse and make changes to the Registry.

As I mentioned, the Registry is hierarchical. It consists of keys and values. Table 4-3 lists the top-level root keys of the Registry along with a brief description of the type of information stored there.

**Table 4-3
Top-Level Keys in the Windows Registry**

<i>Key</i>	<i>Description</i>
HKEY_CLASSES_ROOT	Information on OLE, shortcut, and other interface features
HKEY_CURRENT_USER	Data from the current user's User.dat file (a duplicate of data found in HKEY_USERS)
HKEY_LOCAL_MACHINE	System-specific information from the System.dat file
HKEY_USERS	Information about all users on the system
HKEY_CURRENT_CONFIG	Hardware information
HKEY_DYN_DATA	Information on installed devices

Excel's settings

Information used by Excel 2002 is stored in

```
HKEY_CURRENT_USER\Software\Microsoft\Office\10.0\Excel
```

In this section of the Registry, you'll find a number of keys that contain specific values that determine how Excel operates.

Before You Edit the Registry . . .

You can use the Regedit.exe program to change anything in the Registry, including information that is critical to your system's operation. In other words, if you change the wrong piece of information, Windows may no longer work properly.

Therefore, it's a good idea to take some simple precautions. First, make sure that you have a startup diskette (you can do this by using the Add/Remove Programs app in the Control Panel). You can use this diskette to start Windows in an emergency.

Second, get into the habit of using the Registry ⇨ Export Registry File command in Regedit. This command enables you to save an ASCII version of the Registry or just a specific branch of the Registry. If you find that you messed up something, you can always import the ASCII file to restore the Registry to its previous condition (use the Registry ⇨ Import Registry File command). Refer to the help file for Regedit for details.

The Registry settings are updated automatically by Excel when Excel closes.


Note

It's important to understand that Excel reads the Windows Registry only once—when it starts up. In addition, Excel updates the Registry settings only when Excel closes normally. If Excel crashes your system (unfortunately, not an uncommon occurrence), the Registry information is not updated. For example, if you change one of Excel's settings, such as the visibility of the status bar, this setting is not written to the Registry until Excel closes by normal means.

Table 4-4 lists the Registry sections that are relevant to Excel 2002. You may not find all these sections in your Registry database.

Table 4-4
Excel Configuration Information in the Registry

<i>Section</i>	<i>Description</i>
Add-in Manager	Lists add-ins that appear in the list box when you choose the Tools ⇨ Add-Ins command. Add-ins that are included with Excel do not appear in this list. If you have an add-in entry in this list box that you no longer use, you can remove it by using the Registry Editor.
Converters	Lists additional (external) file converters that are not built into Excel.
AutoSave	Holds the AutoSave option that you set.
Delete Commands	Enables you to specify which menu commands you don't want to appear.
Error Checking	Holds the settings for formula error checking.
Init Commands	Holds information about custom commands.
Init Menus	Holds information about custom menus.
Line Print	Holds settings used in 1-2-3 macro printing. Excel updates this section whenever it executes a 1-2-3 macro that has /wgdu (Worksheet Global Default Update) in it.
Options	A catch-all section; holds a wide variety of settings, including the paths to files that are opened automatically when Excel starts (such as add-ins).
Recent Files	Stores the names of the last files saved (up to nine files).
Resiliency	Information used for recovering documents.
Security	Specifies the security level for opening files that contain macros.
Spell Checker	Stores information about your spelling checker options.
UserInfo	Information about the user.
WK? Settings	Contains settings for opening and saving 1-2-3 files (for example, whether to create an FMT or FM3 format file).

Although you can change most of the settings via Excel's Options dialog box, several other useful settings cannot be changed directly from Excel (but you can use the Registry Editor to make changes).



One more warning is in order. Prior to making any changes to the Registry, refer to the sidebar "Before You Edit the Registry . . ."

Summary

In this chapter, I discussed the files used and created by Excel. I described Excel installation, various ways to load files automatically, Excel's file extensions, and file formats supported by Excel (including HTML format). I also discussed some of Excel's settings in the Windows Registry. Information in this chapter that's particularly relevant to application development and programming appears in more detail in other chapters.

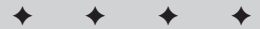
This chapter concludes Part I. Part II provides information about developing user-oriented applications with Excel.



Excel Application Development

This part contains only two chapters, but they are important for readers who want to become effective Excel power programmers. In Chapter 5, I present my views on exactly what constitutes a spreadsheet application. Chapter 6 discusses the general steps involved in creating a spreadsheet application with Excel.

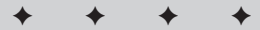
P A R T



In This Part

Chapter 5
What Is a
Spreadsheet
Application?

Chapter 6
Essentials of
Spreadsheet
Application
Development



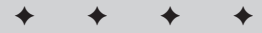
What Is a Spreadsheet Application?

In this chapter, I attempt to clarify how people use spreadsheets in the real world. This is a topic that's germane to this entire book because it can help you determine how much effort you should devote to a particular development project. By the time you finish this chapter, you should have a pretty good idea of what I mean by a "spreadsheet application." And after you've made it through the rest of the book, you'll be well on your way to developing your own spreadsheet applications with Excel. But first, let's get down to the basics.

You've probably been working with spreadsheets for several years, but chances are good that your primary focus has been on simply generating spreadsheets to get the job done. You probably never gave much thought to more global issues like those discussed in this chapter: the different types of spreadsheet users, how to classify various types of spreadsheets, and even basic questions such as why people use spreadsheets. If the title of this book attracted your attention, it's important for you to understand these issues so that you can become an effective "power programmer." I'll first discuss the concept of a *spreadsheet application*. This is, after all, the desired result of your power-programming efforts.

Spreadsheet Applications

Programming, as it relates to spreadsheet use, is essentially the process of building applications that use a spreadsheet rather than a traditional programming language such as C, Pascal, or BASIC. In both cases, however, these applications will be used by other people—not the developer of the application.



In This Chapter

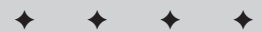
A working definition of a spreadsheet application

The difference between a spreadsheet user and a spreadsheet developer

A system for classifying spreadsheet users to help you conceptualize who the audience is for your applications

A discussion of why people use spreadsheets

A taxonomy of the basic types of spreadsheets



For purposes of this book, a **spreadsheet application is a spreadsheet file (or group of related files) that is designed so that someone other than the developer can perform useful work without extensive training.** According to this definition, most of the spreadsheet files you've developed probably wouldn't qualify as spreadsheet applications. You may have dozens or hundreds of spreadsheet files on your hard drive, but it's a safe bet that most of them aren't really designed for others to use.

A good spreadsheet application has the following characteristics:

- ♦ It enables the end user to perform a task that he or she probably would not be able to do otherwise.
- ♦ It provides the appropriate solution to the problem. (A spreadsheet environment isn't always the optimal approach.)
- ♦ It accomplishes what it is supposed to do. This may be an obvious prerequisite, but it's not at all uncommon for applications to fail this test.
- ♦ It produces accurate results and is free of bugs.
- ♦ It uses appropriate and efficient methods and algorithms to accomplish its job.
- ♦ It traps errors before the user is forced to deal with them. Note that errors and bugs are not the same. Attempting to divide by zero is an error. Failure to identify that error before it occurs is a bug.
- ♦ It does not allow the user to delete or modify important components accidentally (or intentionally).
- ♦ Its user interface is clear and consistent, so the user always knows how to proceed.
- ♦ Its formulas, macros, and user interface elements are well documented, allowing for subsequent changes, if necessary.
- ♦ It is designed so that it can be modified in simple ways without making major changes. A basic fact of life is that a user's needs change over time.
- ♦ It has an easily accessible help system that provides useful information on at least the major procedures.
- ♦ It is designed so that it is portable and runs on any system that has the proper software (in this case, a copy of the appropriate version of Excel).

It should come as no surprise that it is possible to create spreadsheet applications for many different usage levels, ranging from simple fill-in-the-blank templates to extremely complex applications that use custom menus and dialog boxes and that may not even look like spreadsheets.

The Developer and the End User

I've already used the terms *developer* and *end user*, terms you'll see frequently throughout this book. Because you've gotten this far, I think I can safely assume that you're either a spreadsheet application developer or a potential developer.

My definitions regarding developers and end users are simple. The person who creates the spreadsheet application is the *developer*. For joint projects, there are multiple developers (a development team). The person who uses the results of the developer's spreadsheet programming efforts is the *end user* (which I often shorten to simply *user*). In many cases, there will be multiple end users, and often the developer is one of the users.

Who are developers? What do they do?

I've spent about 15 years trading methodologies and basically hanging out with the motley crew of folks who call themselves spreadsheet developers. I divide them into two primary groups:

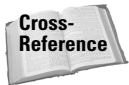
- ♦ *Insiders* are developers who are intimately involved with the users and thoroughly understand their needs. In many cases, these developers are also users of the application. Often, they developed the application in response to a particular problem.
- ♦ *Outsiders* are developers who are hired to produce a solution to a problem. In most cases, developers in this category are familiar with the business in general, but not with the specifics of the application they are developing. In other cases, these developers are employed by the company that requests the application (but they normally work in a different department).

Some developers devote full time to development efforts. These developers may be either insiders or outsiders. A fair number of consultants (outsiders) make a decent living developing spreadsheet applications on a freelance basis.

Other spreadsheet developers don't work full time at the task and may not even realize they are developing spreadsheet applications. These developers are often office computer gurus who seem to know everything about computers and software. These folks often create spreadsheet applications as a way to make their lives easier — the time spent developing a well-designed application for others can often save hours of training time and can greatly reduce the time spent answering others' questions.

Spreadsheet developers are typically involved in the following activities, often performing most or all of each task on their own:

- ♦ Determining the needs of the user
- ♦ Planning an application that meets these needs
- ♦ Determining the most appropriate user interface
- ♦ Creating the spreadsheet, formulas, macros, and user interface
- ♦ Testing the application under all reasonable sets of conditions
- ♦ Making the application relatively “bulletproof” (often based on results from the testing)
- ♦ Making the application aesthetically appealing and intuitive
- ♦ Documenting the development effort
- ♦ Distributing the application to users
- ♦ Updating the application if and when it’s necessary



I discuss these activities in more detail in Chapter 6.

Developers must have a thorough understanding of their development environment (in this case, Excel). And there’s certainly a lot to know when it comes to Excel. By any standard, Excel is easy to use, but defining what’s easy to use depends on the user. Developing nontrivial spreadsheet applications with Excel requires an in-depth knowledge of formulas, functions, macros, custom dialog boxes, custom toolbars, menu modifications, and add-ins. Most Excel users, of course, don’t meet these qualifications and have no intention of learning these details — which brings me to the next topic: classifying spreadsheet users.

Classifying spreadsheet users

Over the years, I’ve found that it’s often useful to classify people who use spreadsheets (including both developers and end users) along two dimensions: their *degree of experience* with spreadsheets and their *interest in learning* about spreadsheets.

To keep things simple, each of these two dimensions has three levels. Combining them results in nine combinations, which are shown in Table 5-1. In reality, only seven segments are worth thinking about because both moderately experienced and very experienced spreadsheet users generally have at least *some* interest in spreadsheets (that’s what motivated them to get their experience). Users who have a lot of spreadsheet experience and a low level of interest would make very bad developers.

Table 5-1
Classification of Spreadsheet Users by Experience and Interest

	<i>No Interest</i>	<i>Moderately Interested</i>	<i>Very Interested</i>
Little Experience	User	User	User/Potential Developer
Moderately Experienced	N/A	User	Developer
Very Experienced	N/A	User	Developer

It should be clear that spreadsheet developers must have a great deal of *experience* with spreadsheets, as well as a high *interest* in spreadsheets. Those with little spreadsheet experience, but with a great deal of interest, are potential developers. All they need is more experience. If you're reading this book, you probably fall into one of the boxes in the last column of the table.

The audience for spreadsheet applications

The remaining segments in the preceding table comprise spreadsheet end users, whom you can think of as the consumers of spreadsheet applications. When you develop a spreadsheet application for others to use, you need to know which of these groups of people will actually be using your application.

Users with little experience and no interest comprise a large percentage of all spreadsheet users, probably the largest segment of all. These are the people who need to use a spreadsheet for their jobs but who view the spreadsheet simply as a means to an end. Typically, they know very little about computers and software, and they usually have no interest in learning anything more than what's required to get their work done. They might even feel a bit intimidated by computers. Often, these users don't even know which version of their spreadsheet they use, and they are largely unfamiliar with what it can do. Obviously, applications developed for this group must be user-friendly. By that I mean straightforward, unintimidating, easy to use, and as bulletproof as possible.

From the developer's point of view, a more interesting group of users are those who have little or moderate spreadsheet experience but are interested in learning more. These users understand the concept of formulas, use built-in worksheet functions, and generally have a good idea of what the product is capable of doing. These users generally appreciate the work you put into an application and are often impressed by your efforts. Even better, they'll often make excellent suggestions for improving your applications. Applications developed for this group should also be user-friendly (easy to use and bulletproof), but they can also be more complex and customizable than applications designed for the less experienced and less interested groups.

Why people use spreadsheets

If I asked you why people use spreadsheets, you would probably have to think about it before coming up with an answer. This question is rarely asked, but asking it and arriving at a meaningful answer can have a major impact on your development efforts. The real and not-at-all-surprising answer is that it depends on the user.

Several years ago, I conducted an informal (and not very scientific) survey of spreadsheet users at the company where I was working. Most of the employees were using Excel, but there were also a few staunch 1-2-3 for DOS holdouts in the group. The survey consisted of one question (*Why do you use a spreadsheet?*) along with a series of check boxes. The survey respondents could choose as many reasons as they liked. After I received the completed survey, I classified each user, based on my knowledge of him or her, into one of two categories: Inexperienced or Moderately/Very Experienced. The results are shown in Table 5-2.

Table 5-2
“Why Do You Use a Spreadsheet?”

<i>Reason</i>	<i>Inexperienced</i>	<i>Moderately or very experienced</i>
It reduces the amount of work I have to do.	12%	100%
It saves time.	20%	91%
It makes my work look better.	76%	82%
It helps prevent calculation errors.	76%	82%
It can handle lots of different tasks.	12%	82%
It’s fun.	12%	73%
It’s the most appropriate tool for a particular task.	8%	73%
It makes good graphs.	12%	64%
I know how to use it.	68%	55%
It’s the only way I know to perform a particular task.	72%	36%
It’s all set up for me.	28%	27%
Making nice columns is easier with a spreadsheet than with a word processor.	60%	18%
It was on my workstation when I came here.	36%	18%
I like the macros.	0%	9%
Everybody else does.	32%	0%

I certainly don't claim that this survey represents the views of all spreadsheet users, and it's likely that the results would be different if I did the survey today. But I find it interesting, and maybe you will, too. I discuss my interpretations of this data in the following sections.

Inexperienced users

More than three-quarters of the inexperienced users claim to use a spreadsheet because it makes their work look better and helps prevent calculation errors. Other reasons often cited by these users are that it's the only way they know to perform a particular task, they know how to use it, and making nice columns is easier with a spreadsheet than with a word processor.

Only 12 percent claim that it reduces the amount of work they have to do or that it can handle a lot of different tasks. This low percentage suggests that many inexperienced users are missing the point of spreadsheets or that they perceive using a spreadsheet as being work, and they don't understand the spreadsheet's capabilities.

This group often uses spreadsheet software because it's there. In many cases, these users did not choose to have the software. It just happened to be installed on their workstations. Or the person who had the job before they took over used a spreadsheet, and it became a part of the job they inherited. When the time comes to produce the monthly sales report, these users fire up the spreadsheet and repeat the same procedures they've followed for the past 12 months.

My experience with these users tells me that most of them learn only enough to perform basic operations, and they typically ignore about 90 percent of a product's features. My survey supports this perception. Most of these users did not use the charting feature, and none used a spreadsheet because of its macro capability. Only 8 percent said they use a spreadsheet because it's the most appropriate tool. As a side note, users in this group frequently use software inappropriately. For example, I've seen people attempt to summarize information from massive databases by importing huge files into a worksheet. Others write letters and memos using Lotus 1-2-3. Still others enter tables of numbers into a word processor and compute sums by using a hand calculator. Go figure.

Moderately experienced and very experienced users

The more experienced survey respondents clearly have a better appreciation for the potential uses of spreadsheet software, and generally, they checked off more reasons for using spreadsheets. The reasons most frequently cited by experienced users are usually those that are *not* checked by the inexperienced users, such as reduced workload, time savings, most appropriate tool for a task, and so on. Interestingly, these users also frequently cited the top two reasons that the inexperienced users gave for using a spreadsheet: better-looking work and fewer calculation errors.

Conclusions

This informal survey may shed some light on why people use spreadsheets. The bottom line is that people use spreadsheets

- ♦ Because spreadsheets make them (and their work) look good
- ♦ Because the results are more accurate
- ♦ Because spreadsheets save time and eliminate manual effort

These are not exactly earth-shattering conclusions, but as a developer, you can translate these reasons into goals for the applications you develop. Your application will be successful if it helps the user look good and generates attractive output, produces more accurate results, and saves time and effort.

Solving Problems with a Spreadsheet

I've covered the basic concept of a spreadsheet application, discussed the end users and developers of such applications, and even attempted to figure out why people use spreadsheets at all. Now it's time to take a look at the types of tasks that are appropriate for spreadsheet applications.

You may already have a pretty good idea of the types of tasks for which you can use a spreadsheet. Traditionally, spreadsheet software has been used for numerical applications that are largely *interactive* in nature. Corporate budgets are an excellent example of this. After the model has been set up (that is, after formulas have been developed), working with a budget is simply a matter of plugging in amounts and observing the bottom-line totals. Often, budgeters simply need to allocate fixed resources among various activities and present the results in a reasonably attractive (or at least legible) format. A spreadsheet, of course, is ideal for this.

Budget-type problems, however, probably account for only a small percentage of your spreadsheet-development time. If you're like me, you've learned that uses for spreadsheet software (particularly in recent years) can often extend well beyond the types of tasks for which spreadsheets were originally designed.

Here are just a few examples of nontraditional ways that a spreadsheet such as Excel can be used:

- ♦ As a presentation device. *For example, with minimal effort you can create an attractive, interactive on-screen slide show using only Excel.*
- ♦ As a data-entry tool. *For repetitive data-entry tasks, a spreadsheet is often the most efficient route to take. The data can then be exported to a variety of formats for use in other programs.*

- ♦ As a forms generator. *For creating attractive printed forms, many find it easier to use Excel's formatting capabilities than to learn a desktop publishing package such as PageMaker.*
- ♦ As a text processor. The text functions found in all spreadsheets enable you to manipulate text in ways that are impossible using a word processor.
- ♦ As a platform for simple games. *Clearly, Excel was not designed with this in mind. However, I've downloaded (and written) some interesting strategy games using the tools found in Excel and other spreadsheets.*

You can probably think of many more examples for this list.

Ironically, the versatility of spreadsheets is a double-edged sword. On one hand, it's tempting to try to use a spreadsheet for every problem that crops up. On the other hand, you'll often be spinning your wheels by trying to use a spreadsheet for a problem that's better suited for a different solution.

Basic Spreadsheet Types

In this section, I classify spreadsheets into several basic types to provide a better perspective on how spreadsheet applications fit into the overall scheme of things. This is all quite arbitrary, of course, and is based solely on my own experience. Moreover, there is quite a bit of overlap between the categories, but they cover most of the spreadsheets I've seen and developed.

My names for these categories are as follows:

- ♦ Quick-and-dirty
- ♦ For-your-eyes-only
- ♦ Single-user applications
- ♦ Spaghetti applications
- ♦ Utility applications
- ♦ Add-ins that contain worksheet functions
- ♦ Single-block budgets
- ♦ What-if models
- ♦ Data storage and access
- ♦ Database front ends
- ♦ Turnkey applications

I discuss each of these categories in the following sections.

Quick-and-dirty spreadsheets

This is probably the most common type of spreadsheet. Most of the spreadsheets in this category are fairly small and are developed to quickly solve a problem or answer a question. Here's an example: You're about to buy a new car, and you want to figure out your monthly payment for various loan amounts. Or perhaps you need to generate a chart that shows your company's sales by month, so you quickly enter 12 values and whip out a chart, which you paste into your word processor.

In both of the preceding cases, you can probably input the entire model in a few minutes, and you certainly won't take the time to document your work. You probably won't even think of developing any macros or custom dialog boxes. In fact, you may not even deem these simple spreadsheets worthy of saving to disk. Obviously, spreadsheets in this category are not applications.

For-your-eyes-only spreadsheets

As the name implies, no one except you — the creator — will ever see or use the spreadsheets that fall into this category. An example of this type might be a file in which you keep information relevant to your income taxes. You open the file whenever a check comes in the mail, you incur an expense that can be justified as business, you buy tax-deductible Girl Scout cookies, and so on. Another example is a spreadsheet that you use to keep track of your employees' time records (sick leave, vacation, and so on).

Spreadsheets in this category differ from quick-and-dirty spreadsheets in that you use them more than once, so you save these spreadsheets to files. But again, they're not worth spending a great deal of time on. You may apply some simple formatting, but that's about it. This type of spreadsheet also lacks any type of error detection because you understand how the formulas are set up; you know enough to avoid inputting data that will produce erroneous results. If an error does crop up, you immediately know what caused it.

Spreadsheets in this category don't qualify as applications, although they sometimes increase in sophistication over time. For example, I have an Excel workbook that I use to track my income by source. This workbook was simple when I first set it up, but I tend to add accouterments to it on a regular basis — more summary formulas, better formatting, and even a chart that displays income by month. My latest modification was to add a best-fit line to the chart to project income based on past trends. I'll probably continue to add more to this file, and it may eventually qualify for the single-user application category.

Single-user applications

This is a spreadsheet application that only the developer uses, but its complexity extends beyond the spreadsheets in the for-your-eyes-only category. For example, I developed a workbook to keep track of registered users for my shareware

applications. It started out as a simple worksheet database (for my eyes only), but then I realized that I could also use it to generate mailing labels and invoices. One day I spent an hour or so writing macros and then realized that I had converted this application from a for-your-eyes-only application to a single-user application.

No one else will ever use this spreadsheet, but it's a slick little application that's very easy to use. In this particular case, the time I spent modifying the spreadsheet from a for-your-eyes-only spreadsheet to a single-user application was definitely time well spent because it has already saved me several hours of work. The application now has buttons that execute macros, and it has greatly reduced the amount of effort required to deal with the mechanics of tracking my customers and mailing products.

Creating single-user applications for yourself is an excellent way to get practice with Excel's developer's tools. For example, you can learn to create custom dialog boxes, modify menus, create a custom toolbar, write VBA macros, and so on. You'll find that working on a meaningful project (even if it's meaningful only to you) is the best way to learn advanced features in Excel — or any other software, for that matter.

Spaghetti applications

An all-too-common type of spreadsheet is what I call a *spaghetti application*. The term stems from the fact that the parts of the application are difficult to follow, much like a plate of spaghetti. Most of these spreadsheets begin life as a reasonably focused single-user application. But over time they are passed along to others who make their own modifications. As requirements change and employees come and go, new parts are added and others are ignored. Before too long, the original purpose of the workbook may have been forgotten. The result is a file that is used frequently, but no one really understands exactly how it all works.

Everyone who's involved with it knows that the spaghetti application should be completely reworked. But because nobody really understands it, the situation tends to worsen over time. Spreadsheet consultants make a lot of money untangling such applications. I've found that, in most cases, the most efficient solution is to redefine the user needs and build a new application from scratch.

Utility applications

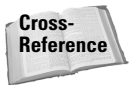
No one is ever completely satisfied with his or her spreadsheet product. Good as it is, I still find quite a bit lacking in Excel. This brings me to the next category of spreadsheets: *utility applications*. Utilities are special tools designed to perform a single recurring task. For example, if you often import text into Excel, you may want some additional text-handling commands, such as the ability to convert selected text to uppercase (without using formulas). The solution? Develop a text-handling utility that does exactly what you want.



The Power Utility Pak is a collection of utility applications for Excel. I developed these utilities to extend Excel's functionality. These utilities work just like normal Excel commands. You can find the shareware version of the Power Utility Pak on the companion CD-ROM, and you can get a free copy of the full version by using the coupon located at the back of the book. And if you're interested, the complete VBA source code is also available.

Utility applications are very general in nature. Most macros are designed to perform a specific operation on a specific type of data found in a specific type of workbook. A good utility application essentially works like a command normally found in Excel. In other words, the utility needs to recognize the context in which a command is executed and take appropriate action. This usually requires quite a bit of error-handling code so that the utility can handle any situation that comes up.

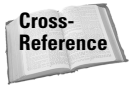
Utility applications always use macros and may or may not use custom dialog boxes. Fortunately, Excel makes it relatively easy to create such utilities, and they can be converted to add-ins and attached to Excel's user interface so that they appear to be part of Excel.



The topic of creating utilities is so important that I devote an entire chapter to it. Chapter 16 discusses how to create custom Excel utilities using VBA.

Add-ins that contain worksheet functions

As you know, Excel has many worksheet functions that you can use in formulas. Chances are, you've needed a particular function, only to find that it doesn't exist. The solution? Create your own, using VBA. Custom worksheet functions can often simplify your formulas and make your spreadsheet easier to maintain.



In Chapter 10, you'll find everything you need to know about creating custom worksheet functions, including lots of examples.

Single-block budgets

By a *single-block budget*, I mean a spreadsheet (not necessarily a budget model) that essentially consists of one block of cells. The top row might contain names that correspond to time (months, quarters, or years), and the left column usually contains categories of some type. Typically, the bottom row and right column contain formulas that add the numbers together. There may or may not be formulas that compute subtotals within the block.

This is a very common type of spreadsheet. In fact, VisiCalc (the world's first spreadsheet) was developed with this type of model in mind. In most cases, simple single-block budget models are not good candidates for applications, because they

are simple to begin with, but there *are* exceptions. For example, you might consider converting such a spreadsheet into an application if the model is an unwieldy 3D spreadsheet, needs to include consolidations from other files, or will be used by departmental managers who may not understand spreadsheets.

What-if models

Many consider the what-if model category to be the epitome of spreadsheets at their best. The ability to instantly recalculate thousands of formulas makes spreadsheet software the ideal tool for financial modeling and other models that depend on the values of several variables. If you think about it, just about any spreadsheet that contains formulas is a what-if model (which are often distributed as templates). Changing the value of a cell used in a formula is akin to asking “what if . . .?” My view of this category, however, is a bit more sophisticated. It includes spreadsheets designed exclusively for systematically analyzing the effects of various inputs.

What-if models are often good candidates for user-oriented applications, especially if the model will be used for a lengthy period of time. Creating a good user interface on an application can make it very easy for anyone to use, including computer-illiterates. As an example, you might create an interface that lets the user provide names for various sets of assumptions and then lets you instantly view the results of a selected scenario and create a perfectly formatted summary chart with the click of a button.

Data storage and access spreadsheets

It’s not surprising that spreadsheets are often used for keeping lists or modest database manipulations. Most people find that it’s much easier to view and manipulate data in a spreadsheet than it is using normal database software. Beginning with Excel 97, each worksheet consists of 65,536 rows, a size increase that greatly extends the potential for database work.

Spreadsheets in this category are often candidates for applications, especially if end users need to perform moderately sophisticated operations. However, Excel’s built-in data form dialog box and its auto-filtering commands make working with databases so easy that even beginning users can master simple database operations quickly.

For more sophisticated database applications, such as those that use multiple tables with relationships between them, you’ll be better off using a real database program such as Access.

Database front ends

Increasingly, spreadsheet products are used to access external databases. Spreadsheet users can access data stored in external files, even if they come in a variety of formats, using tools that Excel provides. When you create an application that does this, it's sometimes referred to as an *executive information system*, or *EIS*. This sort of system combines data from several sources and summarizes it for users.

Accessing external databases from a spreadsheet often strikes fear in the hearts of beginning users. Creating an executive information system is therefore an ideal sort of Excel application because its chief goal is usually ease of use.

Turnkey applications

The final category of spreadsheet types is the most complex. By *turnkey*, I mean ready to go, with little or no preparation by the end user. For example, the user loads the file and is presented with a user interface that makes user choices perfectly clear. Turnkey applications may not even look as if they are being powered by a spreadsheet, and often, the user interacts completely with dialog boxes rather than cells.

Actually, many of the categories just described can be converted into turnkey applications. The critical common elements, as I'll discuss throughout the remainder of the book, are good planning, error handling, and user-interface design.

Summary

In this chapter, I introduced the concept of a spreadsheet application. I then discussed the distinction between a developer and an end user, and I presented a two-way classification system that describes spreadsheet users. Finally, I classified spreadsheets into several categories, some of which qualify as material for application developers.



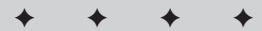
Essentials of Spreadsheet Application Development

My goal in this chapter is to provide you with some *general* guidelines that you may find useful as you learn to create effective applications using Excel. There is no simple, sure-fire recipe for developing an effective spreadsheet application. Everyone has his or her own style for creating such applications, and in my experience, I haven't discovered one "best way" that works for everyone. In addition, every project that you undertake will be different and will therefore require its own approach. Finally, the demands and general attitudes of the people you'll be working with (or for) also play a role in how the development process will proceed.

As I mentioned in the preceding chapter, spreadsheet developers typically perform the following activities:

- ◆ Determine the needs of the user
- ◆ Plan an application that meets these needs
- ◆ Determine the most appropriate user interface
- ◆ Create the spreadsheet, formulas, macros, and user interface
- ◆ Test and debug the application
- ◆ Attempt to make the application bulletproof
- ◆ Make the application aesthetically appealing and intuitive

CHAPTER 6



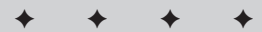
In This Chapter

A discussion of the basic steps involved in spreadsheet application development

Determining end user needs and planning applications to meet those needs

Guidelines for developing and testing your applications

Documenting your development efforts and writing user documentation



- ♦ Document the development effort
- ♦ Develop user documentation and online help
- ♦ Distribute the application to the user
- ♦ Update the application when it's necessary

Not all of these steps are required for each application, and the order in which these activities are performed may vary from project to project. Each of these activities is described in the pages that follow; and in most cases, the technical details are covered in subsequent chapters.

Determining User Needs

When you undertake a spreadsheet application development project, one of your first steps is to identify exactly what the end users require. Failure to thoroughly assess the end users' needs early on often results in additional work later when you have to adjust the application so that it does what it was supposed to do in the first place.

In some cases, you'll be intimately familiar with the end users and may even be an end user yourself. In other cases (for example, a consultant developing a project for a new client), you may know little or nothing about the users or their situation.

Following are some guidelines that may help to make this phase easier:

- ♦ Don't presume that you know what the user needs. Second-guessing at this stage almost always causes problems later on.
- ♦ If possible, talk directly to the end users of the application, not just their supervisor or manager.
- ♦ Learn what, if anything, is currently being done to meet the user's needs. You may be able to save some work by simply adapting an existing application. At the very least, looking at current solutions will familiarize you with the operation.
- ♦ Identify the resources available at the user's site. For example, try to determine whether there are any hardware or software limitations that you must work around.
- ♦ If possible, determine the specific hardware systems that will be used. If your application will be used on slower systems, you need to take that into account.
- ♦ Identify which version(s) of Excel are in use. Although Microsoft does everything in its power to urge users to upgrade to the latest version of their software, I've read estimates that fewer than 50 percent of Microsoft Office users have the most recent version.

- ♦ Understand the skill levels of the end users. This information will help you design the application appropriately.
- ♦ Determine how long the application will be used and whether any changes are anticipated during the lifetime of the project. Knowing this may influence the amount of effort you put into the project and help you plan for changes. How do you determine the needs of the user? If you've been asked to develop a spreadsheet application, it's a good idea to meet with the end user and ask very specific questions. Better yet, get everything in writing, create flow diagrams, pay attention to minor details, and do anything else to ensure that the product you deliver is the product that is needed.

One final note: Don't be surprised if the project specifications change before you complete the application. This is quite common, and you'll be in a better position if you *expect* changes rather than are surprised by them. Just make sure that your contract (if you have one) addresses the issue of changing specifications.

Planning an Application That Meets User Needs

Once you've determined the end users' needs, it's very tempting to jump right in and start fiddling around in Excel — take it from someone who suffers from this problem. But try to restrain yourself. Builders don't construct a house without a set of blueprints, and you shouldn't develop a spreadsheet application without some type of plan. The formality of your plan depends on the scope of the project and your general style of working, but you should at least spend *some* time thinking about what you're going to do and coming up with a plan of action.

Before rolling up your sleeves and settling down at your keyboard, you'll benefit by taking some time to consider the various ways that you can approach the problem. Here is where a thorough knowledge of Excel pays off. Avoiding blind alleys before you stumble into them is always a good idea.

If you ask a dozen Excel gurus to design an application based on very precise specifications, chances are you'll get a dozen different implementations of the project that all meet those specifications. And of those solutions, some will definitely be better than the others because Excel often provides several different options to accomplish a task. If you know Excel inside and out, you'll have a pretty good idea of the potential methods at your disposal, and you can choose the one most appropriate for the project at hand. Often, a bit of creative thinking yields an unusual approach that's vastly superior to other methods.

So at the beginning stage of this planning period, you'll be considering some general options, such as those that follow:

- ♦ *File structure.* Think about whether you want to use one workbook with multiple sheets, several single-sheet workbooks, or a template file.
- ♦ *Data structure.* You should always consider how your data will be structured. This includes the use of external database files versus storing everything in worksheets.
- ♦ *Formulas versus VBA.* Should you use formulas or write VBA procedures to perform calculations? Both have advantages and disadvantages.
- ♦ *Add-in or XLS file.* In some cases, an add-in might be the best choice for your final product. Or, perhaps you might use an add-in in conjunction with a standard workbook.
- ♦ *Version of Excel.* Will your Excel application be used with Excel 2002 only? With Excel 2000 or Excel 97? What about Excel 95 and Excel 5? Will it also be run on a Macintosh? These are very important considerations because each new version of Excel adds features that aren't available in previous versions.
- ♦ *How to handle errors.* Error handling is a major issue with applications. You need to determine how your application will detect and deal with errors. For example, if your application applies formatting to the active worksheet, you need to be able to handle a case in which a chart sheet is active.
- ♦ *Use of special features.* If your application needs to summarize a lot of data, you may want to consider using Excel's pivot table feature. Or, you might want to use Excel's data validation feature as a check for valid data entry.
- ♦ *Performance issues.* The time to start thinking about increasing the speed and efficiency of your application is at the development stage, not when the application is completed and users are complaining.
- ♦ *Level of security.* As you may know, Excel provides several protection options to restrict access to particular elements of a workbook. For example, you can lock cells so that formulas cannot be changed, and you can assign a password to prevent unauthorized users from viewing or accessing specific files. Determining up front exactly what you need to protect — and what level of protection is necessary — will make your job easier.

You'll probably have to deal with many other project-specific considerations in this phase. The important thing is that you consider all options and don't settle on the first solution that comes to mind.

Another design consideration is remembering to plan for change. You'll do yourself a favor if you make your application as generic as possible. For example, don't write a procedure that works with only a specific range of cells. Rather, write a procedure that accepts any range as an argument. When the inevitable changes are requested,

Learning While You Develop

Now a few words about reality: Excel is a moving target. Excel's upgrade cycle is approximately 18–24 months, which means that you have fewer than two years to get up to speed with its current innovations before you have even more innovations to contend with.

Excel 5, which introduced VBA, represented a major paradigm shift for Excel developers. Thousands of people up until that point earned their living developing Excel applications that were largely based on the XLM macro language in Excel 2, 3, and 4. Beginning with Excel 5, dozens of new tools became available and developers, for the most part, eagerly embraced them.

When Excel 97 became available, developers faced yet another shift. This new version introduced a new file format, the Visual Basic editor, and UserForms as a replacement for dialog sheets. Excel 2000 and 2002 introduced additional features, but these changes were not as radical as in previous upgrades.

We can probably look forward to yet another significant shift following Excel 2002. Microsoft is currently developing its .NET ("dot net") technology, and it's likely that Office will be part of that technology. And, word on the street is that Visual Studio for Applications (VSA) will replace VBA.

VBA is not difficult to learn, but it definitely takes time to become comfortable with it, and even more time to master it. The VBA language is still evolving. Consequently, it's not uncommon to be in the process of learning VBA while you're developing applications with it. In fact, I think it's impossible to learn VBA without developing applications. If you're like me, you'll find it much easier to learn VBA if you have a project that requires it. Learning VBA just for the sake of learning VBA usually doesn't work.

such a design makes it easier for you to carry out the revisions. Also, you may find that the work you do for one project is similar to the work you do for another. Keeping reusability in mind when you are planning a project is always a good idea.

One thing that I've learned from experience is to avoid letting the end user completely guide your approach to a problem. For example, suppose you meet with a manager who tells you that the department needs an application that writes text files, which will be imported into another application. Don't confuse the user's need with the solution. The user's real need is to share data. Using an intermediate text file to do it is one possible solution to the need. There may be other ways to approach the problem — such as direct transfer of information by using DDE or OLE. In other words, don't let the users define their problem by stating it in terms of a solution approach. Determining the best approach is *your* job.

Determining the Most Appropriate User Interface

When you develop spreadsheets that others will use, you need to pay special attention to the user interface. By *user interface*, I mean the method by which the user interacts with the application — clicking buttons, using menus, pressing keys, accessing toolbars, and so on.

Again, it's important that you keep the end user in mind. It's likely that you have much more computer experience than the end users, and an interface that's intuitive to you may not be as intuitive to everyone else.

One way to approach the user interface issue is to rely on Excel's built-in features: its menus, toolbars, scroll bars, and so on. In other words, you can simply set up the workbook and then let the user work with it however he or she wants. This may be the perfect solution if the application will be used only by those who know Excel well. More often, however, you'll find that the audience for your application consists of relatively inexperienced (and often disinterested) users. This makes your job more difficult, and you'll need to pay particular attention to the user interface that drives your application.

Excel provides several features that are relevant to user-interface design:

- ♦ Custom dialog boxes (UserForms)
- ♦ Controls (such as a ListBox or a CommandButton) placed directly on a worksheet
- ♦ Custom menus
- ♦ Custom toolbars
- ♦ Custom shortcut keys

I discuss these features briefly in the following sections and cover them more thoroughly in later chapters.

Creating custom dialog boxes

Anyone who has used Excel for any length of time is undoubtedly familiar with dialog boxes. Consequently, custom dialog boxes play a major role in the user interfaces you design for your applications.

**Note**

Excel 97 introduced a completely new way to create custom dialog boxes: UserForms. However, subsequent versions still support Excel 5/95 dialog sheets. This book focuses exclusively on UserForms.

Figure 6-1 shows a custom dialog box that I developed for an application.

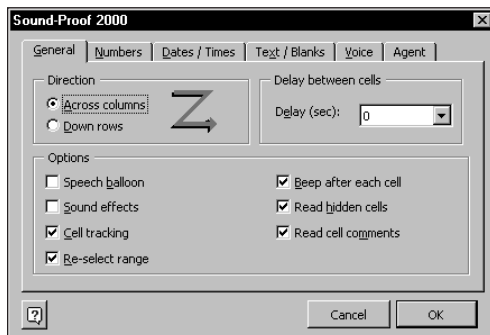


Figure 6-1: Custom dialog boxes are important to an application's user interface.

You can use a custom dialog box to solicit user input, get a user's options or preferences, and direct the flow of your entire application. Custom dialog boxes are stored in UserForms (one dialog box per UserForm). You create and edit custom dialog boxes in the Visual Basic Editor (VBE), which you access by pressing Alt+F11. The elements that make up a dialog box (buttons, drop-down lists, check boxes, and so on) are called controls—more specifically, ActiveX controls. Excel provides a standard assortment of ActiveX controls, and you can also incorporate third-party controls.

After adding a control to a dialog box, you can link it to a worksheet cell so that it doesn't require any macros (except a simple macro to display the dialog box). Linking a control to a cell is easy, but it's not always the best way to get user input from a dialog box. Most of the time, you'll want to develop VBA macros that work with your custom dialog boxes.



I cover UserForms in detail in Part IV.

Using ActiveX controls on a worksheet

Excel also lets you add the UserForm ActiveX controls to a worksheet's draw layer. Figure 6-2 shows a simple worksheet model with several UserForm controls inserted directly on the worksheet. This sheet contains Option Buttons, a ScrollBar, a CommandButton, and a CheckBox.



This workbook, which also includes a few simple macros, is available on the companion CD-ROM.

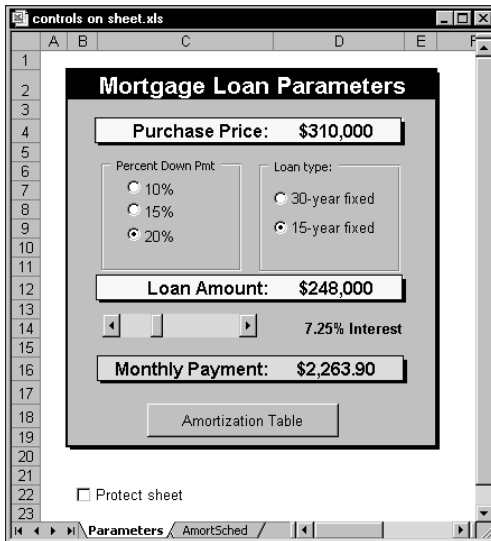


Figure 6-2: Directly adding UserForm controls may make a worksheet easier to use.

Perhaps the most common control is a `CommandButton`. By themselves, buttons don't do anything, so you have to attach a macro to each button.

Using dialog-box controls directly in a worksheet often eliminates the need for custom dialog boxes. You can often greatly simplify the operation of a spreadsheet by adding a few ActiveX controls to a worksheet. This lets the user make choices by operating familiar controls rather than making entries into cells.

The ActiveX controls are found on the Control Toolbox toolbar. You can also use Excel 5/95 compatible controls on a worksheet. These controls, which are not ActiveX controls, are available on the Forms toolbar. These controls are not discussed in this book. Table 6-1 summarizes these two classes of controls.

Table 6-1
ActiveX Controls vs Excel Controls

	<i>ActiveX Controls</i>	<i>Excel Controls</i>
Excel versions	97, 2000, 2002	5, 95, 97, 2000, 2002
Which toolbar?	Control Toolbox	Forms
Macro code storage	In the code module	In any standard VBA module for the Sheet

	<i>ActiveX Controls</i>	<i>Excel Controls</i>
Macro name	Corresponds to the control name (for example, CommandButton1_Click)	Any name you specify
Correspond to...	UserForm controls	Dialog Sheet controls
Customization	Extensive, using the Properties box	Minimal
Respond to events	Yes	Click or Change events only

Customizing menus

Another way to control the user interface in spreadsheet applications is to modify Excel's menus or to create your own menu system. Instead of creating buttons that execute macros, you can add one or more new menus or menu items to execute macros that you've already created. An advantage to custom menus is that the menu bar is always visible, whereas a button placed on a worksheet can easily scroll out of view.


Note

Beginning with Excel 97, Microsoft implemented an entirely different way of dealing with menus. As you'll see in Chapter 22, a menu bar is actually a toolbar in disguise. Figure 6-3 shows an example of a new menu added to Excel. This menu was created by my Power Utility Pak add-in. Each menu item triggers a macro.

There are two ways to customize Excel's menus. You can use VBA code to make the menu modifications, or you can edit the menu directly, using the View ⇄ Toolbars ⇄ Customize command.

As I explain in Chapter 22, the best approach is usually to use VBA commands to modify the menus. You have complete control over the menus, and can even perform such operations as disabling the menu item or adding a checkmark to the item.

Menu modifications that you make using the View ⇄ Toolbars ⇄ Customize command (see Figure 6-4) are "permanent." In other words, if you make a menu change (such as the removal of a menu item), that change will remain in effect even if you restart Excel.


Note

The Menu Editor (which debuted in Excel 5) was removed, beginning with Excel 97. Menus that were created using the Menu Editor will continue to function when the workbook is loaded into Excel 97 or later. However, the only way to modify or delete menus created with the Menu Editor is to use Excel 5 or seek a utility that was designed for this purpose.

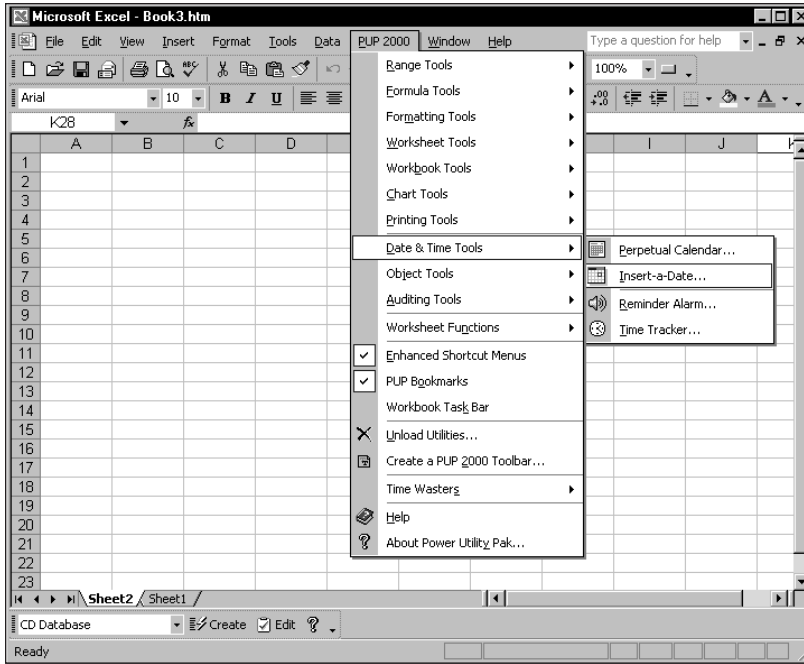


Figure 6-3: This new menu was created by an add-in.

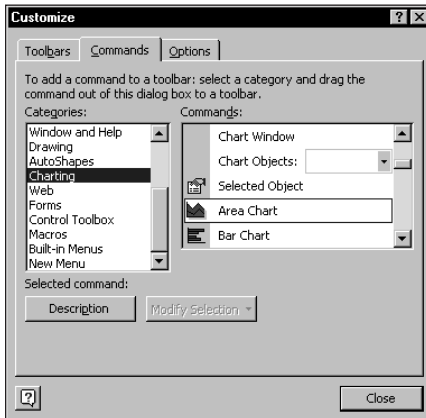


Figure 6-4: The Customize dialog box is where you make manual changes to Excel's menu system.

You'll find that you can customize every menu that Excel displays, even the shortcut menus that appear when you right-click an object. You must use VBA to customize the shortcut menus (you can't do so manually). Figure 6-5 shows a customized shortcut menu that appears when you right-click a cell or range. Notice that this shortcut menu has several new commands that aren't normally available (the menu items with a "P" icon are custom items).

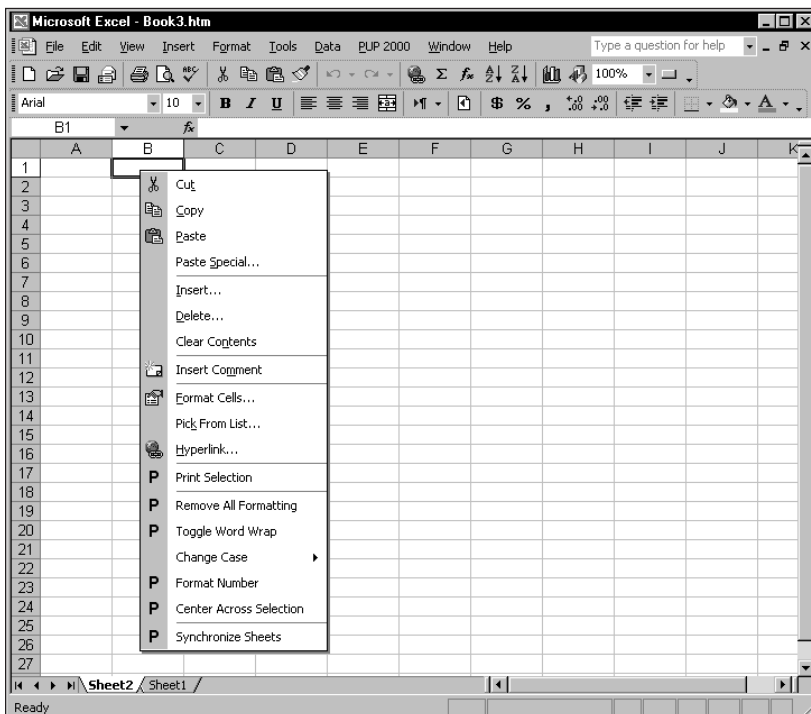


Figure 6-5: An example of a customized shortcut menu



I cover custom menus in detail in Chapter 23.

Customizing toolbars

Toolbars are very common in Windows applications, and Excel offers a huge assortment of built-in toolbars. Generally, toolbar buttons serve as shortcuts for commonly used menu commands to give users a quicker way to issue commands. Because a mouse is required to click a toolbar button, a toolbar button generally isn't the *only* way to execute a particular operation. Excel's toolbars, for example, make it possible to do most of the common spreadsheet operations without even using the menus.

You can create a custom toolbar that contains only the tools you want users to be able to access. In fact, if you attach macros to these tools, a custom toolbar becomes the equivalent of a group of buttons placed on a worksheet. The advantage to using the toolbar in this way is that it is always visible and can be repositioned anywhere on the screen. Buttons inserted on a worksheet are fixed in place and can be scrolled off the screen.

Note

Beginning with Excel 97, you can also add menus to a toolbar.

You can set up your application so that the toolbar appears whenever your application is loaded. You do this by *attaching* a toolbar to a workbook using the Attach button in the Toolbars tab of the Customize dialog box (see Figure 6-6). This lets you store individual toolbars with a workbook application so that you can distribute them to users of your application.

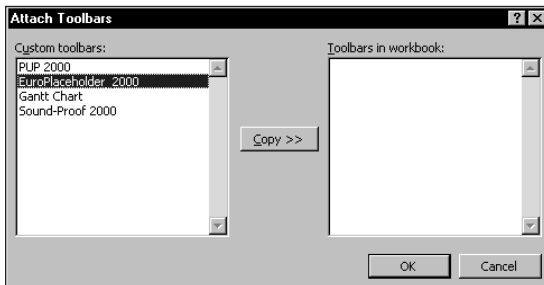


Figure 6-6: You can attach a custom toolbar to a worksheet with the Attach Toolbars dialog box.

Cross-Reference

I discuss the topic of toolbars in detail in Chapter 22.

Creating shortcut keys

The final user-interface option at your disposal is custom shortcut keys. Excel lets you assign a Ctrl key (or Shift+Ctrl key) combination to a macro. When the user presses the key combination, the macro executes. Obviously, you have to make it clear to the user which keys are active and what they do. However, if speed is essential, pressing a key combination is usually faster than issuing menu commands, using a toolbar, or working with a dialog box.

You need to be careful, however, not to assign a key combination that's already in use for something else. For example, Ctrl+S is a built-in shortcut key used to save the current workbook. If you assign this key combination to a macro, you lose the

ability to save the file with Ctrl+S. In other words, a key combination you assign to a macro takes precedence over the built-in shortcut keys. Shortcut keys are case-sensitive, so you can use a combination such as Ctrl+Shift+S.

Executing the development effort

After you've identified user needs, determined the approach you'll take to meet those needs, and decided on the components you'll use for the user interface, it's time to get down to the nitty-gritty and start creating the application. This step, of course, comprises a great deal of the total time you spend on a particular project.

How you go about developing the application depends on your own personal style and the nature of the application. Except for simple fill-in-the-blanks template workbooks, your application will probably use macros. Developing the macros is the tough part. It's easy to create macros in Excel, but it's difficult to create *good* macros. Part III of this book is devoted to VBA, the language you'll use to write your macros.

Concerning Yourself with the End User

In this segment, I discuss the important development issues that surface as your application becomes more and more workable, and the time to package and distribute your work grows nearer.

Testing the application

How many times have you used a commercial software application, only to have it bomb out on you at a crucial moment? Most likely, the problem was caused by insufficient testing that didn't catch all the bugs. All nontrivial software has bugs, but in the best software the bugs are simply more obscure. As you'll see, you sometimes have to work around the bugs in Excel to get your application to perform properly.

After you create your application, you need to test it. This is one of the most crucial steps; it's not uncommon to spend as much time testing and debugging an application as you did creating the application in the first place. Actually, you should be doing a great deal of testing during the development phase. After all, whether you're writing a VBA routine or creating formulas in a worksheet, you'll want to make sure that the application is working the way it's supposed to work.

Bugs? In Excel?

You might think that a product like Excel, which is used by millions of people throughout the world, would be relatively free of bugs. Think again, pal. Excel is such a complex piece of software that it is only natural to expect some problems with it. And Excel *does* have some problems.

Getting a product like Excel out the door is not easy, even for a company like Microsoft with seemingly unlimited resources. Releasing a software product involves compromises and trade-offs. It's commonly known that most major software vendors release their products with full knowledge that they contain bugs. Most of the bugs are considered insignificant enough to ignore. Software companies could postpone their releases by a few months and fix most of them, but software, like everything else, is ruled by economics. The benefits of delaying a product often do not exceed the costs involved. Although Excel definitely has its share of bugs, my guess is that the majority of Excel users never encounter one.

In this book, I point out the problems with Excel that I know about. You'll surely discover some more on your own. Some problems occur only with a particular version of Excel, and under a specific configuration involving hardware and/or software. These are the worst of all bugs because they aren't easily reproducible.

So what's a developer to do? It's called a *workaround*. If something that you try to do doesn't work—and all indications say that it *should* work—it's time to move on to Plan B. Frustrating? Sure. A waste of your time? Absolutely. It's all part of being a developer.

Like standard compiled applications, spreadsheet applications that you develop are prone to bugs. A *bug* is usually defined as (1) something that does happen but shouldn't while a program (or application) is running, or (2) something that doesn't happen when it should happen. Both species of bugs are equally nasty, and you should plan on devoting a good portion of your development time to testing the application under all reasonable conditions and fixing any problems you find. In some cases, unfortunately, the problems aren't entirely your fault. Excel, too, has its problems (see the "Bugs? In Excel?" sidebar).

I probably don't need to tell you to thoroughly test any spreadsheet development you develop for others. And depending on its eventual audience, you might want to make your application *bulletproof*. In other words, try to anticipate all of the errors and screw-ups that could possibly occur, and make efforts to avoid them—or at least handle them gracefully. This not only helps the end user, but also makes it easier on you and your reputation.

Although you cannot conceivably test for all possibilities, your macros should be able to handle common types of errors. For example, what if the user enters a text string instead of a numeric value? What if the user tries to run your macro when a workbook isn't open? What if he or she cancels a dialog box without making any selections? What happens if the user presses Ctrl+F6 and jumps to the next window? As you gain experience, issues like this become very familiar, and you'll account for them without even thinking.

What about Beta Testing?

Software manufacturers typically have a rigorous testing cycle for new products. After extensive internal testing, the prerelease product is usually sent to a group of interested users for *beta testing*. This phase often uncovers additional problems that are usually corrected before the product's final release.

If you're developing an Excel application that more than a few people will use, you may want to consider a beta test. This enables your application to be used in its intended setting on different hardware (usually) and by the intended users.

The beta period should begin after you've completed all of your own testing, and you feel the application is ready to distribute. You'll need to identify a group of users to help you. The process works best if you distribute everything that will ultimately be included in your application: user documentation, installation program, online help, and so on. You can evaluate the beta test in a number of ways, including face-to-face discussions, questionnaires, and phone calls.

You will almost always become aware of problems you need to correct or improvements you need to make before you undertake a widespread distribution of the application. Of course, a beta testing phase takes additional time, and not all projects can afford that luxury.

Making the application bulletproof

If you think about it, it's fairly easy to destroy a spreadsheet. Erasing one critical formula or value often causes errors throughout the entire worksheet — and perhaps even other dependent worksheets. Even worse, if the damaged workbook is saved, it replaces the good copy on disk. Unless a backup procedure is in place, the user of your application could be in trouble and *you'll* probably be blamed for it.

Obviously, it's easy to see why you need to add some protection when users — especially novices — will be using your worksheets. Excel provides several techniques for protecting worksheets and parts of worksheets:

- ♦ You can lock specific cells (using the Protection tab in the Format Cells dialog box) so that they cannot be changed. This takes effect only when the document is protected with the Tools ⇨ Protection ⇨ Protect Sheet command.
- ♦ You can protect an entire workbook — the structure of the workbook, the window position and size, or both. Use the Tools ⇨ Protection ⇨ Protect Workbook command for this purpose.
- ♦ You can hide the formulas in specific cells (using the Protection tab in the Format Cells dialog box) so that others can't see them. Again, this takes effect only when the document is protected with Tools ⇨ Protection ⇨ Protect Sheet command.

How Secure Are Excel's Passwords?

As far as I know, Microsoft has never advertised Excel as a secure program. And for a good reason: It's actually quite easy to thwart Excel's password system. Several commercial programs are available that can break passwords. Excel 2002 seems to have stronger security than previous versions. Bottom line? Don't think of password protection as foolproof. Sure, it will be effective for the casual user. But if someone *really* wants to break your password, it can probably be done.

- ◆ You can lock objects on the worksheet (using the Protection tab in the Format Object dialog box). This takes effect only when the document is protected with the Tools ⇨ Protection ⇨ Protect Sheet command.
- ◆ You can hide rows (Format ⇨ Row ⇨ Hide), columns (Format ⇨ Column ⇨ Hide), sheets (Format ⇨ Sheet ⇨ Hide), and documents (Window ⇨ Hide). This helps prevent the worksheet from looking cluttered and also provides some protection against prying eyes.
- ◆ You can designate an Excel workbook as read-only recommended (and use a password) to ensure that the file cannot be overwritten with any changes. You do this in the Save Options dialog box. Display this dialog box by choosing Tools ⇨ General Options in the Save As dialog box.
- ◆ You can assign a password to prevent unauthorized users from opening your file. You do this in the Save Options dialog box. Display this dialog box by choosing Tools ⇨ General Options in the Save As dialog box.
- ◆ You can use a password-protected add-in, which doesn't allow the user to change *anything* on its worksheets.



Excel 2002 provides several new options in the area of sheet protection. Select Tools ⇨ Protection and you'll see the new Protect Sheet dialog box. This allows you to specify exactly which actions can be performed on a protected sheet. Also, the Save Options dialog box has an Advanced button. Clicking this button allows you to set the encryption level of the workbook.

Making the application aesthetically appealing and intuitive

If you've used many different software packages, you've undoubtedly seen examples of poorly designed user interfaces, difficult-to-use programs, and just plain ugly screens. If you're developing spreadsheets for other people, you should pay particular attention to how the application looks.

The way a computer program looks can make all the difference in the world to users, and the same is true with the applications you develop with Excel. Beauty, however, is in the eye of the beholder. If your skills lean more in the analytical direction, consider enlisting the assistance of someone with a more aesthetic sensibility to provide help with design.

The users of your applications will appreciate a good-looking user interface, and your applications will have a much more polished and professional look if you devote some additional time to design and aesthetic considerations. An application that looks good demonstrates that its developer cared enough about the product to invest some extra time and effort. Take the following suggestions into account:

- ♦ Strive for consistency: When designing dialog boxes, for example, try to emulate Excel's dialog box look and feel whenever possible. Be consistent with formatting, fonts, text size, and colors.
- ♦ A common mistake that developers make is trying to cram too much information into a single screen or dialog box. A good rule of thumb is to present only one or two chunks of information at a time.
- ♦ If you use an input screen to solicit information from the user, consider breaking it up into several, less crowded screens. If you use a complex dialog box, you might want to break it up by using a MultiPage control (which lets you create a familiar "tabbed" dialog box).
- ♦ Use color sparingly, because it's very easy to overdo it and make the screen look gaudy.
- ♦ Pay attention to numeric formats, typefaces and sizes, and borders.

Evaluating aesthetic qualities is very subjective. When in doubt, strive for simplicity and clarity.

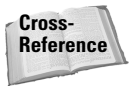
Documenting the development effort

Putting a spreadsheet application together is one thing. Making it understandable for other people is another. As with traditional programming, it's important that you thoroughly document your work. Such documentation helps you if you need to go back to it (and you will), and it helps anyone else you may pass it on to.

You may want to consider a couple of things when you document your project. For example, if you were hired to develop an Excel application, you may not want to share all your hard-earned secrets by thoroughly documenting everything. If this is the case, you should maintain two versions: one thoroughly documented and the other partially documented.

How do you document a workbook application? You can either store the information in a worksheet or use another file. You can even use a paper document if you prefer. Perhaps the easiest way is to use a separate worksheet to store your comments and key information for the project. For VBA code, use comments liberally (text preceded with an apostrophe is ignored). An elegant piece of VBA code may seem perfectly obvious to you today — but come back to it in a few months, and your reasoning may be completely obscured.

With regard to user documentation, you basically have two choices: paper-based documentation or electronic (online) documentation. Online help is standard fare in Windows applications. Fortunately, your Excel applications can also provide online help — even context-sensitive help. Developing online help takes quite a bit of additional effort, but for a large project, it may be worth it.



In Chapter 23, I discuss several alternatives for providing online help for your applications.

Distributing the application to the user

You've completed your project, and you're ready to release it to the end users. How do you go about doing this? You can choose from many ways to distribute your application, and the method you choose depends on many factors.

You could just hand over a disk, scribble a few instructions, and be on your way. Or, you may want to install the application yourself — but this is not always feasible. Another option is to develop an official setup program that performs the task automatically. You can write such a program in a traditional programming language, purchase a generic setup program, or write your own in VBA.



The Developers Edition of Microsoft Office includes a Setup Wizard that helps you prepare your applications for distribution.

Excel 2000 and later uses Microsoft Authenticode technology to enable developers to digitally “sign” their applications. This process is designed to help end users identify the author of an application, ensure that the project has not been altered, and help prevent the spread of macro viruses or other potentially destructive code. To digitally sign a project, you just first apply for a digital certificate from a formal certificate authority (or, you can self-sign your project by creating your own digital certificate). Refer to the online help or Microsoft's Web site for additional information.

Another point to consider is support for your application. In other words, who gets the phone call if the user encounters a problem? If you aren't prepared to handle routine questions, you'll need to identify someone who is. In some cases you'll want to arrange it so that only highly technical or bug-related issues escalate to the developer.

Why Is There No Runtime Version of Excel?

When you distribute your application, you need to be sure that each end user has a licensed copy of the appropriate version of Excel. It's illegal to distribute a copy of Excel along with your application. Why, you might ask, doesn't Microsoft provide a runtime version of Excel? A runtime version is an executable program that can load files, but not create them. With a runtime version, the end user wouldn't need a copy of Excel to run your application (this is common with database programs).

I've never seen a clear or convincing reason why Microsoft does not have a runtime version of Excel, and no other spreadsheet manufacturer offers a runtime version of its product either. The most likely reason is that spreadsheet vendors fear that doing so would reduce sales of the software. Or, it could be that developing a runtime version would require a tremendous amount of programming that would just never pay off.

On a related note . . . Microsoft does offer an Excel file *viewer*. This product lets you view Excel files if you don't own a copy of Excel. Macros, however, will not execute. You can get a copy of this free file viewer from Microsoft's Web site (<http://officeupdate.microsoft.com>).

Updating the application when necessary

After you distribute your application, you're finished with it, right? You can sit back, enjoy yourself, and try to forget about the problems you encountered (and solved) during the course of developing your application. In rare cases, yes, you may be finished. More often, however, the users of your application will not be completely satisfied. Sure, your application adheres to all of the *original* specifications, but things change. Seeing an application working frequently causes the user to think of other things that the application could be doing. We're talking *updates*.

When you need to update or revise your application, you'll appreciate that you designed it well in the first place and you fully documented your efforts. If not, well . . . we learn from our experiences.

Other Development Issues

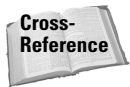
You need to keep several other issues in mind when developing an application — especially if you don't know exactly who will be using the application. If you're developing an application that will have widespread use (a shareware application, for example), you have no way of knowing how the application will be used, what type of system it will run on, or what other software will be running concurrently.

The user's installed version of Excel

With every new release of Excel, the issue of compatibility rears its head. As I write this, Excel 2002 is just about ready to be released — yet many large corporations are still using Excel 95 or Excel 97, and some use even earlier versions.

Unfortunately, there is no guarantee that an application developed for, say Excel 95, will work perfectly with later versions of Excel. If you need your application to work with Excel 95, Excel 97, Excel 2000, and Excel 2002, you're going to have to work with the lowest common denominator (Excel 95) — and then test it thoroughly with all other versions.

Things get even more complicated when you consider Excel's "subversions." Microsoft distributes service releases (SRs) to correct problems. For example, users might have the original Excel 2000, Excel 2000 with SR-1, or Excel 2000 with SR-2.



I discuss compatibility issues in Chapter 25.

Language issues

Consider yourself very fortunate if all of your end users have the English language version of Excel. Non-English versions of Excel aren't always 100 percent compatible, so that would mean additional testing on your part.



I briefly discuss language issues in Chapter 25.

System speed

You're probably a fairly advanced computer user and tend to keep your hardware reasonably up to date. In other words, you have a fairly powerful system that is probably better than the average user's system. In some cases, you'll know exactly what hardware the end users of your applications are using. If so, it's vitally important that you test your application on that system. A procedure that executes almost instantaneously on your system may take several seconds on another system. In the world of computers, several seconds may be unacceptable.



As you gain more experience with VBA, you'll discover that there are ways to get the job done, and there are ways to get the job done *fast*. It's a good idea to get into the habit of coding for speed. Other chapters in this book will certainly help you out in this area.

Video modes

As you may know, most Windows users use one of three standard video modes: 640×480 (that is, standard VGA mode), 800×600 , and 1024×768 . If you develop an application in anything but VGA mode, the application may look terrible when it runs on a VGA system.

**Note**

I certainly don't recommend developing your apps in VGA mode! You should, however, test them in that mode if there's a likelihood that they will be used in that mode.

This can be a big problem if your application relies on specific information being displayed on a single screen. For example, if you develop an input screen using 800×600 mode, users with a standard VGA display may not be able to see all of the input screen without scrolling. Also, it's important to realize that a restored (that is, not maximized or minimized) workbook is displayed at its previous window size and position. In the extreme case, it's possible that a window saved using a high-resolution display may be completely off the screen when opened on a system running in VGA mode.

Although advanced users tend to use higher resolutions in Windows, using VGA is unavoidable in some cases. Some older laptop systems, for example, support only VGA for their built-in display. There's no way to automatically scale things so that they look the same regardless of the display resolution. Unless you're certain of the video resolution that the users of your application will be using, it's important that you design your application using the lowest common denominator—VGA mode.

As you will learn later in the book (see Chapter 10), it's possible to determine the user's video resolution by using Windows API calls from VBA. In some cases, you may want to programmatically adjust things depending on the user's video resolution.

Directory structure

Another issue you need to think about is the structure of the user's hard drive—how the directories are arranged and named. For example, you can't assume that Excel is installed in a directory named `C:\PROGRAM FILES\MICROSOFT OFFICE\OFFICE`. And you can't even assume that it's installed on drive C. Similarly, you can't assume that Windows is installed in a directory named `WINDOWS`. Although these are the default installation locations, many systems won't adhere to these conventions. Fortunately, it's possible to use VBA to determine file storage locations.

Summary

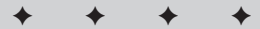
In this chapter, I outlined the basic process for developing a spreadsheet application. Much of the information in this chapter is discussed in more detail later on in the book.



Understanding Visual Basic for Applications

This part is the heart of the book. It begins with an introductory overview of VBA and continues through key topics that get you started developing professional applications. You'll learn about VBA procedures (Sub procedures and Function procedures) and get up to speed with essential programming concepts. In addition, you'll find many practical examples that you can adapt for your own use.

P A R T



In This Part

Chapter 7

Introducing Visual Basic for Applications

Chapter 8

VBA Programming Fundamentals

Chapter 9

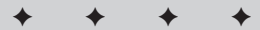
Working with VBA Sub Procedures

Chapter 10

Creating Function Procedures

Chapter 11

VBA Programming Examples and Techniques



Introducing Visual Basic for Applications

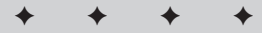
Programming Excel essentially boils down to manipulating objects, which you do by writing instructions in a language that Excel can understand. This chapter introduces you to that language, and provides an introduction to the objects that make up Excel.

Some BASIC Background

Many hard-core programmers scoff at the idea of programming in BASIC. The name itself (an acronym for **B**eginner's **A**ll-purpose **S**ymbolic **I**nstruction **C**ode) suggests that it's not a professional language. In fact, BASIC was first developed in the early 1960s as a way to teach programming techniques to college students. BASIC caught on quickly and is available in hundreds of dialects for many types of computers.

BASIC has evolved and improved over the years. For example, in many early implementations, BASIC was an *interpreted* language. Each line was interpreted before it was executed, causing slow performance. Most modern dialects of BASIC allow the code to be compiled, resulting in much faster execution and improved program portability.

BASIC gained quite a bit of respectability in 1991 when Microsoft released Visual Basic for Windows (which is currently in version 6.0). This product made it easy for the masses to develop standalone applications for Windows. Visual Basic has very little in common with early versions of BASIC, but BASIC is the foundation on which VBA was built.



In This Chapter

An introduction to VBA — the programming language built into Excel 2002

How VBA is different

How to use the Visual Basic Editor (VBE)

How to work in the code windows in the VBE and customize the VBE environment

Information on using Excel's macro recorder

An overview of objects, collections, properties, and methods

A case study of the `Comment` object

Specific information and examples of working with `Range` objects

How to access a lot of information about Excel objects, properties, and methods

About VBA

Excel 5 was the first application on the market to feature Visual Basic for Applications. VBA is best thought of as Microsoft's common application scripting language, and it's now included with all Office 2002 applications, and even applications from other vendors. Therefore, if you master VBA using Excel, you'll be able to jump right in and write macros for other Microsoft (and non-Microsoft) products. Even better, you'll be able to create complete solutions that use features across various applications.

Object models

The secret to using VBA with other applications lies in understanding the *object model* for each application. VBA, after all, simply manipulates objects, and each product (Excel, Word, Access, PowerPoint, and so forth) has its own unique object model. You can program an application using the objects that the application *exposes*.

Excel's object model, for example, exposes several very powerful data analysis objects, such as worksheets, charts, pivot tables, scenarios, and numerous mathematical, financial, engineering, and general business functions. With VBA, you can work with these objects and develop automated procedures. As you work with VBA in Excel, you'll gradually build an understanding of the object model. Warning: It will be very confusing at first. Eventually, however, the pieces will come together and all of a sudden you'll realize that you've mastered it!

VBA versus XLM

Before version 5, Excel used a powerful (but cryptic) macro language called XLM. Later versions of Excel still execute XLM macros, but the ability to record macros in XLM was removed beginning with Excel 97. As a developer, you should be aware of XLM (in case you ever encounter macros written in that system), but you should use VBA for your development work.

Figures 7-1 and 7-2 show a simple procedure coded in both XLM and VBA. This macro works on the selected cells. It changes the cell background color and adds a border around the cells. You probably agree that the VBA code is much easier to read. More important, however, the VBA code is also easier to modify when the need arises.

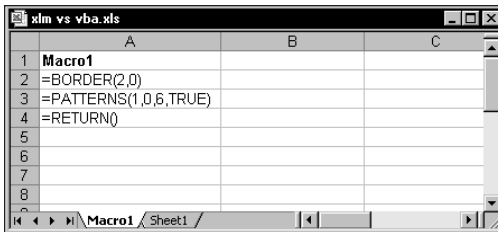


Figure 7-1: A simple macro coded in Excel's XLM language, stored on a macro sheet.

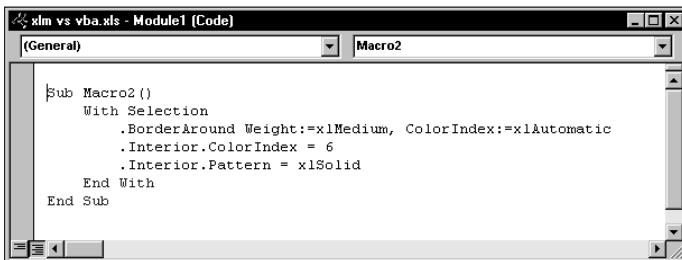


Figure 7-2: A simple macro coded in Excel's VBA language, stored in a VBA module.

VBA versus Lotus macros

Lotus 1-2-3 (the DOS version) was the first spreadsheet to incorporate macro capability. Although this feature was great in its day, it's quite crude by today's standards. The original 1-2-3 for DOS macros were based on simple keystroke recording, and then playing back those keystrokes to execute the macro. For example, a 1-2-3 for DOS macro that names a range might look like this:

```
/RNC~
```

This represents the following 1-2-3 command sequence:

```
/Range Name Create (Enter)
```

The keystroke-oriented macro language in 1-2-3 was eventually replaced by a command-oriented language. The most recent versions of 1-2-3 include a scripting language similar to VBA (see the next section).

VBA versus LotusScript

1-2-3 97 and later editions feature LotusScript, a procedural language that has much in common with VBA. My experience with LotusScript is limited, but from what I have seen, VBA offers many advantages.

In light of the fact that VBA has become a “standard” and users have a huge code base to draw on, one wonders why Lotus developed a new (incompatible) language rather than simply licensing VBA from Microsoft.

The Basics of VBA

Before I get into the meat of things, I suggest that you read through the material in this section to get a broad overview of where I’m heading. These are the topics that I cover in the remainder of this chapter.

Following is a quick-and-dirty summary of what VBA is all about:

- ♦ You perform actions in VBA by executing VBA code.
- ♦ You write (or record) VBA code, which is stored in a VBA module.

VBA modules are stored in an Excel workbook, but you view or edit a module using the Visual Basic Editor (VBE).

- ♦ A VBA module consists of procedures.

A procedure is basically a unit of computer code that performs some action. Here’s an example of a simple Sub procedure called `Test`: This procedure calculates a simple sum and then displays the result in a message box.

```
Sub Test()  
    Sum = 1 + 1  
    MsgBox "The answer is " & Sum  
End Sub
```

- ♦ Besides Sub procedures, a VBA module can also have Function procedures.

A Function procedure returns a single value (or possibly an array). A function can be called from another VBA procedure, or used in a worksheet formula. Here’s an example of a function named `AddTwo`:

```
Function AddTwo(arg1, arg2)  
    AddTwo = arg1 + arg2  
End Function
```

- ♦ VBA manipulates objects contained in its host application (in this case, Excel is the host application).

Excel provides you with more than 100 classes of objects to manipulate. Examples of objects include a workbook, a worksheet, a range on a worksheet, a chart, and a drawn rectangle. Many more objects are at your disposal, and you can manipulate them using VBA code.

- ◆ Object classes are arranged in a hierarchy.

Objects can act as containers for other objects. For example, Excel is an object called `Application`, and it contains other objects, such as `Workbook` and `CommandBar` objects. The `Workbook` object can contain other objects, such as `Worksheet` objects and `Chart` objects. A `Worksheet` object can contain objects such as `Range` objects, `PivotTable` objects, and so on. The arrangement of these objects is referred to as Excel's *object model*.

- ◆ Like objects form a *collection*.

For example, the `Worksheets` collection consists of all the worksheets in a particular workbook. The `CommandBars` collection consists of all `CommandBar` objects. Collections are objects in themselves.

- ◆ When you refer to a contained or member object, you specify its position in the object hierarchy using a period (also known as a “dot”) as a separator between the container and the member.

For example, you can refer to a workbook named `Book1.xls` as

```
Application.Workbooks("Book1.xls")
```

This refers to the `Book1.xls` workbook in the `Workbooks` collection. The `Workbooks` collection is contained in the Excel `Application` object. Extending this to another level, you can refer to `Sheet1` in `Book1` as

```
Application.Workbooks("Book1.xls").Worksheets("Sheet1")
```

You can take it to still another level and refer to a specific cell as follows:

```
Application.Workbooks("Book1.xls").Worksheets("Sheet1").Range("A1")
```

- ◆ If you omit a specific reference to an object, Excel uses the *active* objects.

If `Book1` is the active workbook, the preceding reference can be simplified as

```
Worksheets("Sheet1").Range("A1")
```

If you know that `Sheet1` is the active sheet, you can simplify the reference even more:

```
Range("A1")
```

- ◆ Objects have *properties*.

A property can be thought of as a *setting* for an object. For example, a range object has properties such as `Value` and `Name`. A chart object has properties such as `HasTitle` and `Type`. You can use VBA to determine object properties and also to change them.

- ◆ You refer to properties by combining the object with the property, separated by a period.

For example, you can refer to the value in cell `A1` on `Sheet1` as

```
Worksheets("Sheet1").Range("A1").Value
```

An Analogy

If you like analogies, here's one for you. It may help you understand the relationships between objects, properties, and methods in VBA. In this analogy, I compare Excel with a fast-food restaurant chain.

The basic unit of Excel is a `Workbook` object. In a fast-food chain, the basic unit is an individual restaurant. With Excel, you can add workbooks and close workbooks, and all the open workbooks are known as `Workbooks` (a collection of `Workbook` objects). Similarly, the management of a fast-food chain can add restaurants and close restaurants—and all the restaurants in the chain can be viewed as a collection of `Restaurant` objects.

An Excel workbook is an object, but it also contains other objects such as worksheets, charts, VBA modules, and so on. Furthermore, each object in a workbook can contain its own objects. For example, a `Worksheet` object can contain `Range` objects, `PivotTable` objects, `Shape` objects, and so on.

Continuing with the analogy, a fast-food restaurant (like a workbook) contains objects such as the `Kitchen`, `DiningArea`, and `Tables` (a collection). Furthermore, management can add or remove objects from the `Restaurant` object. For example, management may add more tables to the `Table` collection. Each of these objects can contain other objects. For example, the `Kitchen` object has a `Stove` object, `VentilationFan` object, a `Chef` object, `Sink` object, and so on.

So far, so good. This analogy seems to work. Let's see if I can take it further.

Excel's objects have properties. For example, a `Range` object has properties such as `Value` and `Name`, and a `Shape` object has properties such as `Width`, `Height`, and so on. Not surprisingly, objects in a fast-food restaurant also have properties. The `Stove` object, for example, has properties such as `Temperature` and `NumberOfBurners`. The `VentilationFan` has its own set of properties (`TurnedOn`, `RPM`, and so forth).

Besides properties, Excel's objects also have methods, which perform an operation on an object. For example, the `ClearContents` method erases the contents of a `Range` object. An object in a fast-food restaurant also has methods. You can easily envision a `ChangeThermostat` method for a `Stove` object, or a `SwitchOn` method for a `VentilationFan` object.

With Excel, methods sometimes change an object's properties. The `ClearContents` method for a `Range` changes the `Range's` `Value` property. Similarly, the `ChangeThermostat` method on a `Stove` object affects its `Temperature` property.

With VBA, you can write procedures to manipulate Excel's objects. In a fast-food restaurant, the management can give orders to manipulate the objects in the restaurants ("Turn the stove on and switch the ventilation fan to high."). Now is it clear?

- ♦ You can assign values to VBA variables. Think of a variable as a name that you can use to store a particular value.

To assign the value in cell A1 on Sheet1 to a variable called *Interest*, use the following VBA statement:

```
Interest = Worksheets("Sheet1").Range("A1").Value
```

- ♦ Objects have *methods*.

A method is an action that is performed with the object. For example, one of the methods for a Range object is `ClearContents`. This method clears the contents of the range.

- ♦ You specify methods by combining the object with the method, separated by a period.

For example, to clear the contents of cell A1 on the active worksheet, use this:

```
Range("A1").ClearContents
```

- ♦ VBA also includes all the constructs of modern programming languages, including arrays, looping, and so on.

Believe it or not, the preceding section pretty much describes VBA. Now it's just a matter of learning the details, which is what I cover in the rest of this chapter.

Introducing the Visual Basic Editor

In Excel 5 and Excel 95, a VBA module appeared as a separate sheet in a workbook. Beginning with Excel 97, VBA modules no longer show up as sheets in a workbook. Rather, you use the Visual Basic Editor (VBE) to view and work with VBA modules.



Note

VBA modules are still stored with workbook files; they just aren't visible unless you activate the VBE.

The VBE is a separate application that works seamlessly with Excel. By seamlessly, I mean that Excel takes care of the details of opening the VBE when you need it. You can't run VBE separately; Excel must be running in order for the VBE to run.

Activating the VBE

When you're working in Excel, you can switch to the VBE using any of the following techniques:

- ♦ Press Alt+F11.
- ♦ Select Tools ⇄ Macro ⇄ Visual Basic Editor.
- ♦ Click the Visual Basic Editor button, which is located on the Visual Basic toolbar.

Note

Don't confuse the Visual Basic Editor with the Microsoft Script Editor. These are two entirely different animals. The Script Editor is used to edit HTML scripts written in VBScript or JavaScript. The Script Editor is not covered in this book.

Figure 7-3 shows the VBE. Chances are, your VBE window won't look exactly like the window shown in the figure. This window is highly customizable—you can hide windows, change their sizes, “dock” them, rearrange them, and so on.

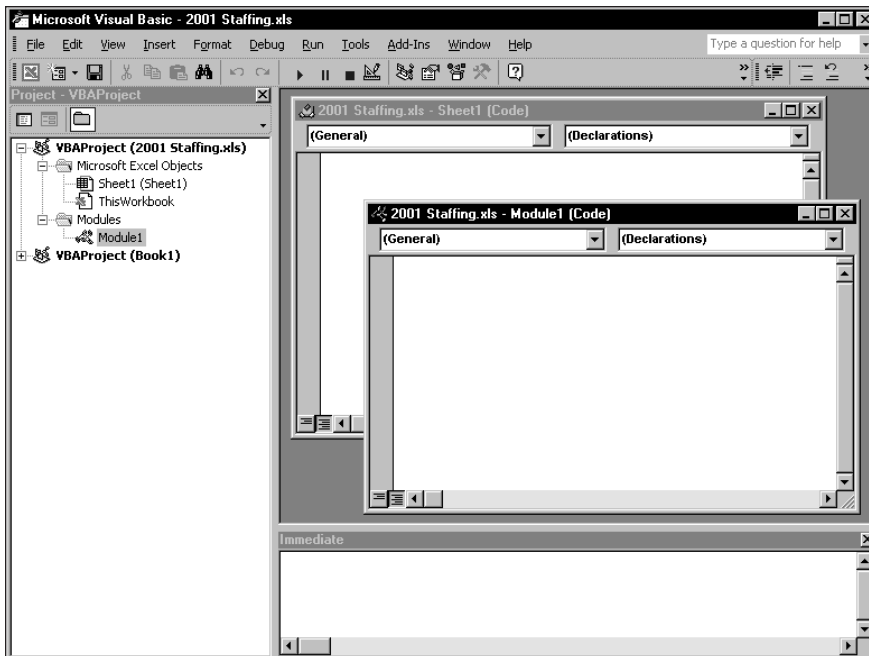


Figure 7-3: The Visual Basic Editor window

The VBE windows

The VBE consists of a number of parts. I briefly describe some of the key components in the sections that follow.

Menu bar

The VBE menu bar, of course, works like every other menu bar you've encountered. It contains commands that you use to work with the various components in the VBE. Also, you'll find that many of the menu commands have shortcut keys associated with them. For example, the View ⇄ Immediate Window command has a shortcut key of Ctrl+G.

**Tip**

The VBE also features shortcut menus. As you'll discover, you can right-click virtually anything in a VBE window and you'll get a shortcut menu of common commands.

Toolbars

The Standard toolbar, which is directly under the menu bar by default, is one of six VBE toolbars available (the menu bar is also considered a toolbar). VBE toolbars work just like those in Excel: You can customize toolbars, move them around, display other toolbars, and so forth. Use the View ⇄ Toolbars ⇄ Customize command to work with VBE toolbars.

Project Explorer window

The Project Explorer window displays a tree diagram that consists of every workbook that is currently open in Excel (including add-ins and hidden workbooks). Each workbook is known as a *project*. I discuss the Project Explorer window in more detail in the next section (“Working with the Project Explorer”).

If the Project Explorer window is not visible, press Ctrl+R. To hide the Project Explorer window, click the Close button in its title bar (or right-click anywhere in the Project Explorer window and select Hide from the shortcut menu).

Code window

A code window (sometimes known as a Module window) contains VBA code. Every item in a project has an associated code window. To view a code window for an object, double-click the object in the Project Explorer window. For example, to view the code window for the Sheet1 object, double-click Sheet1 in the Project Explorer window. Unless you've added some VBA code, the code window will be empty.

Another way to view the code window for an object is to select the object in the Project Explorer window and then click the View Code button in the toolbar at the top of the Project Explorer window.

I discuss code windows later on in this chapter (see “Working with Code Windows”).

Immediate window

The Immediate window is most useful for executing VBA statements directly, testing statements, and debugging your code. This window may or may not be visible. If the Immediate window isn't visible, press Ctrl+G. To close the Immediate window, click the Close button in its title bar (or right-click anywhere in the Immediate window and select Hide from the shortcut menu).

Working with the Project Explorer

When you're working in the VBE, each Excel workbook and add-in that's currently open is considered a *project*. You can think of a project as a collection of objects arranged as an outline. You can expand a project by clicking the plus sign (+) at the left of the project's name in the Project Explorer window. You contract a project by clicking the minus sign (-) to the left of a project's name. You can also use the Toggle Folders button in the toolbar at the top of the Project Explorer window to expand and contract a project. If you try to expand a project that's protected with a password, you'll be prompted to enter the password.

Figure 7-4 shows a Project Explorer window with three projects listed (one add-in and two workbooks).



When you activate the VBE, you cannot assume that the code module that's displayed corresponds to the highlighted object in the Project Explorer window. To make sure you're working in the correct code module, always double-click the object in the Project Explorer window.

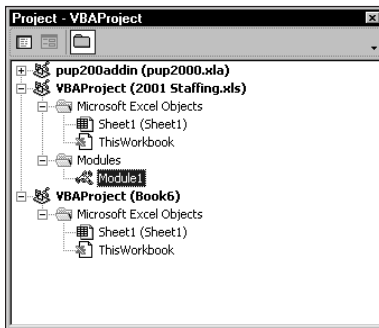


Figure 7-4: A Project Explorer window with three projects listed

If you have many workbooks and add-ins loaded, the Project Explorer window may be a bit overwhelming. Unfortunately, it's not possible to hide projects in the Project Explorer window. However, you'll probably want to keep the project outlines contracted if you're not working on them.

Every project expands to show at least one “node” called Microsoft Excel Objects. This node expands to show an item for each worksheet and chart sheet in the workbook (each sheet is considered an object), and another object called ThisWorkbook (which represents the ActiveWorkbook object). If the project has any VBA modules, the project listing also shows a Modules node and the modules are listed there. A project may also contain a node called Forms which contains UserForm objects (also known as custom dialog boxes). If your project has any class modules, it will display another node call Class Modules.



In Excel 2002, adding a reference to a project (using the Tools ⇨ References command) causes another node to appear: `References`. Each reference is listed as a separate object. The objects listed in this node do not have a code pane associated with them.

Adding a new VBA module

To add a new VBA module to a project, select the project's name in the Project Explorer window and choose Insert ⇨ Module. Or you can just right-click the project's name and choose Insert ⇨ Module from the shortcut menu.



When you record a macro, Excel automatically inserts a VBA module to hold the recorded code.

Removing a VBA module

If you need to remove a VBA module or a class module from a project, select the module's name in the Project Explorer window and choose File ⇨ Remove `xxx` (where `xxx` is the name of the module). Or you can right-click the module's name and choose Remove `xxx` from the shortcut menu. You'll be asked if you want to export the module before removing it. See the next section for details. You cannot remove code modules associated with the workbook (the `ThisWorkbook` code module) or with a sheet (for example, the `Sheet1` code module).

Exporting and importing objects

Except for those listed under the `References` node, every object in a project can be saved to a separate file. Saving an individual object in a project is known as *exporting*. And it stands to reason that you can also *import* objects into a project. Exporting and importing objects might be useful if you want to use a particular object (such as a VBA module or a `UserForm`) in a different project.

To export an object, select it in the Project Explorer window and choose File ⇨ Export File (or press Ctrl+E). You'll get a dialog box that asks for a filename. Note that the object remains in the project (only a copy of it is exported). If you export a `UserForm` object, any code associated with the `UserForm` is also exported.

To import a file into a project, select the project's name in the Project Explorer window and choose File ⇨ Import File. You'll get a dialog box that asks for a file. You can import only a file that has been exported using the File ⇨ Export File command.



If you would like to copy a module or `UserForm` object to another project, it's not really necessary to export and then import the object. Make sure both projects are open and simply activate the Project Explorer and then drag the object from one project to the other.

Working with Code Windows

As you become proficient with VBA, you'll be spending *lots* of time working in code windows. Each object in a project has an associated code window. To summarize, these objects can be

- ♦ The workbook itself (`ThisWorkbook` in the Project window)
- ♦ A worksheet or chart sheet in a workbook (for example, `Sheet1` or `Chart1` in the Project window)
- ♦ A VBA module
- ♦ A class module (a special type of module that lets you create new object classes)
- ♦ A UserForm

Minimizing and maximizing windows

At any given time, VBE may have lots of code windows, and things can get a bit confusing. Figure 7-5 shows an example of what I mean.

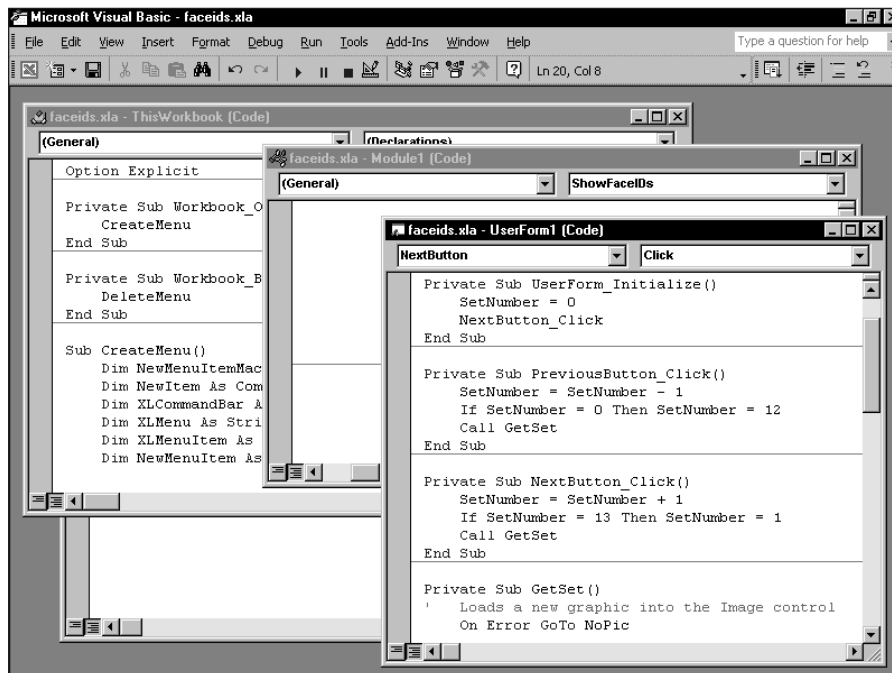


Figure 7-5: Code window overload

Code windows are much like worksheet windows in Excel. You can minimize them, maximize them, hide them, rearrange them, and so on. Many people find it most efficient to maximize the code window that they're working on. Doing so enables you to see more code and keeps you from getting distracted. To maximize a code window, click the maximize button in its title bar or just double-click its title bar. To restore a code window, making it nonmaximized, click the Restore button in its title bar.

Sometimes, you may want to have two or more code windows visible. For example, you might want to compare the code in two modules, or copy code from one module to another.

Minimizing a code window gets it out of the way. You can also click the Close button in a code window's title bar to close the window completely. To open it again, just double-click the appropriate object in the Project Explorer window.

The VBE doesn't let you close a workbook. You must reactivate Excel and close it from there. You can, however, use the Immediate window to close a workbook or add-in. Just activate the Immediate window, type a VBA statement like the one that follows, and press Enter.

```
Workbooks("myaddin.xla").Close
```

As you'll see, this statement executes the `Close` method of the `Workbook` object, which closes a workbook. In this case, the workbook happens to be an add-in.

Storing VBA code

In general, a code window can hold four types of code:

- ♦ *Sub procedures.* A *procedure* is a set of instructions that performs some action.
- ♦ *Function procedures.* A *function* is a set of instructions that returns a single value or an array (similar in concept to a worksheet function such as SUM).
- ♦ *Property procedures.* These are special procedures used in class modules.
- ♦ *Declarations.* A *declaration* is information about a variable that you provide to VBA. For example, you can declare the data type for variables you plan to use.

A single VBA module can store any number of Sub procedures, Function procedures, and declarations. How you organize a VBA module is completely up to you. Some people prefer to keep all their VBA code for an application in a single VBA module; others like to split up the code into several different modules.

Pause for a Terminology Break

Throughout this book, I use the terms *routine*, *procedure*, and *macro*. Programming people typically use the word *procedure* to describe an automated task. In Excel, a procedure is also known as a macro. Technically, a procedure can be a Sub procedure or a Function procedure, both of which are sometimes called *routines*. I use all these terms pretty much interchangeably. There is, however, an important difference between Sub procedures and Function procedures. This distinction will become apparent in Chapters 9 and 10.



Note

Although you have lots of flexibility regarding where to store your VBA code, there are some restrictions. Event-handler procedures must be located in the code window for the object that responds to the event. For example, if you write a procedure that executes when the workbook is opened, that procedure must be located in the code window for the `ThisWorkbook` object, and the procedure must have a special name. This concept will become clearer when I discuss events (Chapter 19) and `UserForms` (Part IV).

Entering VBA code

Before you can do anything meaningful, you must have some VBA code in a code window. And the VBA code must be within a procedure. A procedure consists of VBA statements. For now, I'll focus on one type of code window: a VBA module.

You can add code to a VBA module in three ways:

- ♦ Enter the code the old-fashioned way: Type it from your keyboard.
- ♦ Use Excel's macro-recorder feature to record your actions and convert them into VBA code.
- ♦ Copy the code from another module and paste it into the module you are working in.

Entering code manually

Sometimes, the most direct route is the best one. Entering code directly involves . . . well, entering the code directly. In other words, you type the code using your keyboard. You can use the Tab key to indent the lines that logically belong together — for example, the conditional statements between an `If` and an `End If` statement. This isn't really necessary, but it makes the code easier to read, so it's a good habit to acquire.

Entering and editing text in a VBA module works just as you would expect. You can select text and copy it or cut it, and paste it to another location.

A single instruction in VBA can be as long as you need it to be. For readability's sake, however, you might want to break a lengthy instruction into two or more lines. To do so, end the line with a space followed by an underscore character, then press Enter and continue the instruction on the following line. The following code, for example, is a single VBA statement split over four lines.

```
MsgBox "Can't find " & UCase(SHORTCUTMENUFILE) _
    & vbCrLf & vbCrLf & "The file should be located in _
    " & ThisWorkbook.Path & vbCrLf & vbCrLf & _
    "You may need to reinstall BudgetMan", vbCritical, APPNAME
```

Notice that I indented the last three lines of this statement. Doing so is optional, but it helps clarify the fact that these four lines are, in fact, a single statement.

**Tip**

Like Excel, the VBE has multiple levels of Undo and Redo. Therefore, if you find that you deleted an instruction that you shouldn't have, you can click the Undo button (or press Ctrl+Z) repeatedly until the instruction comes back. After undoing, you can click the Redo button to redo changes that were previously undone. This feature can be a lifesaver, so I recommend that you play around with it until you understand how it works.

Try this: Insert a VBA module into a project, and then enter the following procedure into the code window of the module:

```
Sub SayHello()
    Msg = "Is your name " & Application.UserName & "?"
    Ans = MsgBox(Msg, vbYesNo)
    If Ans = vbNo Then
        MsgBox "Oh, never mind."
    Else
        MsgBox "I must be clairvoyant!"
    End If
End Sub
```

Figure 7-6 shows how this looks in a VBA module.

**Note**

As you enter the code, you might notice that the VBE makes some adjustments to the text you enter. For example, if you omit the space before or after an equals sign (=), VBE inserts the space for you. Also, the color of some of the text is changed. This is all perfectly normal, and you'll appreciate it later.

To execute the `SayHello` procedure, make sure that the cursor is located anywhere within the text you typed. Then do any of the following:

- ♦ Press F5.
- ♦ Select Run ⇄ Run Sub/UserForm.
- ♦ Click the Run Sub/UserForm button on the Standard toolbar.

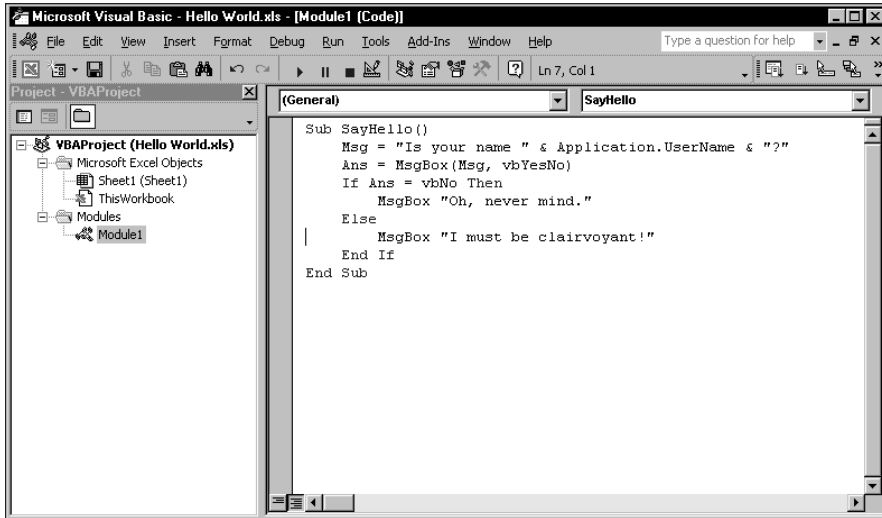


Figure 7-6: Your first VBA procedure

If you entered the code correctly, the procedure will execute and you can respond to a simple dialog box (see Figure 7-7) that displays the user name, as listed in Excel's Options dialog box. Notice that Excel is activated when the macro executes. At this point, it's not important that you understand how the code works; that becomes clear later in this chapter and in subsequent chapters.



Figure 7-7: The result of running the procedure in Figure 7-6

Note

Most of the time, you'll be executing your macros from Excel. However, it's often more efficient to test your macro by running it directly from the VBE.

What you did was write a VBA Sub procedure (also known as a *macro*). When you issued the command to execute the macro, the VBE quickly compiled the code and executed it. In other words, each instruction was evaluated and Excel simply did what it was told to do. You can execute this macro any number of times, although it tends to lose its appeal after a while.

For the record, this simple procedure uses the following concepts (all of which are covered later):

- ♦ Declaring a procedure (the first line)
- ♦ Assigning a value to variables (Msg and Ans)

- ♦ Concatenating strings (using the & operator)
- ♦ Using a built-in VBA function (MsgBox)
- ♦ Using built-in VBA constants (vbYesNo and vbNo)
- ♦ Using an If-Then-Else construct
- ♦ Ending a procedure (the last line)

Not bad for a first effort, eh?

Using the macro recorder

Another way to get code into a VBA module is to record your actions using Excel's macro recorder.

No matter how hard you try, there is absolutely no way to record the `SayHello` procedure shown previously. As you'll see, recording macros is very useful, but it has its limitations. In fact, when you record a macro you almost always need to make some adjustments or enter some code manually.

This next example shows how to record a macro that simply changes the page setup to landscape orientation. If you want to try this, start with a blank workbook and follow these steps:

1. Activate a worksheet in the workbook (any worksheet will do).
2. Select the Tools ⇨ Macro ⇨ Record New Macro command.

Excel displays its Record Macro dialog box.

3. Just click OK to accept the defaults.

Excel automatically inserts a new VBA module into the project. From this point on, Excel converts your actions into VBA code. While recording, Excel displays the word `Recording` in the status bar, and also displays a miniature floating toolbar that contains two toolbar buttons (`Stop Recording` and `Relative Reference`).

4. Select the File ⇨ Page Setup command.

Excel displays its Page Setup dialog box.

5. Select the Landscape option and click OK to close the dialog box.

6. Click the `Stop Recording` button on the miniature toolbar (or select Tools ⇨ Macro ⇨ Stop Recording).

Excel stops recording your actions.

To take a look at the macro, activate the VBE (`Alt+F11` is the easiest way) and locate the project in the Project Explorer window. Click the `Modules` node to expand it. Then click the `Module1` item to display the code window (if the project already had

a Module1, the new macro will be in Module2). The code generated by this single command is shown in Listing 7-1. If you're using a version other than Excel 2002, the code may vary slightly.

Listing 7-1: Macro for changing page setup to landscape orientation

```
Sub Macro1()  
'  
' Macro1 Macro  
' Macro recorded by John Walkenbach  
'  
    With ActiveSheet.PageSetup  
        .PrintTitleRows = ""  
        .PrintTitleColumns = ""  
    End With  
    ActiveSheet.PageSetup.PrintArea = ""  
    With ActiveSheet.PageSetup  
        .LeftHeader = ""  
        .CenterHeader = ""  
        .RightHeader = ""  
        .LeftFooter = ""  
        .CenterFooter = ""  
        .RightFooter = ""  
        .LeftMargin = Application.InchesToPoints(0.75)  
        .RightMargin = Application.InchesToPoints(0.75)  
        .TopMargin = Application.InchesToPoints(1)  
        .BottomMargin = Application.InchesToPoints(1)  
        .HeaderMargin = Application.InchesToPoints(0.5)  
        .FooterMargin = Application.InchesToPoints(0.5)  
        .PrintHeadings = False  
        .PrintGridlines = False  
        .PrintComments = xlPrintNoComments  
        .PrintQuality = 600  
        .CenterHorizontally = False  
        .CenterVertically = False  
        .Orientation = xlLandscape  
        .Draft = False  
        .PaperSize = xlPaperLetter  
        .FirstPageNumber = xlAutomatic  
        .Order = xlDownThenOver  
        .BlackAndWhite = False  
        .Zoom = 100  
    End With  
End Sub
```

You may be surprised by the amount of code generated by this single command (I know I was the first time I tried something like this). Although you changed only one simple setting in the Page Setup dialog box, Excel generates code that reproduces *all* the settings in the dialog box.

This brings up an important concept. Often, the code produced when you record a macro is overkill. If you want your macro only to switch to landscape mode, you can simplify this macro considerably by deleting the extraneous code. This makes the macro easier to read, and the macro also runs faster because it doesn't do things that are not necessary. In fact, this macro can be simplified to the following:

```
Sub Macro1()  
    With ActiveSheet.PageSetup  
        .Orientation = xlLandscape  
    End With  
End Sub
```

I deleted all the code except for the line that sets the `Orientation` property. Actually, this macro can be simplified even more because the `With-End With` construct isn't necessary when we're changing only one property:

```
Sub Macro1()  
    ActiveSheet.PageSetup.Orientation = xlLandscape  
End Sub
```

In this example, the macro changes the `Orientation` property of the `PageSetup` object on the active sheet. By the way, `xlLandscape` is a built-in constant that's provided to make things easier for you. Variable `xlLandscape` has a value of 2, and `xlPortrait` has a value of 1. The following macro works the same as the preceding `Macro1`.

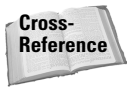
```
Sub Macro1a()  
    ActiveSheet.PageSetup.Orientation = 2  
End Sub
```

Most would agree that it's easier to remember the name of the constant than the arbitrary numbers. You can use the online help to learn the relevant constants for a particular command.

You could have entered this procedure directly into a VBA module. To do so, you would have to know which objects, properties, and methods to use. Obviously, it's much faster to record the macro, and this example has a built-in bonus: You also learned that the `PageSetup` object has an `Orientation` property.

**Note**

A point I make clear throughout this book is that recording your actions is perhaps the *best* way to learn VBA. When in doubt, try recording. Although the result may not be exactly what you want, chances are that it will steer you in the right direction. You can use the online help to check out the objects, properties, and methods that appear in the recorded code.



I discuss the macro recorder in more detail later in this chapter. See “The Macro Recorder.”

Copying VBA code

So far, I’ve covered entering code directly and recording your actions to generate VBA code. The final method of getting code into a VBA module is to copy it from another module. For example, you may have written a procedure for one project that would also be useful in your current project. Rather than reenter the code, you can simply open the workbook, activate the module, and use the normal Clipboard copy-and-paste procedures to copy it into your current VBA module. After you’ve finished pasting, you can modify the code as necessary.



As I noted previously in this chapter, you can also import an entire module that has been exported, to a file.

Customizing the VBE Environment

If you’re serious about becoming an Excel programmer, you’ll be spending a lot of time with the VBE window on your screen. To help make things as comfortable as possible, the VBE provides quite a few customization options.

When VBE is active, choose Tools ⇄ Options. You’ll see a dialog box with four tabs: Editor, Editor Format, General, and Docking. I discuss some of the most useful options on these tabs in the sections that follow. By the way, don’t confuse this with Excel’s Options dialog box, which you bring up by selecting Tools ⇄ Options in Excel. Although they have the same name, these two dialogs set different options.

Using the Editor tab

Figure 7-8 shows the options you access by clicking the Editor tab of the Options dialog box.

Auto Syntax Check option

The Auto Syntax Check setting determines whether the VBE pops up a dialog box if it discovers a syntax error while you’re entering your VBA code. The dialog box tells you roughly what the problem is. If you don’t choose this setting, VBE flags syntax errors by displaying them in a different color from the rest of the code, and you don’t have to deal with any dialog boxes popping up on your screen.

I usually keep this setting turned off because I find the dialog boxes annoying, and I can usually figure out what’s wrong with an instruction. But if you’re new to VBA, you might find this assistance helpful.

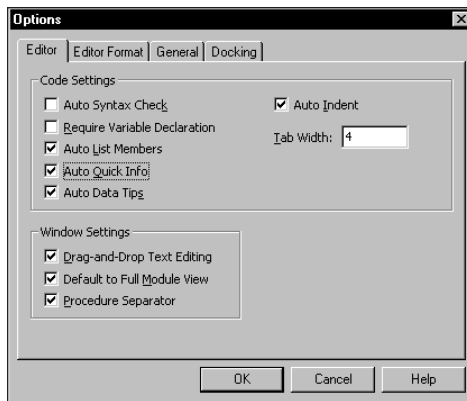


Figure 7-8: The Editor tab of the Options dialog box

Require Variable Declaration option

If the Require Variable Declaration option is set, VBE inserts the following statement at the beginning of each new VBA module you insert:

```
Option Explicit
```

If this statement appears in your module, you must explicitly define each variable that you use. This is an excellent habit to get into, although it does require some additional effort on your part. If you don't declare your variables, they will all be of the variant data type, which is flexible, but not efficient in terms of storage or speed. I'll discuss this in more depth later.

Note

Changing the Require Variable Declaration option affects only new modules, not existing modules.

Auto List Members option

If the Auto List Members option is set, VBE provides some help when you're entering your VBA code by displaying a list of member items for an object. These items include methods and properties for the object you typed.

This option is very helpful, and I always keep it turned on. Figure 7-9 shows an example of Auto List Members (which will make a lot more sense when you actually start writing VBA code). In this example, VBE is displaying a list of members for the Application object. You can just select an item from the list, and avoid typing it (this also ensures that it's spelled correctly).

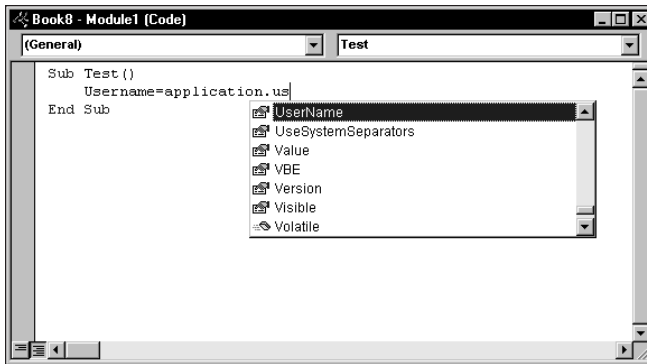


Figure 7-9: An example of Auto List Members

Auto Quick Info option

If the Auto Quick Info option is set, the VBE displays information about the arguments available for functions, properties, and methods as you type. This can be very helpful, and I always leave this setting on. Figure 7-10 shows this feature in action. It's displaying the syntax for the `Range` property.



Figure 7-10: An example of Auto Quick Info offering help about the `Range` property.

Auto Data Tips option

If the Auto Data Tips option is set, VBE displays the value of the variable over which your cursor is placed when you're debugging code. When you enter the wonderful world of debugging, you'll definitely appreciate this option. I always keep this option turned on.

Auto Indent option

The Auto Indent setting determines whether VBE automatically indents each new line of code by the same amount as the previous line. I'm a big fan of using indentations in my code, so I keep this option on. You can also specify the number of characters to indent (the default is four).

**Tip**

Use the Tab key to indent your code, not the space bar. Also, you can use Shift+Tab to “unindent” a line of code. These keys also work if you select more than one statement.

Drag-and-Drop Text Editing option

The Drag-and-Drop Text Editing option, when enabled, lets you copy and move text by dragging and dropping. I keep this option turned on, but never use drag-and-drop editing. I prefer to use keyboard shortcuts for copying and pasting.

Default to Full Module View option

The Default to Full Module View option specifies how procedures are viewed. If set, procedures in the code window appear as a single scrollable window. If this option is turned off, you can see only one procedure at a time. I keep this setting turned on.

Procedure Separator option

When the Procedure Separator option is turned on, it displays separator bars at the end of each procedure in a code window. I like the visual cues of knowing where my procedures end, so I keep this option turned on.

Using the Editor Format tab

Figure 7-11 shows the Editor Format tab of the Options dialog box.

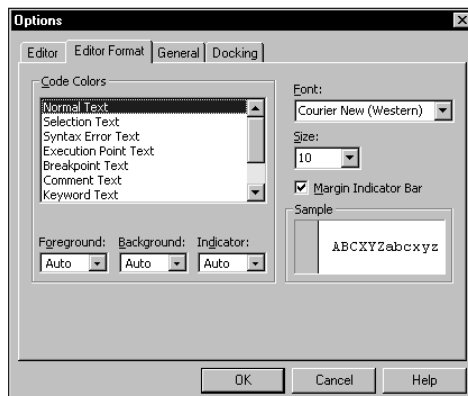


Figure 7-11: The Editor Format tab of the Options dialog box

Code Colors option

The Code Colors option lets you set the text color (foreground and background) and indicator color displayed for various elements of VBA code. This is largely a matter of individual preference. Personally, I find the default colors to be just fine. But for a change of scenery, I occasionally play around with these settings.

Font option

The Font option lets you select the font that's used in your VBA modules. For best results, stick with a fixed-width font such as Courier New. In a fixed-width font, all characters are exactly the same width. This makes your code much more readable because the characters are nicely aligned vertically and you can easily distinguish multiple spaces.

Size setting

The Size setting specifies the size of the font in the VBA modules. This setting is a matter of personal preference determined by your video display resolution and your eyesight. The default size of 10 points works for me.

Margin Indicator Bar option

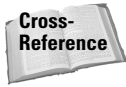
This option controls the display of the vertical margin indicator bar in your modules. You should keep this turned on; otherwise, you won't be able to see the helpful graphical indicators when you're debugging your code.

Using the General tab

Figure 7-12 shows the options available under the General tab in the Options dialog box. In almost every case, the default settings are just fine.



Figure 7-12: The General tab of the Options dialog box



The Error Trapping setting determines what happens when an error is encountered. If you write any error-handling code, make sure that the Break on Unhandled Errors option is set. If the Break on All Errors option is set, error-handling code is ignored (which is hardly ever what you want). I discuss error-handling techniques in Chapter 9.

Using the Docking tab

Figure 7-13 shows the Docking tab of the Options dialog box. These options determine how the various windows in the VBE behave. When a window is docked, it is fixed in place along one of the edges of the VBE window. This makes it much easier to identify and locate a particular window. If you turn off all docking, you'll have a big mess of windows that will be very confusing. Generally, you'll find that the default settings work fine.

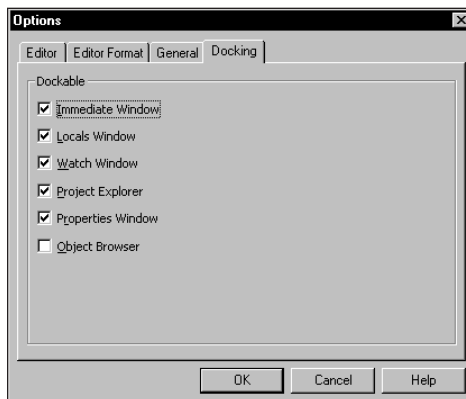


Figure 7-13: The Docking tab of the Options dialog box

The Macro Recorder

Earlier in this chapter, I discussed the macro recorder, a tool that converts your Excel actions into VBA code. This section covers the macro recorder in more detail.



Excel's Visual Basic toolbar has several useful buttons for you. On this toolbar you'll find the Run Macro, Record Macro, Stop Macro, and Visual Basic Editor buttons useful.

The macro recorder is an *extremely* useful tool, but it's important to remember the following points:

- ♦ The macro recorder is appropriate only for simple macros or for recording a small part of a more complex macro.
- ♦ The macro recorder cannot generate code that performs looping (that is, repeating statements), assigns variables, executes statements conditionally, displays dialog boxes, and so on.
- ♦ The code that is generated depends on certain settings that you specify.
- ♦ You'll often want to clean up the recorded code to remove extraneous commands.

What is recorded

As you know, Excel's macro recorder translates your mouse and keyboard actions into VBA code. I could probably write several pages describing how this is done, but the best way to show you is by example. Follow these steps:

1. Start with a blank workbook.
2. Make sure Excel's window is not maximized. You don't want it to fill the entire screen.
3. Press Alt+F11 to activate the VBE window, and make sure *this* window is not maximized.
4. Resize and arrange Excel's window and the VBE window so both are visible. (For best results, minimize any other applications that are running.)
5. Activate Excel, Choose Tools ⇄ Macro ⇄ Record New Macro, and click OK to start the macro recorder.

Excel inserts a new module (named Module1) and starts recording on that sheet.

6. Activate the VBE window.
7. In the Project Explorer window, double-click Module1 to display that module in the code window.
8. Close the Project Explorer window in the VBE to maximize the view of the code window.

Your screen should look something like the example in Figure 7-14. The size of the windows will depend on your video resolution.

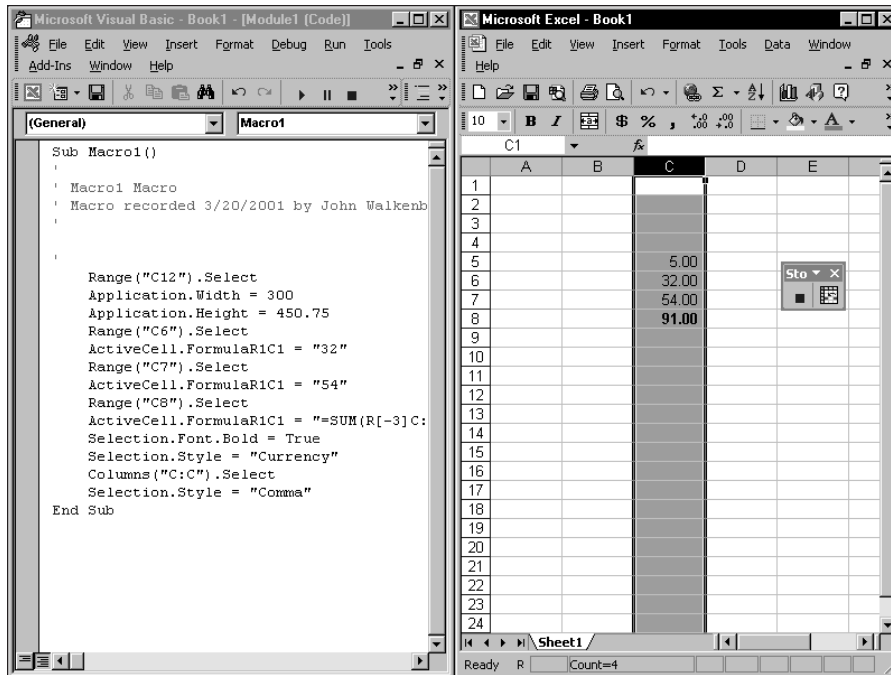


Figure 7-14: A convenient window arrangement for watching the macro recorder do its thing

Now, move around in the worksheet and select various Excel commands. Watch as the code is generated in the window that displays the VBA module. Select cells, enter data, format cells, use the menus and toolbars, create a chart, manipulate graphic objects, and so on. I guarantee that you'll be enlightened as you watch the code being spit out before your very eyes.

Relative or absolute?

When recording your actions, Excel normally records absolute references to cells. In other words, when you select a cell, it will remember that exact cell (not the cell relative to the current active cell). To demonstrate how this works, perform these steps and examine the code:

1. Activate a worksheet and start the macro recorder.
2. Activate cell B1.
3. Enter **Jan** into cell B1.
4. Move to cell C1 and enter **Feb**.

5. Continue this process until you've entered the first six months of the year in B1:G1.
6. Click cell B1 to activate it again.
7. Stop the macro recorder.

Excel generates the following code:

```
Sub Macro1()  
    Range("B1").Select  
    ActiveCell.FormulaR1C1 = "Jan"  
    Range("C1").Select  
    ActiveCell.FormulaR1C1 = "Feb"  
    Range("D1").Select  
    ActiveCell.FormulaR1C1 = "Mar"  
    Range("E1").Select  
    ActiveCell.FormulaR1C1 = "Apr"  
    Range("F1").Select  
    ActiveCell.FormulaR1C1 = "May"  
    Range("G1").Select  
    ActiveCell.FormulaR1C1 = "Jun"  
    Range("B1").Select  
End Sub
```

To execute this macro, choose the Tools ⇨ Macro ⇨ Macros command (or press Alt+F8) and select Macro1 (or whatever the macro is named) and click the Run button.

The macro, when executed, re-creates the actions you performed when you recorded it. These same actions occur regardless of which cell is active when you execute the macro. Recording a macro using absolute references always produces the exact same results.

In some cases, however, you'll want your recorded macro to work with cell locations in a *relative* manner. For example, you'd probably want such a macro to start entering the month names in the active cell. In such a case, you'll want to use relative recording to record the macro.

The Stop Recording toolbar, which consists of only two buttons, is displayed when you are recording a macro. You can change the manner in which Excel records your actions by clicking the Relative Reference button on the Stop Recording toolbar. This button is a toggle. When the button appears in a pressed state, the recording mode is relative. When the button appears normally, you are recording in absolute mode. You can change the recording method at any time, even in the middle of recording.

To see how this works, erase the cells in B1:D1 and then perform the following steps:

1. Activate cell B1.
2. Choose Tools ⇨ Macro ⇨ Record New Macro.
3. Name this macro Relative.
4. Click OK to begin recording.
5. Click the Relative Reference button (on the Stop Recording toolbar) to change the recording mode to relative.

When you click this button, it appears pressed.

6. Enter the first six month names in B1:G1, as in the previous example.
7. Select cell B1.
8. Stop the macro recorder.

With the recording mode set to relative, the code that Excel generates is quite different:

```
Sub Macro2()  
    ActiveCell.FormulaR1C1 = "Jan"  
    ActiveCell.Offset(0, 1).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "Feb"  
    ActiveCell.Offset(0, 1).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "Mar"  
    ActiveCell.Offset(0, 1).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "Apr"  
    ActiveCell.Offset(0, 1).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "May"  
    ActiveCell.Offset(0, 1).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "Jun"  
    ActiveCell.Offset(0, -5).Range("A1").Select  
End Sub
```

You can execute this macro by activating a worksheet and then choosing the Tools ⇨ Macro command. Select the macro's name and click the Run button.

You'll also notice that I varied the procedure slightly in this example: I activated the beginning cell *before* I started recording. This is an important step when you record macros that use the active cell as a base.

Although it looks rather complicated, this macro is actually quite simple. The first statement simply enters **Jan** into the active cell. (It uses the active cell because it's not preceded by a statement that selects a cell.) The next statement uses the `Offset` property to move the selection one cell to the right. The next statement

inserts more text, and so on. Finally, the original cell is selected by calculating a relative offset rather than an absolute cell. Unlike the preceding macro, this one always starts entering text in the active cell.

Note

You'll notice that this macro generates code that appears to reference cell A1 — which may seem strange, because cell A1 was not even involved in the macro. This is simply a by-product of the way the macro recorder works. (I discuss the `Offset` property later in this chapter.) At this point, all you need to know is that the macro works as it should.

By the way, the code generated by Excel is much more complex than it need be, and it's not the most efficient way to code the operation. The macro that follows, which I entered manually, is a simpler and faster way to perform this same operation. This example demonstrates that VBA doesn't have to select a cell before it puts information into it — an important concept that can also speed things up considerably.

```
Sub Macro3()  
    ActiveCell.Offset(0, 0) = "Jan"  
    ActiveCell.Offset(0, 1) = "Feb"  
    ActiveCell.Offset(0, 2) = "Mar"  
    ActiveCell.Offset(0, 3) = "Apr"  
    ActiveCell.Offset(0, 4) = "May"  
    ActiveCell.Offset(0, 5) = "Jun"  
End Sub
```

In fact, this macro can be made even more efficient by using the `With-End With` construct:

```
Sub Macro4()  
    With ActiveCell  
        .Offset(0, 0) = "Jan"  
        .Offset(0, 1) = "Feb"  
        .Offset(0, 2) = "Mar"  
        .Offset(0, 3) = "Apr"  
        .Offset(0, 4) = "May"  
        .Offset(0, 5) = "Jun"  
    End With  
End Sub
```

Or, if you're a VBA guru (like the technical editor for this book), you can impress your colleagues and do it in one statement:

```
Sub Macro54()  
  
    ActiveCell.Resize(,6)=Array("Jan", "Feb", "Mar", "Apr", "May", "Jun"  
    )  
End Sub
```

The point here is that the recorder has two distinct modes, and you need to be aware of which mode you're recording in. Otherwise, the result will not be what you expected.

Recording options

When you record your actions to create VBA code, you have several options. Recall that the Tools ⇨ Macro ⇨ Record New Macro command displays the Record Macro dialog box before recording begins. This dialog box gives you quite a bit of control over your macro. The following paragraphs describe your options.

Macro name

You can enter a name for the procedure that you are recording. By default, Excel uses the names Macro1, Macro2, and so on for each macro you record. I usually just accept the default name and change the name of the procedure later. You, however, may prefer to name the macro before you record it. The choice is yours.

Shortcut key

The Shortcut key option lets you execute the macro by pressing a shortcut key combination. For example, if you enter **w** (lowercase), you can execute the macro by pressing Ctrl+W. If you enter **W** (uppercase), the macro comes alive when you press Ctrl+Shift+W.

You can add or change a shortcut key at any time, so you don't need to set this option while recording a macro.

Store macro in

The Store macro in option tells Excel where to store the macro that it records. By default, Excel puts the recorded macro in a module in the active workbook. If you prefer, you can record it in a new workbook (Excel opens a blank workbook) or in your Personal Macro Workbook.

The Personal Macro Workbook

If you create some VBA macros that you find particularly useful, you may want to store these routines on your Personal Macro Workbook. This is a workbook, named Personal.xls, that is stored in your Xlstart directory. Whenever you start Excel, this workbook is loaded. It's a hidden workbook, so it's out of your way. When you record a macro, one of your options is to record it to your Personal Macro Workbook. The Personal.xls file doesn't exist until you record a macro to it.

Description

By default, Excel inserts five lines of comments (three of them blank) that list the macro name, the user's name, and the date. You can put anything you like here, or nothing at all. As far as I'm concerned, typing anything in is a waste of time, because I always end up deleting this in the module.

In versions of Excel prior to Excel 97, the Record Macro dialog box provided an option that let you assign the macro to a new menu item on the Tools menu. This option was removed, beginning with Excel 97. If you want to be able to execute a macro from a menu, you need to set this up yourself. See Chapter 23 for more details.

Cleaning up recorded macros

Earlier in this section, you saw how recording your actions while you issued a single command (the File ⇨ Page Setup command) can produce an enormous amount of VBA code. In many cases, the recorded code includes extraneous commands that you can delete.

It's also important to understand that the macro recorder doesn't always generate the most efficient code. If you examine the generated code, you'll see that Excel generally records what is selected (that is, an object) and then uses the `Selection` object in subsequent statements. For example, here's what is recorded if you select a range of cells, and then use the buttons on the Formatting toolbar to change the numeric formatting, and apply bold and italic:

```
Range("A1:C5").Select
Selection.NumberFormat = "#,##0.00"
Selection.Font.Bold = True
Selection.Font.Italic = True
```

**Tip**

If you use the Formatting dialog box to record this macro, you'll find that Excel records quite a bit of extraneous code. Recording toolbar button clicks often produces more efficient code.

This is just *one* way to perform these actions. You can also use the more efficient `With-End With` construct, as follows:

```
Range("A1:C5").Select
With Selection
    .NumberFormat = "#,##0.00"
    .Font.Bold = True
    .Font.Italic = True
End With
```


About the Code Examples

Throughout this book, I present many small snippets of VBA code to make a point or to provide an example. Often, this code may consist of just a single statement. In some cases, the example consists of only an *expression*, which isn't a valid instruction by itself.

For example, the following is an expression:

```
Range("A1").Value
```

To test an expression, you must evaluate it. The `MsgBox` function is a handy tool for this:

```
MsgBox Range("A1").Value
```

To try out these examples, you need to put the statement within a procedure in a VBA module, like this:

```
Sub Test()  
    ' statement goes here  
End Sub
```

Then put the cursor anywhere within the procedure and press F5 to execute it. Also, make sure that the code is being executed within the proper context. For example, if a statement refers to `Sheet1`, make sure that the active workbook actually has a sheet named `Sheet1`.

If the code is just a single statement, you can use VBE's Immediate window. The Immediate window is very useful for executing a statement "immediately" — without having to create a procedure. If the Immediate window is not displayed, press `Ctrl+G` in the VBE.

Just type the VBA statement and press `Enter`. To evaluate an expression in the Immediate window, precede the expression with a question mark (?). The question mark is a shortcut for `Print`. For example, you can type the following into the Immediate window:

```
? Range("A1").Value
```

The result of this expression is displayed in the next line of the Immediate window.

Or you can avoid the `Select` method altogether and write the code even more efficiently, like this:

```
With Range("A1:C5")  
    .NumberFormat = "#,##0.00"  
    .Font.Bold = True  
    .Font.Italic = True  
End With
```

If speed is essential in your application, you'll always want to examine any recorded VBA code closely to make sure that it's as efficient as possible.

You will, of course, need to understand VBA thoroughly before you start cleaning up your recorded macros. But for now, just be aware that recorded VBA code isn't always the best, most efficient code.

About Objects and Collections

If you've worked through the first part of this chapter, you have an overview of VBA and you know the basics of working with VBA modules in the VBE. You've also seen some VBA code and were exposed to concepts such as objects and properties. This section gives you some additional details about objects and collections of objects.

As you work with VBA, you must understand the concept of objects and Excel's object model. It helps to think of objects in terms of a *hierarchy*. At the top of this model is the `Application` object—in this case, Excel itself. But if you're programming in VBA using Microsoft Word, the `Application` object is Word.

The object hierarchy

The `Application` object (that is, Excel) contains other objects. Here are a few examples of objects contained in the `Application` object:

Workbooks (a collection of all `Workbook` objects)

Windows (a collection of all `Window` objects)

AddIns (a collection of all `AddIn` objects)

Some objects can contain other objects. For example, the `Workbooks` collection consists of all open `Workbook` objects, and a `Workbook` object contains other objects, a few of which are as follows:

Worksheets (a collection of `Worksheet` objects)

Charts (a collection of `Chart` objects)

Names (a collection of `Name` objects)

Each of these objects, in turn, can contain other objects. The `Worksheets` collection consists of all `Worksheet` objects in a `Workbook`. A `Worksheet` object contains many other objects, which include the following:

`ChartObjects` (a collection of `ChartObject` objects)

`Range`

`PageSetup`

`PivotTables` (a collection of `PivotTable` objects)

If this seems confusing, trust me, it *will* make sense, and you'll eventually realize that this whole object hierarchy thing is quite logical and well structured. By the way, the complete Excel object model is diagrammed in the online help system.

About collections

Another key concept in VBA programming is *collections*. A collection is a group of objects of the same class (and a collection is itself an object). As I noted above, `Workbooks` is a collection of all `Workbook` objects currently open. `Worksheets` is a collection of all `Worksheet` objects contained in a particular `Workbook` object. You can work with an entire collection of objects or with an individual object in a collection. To reference a single object from a collection, you put the object's name or index number in parentheses after the name of the collection, like this:

```
Worksheets("Sheet1")
```

If `Sheet1` is the first worksheet in the collection, you may also use the following reference:

```
Worksheets(1)
```

You refer to the second worksheet in a `Workbook` as `Worksheets(2)`, and so on.

There is also a collection called `Sheets`, which is made up of all sheets in a workbook, whether they're worksheets or chart sheets. If `Sheet1` is the first sheet in the workbook, you can reference it as follows:

```
Sheets(1)
```

Object referral

When you refer to an object using VBA, you often must qualify the object by connecting object names with a period (also known as a "dot operator"). What if you had two workbooks open and they both had a worksheet named `Sheet1`? The solution is to qualify the reference by adding the object's *container*, like this:

```
Workbooks("Book1").Worksheets("Sheet1")
```

Without the workbook qualifier, VBA would look for `Sheet1` in the active workbook.

To refer to a specific range (such as cell `A1`) on a worksheet named `Sheet1` in a workbook named `Book1`, you can use the following expression:

```
Workbooks("Book1").Worksheets("Sheet1").Range("A1")
```

The fully qualified reference for the preceding example also includes the `Application` object, as follows:

```
Application.Workbooks("Book1").Worksheets("Sheet1"). _  
    Range("A1")
```

Most of the time, however, you can omit the `Application` object in your references (it is assumed). If the `Book1` object is the active workbook, you can even omit that object reference and use this:

```
Worksheets("Sheet1").Range("A1")
```

And—I think you know where I’m going with this—if `Sheet1` is the active worksheet, you can use an even simpler expression:

```
Range("A1")
```

**Note**

Contrary to what you might expect, Excel does not have an object that refers to an individual cell that is called “Cell.” A single cell is simply a `Range` object that happens to consist of just one element.

Simply referring to objects (as in these examples) doesn’t do anything. To perform anything meaningful, you must read or modify an object’s properties, or specify a method to be used with an object.

Properties and Methods

It’s easy to be overwhelmed with properties and methods; there are literally thousands available. In this section I describe how to access properties and methods of objects.

Object properties

Every object has properties. For example, a `Range` object has a property called `Value`. You can write VBA code to display the `Value` property or write VBA code to set the `Value` property to a specific value. Here’s a procedure that uses VBA’s `MsgBox` function to pop up a box that displays the value in cell `A1` on `Sheet1` of the active workbook:

```
Sub ShowValue()  
    MsgBox Worksheets("Sheet1").Range("A1").Value  
End Sub
```

**Note**

`MsgBox` is a useful function that you’ll use often to display results while your VBA code is executing. I use it extensively throughout this book.

The code in the preceding example displays the current setting of the `Value` property of a specific cell: cell A1 on a worksheet named `Sheet1` in the active workbook. Note that if the active workbook does not have a sheet named `Sheet1`, the macro will generate an error.

Now, what if you want to change the `Value` property? The following procedure changes the value displayed in cell A1 by changing the cell's `Value` property:

```
Sub ChangeValue()  
    Worksheets("Sheet1").Range("A1").Value = 123  
End Sub
```

After executing this routine, cell A1 on `Sheet1` has the value 123. You might want to enter these procedures into a module and experiment with them.

**Note**

Most objects have a default property. For a `Range` object, the default property is the `Value` property. Therefore, you can omit the `.Value` part from the above code and it will have the same effect. However, it's usually considered good programming practice to include the property, even if it is the default property.

Object methods

In addition to properties, objects also have methods. A *method* is an action that you perform with an object. Here's a simple example that uses the `Clear` method on a range object. After you execute this procedure, A1:C3 on `Sheet1` will be empty, and all of the cell formatting will be removed.

```
Sub ZapRange()  
    Worksheets("Sheet1").Range("A1:C3").Clear  
End Sub
```

If you'd like to delete the values in a range, but keep the formatting, use the `ClearContents` method of the `Range` object.

Most methods also take arguments to define the action further. Here's an example that copies cell A1 to cell B1 by using the `Copy` method of the `Range` object. In this example, the `Copy` method has one argument (the destination of the copy). Notice that I used the line continuation character sequence (a space, followed by an underscore) in this example. You can omit the line continuation sequence and type the statement on a single line.

```
Sub CopyOne()  
    Worksheets("Sheet1").Range("A1").Copy _  
        Worksheets("Sheet1").Range("B1")  
End Sub
```

Specifying Arguments for Methods and Properties

An issue that often leads to confusion among VBA programmers concerns arguments for methods and properties. Some methods use arguments to further clarify the action to be taken, and some properties use arguments to further specify the property value. In some cases, one or more of the arguments is optional.

If a method uses arguments, place the arguments after the name of the method, separated by commas. If the method uses optional arguments, you can insert blank *placeholders* for the optional arguments. Consider the `Protect` method for a workbook object. Check the online help and you'll find that the `Protect` method takes three arguments: password, structure, windows. These arguments correspond to the options in the Protect Workbook dialog box.

If you want to protect a workbook named `MyBook.xls`, for example, you might use a statement like this:

```
Workbooks("MyBook.xls").Protect "xyzyzy", True, False
```

In this case, the workbook is protected with a password (argument 1). Its structure is protected (argument 2), but not its windows (argument 3).

If you don't want to assign a password, you can use a statement like this:

```
Workbooks("MyBook.xls").Protect , True, False
```

Notice that the first argument is omitted, and that I specified the placeholder using a comma.

Another approach, which makes your code more readable, is to use named arguments. Here's an example of how you use named arguments for the preceding example:

```
Workbooks("MyBook.xls").Protect Structure:=True, Windows:=False
```

Using named arguments is a good idea, especially for methods that have lots of optional arguments, and also when you need to use only a few of them. When you use named arguments, there is no need to use a placeholder for missing arguments.

For properties that use arguments, you must place the arguments in parentheses. For example, the `Address` property of a `Range` object takes five arguments, all of which are optional. The following statement is not valid because the parentheses are omitted:

```
MsgBox Range("A1").Address False ' invalid
```

The proper syntax for such a statement requires parentheses, as follows:

```
MsgBox Range("A1").Address(False)
```

Or the statement could also be written using a named argument:

```
MsgBox Range("A1").Address(rowAbsolute:=False)
```

These nuances will become clearer as you gain more experience with VBA.

The Comment Object: A Case Study

To help you better understand the properties and methods available for an object, I focus on a particular object: the `Comment` object. You create a `Comment` object when you use Excel's Insert ⇨ Comment command to enter a cell comment. In the sections that follow, you'll get a feel for working with objects. If you're a bit overwhelmed by the material in this section, don't fret. These concepts will become much clearer over time.

Online help for the Comment object

One way to learn about a particular object is to look it up in the online help system. Figure 7-15 shows the main help screen for the `Comment` object.

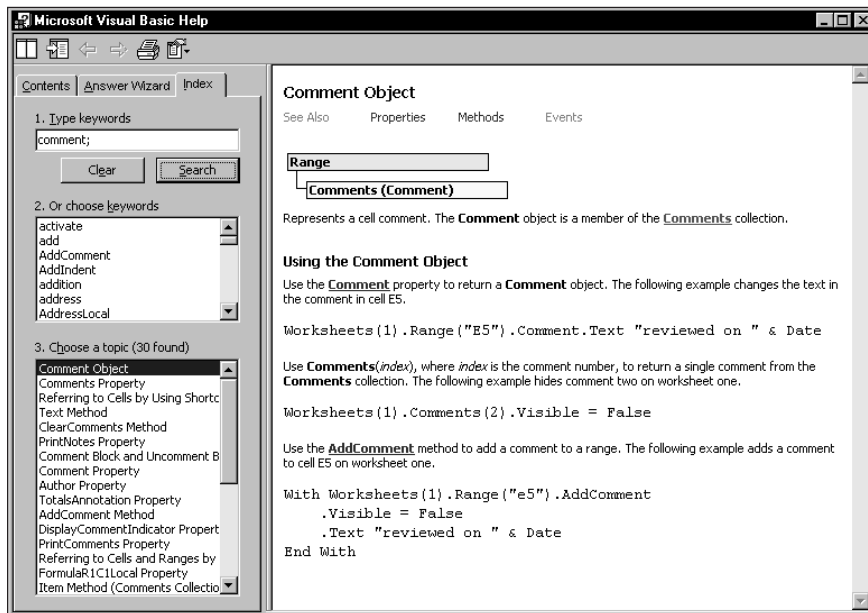


Figure 7-15: The main help screen for the `Comment` object

Notice that the colored or underlined words are hyperlinks that display additional information. For example, you can click the [Properties](#) hyperlink to get a list of all properties for the `Comment` object. Or click the [Method](#) hyperlink to get a list of the object's methods.

Using the Online Help System

The easiest way to get specific help about a particular object, property, or method is to type the word in a code window and press F1. If there is any ambiguity about the word you typed, you'll get a dialog box like the one shown in the accompanying figure.

Unfortunately, the items listed in the dialog box are not always clear, so it may require some trial and error to locate the correct help topic. The dialog box in the figure appears when you type **Comment** and then press F1. In this case, although `Comment` is an object, it may behave like a property. Clicking the first item displays the help topic for the `Comment` object; clicking the second item displays the help topic for the `Comment` property.

Properties of a Comment object

The `Comment` object has six properties. Table 7-1 contains a list of these properties, along with a brief description of each. If a property is *read-only*, your VBA code can read the property but cannot change it.

Table 7-1
Properties of a Comment Object

<i>Property</i>	<i>Read-Only</i>	<i>Description</i>
Application	Yes	Returns an object that represents the application that created the comment (that is, Excel).
Author	Yes	Returns the name of the person who created the comment.
Creator	Yes	Returns a number that specifies the application that created the object. Not used in Excel for Windows (relevant only for Excel for Macintosh).
Parent	Yes	Returns the parent object for the comment (it is always a Range object).
Shape	Yes	Returns a <code>Shape</code> object that represents the shape attached to the comment.
Visible	No	Is <code>True</code> if the comment is visible.

Methods of a Comment object

Table 7-2 shows the methods that you can use with a `Comment` object. Again, these methods perform common operations that you may have performed manually with a comment at some point . . . but you probably never thought of these operations as methods.

Table 7-2
Methods of a Comment Object

<i>Method</i>	<i>Description</i>
Delete	Deletes a comment.
Next	Returns a <code>Comment</code> object that represents the next comment.
Previous	Returns a <code>Comment</code> object that represents the previous comment.
Text	Returns or sets the text in a comment (takes three arguments).

**Note**

You may be surprised to see that `Text` is a method rather than a property. This leads to an important point: The distinction between properties and methods isn't always clear-cut, and the object model isn't perfectly consistent. In fact, it's not really important that you distinguish between properties and methods. As long as you get the syntax correct, it doesn't matter if a word in your code is a property or a method.

The Comments collection

Recall that a collection is a group of like objects. Every worksheet has a `Comments` collection, which consists of all `Comment` objects on the worksheet. If the worksheet has no comments, this collection is empty.

For example, the following code refers to the first comment on `Sheet1` of the active workbook:

```
Worksheets("Sheet1").Comments(1)
```

The following statement displays the text contained in the first comment on `Sheet1`:

```
MsgBox Worksheets("Sheet1").Comments(1).Text
```

Unlike most objects, a `Comment` object does not have a `Name` property. Therefore, to refer to a specific comment you must use an index number, or use the `Comment` property of a `Range` object to return a specific comment (keep reading, and this will make sense).

The `Comments` collection is also an object and has its own set of properties and methods. For example, the following example shows the total number of comments:

```
MsgBox ActiveSheet.Comments.Count
```

The `Comments` collection here has a `Count` property that stores the number of `Comment` objects in the active worksheet. The next example shows the address of the cell that has the first comment:

```
MsgBox ActiveSheet.Comments(1).Parent.Address
```

Here, `Comments(1)` returns the first `Comment` object in the `Comments` collection. The `Parent` property of the `Comment` object returns its container, which is a `Range` object. The message box displays the `Address` property of the `Range`. The net effect is that the statement displays the address of the cell that contains the first comment.

You can also loop through all the comments on a sheet by using the `For Each-Next` construct (this is explained in Chapter 8). Here's an example that displays a separate message box for each comment on the active worksheet:

```
For Each cmt in ActiveSheet.Comments
    MsgBox cmt.Text
Next cmt
```

If you'd rather not deal with a series of message boxes, use this procedure to print the comments to the Intermediate window in the VBE:

```
For Each cmt in ActiveSheet.Comments
    Debug.Print cmt.Text
Next cmt
```

About the Comment property

In this section I've been discussing the `Comment` object. If you dig through the online help, you'll find that a `Range` object has a property named `Comment`. If the cell contains a comment, the `Comment` property returns an object: a `Comment` object. For example, the following statement refers to the `Comment` object in cell A1:

```
Range("A1").Comment
```

If this were the first comment on the sheet, you could refer to the same `Comment` object as follows:

```
Comments(1)
```

To display the comment in cell A1 in a message box, use a statement like this:

```
MsgBox Range("A1").Comment.Text
```

If cell A1 does not contain a comment, this statement will generate an error.

**Note**

The fact that a property can return an object is a very important concept—a difficult one to grasp, perhaps, but critical to mastering VBA.

Objects within a Comment object

Working with properties is confusing at first because some properties actually return objects. Suppose that you want to determine the background color of a particular comment on Sheet1. If you look through the list of properties for a `Comment` object, you won't find anything that relates to color. Rather, you must do this:

1. Use the `Comment` object's `Shape` property to return the `Shape` object that's contained in the comment.
2. Use the `Shape` object's `Fill` property to return a `FillFormat` object.
3. Use the `FillFormat` object's `ForeColor` property to return a `ColorFormat` object.
4. Use the `ColorFormat` object's `RGB` property (or `SchemeColor` property) to set the color.

Put another way, getting at the interior color for a `Comment` object involves accessing other objects contained in the `Comment` object. Here's a look at the object hierarchy that's involved.

```
Application (Excel)
  Workbook object
    Worksheet object
      Comment object
        Shape object
          FillFormat object
            ColorFormat object
```

I'll be the first to admit it: This can get very confusing! But, as an example of the "elegance" of VBA, code to change the color of a comment can be written with a single statement:

```
Worksheets("Sheet1").Comments(1).Shape.Fill.ForeColor _
    .RGB = RGB(0, 255, 0)
```

Or, if you use the `SchemeColor` property (which ranges from 0 to 80):

```
Worksheets("Sheet1").Comments(1).Shape.Fill.ForeColor _
    .SchemeColor = 12
```

This type of referencing is certainly not intuitive at first, but it will eventually make sense. Fortunately, recording your actions in Excel almost always yields some insights regarding the hierarchy of the objects involved.

Confused by Colors?

As you gain experience with VBA and start working with setting colors for various objects, you will probably reach a head-scratching point and wonder what's going on. Keep this in mind: Excel uses a 56-color palette of colors, and the specific colors are saved with each workbook. These are the colors you see when you use the Fill Color button on Excel's Formatting toolbar (the same colors that are displayed in the Color tab of the Options dialog box). So what does this mean for a VBA programmer? The color you specify in your VBA code may or may not be the color that actually appears.

Things get even more confusing. Depending on the object you're manipulating, you'll need to deal with several different color-related objects and properties.

You can set the color of a Shape object by using either the `RGB` property or the `SchemeColor` property. The `RGB` property lets you specify a color in terms of its red, green, and blue components. This is used in conjunction with VBA's `RGB` function, which takes three arguments, each of which ranges from 0 to 255. The `RGB` function returns a value between 0 and 16,777,215. But, as I mentioned, Excel can only handle 56 different colors. Therefore, the actual color that results when you use the `RGB` function will be the closest color match in the workbook's 56-color palette. The `SchemeColor` property accepts values between 0 and 80. The online help says virtually nothing about what these colors actually represent. They are, however, limited to the workbook's color palette.

When you're dealing with colors in a `Range` object, you need to access the `Interior` object, contained in the `Range` object. You have a choice of setting the color using the `Color` property or the `ColorIndex` property. Valid values for the `ColorIndex` property are 0 through 56 (0 represents no fill). These values correspond to the workbook's color palette. Unfortunately, the order of the colors displayed bears no relationship to the numbering system for the `ColorIndex` property, so you'll need to record a macro to determine the `ColorIndex` value for a particular color. Even then, there's no guarantee that the user hasn't changed the color palette for the workbook. If so, the `ColorIndex` may result in a color completely different from the one you had in mind.

If you use the `Color` property, you can specify a color value using VBA's `RGB` function. But, again, the actual color that you get will be the one closest to a color in the workbook's color palette.

By the way, to change the color of the text in a comment, you'll need to access the `Comment` object's `TextFrame` object, which contains the `Characters` object, which contains the `Font` object. Then, you'll have access to the `Font` object's `Color` or `ColorIndex` properties. Here's an example that sets `ColorIndex` property to 5:

```
Worksheets("Sheet1").Comments(1) _  
    .Shape.TextFrame.Characters.Font.ColorIndex = 5
```

Determining whether a cell has a comment

The following statement will display the comment in cell A1 of the active sheet:

```
MsgBox Range("A1").Comment.Text
```

If cell A1 does not have a comment, executing this statement will generate a cryptic error message: Object variable or With block variable not set.

To determine whether a particular cell has a comment, you can write code to see whether the `Comment` object is `Nothing` (yes, `Nothing` is a valid keyword). The following statement displays `True` if cell A1 does not have a comment:

```
MsgBox Range("A1").Comment Is Nothing
```

Note that I use the `Is` keyword, not an equals sign.

Adding a new Comment object

You may have noticed that the list of methods for the `Comment` object doesn't include a method to add a new comment. This is because the `AddComment` method belongs to the `Range` object. The following statement adds a comment (an empty comment) to cell A1 on the active worksheet:

```
Range("A1").AddComment
```

If you consult the online help, you'll discover that the `AddComment` method takes an argument that represents the text for the comment. Therefore, you can add a comment and then add text to the comment with a single statement, like this:

```
Range("A1").AddComment "Formula developed by JW."
```



Note

The `AddComment` method generates an error if the cell already contains a comment.



On the
CD-ROM

If you'd like to see these `Comment` object properties and methods in action, check out the example workbook on the companion CD-ROM. This workbook contains several examples that manipulate `Comment` objects with VBA code. You probably won't understand all the code, but you will get a feel for how you can use VBA to manipulate an object.

Some useful Application properties

As you know, when you're working with Excel, only one workbook at a time can be active. And if the sheet is a worksheet, one cell is the active cell (even if a multicell range is selected).

VBA knows this and lets you refer to these active objects in a simplified manner. This is often useful, because you won't always know the exact workbook, worksheet, or range that you want to operate on. VBA handles this by providing properties of the `Application` object. For example, the `Application` object has an `ActiveCell` property that returns a reference to the active cell. The following instruction assigns the value 1 to the active cell:

```
ActiveCell.Value = 1
```

Notice that I omitted the reference to the `Application` object in the preceding example because it is assumed. It's important to understand that this instruction will fail if the active sheet is not a worksheet. For example, if VBA executes this statement when a chart sheet is active, the procedure halts and you'll get an error message.

If a range is selected in a worksheet, the active cell will be in a cell within the selected range. In other words, the active cell is always a single cell (never a multi-cell range).

The `Application` object also has a `Selection` property that returns a reference to whatever is selected, which could be a single cell (the active cell), a range of cells, or an object such as `ChartObject`, `TextBox`, or `Shape`.

Table 7-3 lists the other `Application` properties that are useful when working with cells and ranges.

Table 7-3
Some Useful Properties of the Application Object

<i>Property</i>	<i>Object Returned</i>
<code>ActiveCell</code>	The active cell
<code>ActiveChart</code>	The active chart sheet or chart object on a worksheet. This property will be <code>Nothing</code> if a chart is not active.
<code>ActiveSheet</code>	The active sheet (worksheet or chart)
<code>ActiveWindow</code>	The active window
<code>ActiveWorkbook</code>	The active workbook
<code>RangeSelection</code>	The selected cells on the worksheet in the specified window, even when a graphic object is selected
<code>Selection</code>	The object selected (it could be a <code>Range</code> object, <code>Shape</code> , <code>ChartObject</code> , and so on)
<code>ThisWorkbook</code>	The workbook that contains the procedure being executed

The advantage of using these properties to return an object is that you don't need to know which cell, worksheet, or workbook is active, or provide a specific reference to it. This allows you to write VBA code that is not specific to a particular workbook, sheet, or range. For example, the following instruction clears the contents of the active cell, even though the address of the active cell is not known:

```
ActiveCell.ClearContents
```

The example that follows displays a message that tells you the name of the active sheet:

```
MsgBox ActiveSheet.Name
```

If you want to know the name of the active workbook, use a statement like this:

```
MsgBox ActiveWorkbook.Name
```

If a range on a worksheet is selected, you can fill the entire range with a value by executing a single statement. In the following example, the `Selection` property of the `Application` object returns a `Range` object that corresponds to the selected cells. The instruction simply modifies the `Value` property of this `Range` object, and the result is a range filled with a single value:

```
Selection.Value = 12
```

Note that if something other than a range is selected (such as a `ChartObject` or a `Shape`), the preceding statement will generate an error because `ChartObjects` and `Shape` objects do not have a `Value` property.

The following statement, however, enters a value of 12 into the `Range` object that was selected before a non-`Range` object was selected. If you look up the `RangeSelection` property in the online help, you'll find that this property applies only to a `Window` object.

```
ActiveWindow.RangeSelection.Value = 12
```

To find out how many cells are selected in the active worksheet, access the `Count` property. Here's an example:

```
MsgBox ActiveWindow.RangeSelection.Count
```

Working with Range Objects

Much of the work you will do in VBA involves cells and ranges in worksheets. After all, that's what spreadsheets are designed to do. The earlier discussion on relative versus absolute macro recording exposed you to working with cells in VBA, but you need to know a lot more.

A Range object is contained in a Worksheet object, and consists of a single cell or range of cells on a single worksheet. In the sections that follow, I discuss three ways of referring to Range objects in your VBA code:

- ♦ The Range property of a Worksheet or Range class object
- ♦ The Cells property of a Worksheet object
- ♦ The Offset property of a Range object

The Range property

The Range property returns a Range object. If you consult the online help for the Range property, you'll learn that this property has two syntaxes:

```
object.Range(cell1)  
object.Range(cell1, cell2)
```

The Range property applies to two types of objects: a Worksheet object or a Range object. Here, *cell1* and *cell2* refer to placeholders for terms that Excel will recognize as identifying the range (in the first instance) and *delineating* the range (in the second instance). Following are a few examples of using the Range method.

You've already seen examples like the following one earlier in the chapter. The instruction that follows simply enters a value into the specified cell. In this case, it puts a 1 into cell A1 on Sheet1 of the active workbook:

```
Worksheets("Sheet1").Range("A1").Value = 1
```

The Range property also recognizes defined names in workbooks. Therefore, if a cell is named "Input," you can use the following statement to enter a value into that named cell:

```
Worksheets("Sheet1").Range("Input").Value = 1
```

The example that follows enters the same value into a range of 20 cells on the active sheet. If the active sheet is not a worksheet, this causes an error message:

```
ActiveSheet.Range("A1:B10").Value = 2
```

The next example produces exactly the same result as the preceding example:

```
Range("A1", "B10") = 2
```

The sheet reference is omitted, however, so the active sheet is assumed. Also, the value property is omitted, so the default property (which is Value, for a Range object) is assumed. This example also uses the second syntax of the Range property. With this syntax, the first argument is the cell at the top left of the range and the second argument is the cell at the lower right of the range.

The following example uses Excel's range intersection operator (a space) to return the intersection of two ranges. In this case, the intersection is a single cell, C6. Therefore, this statement enters 3 into cell C6:

```
Range("C1:C10 A6:E6") = 3
```

And finally, this next example enters the value 4 into five cells, that is, a noncontiguous range. The comma serves as the union operator:

```
Range("A1,A3,A5,A7,A9") = 4
```

So far, all the examples have used the `Range` property on a `Worksheet` object. As I mentioned, you can also use the `Range` property on a `Range` object. This can be rather confusing, but bear with me.

Following is an example of using the `Range` property on a `Range` object (in this case, the `Range` object is the active cell). This example treats the `Range` object as if it were the upper-left cell in the worksheet, and then enters a value of 5 into the cell that *would be* B2. In other words, the reference returned is relative to the upper-left corner of the `Range` object. Therefore, the statement that follows enters a value of 5 into the cell directly to the right and one row below the active cell:

```
ActiveCell.Range("B2") = 5
```

I said this is confusing. Fortunately, there is a much clearer way to access a cell relative to a range, called the `Offset` property. I'll discuss this property after the next section.

The Cells property

Another way to reference a range is to use the `Cells` property. Like the `Range` property, you can use the `Cells` property on `Worksheet` objects and `Range` objects. Check the online help, and you'll see that the `Cells` property has three syntaxes:

```
object.Cells(rowIndex, columnIndex)  
object.Cells(rowIndex)  
object.Cells
```

I'll give you some examples that demonstrate how to use the `Cells` property. The first example enters the value 9 into cell 1 on Sheet1. In this case, I'm using the first syntax, which accepts the index number of the row (from 1 to 65536) and the index number of the column (from 1 to 256):

```
Worksheets("Sheet1").Cells(1, 1) = 9
```

Here's an example that enters the value 7 into cell D3 (that is, row 3, column 4) in the active worksheet:

```
ActiveSheet.Cells(3, 4) = 7
```

You can also use the `Cells` property on a `Range` object. When you do so, the `Range` object returned by the `Cells` property is relative to the upper-left cell of the referenced `Range`. Confusing? Probably. An example might help clear this up. The following instruction enters the value 5 into the active cell. Remember, in this case, the active cell is treated as if it were cell A1 in the worksheet:

```
ActiveCell.Cells(1, 1) = 5
```

Note

The real advantage of this type of cell referencing will be apparent when I discuss variables and looping (see Chapter 8). In most cases, you will not use actual values for the arguments. Rather, you'll use variables.

To enter a value of 5 into the cell directly below the active cell, you can use the following instruction:

```
ActiveCell.Cells(2, 1) = 5
```

Think of the preceding example as though it said this: “Start with the active cell and consider this cell as cell A1. Return the cell in the second row and the first column.”

The second syntax of the `Cells` method uses a single argument that can range from 1 to 16,777,216. This number is equal to the number of cells in a worksheet (65,536 rows × 256 columns). The cells are numbered starting from A1 and continuing right and then down to the next row. The 256th cell is IV1, the 257th is A2.

The next example enters the value 2 into cell H3 (which is the 520th cell in the worksheet) of the active worksheet:

```
ActiveSheet.Cells(520) = 2
```

To display the value in the last cell in a worksheet (IV65536), use this statement:

```
MsgBox ActiveSheet.Cells(16777216)
```

This syntax can also be used with a `Range` object. In this case, the cell returned is relative to the `Range` object referenced. For example, if the `Range` object is A1:D10 (40 cells), the `Cells` property can have an argument from 1 to 40 and return one of the cells in the `Range` object. In the following example, a value of 2000 is entered into cell A2 because A2 is the fifth cell (counting from the top and to the right, then down) in the referenced range:

```
Range("A1:D10").Cells(5) = 2000
```

Note

In the preceding example, the argument for the `Cells` property is not limited to values between 1 and 40. If the argument exceeds the number of cells in the range, the counting continues as if the range were larger than it actually is. Therefore, a statement like the preceding one could change the value in a cell that's outside of the range A1:D10.

The third syntax for the `Cells` property simply returns all cells on the referenced worksheet. Unlike the other two syntaxes, in this one, the return data is not a single cell. This example uses the `ClearContents` method on the range returned by using the `Cells` property on the active worksheet. The result is that the contents of every cell on the worksheet are cleared:

```
ActiveSheet.Cells.ClearContents
```

The Offset property

The `Offset` property (like the `Range` and `Cells` properties) also returns a `Range` object. But unlike the other two methods I discussed, the `Offset` property applies only to a `Range` object and no other class. Its syntax is as follows:

```
object.Offset(rowOffset, columnOffset)
```

The `Offset` property takes two arguments that correspond to the relative position from the upper-left cell of the specified `Range` object. The arguments can be positive (down or right), negative (up or left), or zero. The example that follows enters a value of 12 into the cell directly below the active cell:

```
ActiveCell.Offset(1,0).Value = 12
```

The next example enters a value of 15 into the cell directly above the active cell:

```
ActiveCell.Offset(-1,0).Value = 15
```

By the way, if the active cell is in row 1, the `Offset` property in the preceding example generates an error, because it cannot return a `Range` object that doesn't exist.

The `Offset` property is quite useful, especially when you use variables within looping procedures. I discuss these topics in the next chapter.

When you record a macro using the relative reference mode, Excel uses the `Offset` property to reference cells relative to the starting position (that is, the active cell when macro recording begins). For example, I used the macro recorder to generate the following code. I started with the cell pointer in cell B1, entered values into B1:B3, and then returned to B1.

```
Sub Macro1()  
    ActiveCell.FormulaR1C1 = "1"  
    ActiveCell.Offset(1, 0).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "2"  
    ActiveCell.Offset(1, 0).Range("A1").Select  
    ActiveCell.FormulaR1C1 = "3"  
    ActiveCell.Offset(-2, 0).Range("A1").Select  
End Sub
```

Notice that the macro recorder uses the `FormulaR1C1` property. Normally, you'll want to use the `Value` property to enter a value into a cell. However using `FormulaR1C1` or even `Formula` produces the same result.

Also notice that the generated code references cell A1, which may seem a bit odd, because that cell was not even involved in the macro. This is a quirk in the macro recording procedure that makes the code more complex than necessary. You can delete all references to `Range("A1")` and the macro still works perfectly:

```
Sub Modified Macro1()  
    ActiveCell.FormulaR1C1 = "1"  
    ActiveCell.Offset(1, 0).Select  
    ActiveCell.FormulaR1C1 = "2"  
    ActiveCell.Offset(1, 0).Select  
    ActiveCell.FormulaR1C1 = "3"  
    ActiveCell.Offset(-2, 0).Select  
End Sub
```

In fact, here's a much more efficient version of the macro (which I wrote myself) that doesn't do any selecting:

```
Sub Macro1()  
    ActiveCell = 1  
    ActiveCell.Offset(1, 0) = 2  
    ActiveCell.Offset(2, 0) = 3  
End Sub
```

Things to Know about Objects

The preceding sections introduced you to objects (including collections), properties, and methods. But I've barely scratched the surface.

Esoteric but essential concepts to remember

In this section, I'll add some more concepts that are essential for would-be VBA gurus. These concepts become clearer as you work with VBA and read subsequent chapters:

- ♦ Objects have unique properties and methods.

Each object has its own set of properties and methods. Some objects, however, share some properties (for example, `Name`) and some methods (such as `Delete`).

- ♦ You can manipulate objects without selecting them.

This may be contrary to how you normally think about manipulating objects in Excel, especially if you've programmed XLM macros. Fact is, it's usually more efficient to perform actions on objects without selecting them first. When you record a macro, Excel generally selects the object first. This is not necessary and may actually make your macro run slower.

- ♦ It's important that you understand the concept of collections.

Most of the time, you'll refer to an object indirectly by referring to the collection that it's in. For example, to access a `Workbook` object named `Myfile`, reference the `Workbooks` collection as follows:

```
Workbooks("Myfile.xls")
```

This reference returns an object, which is the workbook with which you are concerned.

- ♦ Properties can return a reference to another object. For example, in the following statement, the `Font` property returns a `Font` object contained in a `Range` object:

```
Range("A1").Font.Bold = True
```

- ♦ There can be many different ways to refer to the same object.

Assume that you have a workbook named `Sales`, and it's the only workbook open. Then assume that this workbook has one worksheet, named `Summary`. You can refer to the sheet in any of the following ways:

```
Workbooks("Sales.xls").Worksheets("Summary")  
Workbooks(1).Worksheets(1)  
Workbooks(1).Sheets(1)  
Application.ActiveWorkbook.ActiveSheet  
ActiveWorkbook.ActiveSheet  
ActiveSheet
```

The method you use is usually determined by how much you know about the workspace. For example, if there is more than one workbook open, the second or third method is not reliable. If you want to work with the active sheet (whatever it may be), any of the last three methods would work. To be absolutely sure that you're referring to a specific sheet on a specific workbook, the first method is your best choice.

Learn more about objects and properties

If this is your first exposure to VBA, you're probably a bit overwhelmed about objects, properties, and methods. I don't blame you. If you try to access a property that an object doesn't have, you'll get a runtime error, and your VBA code will grind to a screeching halt until you correct the problem.

Fortunately, there are several good ways to learn about objects, properties, and methods.

Read the rest of the book

Don't forget, the name of this chapter is "Introducing Visual Basic for Applications." The remainder of this book covers a lot of additional details and provides many useful and informative examples.

Record your actions

The absolute best way to become familiar with VBA, without question, is to simply turn on the macro recorder and record some actions you make in Excel. This is a quick way to learn the relevant objects, properties, and methods for a task. It's even better if the VBA module in which the code is being recorded is visible while you're recording.

Use the online help system

The main source of detailed information about Excel's objects, methods, and procedures is the online help system.

Figure 7-16 shows the help topic for the `Value` property. This particular property applies to a number of different objects, and the help topic contains hyperlinks labeled See Also, Applies To, and Example. If you click See Also, you get a list of related topics (if any). Clicking Applies To displays a window that lists all objects that use this property. If you click Example, you'll be able to view one or more examples (you can copy the example text and paste it into a VBA module to try it out).

Use the Object Browser

The Object Browser is a handy tool that lists every property and method for every object available. When the VBE is active, you can bring up the Object Browser in any of the following three ways:

- ♦ Press F2.
- ♦ Choose the View ⇄ Object Browser command from the menu.
- ♦ Click the Object Browser tool on the Standard toolbar.

The Object Browser is shown in Figure 7-17.

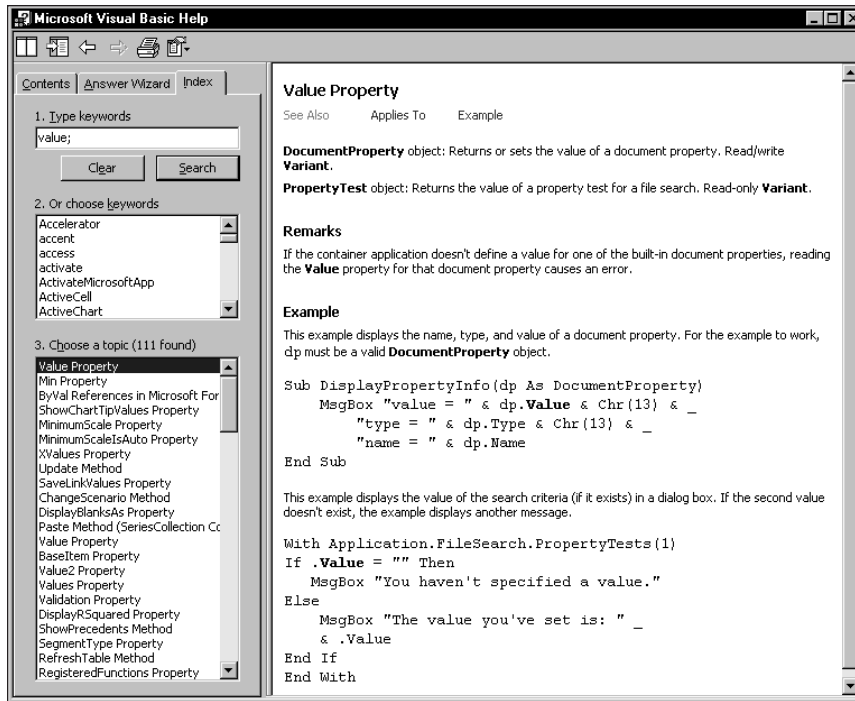


Figure 7-16: A typical VBA help screen

The drop-down list in the upper-left corner of the Object Browser includes a list of all object libraries that you have access to:

- ♦ Excel itself
- ♦ MSForms (used to create custom dialog boxes)
- ♦ Office (objects common to all Microsoft Office applications)
- ♦ Stdole (OLE automation objects)
- ♦ VBA
- ♦ Each open workbook (each workbook is considered an object library because it contains objects)

Your selection in this upper-left drop-down list determines what is displayed in the Classes window, and your selection in the Classes window determines what is visible in the Members of window.

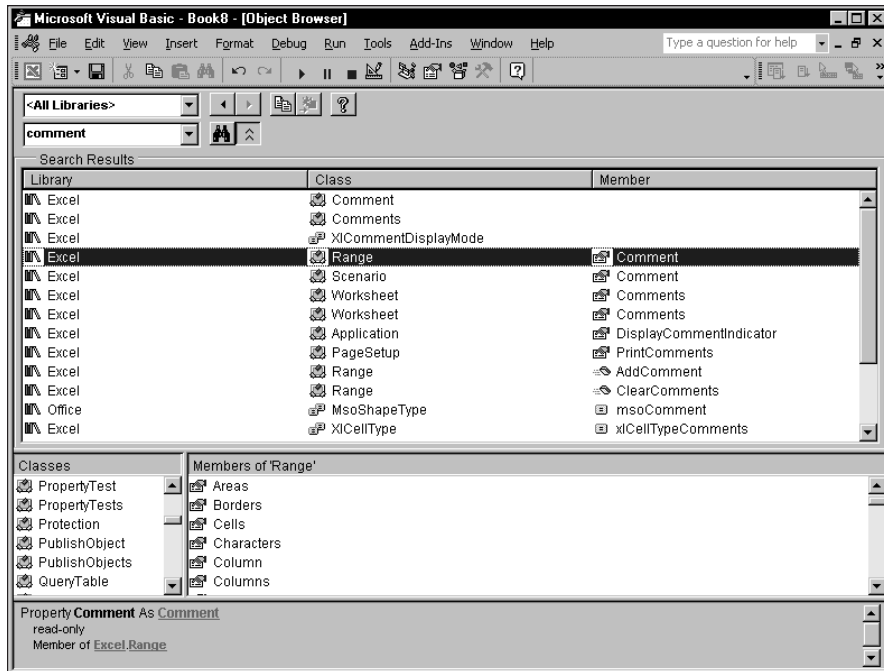


Figure 7-17: The Object Browser is a great reference source.

Once you select a library, you can search for a particular text string to get a list of properties and methods that contain the text. You do so by entering the text in the second drop-down list and then clicking the binoculars icon. For example, assume that you're working on a project that manipulates cell comments:

1. Select the library of interest. If you're not sure which object library is appropriate, you can select <All Libraries>).
2. Enter **Comment** in the drop-down list below the library list.
3. Click the binoculars icon to begin the text search.

The Search Results window displays the matching text. Select an object to display its classes in the Classes window. Select a class to display its members (properties, methods, and constants). Pay attention to the bottom pane, which shows more information about the object. You can press F1 to go directly to the appropriate help topic.

The Object Browser may seem complex at first, but its usefulness to you will increase over time.

Experiment with the Immediate window

As I described in the sidebar earlier in this chapter (see “About the Code Examples”), the Immediate window of the VBE is very useful for testing statements and trying out various VBA expressions. I generally keep the Immediate window visible at all times, and I use it frequently to test various expressions and to help in debugging code.

Summary

In this chapter, I introduced VBA and discussed how VBA compares to other languages. I explained that a VBA module contains procedures and that VBA is based on objects, properties, and methods. I also explained how to use the macro recorder to translate your actions into VBA code.

Chapter 8 discusses programming concepts that are necessary to get the most out of VBA.



VBA Programming Fundamentals

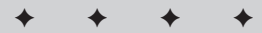
In the preceding chapter, I introduced you to VBA; now it's time to get better acquainted. This chapter discusses some of the key language elements and programming concepts in VBA. If you've used other programming languages, much of this information may sound familiar. VBA has a few unique wrinkles, however, so even experienced programmers may find some new information.

VBA Language Elements: An Overview

In Chapter 7, I presented an overview of objects, properties, and methods. But I didn't tell you much about how to manipulate objects so that they do meaningful things. This chapter gently nudges you in that direction by exploring VBA's *language elements*, the keywords and control structures that you use to write VBA routines.

To get the ball rolling, I'll start by presenting a simple procedure. The following procedure is stored in a VBA module, and calculates the sum of the first 100 integers. When done, the procedure displays a message with the result.

```
Sub VBA_Demo()  
' This is a simple VBA Example  
Dim Total As Integer, i As Integer  
Total = 0  
For i = 1 To 100  
    Total = Total + i  
Next i  
MsgBox Total
```



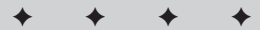
In This Chapter

Understanding VBA's language elements, including variables, data types, constants, and arrays

Using VBA's built-in functions

Manipulating objects and collections

Controlling the execution of your procedures



End Sub This procedure uses some common language elements, including a comment (the line preceded by the apostrophe), a variable (`Total`), two assignment statements (`Total = 0` and `Total = Total + i`), a looping structure (`For-Next`), and a VBA statement (`MsgBox`). All these are discussed in subsequent sections of this chapter.

Note

VBA procedures need not manipulate any objects. The preceding procedure, for example, doesn't do anything with objects. It simply works with numbers.

Comments

A *comment* is descriptive text embedded within your code. The text of a comment is completely ignored by VBA. It's a good idea to use comments liberally to describe what you're doing (an instruction's purpose is not always obvious).

You can use a complete line for your comment, or you can insert a comment *after* an instruction on the same line. A comment is indicated by an apostrophe. VBA ignores any text that follows an apostrophe—except when the apostrophe is contained within quotation marks—up until the end of the line. For example, the following statement does not contain a comment, even though it has an apostrophe:

```
Msg = "Can't continue"
```

The following example shows a VBA procedure with three comments:

```
Sub Comments()  
' This procedure does nothing of value  
  x = 0 'x represents nothingness  
' Display the result  
  MsgBox x  
End Sub
```

Although the apostrophe is the preferred comment indicator, you can also use the `Rem` keyword to mark a line as a comment. For example,

```
Rem -- The next statement prompts the user for a filename
```

The `Rem` keyword is essentially a holdover from old versions of BASIC; it is included in VBA for the sake of compatibility. Unlike the apostrophe, `Rem` can be written only at the beginning of a line, not on the same line as another instruction.

Using comments is definitely a good idea, but not all comments are equally beneficial. To be useful, comments should convey information that's not immediately obvious from reading the code. Otherwise, you're just chewing up valuable bytes. The following procedure, for example, contains many comments, none of which really adds anything of value:

```
Sub BadComments()
```

Entering VBA Code

VBA code, which resides in a VBA module, consists of instructions. The accepted practice is to use one instruction per line. This standard is not a requirement, however; you can use a colon to separate multiple instructions on a single line. The following example combines four instructions on one line:

```
Sub OneLine()
    x= 1: y= 2: z= 3: MsgBox x + y + z
End Sub
```

Most programmers agree that code is easier to read if you use one instruction per line:

```
Sub OneLine()
    x = 1
    y = 2
    z = 3
    MsgBox x + y + z
End Sub
```

Each line can be as long as you like; the VBA module window scrolls to the left when you reach the right side. For lengthy lines, you may want to use VBA's line continuation sequence: an underscore (`_`) preceded by a space. For example,

```
Sub LongLine()
    SummedValue = _
        Worksheets("Sheet1").Range("A1").Value + _
        Worksheets("Sheet2").Range("A1").Value
End Sub
```

When you record macros, Excel often uses underscores to break long statements into multiple lines.

After you enter an instruction, VBA performs the following actions to improve readability:

- ♦ It inserts spaces between operators. If you enter `Ans=1+2` (without spaces), for example, VBA converts it to

```
Ans = 1 + 2
```

- ♦ VBA adjusts the case of the letters for keywords, properties, and methods. If you enter the following text

```
Result=activesheet.range("a1").value=12
```

VBA converts it to

```
Result = ActiveSheet.Range("a1").Value = 12
```

Notice that text within quotation marks (in this case, "a1") is not changed.

Continued

Continued

- ♦ Because VBA variable names are not case sensitive, the interpreter by default adjusts the names of all variables with the same letters so that their case matches the case of letters that you most recently typed. For example, if you first specify a variable as `myvalue` (all lowercase) and then enter the variable as `MyValue` (mixed case), VBA changes all other occurrences of the variable to `MyValue`. An exception occurs if you declare the variable with `Dim` or a similar statement; in this case, the variable name always appears as it was declared.
- ♦ VBA scans the instruction for syntax errors. If VBA finds an error, it changes the color of the line and may display a message describing the problem. Use the VBE's Tools ⇨ Options command to display the Options dialog box, where you control the error color (use the Editor Format tab) and whether the error message is displayed (use the Auto Syntax Check option in the Editor tab).

```
' Declare variables
Dim x As Integer
Dim y As Integer
Dim z As Integer
' Start the routine
x = 100 ' Assign 100 to x
y = 200 ' Assign 200 to y
' Add x and y and store in z
z = x + y
' Show the result
MsgBox z
End Sub
```

Following are a few general tips on making the best use of comments:

- ♦ Use comments to describe briefly the purpose of each procedure you write.
- ♦ Use comments to describe changes you make to a procedure.
- ♦ Use comments to indicate that you're using functions or constructs in an unusual or nonstandard manner.
- ♦ Use comments to describe the purpose of variables so that you and other people can decipher otherwise cryptic names.
- ♦ Use comments to describe workarounds that you develop to overcome Excel bugs.
- ♦ Write comments *as* you code rather than after.

**Tip**

You may want to test a procedure without including a particular instruction or group of instructions. Instead of deleting the instruction, simply turn it into a comment by inserting an apostrophe at the beginning. VBA then ignores the instruction(s) when the routine is executed. To convert the comment back to an instruction, delete the apostrophe.

VBE's Edit toolbar contains two very useful buttons. Select a group of instructions and then use the Comment Block button to convert the instructions to comments. The Uncomment Block button converts a group of comments back to instructions. These buttons are very useful, so you may want to copy them to your Standard toolbar.

Variables, Data Types, and Constants

VBA's main purpose in life is to manipulate data. Some data resides in objects, such as worksheet ranges. Other data is stored in variables that you create.

A *variable* is simply a named storage location in your computer's memory. Variables can accommodate a wide variety of *data types* — from simple Boolean values (True or False) to large, double-precision values (see the following section). You assign a value to a variable by using the equals sign operator (more about this later).

You'll make your life easier if you get into the habit of making your variable names as descriptive as possible. VBA does, however, have a few rules regarding variable names:

- ♦ You can use alphabetic characters, numbers, and some punctuation characters, but the first character must be alphabetic.
- ♦ VBA does not distinguish between case. To make variable names more readable, programmers often use mixed case (for example, `InterestRate` rather than `interestrate`).
- ♦ You cannot use spaces or periods. To make variable names more readable, programmers often use the underscore character (`Interest_Rate`).
- ♦ Special type declaration characters (`#`, `$`, `%`, `&`, or `!`) cannot be embedded in a variable name.
- ♦ Variable names may comprise as many as 254 characters — but no one in his right mind would create a variable name that long!

The following list contains some examples of assignment expressions that use various types of variables. The variable names are to the left of the equals sign. Each statement assigns the value to the right of the equal sign to the variable on the left.

```
x = 1
InterestRate = 0.075
LoanPayoffAmount = 243089
DataEntered = False
x = x + 1
MyNum = YourNum * 1.25
UserName = "Bob Johnson"
```

```
DateStarted = #3/14/98#
```

VBA has many *reserved words*, which are words that you cannot use for variable or procedure names. If you attempt to use one of these words, you get an error message. For example, although the reserved word `Next` might make a very descriptive variable name, the following instruction generates a syntax error:

```
Next = 132
```

Unfortunately, syntax error messages aren't always very descriptive. The preceding instruction generates this error message: `Compile error: Expected variable.` It would be nice if the error message were something like `Reserved word used as a variable.` So if an instruction produces a strange error message, check the online help to make sure your variable name doesn't have a special use in VBA.

Defining data types

VBA makes life easy for programmers because it can automatically handle all the details involved in dealing with data. Not all programming languages make it so easy. For example, some languages are *strictly typed*, which means that the programmer must explicitly define the data type for every variable used.

Data type refers to how data is stored in memory — as integers, real numbers, strings, and so on. Although VBA can take care of data typing automatically, it does so at a cost: slower execution and less efficient use of memory. (There's no such thing as a free lunch.) As a result, letting VBA handle data typing may present problems when you're running large or complex applications. If you need to conserve every last byte of memory, you need to be on familiar terms with data types. Another advantage to explicitly declaring your variables as a particular data type is that VBA can perform some additional error checking at the compile stage. These errors might otherwise be difficult to locate.

Table 8-1 lists VBA's assortment of built-in data types (note that you can also define custom data types, which I describe later in this chapter).

Table 8-1
VBA's Built-in Data Types

<i>Data Type</i>	<i>Bytes Used</i>	<i>Range of Values</i>
Byte	1 byte	0 to 255
Boolean	2 bytes	True or False
Integer	2 bytes	-32,768 to 32,767

Data Type	Bytes Used	Range of Values
Long	4 bytes	-2,147,483,648 to 2,147,483,647
Single	4 bytes	-3.402823E38 to -1.401298E-45 (for negative values); 1.401298E-45 to 3.402823E38 (for positive values)
Double	8 bytes	-1.79769313486232E308 to -4.94065645841247E-324 (negative values); 4.94065645841247E-324 to 1.79769313486232E308 (positive values)
Currency	8 bytes	-922,337,203,685,477.5808 to 922,337,203,685,477.5807
Decimal	14 bytes	+/-79,228,162,514,264,337,593,543,950,335 with no decimal point; +/-7.9228162514264337593543950335 with 28 places to the right of the decimal
Date	8 bytes	January 1, 0100 to December 31, 9999
Object	4 bytes	Any object reference
String (variable-length)	10 bytes + string length	0 to approximately 2 billion
String (fixed-length)	Length of string	1 to approximately 65,400
Variant (with numbers)	16 bytes	Any numeric value up to the range of a double data type
Variant (with characters)	22 bytes + string length	0 to approximately 2 billion
User-defined	Varies	Varies by element

Note

The Decimal data type was introduced in Excel 2000, and cannot be used in previous versions. This is a rather unusual data type because you cannot actually declare it. In fact, it is a “subtype” of a variant. You need to use VBA’s `CDec` function to convert a variant to the decimal data type.

Generally, it’s best to use the data type that uses the smallest number of bytes yet still can handle all the data assigned to it. When VBA works with data, execution speed is a function of the number of bytes VBA has at its disposal. In other words, the fewer bytes used by data, the faster VBA can access and manipulate the data.

For worksheet calculation, Excel uses the Double data type, so that’s a good choice for processing numbers in VBA when you don’t want to lose any precision. For integer calculations, you can use the Integer type if you’re sure that the values will not

exceed 32,767. Otherwise, use the Long data type. When dealing with Excel worksheet row numbers, you'll want to use the Long data type because the number of rows in a worksheet exceed the maximum value for the Integer data type.

Declaring variables

If you don't declare the data type for a variable that you use in a VBA routine, VBA uses the default data type, variant. Data stored as a variant acts like a chameleon: It changes type, depending on what you do with it. The following procedure demonstrates how a variable can assume different data types:

```
Sub VariantDemo()  
    MyVar = "123"  
    MyVar = MyVar / 2  
    MyVar = "Answer: " & MyVar  
    MsgBox MyVar  
End Sub
```

In the `VariantDemo` procedure, `MyVar` starts out as a three-character string. Then this “string” is divided by two and becomes a numeric data type. Next, `MyVar` is appended to a string, converting `MyVar` back to a string. The `MsgBox` statement displays the final string: *Answer: 61.5*.

To further demonstrate the potential problems in dealing with variant data types, try executing this procedure:

```
Sub VariantDemo2()  
    MyVar = "123"  
    MyVar = MyVar + MyVar  
    MyVar = "Answer: " & MyVar  
    MsgBox MyVar  
End Sub
```

The message box will display: *Answer: 123123*. This is probably *not* what you wanted. When dealing with variants that contain text string, the `+` operator performs string concatenation.

Determining a data type

You can use VBA's `TypeName` function to determine the data type of a variable. Here's a modified version of the previous procedure. This version displays the data type of `MyVar` at each step. You'll see that it starts out as a string, then is converted to a double, and finally ends up as a string again.

```
Sub VariantDemo2()  
    MyVar = "123"  
    MsgBox TypeName(MyVar)  
    MyVar = MyVar / 2  
    MsgBox TypeName(MyVar)
```

Benchmarking Variant Data Types

To test whether data-typing is important, I developed the following routine, which performs some meaningless calculations in a loop and then displays the procedure's total execution time:

```
Sub TimeTest()
    Dim x As Integer, y As Integer
    Dim A As Integer, B As Integer, C As Integer
    Dim i As Integer, j As Integer
    Dim StartTime As Date, EndTime As Date
    ' Store the starting time
    StartTime = Timer
    ' Perform some calculations
    x = 0
    y = 0
    For i = 1 To 5000
        For j = 1 To 1000
            A = x + y + i
            B = y - x - i
            C = x - y - i
        Next j
    Next i
    ' Get ending time
    EndTime = Timer
    ' Display total time in seconds
    MsgBox Format(EndTime - StartTime, "0.0")
End Sub
```

On my system, this routine took 4.0 seconds to run (the time will vary, depending on your system's processor speed). I then *commented out* the `Dim` statements, which declare the data types. That is, I turned the `Dim` statements into comments by adding an apostrophe at the beginning of the lines. As a result, VBA used the default data type, variant. I ran the procedure again. It took 8.3 seconds, more than twice as long as before.

The moral is simple: If you want your VBA applications to run as fast as possible, declare your variables!

```
MyVar = "Answer: " & MyVar
MsgBox TypeName(MyVar)
MsgBox MyVar
End Sub
```

Thanks to VBA, the data type conversion of undeclared variables is automatic. This process may seem like an easy way out, but remember that you sacrifice speed and memory.

It's an excellent habit to declare each variable in a procedure before you use it. Declaring a variable tells VBA its name and data type. Declaring variables provides two main benefits:

- ♦ *Your programs run faster and use memory more efficiently.* The default data type, variant, causes VBA to repeatedly perform time-consuming checks and reserve more memory than necessary. If VBA knows the data type, it doesn't have to investigate, and it can reserve just enough memory to store the data.
- ♦ *You avoid problems involving misspelled variable names.* This assumes that you use `Option Explicit` to force yourself to declare all variables (see the next section). Say that you use an undeclared variable named `CurrentRate`. At some point in your routine, however, you insert the statement `CurrentRate = .075`. This misspelled variable name, which is very difficult to spot, will likely cause your routine to give incorrect results.

Forcing yourself to declare all variables

To force yourself to declare all the variables that you use, include the following as the first instruction in your VBA module:

```
Option Explicit
```

This statement causes your program to stop whenever VBA encounters a variable name that has not been declared. VBA issues an error message, and you must declare the variable before you can proceed.



Tip

To ensure that the `Option Explicit` statement is automatically inserted whenever you insert a new VBA module, enable the **Require Variable Declaration** option in the **Editor** tab of the VBE's **Options** dialog box. I highly recommend doing so.

Scoping variables

A variable's *scope* determines which modules and procedures the variable can be used in. A variable's scope can be any of the following:

<i>Scope</i>	<i>How a Variable with this Scope Is Declared</i>
Single procedure	Include a <code>Dim</code> or <code>Static</code> statement within the procedure.
Single module	Include a <code>Dim</code> or <code>Private</code> statement before the first procedure in a module.
All modules	Include a <code>Public</code> statement before the first procedure in a module.

I discuss each scope further in the following sections.

A Note about the Examples in This Chapter

This chapter contains many examples of VBA code, usually presented in the form of simple procedures. These examples demonstrate various concepts as simply as possible. Most of these examples do not perform any particularly useful task; in fact, the task can often be performed in a different way. In other words, don't use these examples in your own work. Subsequent chapters provide many more code examples that *are* useful.

Local variables

A *local variable* is a variable declared within a procedure. Local variables can be used only in the procedure in which they are declared. When the procedure ends, the variable no longer exists, and Excel frees up its memory.

**Note**

If you need the variable to retain its value, declare it as a `Static` variable (see "Static variables" later in this section).

The most common way to declare a local variable is to place a `Dim` statement between a `Sub` statement and an `End Sub` statement. `Dim` statements usually are placed right after the `Sub` statement, before the procedure's code.

If you're curious about this word, `Dim` is a shortened form of *Dimension*. In old versions of BASIC, this statement was used exclusively to declare the dimensions for an array. In VBA, the `Dim` keyword is used to declare any variable, not just arrays.

The following procedure uses six local variables declared using `Dim` statements:

```
Sub MySub()  
    Dim x As Integer  
    Dim First As Long  
    Dim InterestRate As Single  
    Dim TodaysDate As Date  
    Dim UserName As String * 20  
    Dim MyValue  
    ' - [The procedure's code goes here] -  
End Sub
```

Notice that the last `Dim` statement in the preceding example doesn't declare a data type; it simply names the variable. As a result, that variable becomes a variant.

By the way, you also can declare several variables with a single `Dim` statement. For example,

```
Dim x As Integer, y As Integer, z As Integer  
Dim First As Long, Last As Double
```

Another Way of Data-Typing Variables

Like most other dialects of BASIC, VBA lets you append a character to a variable's name to indicate the data type. For example, you can declare the `MyVar` variable as an integer by tacking `%` onto the name:

```
Dim MyVar%
```

Type-declaration characters exist for most of VBA's data types (data types not listed don't have type-declaration characters).

<i>Data Type</i>	<i>Type-Declaration Character</i>
Integer	%
Long	&
Single	!
Double	#
Currency	@
String	\$

This method of data typing is essentially a holdover from BASIC; it's better to declare your variables using the techniques described in this chapter.



Caution

Unlike some languages, VBA does not let you declare a group of variables to be a particular data type by separating the variables with commas. For example, the following statement, although valid, does *not* declare all the variables as integers:

```
Dim i, j, k As Integer
```

In VBA, only `k` is declared to be an integer; the other variables are declared variants. To declare `i`, `j`, and `k` as integers, use this statement:

```
Dim i As Integer, j As Integer, k As Integer
```

If a variable is declared with a local scope, other procedures in the same module can use the same variable name, but each instance of the variable is unique to its own procedure.

In general, local variables are the most efficient because VBA frees up the memory they use when the procedure ends.

Modulewide variables

Sometimes, you'll want a variable to be available to all procedures in a module. If so, just declare the variable *before* the module's first procedure (outside of any procedures or functions).

In the following example, the `Dim` statement is the first instruction in the module. Both `MySub` and `YourSub` have access to the `CurrentValue` variable.

```
Dim CurrentValue as Integer

Sub MySub()
'   - [Code goes here] -
End Sub

Sub YourSub()
'   - [Code goes here] -
End Sub
```

The value of a modulewide variable does not change when a procedure ends.

Public variables

To make a variable available to all the procedures in all the VBA modules in a project, declare the variable at the module level by using the `Public` keyword rather than `Dim`. Here's an example:

```
Public CurrentRate as Long
```

The `Public` keyword makes the `CurrentRate` variable available to any procedure in the project, even those in other modules within the project. You must insert this statement before the first procedure in a module. This type of declaration must also appear in a standard VBA module, not in a code module for a sheet or a UserForm.

Static variables

Static variables are a special case. They are declared at the procedure level, and they retain their value when the procedure ends.

You declare static variables using the `Static` keyword:

```
Sub MySub()
    Static Counter as Integer
    - [Code goes here] -
End Sub
```

Working with constants

A variable's value may, and often does, change while a procedure is executing (that's why it's called a variable). Sometimes, you need to refer to a named value or string that never changes: a *constant*.

Declaring constants

You declare constants using the `Const` statement. Here are some examples:

```
Const NumQuarters as Integer = 4
Const Rate = .0725, Period = 12
Const ModName as String = "Budget Macros"
Public Const AppName as String = "Budget Application"
```

The second example doesn't declare a data type. Consequently, the two constants are variants. Because a constant never changes its value, you'll normally want to declare your constants as a specific data type.

Like variables, constants also have a scope. If you want a constant to be available within a single procedure only, declare it after the `Sub` or `Function` statement to make it a local constant. To make a constant available to all procedures in a module, declare it before the first procedure in the module. To make a constant available to all modules in the workbook, use the `Public` keyword, and declare the constant before the first procedure in a module. For example:

```
Public Const InterestRate As Double = 0.0725
```

**Note**

If you attempt to change the value of a constant in a VBA procedure, you get an error—which is what you would expect. A constant is a constant, not a variable.

Using constants throughout your code in place of hard-coded values or strings is an excellent programming practice. For example, if your procedure needs to refer to a specific value, such as an interest rate, several times, it's better to declare the value as a constant and use the constant's name rather than its value in your expressions. This technique not only makes your code more readable, it also makes it easier to change should the need arise—you have to change only one instruction rather than several.

Using predefined constants

Excel and VBA provide many predefined constants, which you can use without declaring. In fact, you don't even need to know the value of these constants to use them. The macro recorder generally uses constants rather than actual values. The following procedure uses a built-in constant (`x1Landscape`) to set the page orientation to landscape for the active sheet:

```
Sub SetToLandscape()
    ActiveSheet.PageSetup.Orientation = x1Landscape
End Sub
```


Variable Naming Conventions

Some programmers name variables so that their data types can be identified just by looking at their names. Personally, I usually don't use this technique because I think it makes the code more difficult to read. But you might find it helpful.

The naming convention involves using a standard lowercase prefix for the variable's name. For example, if you have a Boolean variable that tracks whether a workbook has been saved, you might name the variable `bWasSaved`. That way, it is clear that the variable is a Boolean variable. The following table lists some standard prefixes for data types:

<i>Data Type</i>	<i>Prefix</i>
Boolean	b
Integer	i
Long	l
Single	s
Double	d
Currency	c
Date/Time	dt
String	str
Object	obj
Variant	v
User-defined	u

I discovered the `xlLandscape` constant by recording a macro. I also could have found this information in the online help. And, if you have the `AutoList Members` option turned on, you can often get some assistance as you enter your code. In many cases, VBA lists all the constants that can be assigned to a property.

The actual value for `xlLandscape` is 2. The other built-in constant for changing paper orientation is `xlPortrait`, which has a value of 1. Obviously, if you use the built-in constants, there is really no need to know their values.

**Note**

The Object Browser, which I discuss in Chapter 7, contains a list of all Excel and VBA constants. In the VBE, press F2 to bring up the Object Browser.

Working with strings

Like Excel, VBA can manipulate both numbers and text (strings). There are two types of strings in VBA:

- ♦ *Fixed-length strings* are declared with a specified number of characters. The maximum length is 65,535 characters.
- ♦ *Variable-length strings* theoretically can hold up to 2 billion characters.

Each character in a string requires 1 byte of storage, and a small additional amount of storage is used for the header of each string. When you declare a string variable with a `Dim` statement, you can specify the length if you know it (that is, a fixed-length string), or you can let VBA handle it dynamically (a variable-length string). Working with fixed-length strings is slightly more efficient in terms of memory usage.

In the following example, the `MyString` variable is declared to be a string with a maximum length of 50 characters. `YourString` is also declared as a string, but its length is unfixed.

```
Dim MyString As String * 50
Dim YourString As String
```

Working with dates

You can use a string variable to store a date, of course, but you can't perform date calculations on one. Using the date data type is a better way to work with dates.

A variable defined as a date uses 8 bytes of storage and can hold dates ranging from January 1, A.D. 100, to December 31, 9999. That's a span of nearly 10,000 years — more than enough for even the most aggressive financial forecast! The date data type is also useful for storing time-related data. In VBA, you specify dates and times by enclosing them between two pound signs (`#`), as shown next.

About Excel's Date Bug

It is commonly known that Excel has a date bug: It incorrectly assumes that the year 1900 is a leap year. Even though there was no February 29, 1900, Excel accepts the following formula and displays the result as the 29th day of February, 1900:

```
=Date(1900,2,29)
```

VBA does not have this date bug. The VBA equivalent of Excel's `DATE` function is `DateSerial`. The following expression (correctly) returns March 1, 1900:

```
DateSerial(1900,2,29)
```

Therefore, Excel's date serial number system does not correspond exactly to VBA's date serial number system. These two systems return different values for dates between January 1, 1900 and March 1, 1900.

Note

The range of dates that VBA can handle is much larger than Excel's own date range, which begins with January 1, 1900. Therefore, be careful that you don't attempt to use a date in a worksheet that is outside of Excel's acceptable date range.

Here are some examples of declaring variables and constants as Date data types:

```
Dim Today As Date
Dim StartTime As Date
Const FirstDay As Date = #1/1/2001#
Const Noon = #12:00:00#
```

Date constants are always defined using month/day/year format, even if your system is set up to display dates in a different format (for example, day/month/year).

If you use a message box to display a date, it will be displayed according to your system's short date format. Similarly, a time is displayed according to your system's time format (either 12- or 24-hour). You can modify these system settings by using the Regional Settings option in the Windows Control Panel.



The companion CD-ROM contains an Excel add-in that I created called Extended Data Functions. This add-in, which was created using VBA, adds new worksheet functions to Excel. These new functions enable you to create formulas that work with dates prior to January 1, 1900.

Assignment Statements

An *assignment statement* is a VBA instruction that makes a mathematical evaluation and assigns the result to a variable or an object. Excel's online help defines *expression* as

a combination of keywords, operators, variables, and constants that yields a string, number, or object. An expression can perform a calculation, manipulate characters, or test data.

I couldn't have said it better myself. Much of the work done in VBA involves developing (and debugging) expressions.

If you know how to create formulas in Excel, you'll have no trouble creating expressions in VBA. With a worksheet formula, Excel displays the result in a cell. A VBA expression, on the other hand, can be assigned to a variable or used as a property value.

VBA uses the equals sign (=) as its assignment operator. The following are examples of assignment statements (the expressions are to the right of the equals sign):

```

x = 1
x = x + 1
x = (y * 2) / (z * 2)
FileOpen = True
FileOpen = Not FileOpen
Range("TheYear").Value = 2001

```

**Tip**

Expressions can be very complex. You may want to use the continuation sequence (space followed by an underscore) to make lengthy expressions easier to read.

Often, expressions use functions. These functions can be VBA's built-in functions, Excel's worksheet functions, or custom functions that you develop in VBA. I discuss built-in VBA functions later in this chapter.

Operators play a major role in VBA. Familiar operators describe mathematical operations, including addition (+), multiplication (*), division (/), subtraction (-), exponentiation (^), and string concatenation (&). Less-familiar operators are the backslash (\), used in integer division, and the Mod operator, used in modulo arithmetic. The Mod operator returns the remainder of one number divided by another. For example, the following expression returns 2:

```
17 Mod 3
```

VBA also supports the same comparative operators used in Excel formulas: equal to (=), greater than (>), less than (<), greater than or equal to (>=), less than or equal to (<=), and not equal to (<>).

In addition, VBA provides a full set of logical operators, shown in Table 8-2. For complete details on these operators (including examples), use the VBA help system.

Table 8-2
VBA's Logical Operators

Operator	What It Does
Not	Performs a logical negation on an expression
And	Performs a logical conjunction on two expressions
Or	Performs a logical disjunction on two expressions
XoR	Performs a logical exclusion on two expressions
Eqv	Performs a logical equivalence on two expressions
Imp	Performs a logical implication on two expressions

The order of precedence for operators in VBA is exactly the same as in Excel. Of course, you can add parentheses to change the natural order of precedence.

The following instruction uses the `Not` operator to toggle the grid-line display in the active window. The `DisplayGridlines` property takes a value of either `True` or `False`. Therefore, using the `Not` operator changes `False` to `True` and `True` to `False`.

```
ActiveWindow.DisplayGridlines = _  
    Not ActiveWindow.DisplayGridlines
```

The following expression performs a logical `And` operation. The `MsgBox` statement displays `True` only when `Sheet1` is the active sheet *and* the active cell is in row 1. If either or both of these conditions are not true, the `MsgBox` statement displays `False`.

```
MsgBox ActiveSheet.Name = "Sheet1" And ActiveCell.Row = 1
```

The following expression performs a logical `Or` operation. The `MsgBox` statement displays `True` when either `Sheet1` *or* `Sheet2` is the active sheet.

```
MsgBox ActiveSheet.Name = "Sheet1" _  
    Or ActiveSheet.Name = "Sheet2"
```

Arrays

An *array* is a group of elements of the same type that have a common name; you refer to a specific element in the array using the array name and an index number. For example, you may define an array of 12 string variables so that each variable corresponds to the name of a month. If you name the array `MonthNames`, you can refer to the first element of the array as `MonthNames(0)`, the second element as `MonthNames(1)`, and so on, up to `MonthNames(11)`.

Declaring arrays

You declare an array with a `Dim` or `Public` statement, just as you declare a regular variable. You can also specify the number of elements in the array. You do so by specifying the first index number, the keyword `To`, and the last index number—all inside parentheses. For example, here's how to declare an array comprising exactly 100 integers:

```
Dim MyArray(1 To 100) As Integer
```



Tip

When you declare an array, you need specify only the upper index, in which case VBA assumes that 0 is the lower index. Therefore, the two statements that follow have the same effect:

```
Dim MyArray(0 to 100) As Integer
Dim MyArray(100) As Integer
```

In both these cases, the array consists of 101 elements.

If you would like VBA to assume that 1 is the lower index for all arrays that declare only the upper index, include the following statement before any procedures in your module:

```
Option Base 1
```

Declaring multidimensional arrays

The arrays examples in the preceding section were one-dimensional arrays. VBA arrays can have up to 60 dimensions, although it's rare to need more than 3 dimensions (a 3D array). The following statement declares a 100-integer array with two dimensions (2D):

```
Dim MyArray(1 To 10, 1 To 10) As Integer
```

You can think of the preceding array as occupying a 10×10 matrix. To refer to a specific element in a 2D array, you need to specify two index numbers. For example, here's how you can assign a value to an element in the preceding array:

```
MyArray(3, 4) = 125
```

You can think of a 3D array as a cube, but I can't tell you how to visualize the data layout of an array of more than three dimensions.

A *dynamic array* doesn't have a preset number of elements. You declare a dynamic array with a blank set of parentheses:

```
Dim MyArray() As Integer
```

Before you can use a dynamic array in your code, however, you must use the `ReDim` statement to tell VBA how many elements are in the array (or `ReDim Preserve` if you want to keep the existing values in the array). You can use the `ReDim` statement any number of times, changing the array's size as often as you need to.

Arrays crop up later in this chapter when I discuss looping.

Object Variables

An *object variable* is a variable that represents an entire object, such as a range or a worksheet. Object variables are important for two reasons:

- ♦ They can simplify your code significantly.
- ♦ They can make your code execute more quickly.

Object variables, like normal variables, are declared with the `Dim` or `Public` statement. For example, the following statement declares `InputArea` as a `Range` object:

```
Public InputArea As Range
```

To see how object variables simplify your code, examine the following procedure, which was written without using object variables:

```
Sub NoObjVar()  
    Worksheets("Sheet1").Range("A1").Value = 124  
    Worksheets("Sheet1").Range("A1").Font.Bold = True  
    Worksheets("Sheet1").Range("A1").Font.Italic = True  
End Sub
```

This routine enters a value into cell A1 of Sheet1 on the active workbook and then boldfaces and italicizes the cell's contents. That's a lot of typing. To reduce wear and tear on your fingers, you can condense the routine with an object variable:

```
Sub ObjVar()  
    Dim MyCell As Range  
    Set MyCell = Worksheets("Sheet1").Range("A1")  
    MyCell.Value = 124  
    MyCell.Font.Bold = True  
    MyCell.Font.Italic = True  
End Sub
```

After the variable `MyCell` is declared as a `Range` object, the `Set` statement assigns an object to it. Subsequent statements can then use the simpler `MyCell` reference in place of the lengthy `Worksheets("Sheet1").Range("A1")` reference.

**Tip**

After an object is assigned to a variable, VBA can access it more quickly than it can a normal lengthy reference that has to be resolved. So when speed is critical, use object variables. One way to think about this is in terms of "dot processing." Every time VBA encounters a dot, as in `Sheets(1).Range("A1")`, it takes time to resolve the reference. Using an object variable reduces the number of dots to be processed. The fewer the dots, the faster the processing time. Another way to improve the speed of your code is by using the `With-End With` construct, which also reduces the number of dots to be processed. I discuss this construct later in this chapter.

The true value of object variables will become apparent when I discuss looping later in this chapter.

User-Defined Data Types

VBA lets you create custom, or *user-defined*, data types (a concept much like Pascal records or C structures). A user-defined data type can ease your work with some types of data. For example, if your application deals with customer information, you may want to create a user-defined data type named `CustomerInfo`, as follows:

```
Type CustomerInfo
    Company As String * 25
    Contact As String * 15
    RegionCode As Integer
    Sales As Long
End Type
```

**Note**

You define custom data types at the top of your module, before any procedures.

After you create a user-defined data type, you use a `Dim` statement to declare a variable as that type. Usually, you define an array. For example,

```
Dim Customers(1 To 100) As CustomerInfo
```

Each of the 100 elements in this array consists of four components (as specified by the user-defined data type, `CustomerInfo`). You can refer to a particular component of the record as follows:

```
Customers(1).Company = "Acme Tools"
Customers(1).Contact = "Tim Robertson"
Customers(1).RegionCode = 3
Customers(1).Sales = 150677
```

You can also work with an element in the array as a whole. For example, to copy the information from `Customers(1)` to `Customers(2)`, use this instruction:

```
Customers(2) = Customers(1)
```

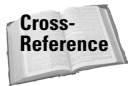
The preceding example is equivalent to the following instruction block:

```
Customers(2).Company = Customers(1).Company
Customers(2).Contact = Customers(1).Contact
Customers(2).RegionCode = Customers(1).RegionCode
Customers(2).Sales = Customers(1).Sales
```

Built-in Functions

Like most programming languages, VBA has a variety of built-in functions that simplify calculations and operations. Often, the functions enable you to perform operations that are otherwise difficult, or even impossible. Many of VBA's functions are

similar (or identical) to Excel's worksheet functions. For example, the VBA function `UCase`, which converts a string argument to uppercase, is equivalent to the Excel worksheet function `UPPER`.



Appendix B contains a complete list of VBA's functions, with a brief description of each. All are thoroughly described in the online help system.



To get a list of VBA functions while you're writing your code, type **VBA** followed by a period (.). The VBE displays a list of all of its members, including functions (see Figure 8-1). The functions are preceded by a green icon. If this technique doesn't work for you, make sure that the Auto List Members option is selected. Choose **Tools** ⇨ **Options**, and click the Editor tab.

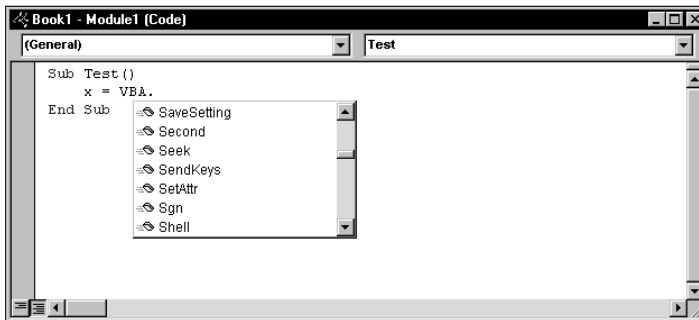


Figure 8-1: Displaying a list of VBA functions in the VBE

You use functions in VBA expressions in much the same way that you use functions in worksheet formulas. For instance, you can nest VBA functions.

Here's a simple procedure that calculates the square root of a variable using VBA's `Sqr` function, stores the result in another variable, and then displays the result:

```
Sub ShowRoot()  
    MyValue = 25  
    SquareRoot = Sqr(MyValue)  
    MsgBox SquareRoot  
End Sub
```

VBA's `Sqr` function is equivalent to Excel's `SQRT` worksheet function.

You can use many (but not all) of Excel's worksheet functions in your VBA code. The `WorksheetFunction` object, which is contained in the `Application` object, holds all the worksheet functions that you can call from your VBA procedures.

To use a worksheet function in a VBA statement, just precede the function name with

```
Application.WorksheetFunction
```

The following example demonstrates how to use an Excel worksheet function in a VBA procedure. Excel's infrequently used `ROMAN` function converts a decimal number into a Roman numeral.

```
Sub ShowRoman()  
    DecValue = 2001  
    RomanValue = Application.WorksheetFunction.Roman(DecValue)  
    MsgBox RomanValue  
End Sub
```

The MsgBox Function

The `MsgBox` function is one of the most useful VBA functions. Many of the examples in this chapter use this function to display the value of a variable.

This function often is a good substitute for a simple custom dialog box. It's also an excellent debugging tool because you can insert `MsgBox` functions at any time to pause your code and display the result of a calculation or assignment.

Most functions return a single value, which you assign to a variable. The `MsgBox` function not only returns a value, but also displays a dialog box that the user can respond to. The value returned by the `MsgBox` function represents the user's response to the dialog. You can use the `MsgBox` function even when you have no interest in the user's response but want to take advantage of the message display.

The official syntax of the `MsgBox` function has five arguments (those in square brackets are optional):

```
MsgBox(prompt[, buttons][, title][, helpfile, context])
```

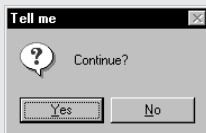
- ♦ *prompt* – (Required) The message displayed in the pop-up display.
- ♦ *buttons* – (Optional) A value that specifies which buttons and which icons, if any, appear in the message box. Use built-in constants – for example, `vbYesNo`.
- ♦ *title* – (Optional) The text that appears in the message box's title bar. The default is `Microsoft Excel`.
- ♦ *helpfile* – (Optional) The name of the help file associated with the message box.
- ♦ *context* – (Optional) The context ID of the help topic. This represents a specific help topic to display.

You can assign the value returned to a variable, or you can use the function by itself without an assignment statement. The next example assigns the result to the variable `Ans`.

```
Ans = MsgBox("Continue?", vbYesNo + vbQuestion, "Tell me")
If Ans = vbNo Then Exit Sub
```

Notice that I used the sum of two built-in constants (`vbYesNo + vbQuestion`) for the buttons argument. Using `vbYesNo` displays two buttons in the message box: one labeled Yes and one labeled No. Adding `vbQuestion` to the argument also displays a question mark icon (see the accompanying figure). When the first statement is executed, `Ans` contains one of two values, represented by the constants `vbYes` or `vbNo`. In this example, if the user clicks the No button, the procedure ends.

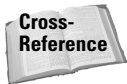
For more information, refer to the online help, which lists all the constants you can use.



When you execute this procedure, the `MsgBox` function displays the string `MMI`. Fans of old movies are often dismayed when they learn that Excel doesn't have a function to convert a Roman numeral to its decimal equivalent.

It's important to understand that you cannot use worksheet functions that have an equivalent VBA function. For example, VBA cannot access Excel's `SQRT` worksheet function because VBA has its own version of that function: `Sqr`. Therefore, the following statement generates an error:

```
MsgBox Application.WorksheetFunction.Sqrt(123) 'error
```



As I describe in Chapter 10, you can use VBA to create custom worksheet functions that work just like Excel's built-in worksheet functions.

Manipulating Objects and Collections

As an Excel programmer, you'll spend a lot of time working with objects and collections. Therefore, you'll want to know the most efficient ways to write your code to manipulate these objects and collections. VBA offers two important constructs that can simplify working with objects and collections:

- ♦ `With-End With` constructs
- ♦ `For Each-Next` constructs

With-End With constructs

The `With-End With` instruction construct enables you to perform multiple operations on a single object. To start understanding how the `With-End With` construct works, examine the following procedure, which modifies five properties of a selection's formatting (the selection is assumed to be a `Range` object):

```
Sub ChangeFont1()  
    Selection.Font.Name = "Times New Roman"  
    Selection.Font.FontStyle = "Bold Italic"  
    Selection.Font.Size = 12  
    Selection.Font.Underline = xlUnderlineStyleSingle  
    Selection.Font.ColorIndex = 5  
End Sub
```

This procedure can be rewritten using the `With-End With` construct. The following procedure performs exactly like the preceding one:

```
Sub ChangeFont2()  
    With Selection.Font  
        .Name = "Times New Roman"  
        .FontStyle = "Bold Italic"  
        .Size = 12  
        .Underline = xlUnderlineStyleSingle  
        .ColorIndex = 5  
    End With  
End Sub
```

Some people think that the second incarnation of the procedure is actually more difficult to read. Remember, though, that the objective is increased speed. Although the first version may be more straightforward and easier to understand, a procedure that uses the `With-End With` construct when changing several properties of an object can be significantly faster than the equivalent procedure that explicitly references the object in each statement.

**Note**

When you record a VBA macro, Excel uses the `With-End With` construct every chance it gets. To see a good example of this construct, try recording your actions while you change the page setup by choosing the `File` ⇨ `Page Setup` command.

For Each-Next constructs

Recall from the preceding chapter that a *collection* is a group of related objects. For example, the `Workbooks` collection is a collection of all open `Workbook` objects. There are many other collections that you can work with. You don't have to know how many elements are in a collection to use the `For Each-Next` construct.

Suppose that you want to perform some action on all objects in a collection. Or suppose that you want to evaluate all objects in a collection and take action under certain conditions. These are perfect occasions for the `For Each-Next` construct.

The syntax of the For Each-Next construct is:

```
For Each element In group
    [instructions]
    [Exit For]
    [instructions]
Next [element]
```

The following procedure uses the For Each-Next construct to refer to each of the six single-precision members of a fixed-length array one at a time:

```
Sub Macro1()
    Dim MyArray(5)
    For i = 0 To 5
        MyArray(i) = Rnd
    Next i
    For Each n In MyArray
        Debug.Print n
    Next n
End Sub
```

The next procedure uses the For Each-Next construct with the Sheets collection in the active workbook. When you execute the procedure, the MsgBox function displays each worksheet's Name property. (If there are five worksheets in the active workbook, the MsgBox function is called five times.)

```
Sub CountSheets()
    Dim Item as Worksheet
    For Each Item In ActiveWorkbook.WorkSheets
        MsgBox Item.Name
    Next Item
End Sub
```

**Note**

In the preceding example, *Item* is an object variable (more specifically, a Worksheet object). There's nothing special about the name *Item*; you can use any valid variable name in its place.

The next example uses For Each-Next to cycle through all objects in the Windows collection:

```
Sub HiddenWindows()
    Dim AllVisible As Boolean
    Dim Item As Window
    AllVisible = True
    For Each Item In Windows
        If Item.Visible = False Then
            AllVisible = False
            Exit For
        End If
    Next Item
    MsgBox AllVisible
End Sub
```

If a window is hidden, the value of `AllVisible` is changed to `False`, and the `For Each-Next` loop is exited. The message box displays `True` if all windows are visible and `False` if at least one window is hidden. The `Exit For` statement is optional. It provides a way to exit the `For Each-Next` loop early. This is generally used in conjunction with an `If-Then` statement (described later in this chapter).

Here's an example that closes all workbooks except the active workbook. This procedure uses the `If-Then` construct to evaluate each workbook in the `Workbooks` collection.

```
Sub CloseInactive()  
    Dim Book as Workbook  
    For Each Book In Workbooks  
        If Book.Name <> ActiveWorkbook.Name Then Book.Close  
    Next Book  
End Sub
```

My final example of `For Each-Next` is designed to be executed after the user selects a range of cells. Here, the `Selection` object acts as a collection that consists of `Range` objects because each cell in the selection is a `Range` object. The procedure evaluates each cell and uses VBA's `UCase` function to convert its contents to uppercase (numeric cells are not affected).

```
Sub MakeUpperCase()  
    Dim Cell as Range  
    For Each Cell In Selection  
        Cell.Value = UCase(Cell.Value)  
    Next Cell  
End Sub
```

Controlling Execution

Some VBA procedures start at the top and progress line by line to the bottom. Macros that you record, for example, always work in this fashion. Often, however, you need to control the flow of your routines by skipping over some statements, executing some statements multiple times, and testing conditions to determine what the routine does next.

The preceding section described the `For Each-Next` construct, which is a type of loop. This section discusses the additional ways of controlling the execution of your VBA procedures:

- ♦ `GoTo` statements
- ♦ `If-Then` constructs
- ♦ `Select Case` constructs

- ♦ For-Next loops
- ♦ Do While loops
- ♦ Do Until loops

GoTo statements

The most straightforward way to change the flow of a program is to use a `GoTo` statement. This statement simply transfers program execution to a new instruction, which must be preceded by a label (a text string followed by a colon, or a number with no colon). VBA procedures can contain any number of labels, and a `GoTo` statement cannot branch outside of a procedure.

The following procedure uses VBA's `InputBox` function to get the user's name. If the name is not Howard, the procedure branches to the `WrongName` label and ends. Otherwise, the procedure executes some additional code. The `Exit Sub` statement causes the procedure to end.

```
Sub GoToDemo()  
    UserName = InputBox("Enter Your Name:")  
    If UserName <> "Howard" Then GoTo WrongName  
    MsgBox ("Welcome Howard...")  
    ' -[More code here] -  
    Exit Sub  
WrongName:  
    MsgBox "Sorry. Only Howard can run this."  
End Sub
```

This simple procedure works, but in general you should use the `GoTo` statement only when there is no other way to perform an action. In fact, the only time you *really* need to use a `GoTo` statement in VBA is for error trapping (refer to Chapter 9).

If-Then constructs

Perhaps the most commonly used instruction grouping in VBA is the `If-Then` construct. This common instruction is one way to endow your applications with decision-making capability. Good decision making is the key to writing successful programs. A successful Excel application essentially boils down to making decisions and acting on them.

The basic syntax of the `If-Then` construct is:

```
If condition Then true_instructions [Else false_instructions]
```

The `If-Then` construct is used to execute one or more statements conditionally. The `Else` clause is optional. If included, it lets you execute one or more instructions when the condition you're testing is not true.

The following procedure demonstrates an `If-Then` structure without an `Else` clause. The example deals with time. VBA uses a similar date-and-time serial number system as Excel. The time of day is expressed as a fractional value—for example, noon is represented as `.5`. VBA's `Time` function returns a value that represents the time of day, as reported by the system clock. In the following example, a message is displayed if the time is before noon. If the current system time is greater than or equal to `.5`, the procedure ends and nothing happens.

```
Sub GreetMe1()  
    If Time < 0.5 Then MsgBox "Good Morning"  
End Sub
```

If you want to display a different greeting when the time of day is after noon, add another `If-Then` statement, like so:

```
Sub GreetMe2()  
    If Time < 0.5 Then MsgBox "Good Morning"  
    If Time >= 0.5 Then MsgBox "Good Afternoon"  
End Sub
```

Notice that I used `>=` (greater than or equal to) for the second `If-Then` statement. This covers the extremely remote chance that the time is precisely 12:00 noon.

Another approach is to use the `Else` clause of the `If-Then` construct. For example,

```
Sub GreetMe3()  
    If Time < 0.5 Then MsgBox "Good Morning" Else _  
        MsgBox "Good Afternoon"  
End Sub
```

Notice that I used the line continuation sequence; `If-Then-Else` is actually a single statement.

If you need to expand a routine to handle three conditions (for example, morning, afternoon, and evening), you can use either three `If-Then` statements or a nested `If-Then-Else` structure. The first approach is the simpler:

```
Sub GreetMe4()  
    If Time < 0.5 Then MsgBox "Good Morning"  
    If Time >= 0.5 And Time < 0.75 Then MsgBox "Good Afternoon"  
    If Time >= 0.75 Then MsgBox "Good Evening"  
End Sub
```

The value `0.75` represents 6:00 p.m.—three-quarters of the way through the day and a good point at which to call it evening.

In the preceding examples, every instruction in the procedure gets executed, even in the morning. A more efficient procedure would include a structure that ends the routine when a condition is found to be true. For example, it might display the `Good`

Morning message in the morning and then exit without evaluating the other, superfluous conditions. True, the difference in speed is inconsequential when you design a procedure as small as this routine. But for more complex applications, you need another syntax:

```
If condition Then
    [true_instructions]
[ElseIf condition-n Then
    [alternate_instructions]]
[Else
    [default_instructions]]
End If
```

Here's how you can use this syntax to rewrite the GreetMe procedure:

```
Sub GreetMe5()
    If Time < 0.5 Then
        MsgBox "Good Morning"
    ElseIf Time >= 0.5 And Time < 0.75 Then
        MsgBox "Good Afternoon"
    ElseIf Time >= 0.75 Then
        MsgBox "Good Evening"
    End If
End Sub
```

With this syntax, when a condition is true, the conditional statements are executed and the If-Then construct ends. In other words, the extraneous conditions are not evaluated. Although this syntax makes for greater efficiency, some may find the code to be more difficult to understand.

The following procedure demonstrates yet another way to code this example. It uses nested If-Then-Else constructs (without using ElseIf). This procedure is efficient, and also easy to understand. Note that each If statement has a corresponding End If statement.

```
Sub GreetMe6()
    If Time < 0.5 Then
        MsgBox "Good Morning"
    Else
        If Time >= 0.5 And Time < 0.75 Then
            MsgBox "Good Afternoon"
        Else
            If Time >= 0.75 Then
                MsgBox "Good Evening"
            End If
        End If
    End If
End Sub
```

The following is another example that uses the simple form of the If-Then construct. This procedure prompts the user for a value for `Quantity` and then displays the appropriate discount based on that value. If the `InputBox` is cancelled, `Quantity` contains an empty string, and the procedure ends. Note that this procedure does not perform any other error checking. For example, it does not ensure that the quantity entered is a non-negative numeric value.

```
Sub Discount1()  
    Quantity = InputBox("Enter Quantity: ")  
    If Quantity = "" Then Exit Sub  
    If Quantity >= 0 Then Discount = 0.1  
    If Quantity >= 25 Then Discount = 0.15  
    If Quantity >= 50 Then Discount = 0.2  
    If Quantity >= 75 Then Discount = 0.25  
    MsgBox "Discount: " & Discount  
End Sub
```

Notice that each If-Then statement in this procedure is always executed, and the value for `Discount` can change. The final value, however, is the desired value.

The following procedure is the previous one rewritten to use the alternate syntax. In this case, the procedure ends after executing the True instruction block.

```
Sub Discount2()  
    Quantity = InputBox("Enter Quantity: ")  
    If Quantity = "" Then Exit Sub  
  
    If Quantity >= 0 And Quantity < 25 Then  
        Discount = 0.1  
    ElseIf Quantity < 50 Then  
        Discount = 0.15  
    ElseIf Quantity < 75 Then  
        Discount = 0.2  
    ElseIf Quantity >= 75 Then  
        Discount = 0.25  
    End If  
    MsgBox "Discount: " & Discount  
End Sub
```

I find nested If-Then structures rather cumbersome. As a result, I usually use the If-Then structure only for simple binary decisions. When you need to choose among three or more alternatives, the `Select Case` structure is often a better construct to use.

Select Case constructs

The `Select Case` construct is useful for choosing among three or more options. This construct also works with two options and is a good alternative to If-Then-Else. The syntax for `Select Case` is as follows:

VBA's IIf Function

VBA offers an alternative to the If-Then construct: the IIf function. This function takes three arguments, and works much like Excel's IF worksheet function. The syntax is:

```
IIf(expr, truepart, falsepart)
```

expr (Required) Expression you want to evaluate.

truepart (Required) Value or expression returned if *expr* is True.

falsepart (Required) Value or expression returned if *expr* is False.

The following instruction demonstrates the use of the IIf function. The message box displays *Zero* if cell A1 contains a zero or is empty, and displays *Nonzero* if cell A1 contains anything else.

```
MsgBox IIf(Range("A1") = 0, "Zero", "Nonzero")
```

It's important to understand that the third argument (*falsepart*) is always evaluated, even if the second argument (*truepart*) is True. Therefore, the following statement will generate an error if the value of *n* is zero:

```
MsgBox IIf(n = 0, 0, 1 / n)
```

```
Select Case testexpression
  [Case expressionlist-n
    [instructions-n]]
  [Case Else
    [default_instructions]]
End Select
```

The following example of a Select Case construct shows another way to code the GreetMe examples presented in the preceding section:

```
Sub GreetMe()
  Select Case Time
    Case Is < 0.5
      Msg = "Good Morning"
    Case 0.5 To 0.75
      Msg = "Good Afternoon"
    Case Else
      Msg = "Good Evening"
  End Select
  MsgBox Msg
End Sub
```

And here's a rewritten version of the Discount example, using a Select Case construct. This procedure assumes that Quantity will always be an integer value. For simplicity, the procedure performs no error checking.

```
Sub Discount3()  
    Quantity = InputBox("Enter Quantity: ")  
    Select Case Quantity  
        Case ""  
            Exit Sub  
        Case 0 To 24  
            Discount = 0.1  
        Case 25 To 49  
            Discount = 0.15  
        Case 50 To 74  
            Discount = 0.2  
        Case Is >= 75  
            Discount = 0.25  
    End Select  
    MsgBox "Discount: " & Discount  
End Sub
```

The **Case** statement also can use the **Or** operator. The following procedure uses VBA's **WeekDay** function to determine whether the current day is a weekend; then it displays an appropriate message. Note the use of the **Or** operator, which checks for a **Sunday** or a **Saturday**.

```
Sub GreetUser()  
    Select Case Weekday(Now)  
        Case 1 Or 7  
            MsgBox "This is the weekend"  
        Case Else  
            MsgBox "This is not the weekend"  
    End Select  
End Sub
```

Alternatively, you can use a comma to separate expressions in a **Case** statement. The following example shows another way to code the previous procedure:

```
Sub GreetUser()  
    Select Case Weekday(Now)  
        Case 2, 3, 4, 5, 6  
            MsgBox "This is not the weekend"  
        Case Else  
            MsgBox "This is the weekend"  
    End Select  
End Sub
```

Any number of instructions can be written below each **Case** statement, and they all are executed if that case evaluates to **True**. If you use only one instruction per case, as in the preceding example, you may want to put the instruction on the same line as the **Case** keyword (but don't forget VBA's statement-separator character, the colon). This technique makes the code more compact. For example,

```

Sub Discount3()
    Quantity = InputBox("Enter Quantity: ")
    Select Case Quantity
        Case "": Exit Sub
        Case 0 To 24: Discount = 0.1
        Case 25 To 49: Discount = 0.15
        Case 50 To 74: Discount = 0.2
        Case Is >= 75: Discount = 0.25
    End Select
    MsgBox "Discount: " & Discount
End Sub

```

**Tip**

VBA exits a **Select Case** construct as soon as a **True** case is found. Therefore, for maximum efficiency, you might want to check the most likely case first.

Select Case structures can also be nested. The following procedure, for example, tests for Excel's window state (maximized, minimized, or normal) and then displays a message describing the window state. If Excel's window state is normal, the procedure tests for the window state of the active window and then displays another message.

```

Sub AppWindow()
    Select Case Application.WindowState
        Case xlMaximized: MsgBox "App Maximized"
        Case xlMinimized: MsgBox "App Minimized"
        Case xlNormal: MsgBox "App Normal"
            Select Case ActiveWindow.WindowState
                Case xlMaximized: MsgBox "Book Maximized"
                Case xlMinimized: MsgBox "Book Minimized"
                Case xlNormal: MsgBox "Book Normal"
            End Select
    End Select
End Sub

```

You can nest **Select Case** constructs as deeply as you need, but make sure that each **Select Case** statement has a corresponding **End Select** statement.

This procedure demonstrates the value of using indentation in your code to clarify the structure. For example, take a look at the same procedure without the indentations:

```

Sub AppWindow()
Select Case Application.WindowState
Case xlMaximized: MsgBox "App Maximized"
Case xlMinimized: MsgBox "App Minimized"
Case xlNormal: MsgBox "App Normal"
Select Case ActiveWindow.WindowState
Case xlMaximized: MsgBox "Book Maximized"
Case xlMinimized: MsgBox "Book Minimized"
Case xlNormal: MsgBox "Book Normal"
End Select
End Select
End Sub

```

Fairly incomprehensible, eh?

Looping blocks of instructions

Looping is the process of repeating a block of instructions. You may know the number of times to loop, or it may be determined by the values of variables in your program.

The following code, which enters consecutive numbers into a range, demonstrates what I call a *bad loop*. The procedure uses two variables to store a starting value (`StartVal`) and the total number of cells to fill (`NumToFill`). This loop uses the `GoTo` statement to control the flow. If the `Cnt` variable, which keeps track of how many cells are filled, is less than the number requested by the user, program control loops back to `DoAnother`.

```
Sub BadLoop()  
    StartVal = 1  
    NumToFill = 100  
    ActiveCell.Value = StartVal  
    Cnt = 1  
DoAnother:  
    ActiveCell.Offset(Cnt, 0).Value = StartVal + Cnt  
    Cnt = Cnt + 1  
    If Cnt < NumToFill Then GoTo DoAnother Else Exit Sub  
End Sub
```

This procedure works as intended, so why is it an example of bad looping? Programmers generally frown on using a `GoTo` statement when not absolutely necessary. Using `GoTo` statements to loop is contrary to the concept of structured coding (see the “What Is Structured Programming?” sidebar). In fact, a `GoTo` statement makes the code much more difficult to read because it’s almost impossible to represent a loop using line indentations. In addition, this type of unstructured loop makes the procedure more susceptible to error. Furthermore, using lots of labels results in *spaghetti code*—code that appears to have little or no structure and flows haphazardly.

Because VBA has several structured looping commands, you almost never have to rely on `GoTo` statements for your decision making.

For-Next loops

The simplest type of *good loop* is a For-Next loop, which I’ve already used in a few previous examples. Its syntax is:

```
For counter = start To end [Step stepval]  
    [instructions]  
    [Exit For]  
    [instructions]  
Next [counter]
```

What Is Structured Programming?

Hang around with programmers, and sooner or later you'll hear the term *structured programming*. You'll also discover that structured programs are considered superior to unstructured programs.

So what is structured programming? And can you do it with VBA?

The basic premise is that a routine or code segment should have only one entry point and one exit point. In other words, a body of code should be a standalone unit, and program control should not jump into or exit from the middle of this unit. As a result, structured programming rules out the `GoTo` statement. When you write structured code, your program progresses in an orderly manner and is easy to follow—as opposed to spaghetti code, where a program jumps around.

A structured program is easier to read and understand than an unstructured one. More important, it's also easier to modify.

VBA is a structured language. It offers standard structured constructs, such as `If-Then-Else` and `Select Case`, and the `For-Next`, `Do Until`, and `Do While` loops. Furthermore, VBA fully supports modular code construction.

If you're new to programming, it's a good idea to form good structured programming habits early.

Following is an example of a `For-Next` loop that doesn't use the optional `Step` value or the optional `Exit For` statement. This routine executes the `Sum = Sum + Sqr(Count)` statement 100 times and displays the result—that is, the sum of the square roots of the first 100 integers.

```
Sub SumSquareRoots()  
    Dim Sum As Double, Count As Integer  
    Sum = 0  
    For Count = 1 To 100  
        Sum = Sum + Sqr(Count)  
    Next Count  
    MsgBox Sum  
End Sub
```

In this example, `Count` (the loop counter variable) started out as 1 and increased by 1 each time the loop repeated. The `Sum` variable simply accumulates the square roots of each value of `Count`.



Caution

When you use `For-Next` loops, it's important to understand that the loop counter is a normal variable—nothing special. As a result, it's possible to change the value of the loop counter within the block of code executed between the `For` and `Next` statements. This is, however, a *ba-a-ad* practice and can cause unpredictable results. In fact, you should take special precautions to ensure that your code does not change the loop counter.

You can also use a Step value to skip some values in the loop. Here's the same procedure rewritten to sum the square roots of the odd numbers between 1 and 100:

```
Sub SumOddSquareRoots()  
    Sum = 0  
    For Count = 1 To 100 Step 2  
        Sum = Sum + Sqr(Count)  
    Next Count  
    MsgBox Sum  
End Sub
```

In this procedure, Count starts out as 1 and then takes on values of 3, 5, 7, and so on. The final value of Count used within the loop is 99. When the loop ends, the value of Count is 101.

The following procedure performs the same task as the BadLoop example found at the beginning of the “Looping blocks of instructions” section. I eliminated the GoTo statement, however, converting a bad loop into a good loop that uses the For-Next structure.

```
Sub GoodLoop()  
    StartVal = 1  
    NumToFill = 100  
    ActiveCell.Value = StartVal  
    For Cnt = 0 To NumToFill - 1  
        ActiveCell.Offset(Cnt, 0).Value = StartVal + Cnt  
    Next Cnt  
End Sub
```

For-Next loops can also include one or more Exit For statements within the loop. When this statement is encountered, the loop terminates immediately, as the following example demonstrates. This procedure determines which cell has the largest value in column A of the active worksheet:

```
Sub ExitForDemo()  
    MaxVal = Application.WorksheetFunction.Max(Range("A:A"))  
    For Row = 1 To 65536  
        Set TheCell = Range("A1").Offset(Row - 1, 0)  
        If TheCell.Value = MaxVal Then  
            MsgBox "Max value is in Row " & Row  
            TheCell.Activate  
            Exit For  
        End If  
    Next Row  
End Sub
```

The maximum value in the column is calculated by using Excel's MAX function. This value is then assigned to the MaxVal variable. The For-Next loop checks each cell in the column. If the cell being checked is equal to MaxVal, the Exit For statement ends the procedure. Before terminating the loop, though, the procedure informs the user of the row location and then activates the cell.

The `ExitForDemo` is presented to demonstrate how to use `exit` from a `For-Next` loop. However, it is not the most efficient way to activate the largest value in a range. In fact, a single statement will do the job:

```
Range("A:A").Find(Application.WorksheetFunction.Max _
    (Range("A:A"))).Activate
```

The previous examples use relatively simple loops. But you can have any number of statements in the loop, and you can even nest `For-Next` loops inside other `For-Next` loops. Here's an example that uses nested `For-Next` loops to initialize a $10 \times 10 \times 10$ array with the value `-1`. When the procedure is finished, each of the 1,000 elements in `MyArray` will contain `-1`.

```
Sub NestedLoops()
    Dim MyArray(1 to 10, 1 to 10, 1 to 10)
    Dim i As Integer, j As Integer, k As Integer
    For i = 1 To 10
        For j = 1 To 10
            For k = 1 To 10
                MyArray(i, j, k) = -1
            Next k
        Next j
    Next i
End Sub
```

Do While loops

A `Do While` loop is another type of looping structure available in VBA. Unlike a `For-Next` loop, a `Do While` loop executes while a specified condition is met. A `Do While` loop can have either of two syntaxes:

```
Do [While condition]
    [instructions]
    [Exit Do]
    [instructions]
Loop
```

or

```
Do
    [instructions]
    [Exit Do]
    [instructions]
Loop [While condition]
```

As you can see, VBA lets you put the `While` condition at the beginning or the end of the loop. The difference between these two syntaxes involves the point in time when the condition is evaluated. In the first syntax, the contents of the loop may never be executed. In the second syntax, the contents of the loop are always executed at least one time.

The following example uses a Do While loop with the first syntax.

```
Sub DoWhileDemo()  
    Do While Not IsEmpty(ActiveCell)  
        ActiveCell.Value = 0  
        ActiveCell.Offset(1, 0).Select  
    Loop  
End Sub
```

This procedure uses the active cell as a starting point and then travels down the column, inserting a zero into the active cell. Each time the loop repeats, the next cell in the column becomes the active cell. The loop continues until VBA's `IsEmpty` function determines that the active cell is not empty.

The following procedure uses the second Do While loop syntax. The loop will always be executed at least one time, even if the initial active cell is empty.

```
Sub DoWhileDemo2()  
    Do  
        ActiveCell.Value = 0  
        ActiveCell.Offset(1, 0).Select  
    Loop While Not IsEmpty(ActiveCell)  
End Sub
```

The following is another Do While loop example. This procedure opens a text file, reads each line, converts the text to uppercase, and then stores it in the active sheet, beginning with cell A1 and continuing down the column. The procedure uses VBA's `EOF` function, which returns `True` when the end of the file has been reached. The final statement closes the text file.

```
Sub DoWhileDemo1()  
    Open "c:\data\textfile.txt" For Input As #1  
    LineCt = 0  
    Do While Not EOF(1)  
        Line Input #1, LineOfText  
        Range("A1").Offset(LineCt, 0) = UCase(LineOfText)  
        LineCt = LineCt + 1  
    Loop  
    Close #1  
End Sub
```



For additional information about reading and writing text files using VBA, see Chapter 27.

Do While loops can also contain one or more `Exit Do` statements. When an `Exit Do` statement is encountered, the loop ends immediately.

Do Until loops

The `Do Until` loop structure is very similar to the `Do While` structure. The difference is evident only when the condition is tested. In a `Do While` loop, the loop

executes *while* the condition is true. In a `Do Until` loop, the loop executes *until* the condition is true.

`Do Until` also has two syntaxes:

```
Do [Until condition]
    [instructions]
    [Exit Do]
    [instructions]
Loop
```

or

```
Do
    [instructions]
    [Exit Do]
    [instructions]
Loop [Until condition]
```

The following example was originally presented for the `Do While` loop but has been rewritten to use a `Do Until` loop. The only difference is the line with the `Do` statement. This example makes the code a bit clearer because it avoids the negative required in the `Do While` example.

```
Sub DoUntilDemo1()
    Open "c:\data\textfile.txt" For Input As #1
    LineCt = 0
    Do Until EOF(1)
        Line Input #1, LineOfText
        Range("A1").Offset(LineCt, 0) = UCase(LineOfText)
        LineCt = LineCt + 1
    Loop
    Close #1
End Sub
```

Summary

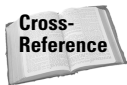
In this chapter, I discussed the fundamentals of programming in VBA, including variables, constants, data types, arrays, and VBA's built-in functions. I also discussed techniques for manipulating objects and controlling the execution of your procedures.

Chapter 9 focuses on one of the two types of procedures you can write in VBA.



Working with VBA Sub Procedures

A *procedure* holds a group of VBA statements that accomplishes a desired task. Most VBA code is contained in procedures. This chapter focuses on *Sub procedures*, which perform tasks but do not return discrete values. VBA also supports Function procedures, which I discuss in Chapter 10.



Chapter 11 has many additional examples of procedures that you can incorporate into your work.

About Procedures

A *procedure* is a series of VBA statements that resides in a VBA module, which you access in the VBE. A module can hold any number of procedures.

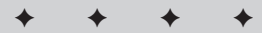
You have a number of ways to *call*, or execute, procedures. A procedure is executed from beginning to end (but it can also be ended prematurely).



Tip

A procedure can be any length, but many people prefer to avoid creating extremely long procedures that perform many different operations. You may find it easier to write several smaller procedures, each with a single purpose. Then design a main procedure that calls those other procedures. This approach can make your code easier to maintain.

Some procedures are written to receive arguments. An *argument* is simply information that is used by the procedure that is “passed” to the procedure when it is executed. Procedure arguments work much like the arguments you use in Excel worksheet functions. Instructions within the procedure



In This Chapter

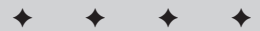
Declaring and creating VBA Sub procedures

Executing procedures

Passing arguments to a procedure

Using error-handling techniques

An example of developing a useful procedure



generally perform logical operations on these arguments, and the results of the procedure are usually based on those arguments.

Declaring a Sub procedure

A procedure declared with the `Sub` keyword must adhere to the following syntax:

```
[Private | Public][Static] Sub name ([arglist])  
    [instructions]  
    [Exit Sub]  
    [instructions]  
End Sub
```

Private (Optional) Indicates that the procedure is accessible only to other procedures in the same module.

Public (Optional) Indicates that the procedure is accessible to all other procedures in all other modules in the workbook. If used in a module that contains an `Option Private Module` statement, the procedure is not available outside the project.

Static (Optional) Indicates that the procedure's variables are preserved when the procedure ends.

Sub (Required) The keyword that indicates the beginning of a procedure.

name (Required) Any valid procedure name.

arglist (Optional) Represents a list of variables, enclosed in parentheses, that receive arguments passed to the procedure. Use a comma to separate arguments. If the procedure uses no arguments, a set of empty parentheses is required.

instructions (Optional) Represents valid VBA instructions.

Exit Sub (Optional) A statement that forces an immediate exit from the procedure prior to its formal completion.

End Sub (Required) Indicates the end of the procedure.

**Note**

With a few exceptions, all VBA instructions in a module must be contained within procedures. Exceptions include module-level variable declarations, user-defined data type definitions, and a few other instructions that specify module-level options (for example, `Option Explicit`).

Naming Procedures

Every procedure must have a name. The rules governing procedure names are generally the same as for variable names. Ideally, a procedure's name should describe what its contained processes do. A good rule of thumb is to use a name that includes a verb and a noun (for example, `ProcessDate`, `PrintReport`, `Sort_Array`, or `CheckFilename`). Avoid meaningless names such as `DoIt`, `Update`, and `Fix`.

Some programmers use sentence-like names that describe the procedure (for example, `WriteReportToTextFile` and `Get_Print_Options_and_Print_Report`). Although long names are very descriptive and unambiguous, they are also more difficult to type.

Scoping a procedure

In the preceding chapter, I noted that a variable's scope determines the modules and procedures in which the variable can be used. Similarly, a procedure's scope determines which other procedures can call it.

Public procedures

By default, procedures are *public*—that is, they can be called by other procedures in any module in the workbook. It's not necessary to use the `Public` keyword, but programmers often include it for clarity. The following two procedures are both public:

```
Sub First()  
' ... [code goes here] ...  
End Sub  
  
Public Sub Second()  
' ... [code goes here] ...  
End Sub
```

Private procedures

Private procedures can be called by other procedures in the same module, but not by procedures in other modules.

**Note**

When you choose Excel's `Tools` ⇨ `Macro` ⇨ `Macros` command, the Macro dialog box displays only the public procedures. Therefore, if you have procedures that are designed to be called only by other procedures in the same module, you should make sure that the procedure is declared as `Private`. This prevents the user from running the procedure from the Macro dialog box.

The following example declares a private procedure, named `MySub`:

```
Private Sub MySub()  
' ... [code goes here] ...  
End Sub
```

**Tip**

You can force all procedures in a module to be private—even those declared with the `Public` keyword—by including the following statement before your first `Sub` statement:

```
Option Private Module
```

If you write this statement in a module, you can omit the `Private` keyword from your `Sub` declarations.

Excel's macro recorder normally creates new `Sub` procedures called `Macro1`, `Macro2`, and so on. These procedures are all public procedures, and they will never use any arguments.

Executing Procedures

In this section I describe the many ways to *execute*, or call, a VBA `Sub` procedure:

- ♦ With the Run ⇨ Run Sub/UserForm command (in the VBE). Or you can press the F5 shortcut key. Excel executes the procedure at the cursor position. This method doesn't work if the procedure requires one or more arguments.
- ♦ From Excel's Macro dialog box (which you open by choosing Tools ⇨ Macro ⇨ Macros). Or you can press the Alt+F8 shortcut key to access the Macro dialog box.
- ♦ Using the Ctrl key shortcut assigned to the procedure (assuming you assigned one).
- ♦ By clicking a button or a shape on a worksheet. The button or shape must have the procedure assigned to it.
- ♦ From another procedure you write.
- ♦ From a Toolbar button.
- ♦ From a custom menu that you develop.
- ♦ When an event occurs. These events include opening the workbook, saving the workbook, closing the workbook, making a change to a cell, activating a sheet, and many other things.
- ♦ From the Immediate window in the VBE. Just type the name of the procedure, including any arguments that may apply, and press Enter.

Note

Excel 5 and Excel 95 made it very easy to assign a macro to a new menu item on the Tools menu. This feature was removed beginning with Excel 97.

I discuss these methods of executing procedures in the following sections.

Note

In many cases, a procedure will not work properly unless it is in the appropriate context. For example, if a procedure is designed to work with the active worksheet,

it will fail if a chart sheet is active. A good procedure incorporates code that checks for the appropriate context and exits gracefully if it can't proceed.

Executing a procedure with the Run ⇨ Run Sub/ UserForm command

VBE's Run ⇨ Run Sub/UserForm menu command is used primarily to test a procedure while you are developing it. You would never expect a user to have to activate the VBE to execute a procedure. Use the Run ⇨ Run Sub/UserForm command (or F5) in the VBE to execute the current procedure (in other words, the procedure that contains the cursor).

If the cursor is not located within a procedure when you issue the Run ⇨ Run Sub/ UserForm command, VBE displays its Macro dialog box so that you can select a procedure to execute.

Executing a procedure from the Macro dialog box

Choosing Excel's Tools ⇨ Macro ⇨ Macros command displays the Macro dialog box, shown in Figure 9-1 (you can also press Alt+F8 to access this dialog box). The Macro dialog box lists all available Sub procedures. Use the Macros In drop-down box to limit the scope of the macros displayed (for example, show only the macros in the active workbook). The Macro dialog box does not display Function procedures. In addition, it does not display Sub procedures declared with the `Private` keyword, Sub procedures that require one or more arguments, or Sub procedures contained in add-ins.



Tip

Procedures stored in an add-in are not listed in the Macro dialog box, but you still can execute such a procedure if you know the name. Simply type the procedure name into the Macro name field in the Macro dialog box, and click Run.

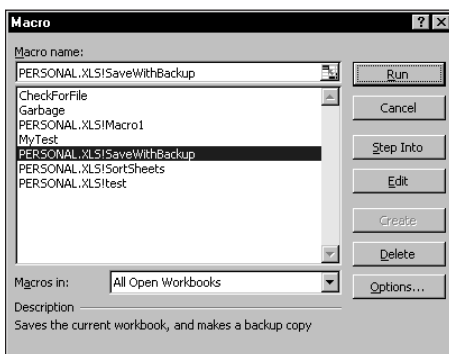


Figure 9-1: The Macro dialog box lists all available procedures.

Executing a procedure using a Ctrl+ shortcut key combination

You can assign a Ctrl+shortcut key combination to any procedure that doesn't use any arguments. If you assign the Ctrl+U key combo to a procedure named Update, for example, pressing Ctrl+U executes the Update procedure.

When you begin recording a macro, the Record Macro dialog box gives you the opportunity to assign a shortcut key. However, you can assign a shortcut key at any time. To assign a Ctrl shortcut key to a procedure (or change a procedure's shortcut key), follow these steps:

1. Activate Excel and choose the Tools ⇨ Macro ⇨ Macros command.
2. Select the appropriate procedure from the list box in the Macro dialog box.
3. Click the Options button to display the Macro Options dialog box (see Figure 9-2).

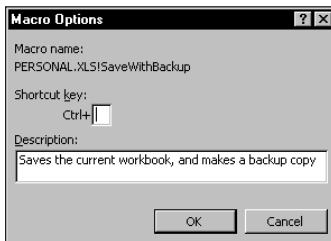


Figure 9-2: The Macro Options dialog box lets you assign a Ctrl key shortcut and an optional description to a procedure.

4. Enter a character into the text box labeled Ctrl+.
The character that you enter into the text box labeled Ctrl+ is case-sensitive. If you enter a lowercase *s*, the shortcut key combo is Ctrl+S. If you enter an uppercase *S*, the shortcut key combo is Ctrl+Shift+S.
5. Enter a description (optional). If you enter a description for a macro, it is displayed at the bottom of the Macro dialog box when the procedure is selected in the list box.
6. Click OK to close the Macro Options dialog box, and click Close to close the Macro dialog box.



If you assign one of Excel's predefined shortcut key combinations to a procedure, your key assignment takes precedence over the predefined key assignment. For example, Ctrl+S is Excel's predefined shortcut key for saving the active workbook.

But if you assign Ctrl+S to a procedure, pressing Ctrl+S no longer saves the active workbook.



Tip

The following Ctrl+key combinations are *not* used by Excel: E, J, L, M, Q, and T. Excel doesn't use too many Ctrl+Shift+key combinations. In fact, you can safely use any of them *except* F, O, and P.

Executing a procedure from a custom menu

As I describe in Chapter 23, Excel provides two ways for you to customize its menus: using the View ⇨ Toolbars ⇨ Customize command or writing VBA code. The latter method is preferable, but you can use either technique to assign a macro to a new menu item.



Note

Excel 5 and Excel 95 include a menu editor, which was removed beginning with Excel 97.

Following are the steps required to display a new menu item on a menu and to assign a macro to the menu item. It assumes that the new menu item is on the Data menu, that the menu item text is Open Customer File, and that the procedure is named `OpenCustomerFile`.

1. Choose the View ⇨ Toolbars ⇨ Customize command. Excel displays the Customize dialog box.
When the Customize dialog box is displayed, Excel is in a special “customization” mode. The menus and toolbars are not active, but they can be customized.
2. Click the Commands tab in the Customize dialog box.
3. Scroll down and click Macros in the Categories list.
4. In the Commands list, drag the first item (labeled Custom Menu Item) to the bottom of the Data menu (after the Refresh Data menu item). The Data menu drops down when you click it.
5. Right-click the new menu item (which is labeled Custom Menu Item) to display a shortcut menu.
6. Enter a new name for the menu item: **&Open Customer File** in the text box labeled Name (see Figure 9-3).

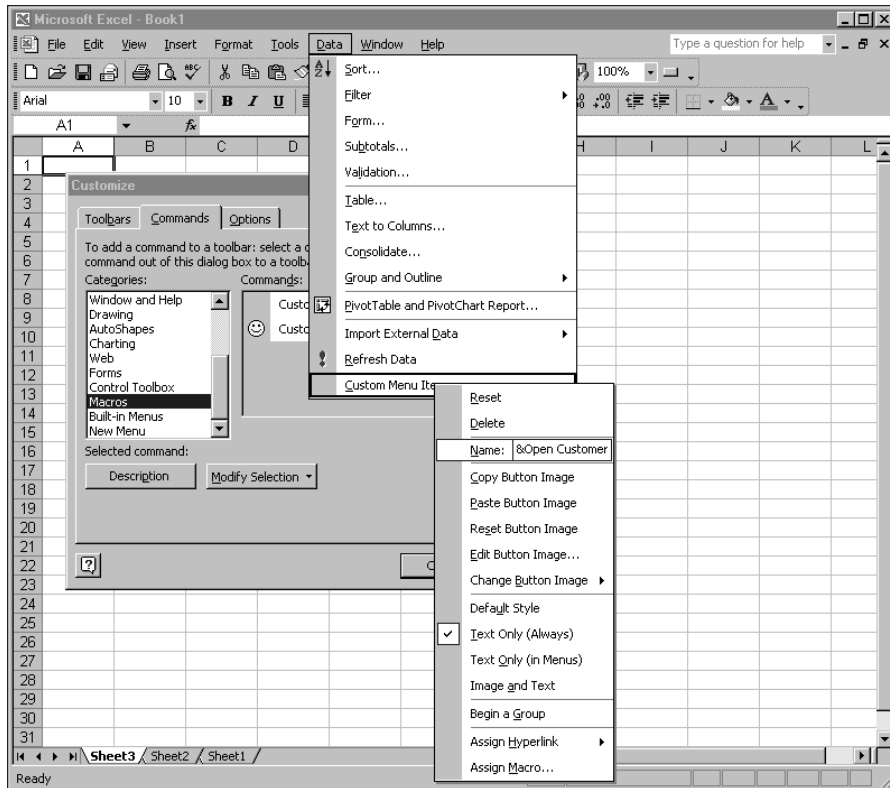


Figure 9-3: Changing the text for a menu item

7. Click Assign Macro on the shortcut menu.
8. In the Assign Macro dialog box, select the `OpenCustomerFile` procedure from the list of macros.
9. Click OK to close the Assign Macro dialog box, and click Close to close the Customize dialog box.



Caution

After you follow the process mentioned above, the new menu item always appears on the menu, even when the workbook that contains the macro is not open. In other words, changes you make using the **View** ⇄ **Toolbars** ⇄ **Customize** command are “permanent.” Selecting the new menu item opens the workbook if it’s not already open.



Cross-Reference

Refer to Chapter 23 to learn how to use VBA to create menu items that are displayed only when a particular workbook is open.

Executing a procedure from another procedure

One of the most common ways to execute a procedure is from another procedure. You have three ways to do this:

- ♦ Enter the procedure's name followed by its arguments (if any) separated by commas.
- ♦ Use the `Call` keyword followed by the procedure's name and then its arguments (if any) enclosed in parentheses and separated by commas.
- ♦ Use the `Run` method of the `Application` object. You can use this method to execute other VBA procedures or XLM macros. The `Run` method is useful when you need to run a procedure and the procedure's name is assigned to a variable. You can then pass the variable as an argument to the `Run` method.

The following example demonstrates the first method. In this case, the `MySub` procedure processes some statements (not shown), executes the `UpdateSheet` procedure, and then executes the rest of the statements.

```
Sub MySub()  
' ... [code goes here] ...  
    UpdateSheet  
' ... [code goes here] ...  
End Sub  
  
Sub UpdateSheet()  
' ... [code goes here] ...  
End Sub
```

The following example demonstrates the second method. The `Call` keyword executes the `Update` procedure, which requires one argument; the calling procedure passes the argument to the called procedure. I discuss procedure arguments later in this chapter.

```
Sub MySub()  
    MonthNum = InputBox("Enter the month number: ")  
    Call UpdateSheet(MonthNum)  
' ... [code goes here] ...  
End Sub  
  
Sub UpdateSheet(MonthSeq)  
' ... [code goes here] ...  
End Sub
```



Tip

Even though it's optional, some programmers always use the `Call` keyword just to make it perfectly clear that another procedure is being called.

The next example uses the `Run` method to execute the `UpdateSheet` procedure, and passes `MonthNum` as the argument:

```

Sub MySub()
    MonthNum = InputBox("Enter the month number: ")
    Result = Application.Run("UpdateSheet", MonthNum)
    ' ... [code goes here] ...
End Sub

Sub UpdateSheet(MonthSeq)
    ' ... [code goes here] ...
End Sub

```

Perhaps the best reason to use the `Run` method is when the procedure name is assigned to a variable. In fact, it's the only way to execute a procedure in such a way. The following example demonstrates this. The `Main` procedure uses VBA's `WeekDay` function to determine the day of the week (an integer between 1 and 7, beginning with Sunday). The `SubToCall` variable is assigned a string that represents a procedure name. The `Run` method then calls the appropriate procedure (either `WeekEnd` or `Daily`).

```

Sub Main()
    Select Case WeekDay(Now)
        Case 1: SubToCall = "WeekEnd"
        Case 7: SubToCall = "WeekEnd"
        Case Else: SubToCall = "Daily"
    End Select
    Application.Run SubToCall
End Sub

Sub WeekEnd()
    MsgBox "Today is a weekend"
    ' Code to execute on the weekend
    ' goes here
End Sub

Sub Daily()
    MsgBox "Today is not a weekend"
    ' Code to execute on the weekdays
    ' goes here
End Sub

```

Calling a procedure in a different module

If VBA can't locate a called procedure in the current module, it looks for public procedures in other modules in the same project.

If you need to call a private procedure from another procedure, both procedures must reside in the same module.

You can't have two procedures with the same name in the same module, but you can have identically named procedures in different modules. You can force VBA to execute an *ambiguously named* procedure—that is, another procedure in a different module that has the same name. To do so, precede the procedure name with the module name and a dot. For example, say that you define procedures named `MySub`

in Module1 and Module2. If you want a procedure in Module2 to call the MySub in Module1, you can use either of the following statements:

```
Module1.MySub  
Call Module1.MySub
```

If you do not differentiate between procedures that have the same name, you get an Ambiguous name detected error message.

Calling a procedure in a different workbook

In some cases, you may need your procedure to execute another procedure defined in a different workbook. To do so, you have two options: Establish a reference to the other workbook, or use the Run method and specify the workbook name explicitly.

To add a reference to another workbook, select the VBE's Tools ⇨ References command. Excel displays the References dialog box (see Figure 9-4), which lists all available references, including all open workbooks. Simply check the box that corresponds to the workbook that you want to add as a reference and click OK. After you establish a reference, you can call procedures in the workbook as if they were in the same workbook as the calling procedure.

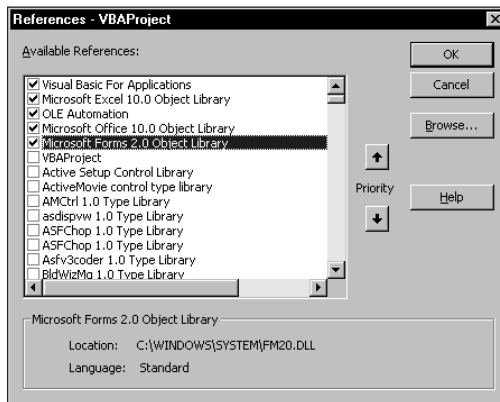


Figure 9-4: The References dialog box lets you establish a reference to another workbook.

A referenced workbook does not have to be open; it is treated like a separate object library. Use the Browse button in the References dialog box to establish a reference to a workbook that isn't open. The workbook names that appear in the list of references are listed by their VBE project names. By default, every project is initially named *VBAProject*. Therefore, the list may contain several identically named items. To distinguish a project, change its name in the Properties window of the VBE. The list of references displayed in the References dialog box also includes object

libraries and ActiveX controls that are registered on your system. Your Excel 2002 workbooks always include references to the following object libraries:

- ♦ Visual Basic for Applications
- ♦ Microsoft Excel 10.0 Object Library
- ♦ OLE Automation
- ♦ Microsoft Office 10.0 Object Library
- ♦ Microsoft Forms 2.0 Object Library (optional, included only if your project includes a UserForm)



In Excel 2002, any additional references that you add are also listed in your project outline in the Project Explorer window in the VBE. These references are listed under a node called References.

If you've established a reference to a workbook that contains the procedure `YourSub`, for example, you can use either of the following statements to call `YourSub`:

```
YourSub  
Call YourSub
```

To precisely identify a procedure in a different workbook, specify the project name, module name, and procedure name using the following syntax:

```
MyProject.MyModule.MySub
```

Alternatively, you can use the `Call` keyword:

```
Call MyProject.MyModule.MySub
```

Another way to call a procedure in a different open workbook is to use the `Run` method of the `Application` object. This technique does not require that you establish a reference. The following statement executes the `Consolidate` procedure located in a workbook named `budget macros.xls`:

```
Application.Run "'budget macros.xls'!Consolidate"
```

Executing a procedure from a toolbar button

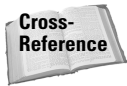
You can customize Excel's toolbars to include buttons that execute procedures when clicked. The procedure for assigning a macro to a toolbar button is virtually identical to the procedure for assigning a macro to a menu item.

Assume that you want to assign a procedure to a toolbar button on a toolbar. Here are the steps required to do so:

1. Choose the View ⇨ Toolbars ⇨ Customize command. Excel displays the Customize dialog box.
When the Customize dialog box is displayed, Excel is in a special “customization” mode. The menus and toolbars are not active, but they can be customized.
2. Click the Commands tab in the Customize dialog box.
3. Scroll down and click Macros in the Categories list.
4. In the Commands list, drag the second item (labeled Custom Button) to the desired toolbar.
5. Right-click the new button to display a shortcut menu.
6. Enter a new name for the button in the text box labeled Name. This is the “tooltip” text that appears when the mouse pointer moves over the button. This step is optional; if you omit it, the tooltip displays Custom.
7. Right-click the new button and select Assign Macro from the shortcut menu. Excel displays its Assign Macro dialog box.
8. Select the procedure from the list of macros.
9. Click OK to close the Assign Macro dialog box.
10. Click Close to close the Customize dialog box.



After you follow the process above, the new toolbar button always appears on the assigned toolbar – even when the workbook that contains the macro is not open. In other words, changes you make using the View ⇨ Toolbars ⇨ Customize command are “permanent.” Clicking the new toolbar button item opens the workbook if it’s not already open.



I cover custom toolbars in Chapter 22.

Executing a procedure by clicking an object

Excel provides a variety of objects that you can place on a worksheet or chart sheet, and you can attach a macro to any of these objects. These objects are available from three toolbars:

- ♦ The Drawing toolbar
- ♦ The Forms toolbar
- ♦ The Control Toolbox toolbar

In addition, you can assign a macro to pictures that you place on the worksheet using the Insert ⇨ Picture command. Right-click the picture and choose Assign Macro.

Why Call Other Procedures?

If you're new to programming, you may wonder why anyone would ever want to call a procedure from another procedure. You may ask, "Why not just put the code from the called procedure into the calling procedure and keep things simple?"

One reason is to clarify your code. The simpler your code, the easier it is to maintain and modify. Smaller routines are easier to decipher and then debug. Examine the accompanying procedure, which does nothing but call other procedures. This procedure is very easy to follow.

```
Sub Main()  
    Call GetUserOptions  
    Call ProcessData  
    Call CleanUp  
    Call CloseItDown  
End Sub
```

Calling other procedures also eliminates redundancy. Suppose that you need to perform an operation at ten different places in your routine. Rather than enter the code ten times, you can write a procedure to perform the operation and then simply call the procedure ten times.

Also, you may have a series of general-purpose procedures that you use frequently. If you store these in a separate module, you can import the module to your current project and then call these procedures as needed – which is much easier than copying and pasting the code into your new procedures.

Creating several small procedures rather than a single large one is often considered good programming practice. A modular approach not only makes your job easier, but also makes life easier for the people who wind up working with your code.

**Note**

The Control Toolbox toolbar contains ActiveX controls, which are the same controls that you use in a UserForm. The Forms toolbar, included for compatibility purposes, contains similar controls (which are not ActiveX controls). The controls on the Forms toolbar were designed for Excel 5 and Excel 95. However, they can still be used in later versions (and may be preferable in some cases). The discussion that follows applies to the Button control on the Forms toolbar. Refer to Chapter 13 for information about using ActiveX controls on worksheets.

To assign a procedure to a `Button` object (which is on the Forms toolbar), follow these steps:

1. Make sure the Forms toolbar is displayed.
2. Click the Button tool on the Forms toolbar.
3. Drag in the worksheet to create the button.

**Tip**

If you press Alt while dragging, the button will conform to the sheet's gridlines. Or, press Shift while dragging to force a perfectly square button.

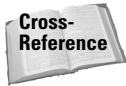
Excel jumps right in and displays the Assign Macro dialog box. Select the macro you want to assign to the button, and click OK.

To assign a macro to a shape, create a shape using the Drawing toolbar. Right-click the shape and choose Assign Macro from the shortcut menu.

Executing a procedure when an event occurs

You might want a procedure to be executed when a particular event occurs. Examples of events include opening a workbook, entering data into a worksheet, saving a workbook, clicking a `CommandButton` control, and many others. A procedure that is executed when an event occurs is known as an *event-handler* procedure. Event-handler procedures are characterized by the following:

- ♦ They have special names that are made up of an object, an underscore, and the event name. For example, the procedure that is executed when a workbook is opened is called `Workbook_Open`.
- ♦ They are stored in the code window for the particular object.

**Cross-Reference**

Chapter 19 is devoted to event-handler procedures.

Executing a procedure from the Immediate window

You also can execute a procedure by entering its name in the Immediate window of the VBE. If the Immediate window is not visible, press Ctrl+G. The Immediate window executes VBA statements as you enter them. To execute a procedure, simply enter the name of the procedure in the Immediate window and press Enter.

This method can be quite useful when you're developing a procedure because you can insert commands to display results in the Immediate window. The following procedure demonstrates this technique:

```
Sub ChangeCase()  
    MyString = "This is a test"  
    MyString = UCase(MyString)  
    Debug.Print MyString  
End Sub
```

Figure 9-5 shows what happens when you enter `ChangeCase` in the Immediate window: The `Debug.Print` statement displays the result immediately.

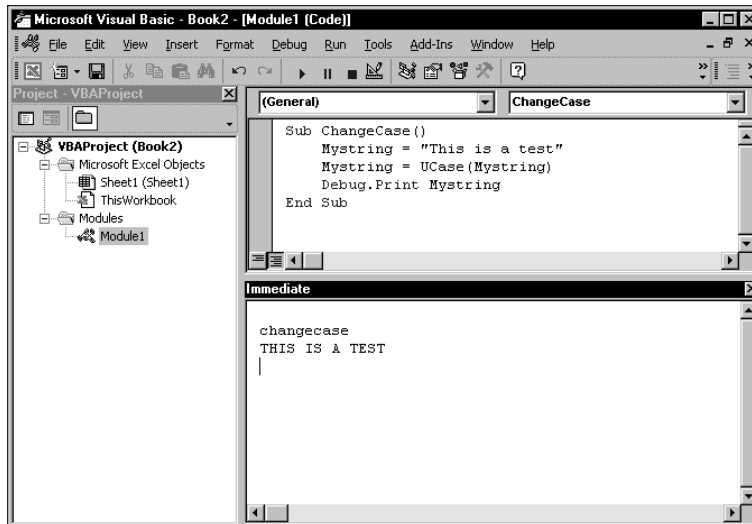


Figure 9-5: Executing a procedure by entering its name in the Immediate window

Passing Arguments to Procedures

A procedure's *arguments* provide it with data that it uses in its instructions. The data that's *passed* by an argument can be any of the following:

- ♦ A variable
- ♦ A constant
- ♦ An array
- ♦ An object

With regard to arguments, procedures are very similar to worksheet functions in the following respects:

- ♦ A procedure may not require any arguments.
- ♦ A procedure may require a fixed number of arguments.
- ♦ A procedure may accept an indefinite number of arguments.
- ♦ A procedure may require some arguments, leaving others optional.
- ♦ A procedure may have all optional arguments.

For example, a few of Excel's worksheet functions such as `RAND` use no arguments. Others, such as `COUNTIF`, require two arguments. Others still, such as `SUM`, can use an indefinite number of arguments (up to 30). Still other worksheet functions have

optional arguments. The `PMT` function, for example, can have five arguments (three are required, two are optional).

Most of the procedures that you've seen so far in this book have been declared without any arguments. They were declared with just the `Sub` keyword, the procedure's name, and a set of empty parentheses. Empty parentheses indicate that the procedure does not accept arguments.

The following example shows two procedures. The `Main` procedure calls the `ProcessFile` procedure three times (the `Call` statement is in a `For-Next` loop). Before calling `ProcessFile`, however, a three-element array is created. Inside the loop, each element of the array becomes the argument for the procedure call. The `ProcessFile` procedure takes one argument (named `TheFile`). Notice that the argument goes inside parentheses in the `Sub` statement. When `ProcessFile` finishes, program control continues with the statement after the `Call` statement.

```
Sub Main()  
    File(1) = "dept1.xls"  
    File(2) = "dept2.xls"  
    File(3) = "dept3.xls"  
    For i = 1 To 3  
        Call ProcessFile(File(i))  
    Next i  
End Sub  
  
Sub ProcessFile(TheFile)  
    Workbooks.Open FileName:=TheFile  
    ' ...[more code here]...  
End Sub
```

You can also, of course, pass literals (that is, not variables) to a procedure. For example,

```
Sub Main()  
    Call ProcessFile("budget.xls")  
End Sub
```

You can pass an argument to a procedure two ways: by reference and by value. Passing an argument by reference (the default method) simply passes the memory address of the variable. Passing an argument by value, on the other hand, passes a *copy* of the original variable. Consequently, changes to the argument within the procedure are not reflected in the original variable.

The following example demonstrates this concept. The argument for the `Process` procedure is passed by reference (the default method). After the `Main` procedure assigns a value of 10 to `MyValue`, it calls the `Process` procedure and passes `MyValue` as the argument. The `Process` procedure multiplies the value of its argument (named `YourValue`) by 10. When `Process` ends and program control passes back to `Main`, the `MsgBox` function displays `MyValue: 100`.

```
Sub Main()  
    MyValue = 10  
    Call Process(MyValue)  
    MsgBox MyValue  
End Sub  
  
Sub Process(YourValue)  
    YourValue = YourValue * 10  
End Sub
```

If you don't want the called procedure to modify any variables passed as arguments, you can modify the called procedure's argument list so that arguments are passed to it *by value* rather than *by reference*. To do so, precede the argument with the `ByVal` keyword. This technique causes the called routine to work with a copy of the passed variable's data, not the data itself. In the following procedure, for example, the changes made to `YourValue` in the `Process` procedure do not affect the `MyValue` variable in `Main`. As a result, the `MsgBox` function displays 10, not 100.

```
Sub Process(ByVal YourValue)  
    YourValue = YourValue * 10  
End Sub
```

In most cases, you'll be content to use the default reference method of passing arguments. However, if your procedure needs to use data passed to it in an argument — and you absolutely must keep the original data intact — you'll want to pass the data by value.

A procedure's arguments can mix and match by value and by reference. Arguments preceded with `ByVal` are passed by value; all others are passed by reference.

**Note**

If you pass a variable defined as a user-defined data type to a procedure, it must be passed by reference. Attempting to pass it by value generates an error.

Because I didn't declare a data type for any of the arguments in the preceding examples, all the arguments have been of the `Variant` data type. But a procedure that uses arguments can define the data types directly in the argument list. The following is a `Sub` statement for a procedure with two arguments of different data types. The first is declared as an integer, and the second is declared as a string.

```
Sub Process(Iterations As Integer, TheFile As String)
```

When you pass arguments to a procedure, it's important that the data that is passed as the argument matches the argument's data type. For example, if you call `Process` in the preceding example and pass a string variable for the first argument, you get an error: *ByRef argument type mismatch*.

**Note**

Arguments are relevant to both `Sub` procedures and `Function` procedures. In fact, arguments are more often used in `Function` procedures. In Chapter 10, where I focus on `Function` procedures, I provide additional examples of using arguments with your routines, including how to handle optional arguments.

Public Variables versus Passing Arguments to a Procedure

In Chapter 8, I pointed out how a variable declared as `Public` (at the top of the module) is available to all procedures in the module. In some cases, you may want to access a `Public` variable rather than pass the variable as an argument when calling another procedure.

For example, the procedure that follows passes the value of `MonthVal` to the `ProcessMonth` procedure:

```
Sub MySub()  
    Dim MonthVal as Integer  
    ' ... [code goes here]  
    MonthVal = 4  
    Call ProcessMonth(MonthVal)  
    ' ... [code goes here]  
End Sub
```

An alternative approach is:

```
Public MonthVal as Integer  
  
Sub MySub()  
    ' ... [code goes here]  
    MonthVal = 4  
    Call ProcessMonth  
    ' ... [code goes here]  
End Sub
```

In the revised code, because `MonthVal` is a public variable, the `ProcessMonth` procedure can access it, eliminating the need for an argument for the `ProcessMonth` procedure.

Error-Handling Techniques

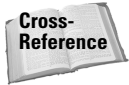
When a VBA procedure is running, errors can occur, as you undoubtedly know. These include either syntax errors (which you must correct before you can execute a procedure) or runtime errors (which occur while the procedure is running). This section deals with runtime errors.



For error-handling procedures to work, the `Break on All Errors` setting *must* be turned off. In the VBE, select `Tools` ⇨ `Options` and click the `General` tab in the `Options` dialog box. If `Break on All Errors` is selected, VBA ignores your error-handling code. You'll usually want to use the `Break on Unhandled Errors` option.

Normally, a runtime error causes VBA to stop, and the user sees a dialog box that displays the error number and a description of the error. A good application doesn't make the user deal with these messages. Rather, it incorporates error-handling

code to trap errors and take appropriate actions. At the very least, your error-handling code can display a more meaningful error message than the one popped up by VBA.



Appendix C lists all the VBA error codes and descriptions.

Trapping errors

You can use the `On Error` statement to specify what happens when an error occurs. Basically, you have two choices:

- ♦ Ignore the error, and let VBA continue. You can later examine the `Err` object to determine what the error was, and take action if necessary.
- ♦ Jump to a special error-handling section of your code to take action. This section is placed at the end of the procedure, and marked by a label.

To cause your VBA code to continue when an error occurs, insert the following statement in your code:

```
On Error Resume Next
```

Some errors are inconsequential, and can simply be ignored. But you may want to determine what the error was. When an error occurs, you can use the `Err` object to determine the error number. VBA's `Error` function can be used to display the text for `Err.Value`, which defaults to just `Err`. For example, the following statement displays the same information as the normal Visual Basic error dialog box (the error number and the error description):

```
MsgBox "Error" & Err & ": " & Error(Err)
```

Figure 9-6 shows a VBA error message, and Figure 9-7 shows the same error displayed in a message box. You can, of course, make the error message a bit more meaningful to your end users by using more descriptive text.



Referencing `Err` is equivalent to accessing the `Number` property of the `Err` object. Therefore, the following two statements have the same effect:

```
MsgBox Err  
MsgBox Err.Number
```

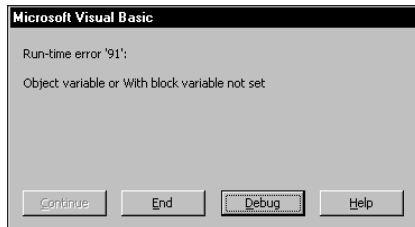



Figure 9-6: VBA's error messages aren't always user friendly.

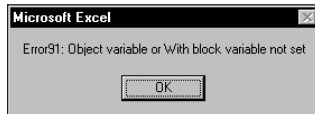


Figure 9-7: You can create a message box to display the error code and description.

You also use the `On Error` statement to specify a location in your procedure to jump to when an error occurs. You use a label to mark the location. For example,

```
On Error GoTo ErrorHandler
```

Error-handling examples

The first example demonstrates an error that can safely be ignored. The `SpecialCells` method selects cells that meet a certain criteria. (This method is equivalent to selecting the `Edit ⇨ Go To` command and clicking the `Special` button to select, for example, all cells that contain formulas.)

In the example that follows, the `SpecialCells` method selects all the cells in the current range selection that contain a formula that returns a number. Normally, if no cells in the selection qualify, VBA generates an error message. Using the `On Error Resume Next` statement simply prevents the error message from appearing.

```
Sub SelectFormulas()
    On Error Resume Next
    Selection.SpecialCells(xlFormulas, xlNumbers).Select
    On Error GoTo 0
End Sub
```

Notice that the `On Error GoTo 0` statement restores normal error handling before the procedure ends.

The following procedure uses an additional statement to determine if an error did occur:

```

Sub SelectFormulas2()
    On Error Resume Next
    Selection.SpecialCells(xlFormulas, xlNumbers).Select
    If Err <> 0 Then MsgBox "No formula cells were found."
    On Error GoTo 0
End Sub

```

If the value of `Err` is not equal to 0, an error occurred, and a message box displays a notice to the user.

The next example demonstrates error handling by jumping to a label.

```

Sub ErrorDemo()
    On Error GoTo Handler
    Selection.Value = 123
    Exit Sub
Handler:
    MsgBox "Cannot assign a value to the selection."
End Sub

```

The procedure attempts to assign a value to the current selection. If an error occurs (for example, a range is not selected or the sheet is protected), the assignment statement results in an error. The `On Error` statement specifies a jump to the `Handler` label if an error occurs. Notice the use of the `Exit Sub` statement before the label. This prevents the error-handling code from being executed if no error occurs. If this statement is omitted, the error message would be displayed even if an error did not occur.

Sometimes, you can take advantage of an error to get information. The example that follows simply checks to see whether a particular workbook is open. It does not use any error handling.

```

Sub CheckForFile1()
    FileName = "BUDGET.XLS"
    FileExists = False

    ' Cycle through all workbooks
    For Each book In Workbooks
        If UCase(book.Name) = FileName Then
            FileExists = True
        End If
    Next book

    ' Display appropriate message
    If FileExists Then _
        MsgBox FileName & " is open." Else _
        MsgBox FileName & " is not open."
End Sub

```

Here, a `For Each-Next` loop cycles through all objects in the `Workbooks` collection. If the workbook is open, the `FileExists` variable is set to `True`. Finally, a message is displayed that tells the user whether the workbook is open.

The preceding routine can be rewritten to use error handling to determine whether the file is open. In the example that follows, the `On Error Resume Next` statement causes VBA to ignore any errors. The next instruction attempts to reference the workbook by assigning the workbook to an object variable (using the `Set` keyword). If the workbook is not open, an error occurs. The `If-Then-Else` structure checks the `Value` property of `Err` and displays the appropriate message.

```
Sub CheckForFile()  
    Dim x as Workbook  
    FileName = "BUDGET.XLS"  
    On Error Resume Next  
    Set x = Workbooks(FileName)  
    If Err = 0 Then  
        MsgBox FileName & " is open."  
    Else  
        MsgBox FileName & " is not open."  
    End If  
    On Error GoTo 0  
End Sub
```



Chapter 11 presents several additional examples that use error handling.

A Realistic Example

In this chapter, I have provided you with the basic foundation for creating Sub procedures. Most of the previous examples, I will admit, have been rather wimpy. The remainder of this chapter is a real-life exercise that demonstrates many of the concepts covered in this and the preceding two chapters.

This section describes the development of a useful utility that qualifies as an application as defined in Chapter 5. More important, I demonstrate the *process* of analyzing a problem and then solving it with VBA. A word of warning to the more experienced users in the audience: I wrote this section with VBA newcomers in mind. As a result, I don't simply present the code, I also show how to find out what you need to know to develop the code.



The completed application can be found on the companion CD-ROM.

The goal

The goal of this exercise is to develop a utility that rearranges a workbook by alphabetizing its sheets (something Excel cannot do on its own). If you tend to create workbooks that consist of many sheets, you know that it can be difficult to locate a particular sheet. If the sheets are ordered alphabetically, though, it's much easier to find a desired sheet.

Project requirements

Where to begin? One way to get started is to list the requirements for your application. As you develop your application, you can check your list to ensure that you're covering all the bases.

Here's the list of requirements that I compiled for this example application:

1. It should sort the sheets (that is, worksheets and chart sheets) in the active workbook in ascending order of their names.
2. It should be easy to execute.
3. It should always be available. In other words, the user shouldn't have to open a workbook to use this utility.
4. It should work properly for any open workbook.
5. It should not display any VBA error messages.

What you know

Often, the most difficult part of a project is figuring out where to start. In this case, I started by listing things that I know about Excel that may be relevant to the project requirements:

- ♦ Excel doesn't have a command that sorts sheets. Therefore, recording a macro to alphabetize the sheets is out of the question.
- ♦ I can move a sheet easily by dragging its sheet tab.

Mental note: Turn on the macro recorder and drag a sheet to a new location to find out what kind of code this action generates.

- ♦ I'll need to know how many sheets are in the active workbook. I can get this information with VBA.
- ♦ I'll need to know the names of all the sheets. Again, I can get this information with VBA.
- ♦ Excel has a command that sorts data in worksheet cells.

Mental note: Maybe I can transfer the sheet names to a range and use this feature. Or, maybe VBA has a sorting method that I can take advantage of.

- ♦ Thanks to the Macro Options dialog box, it's easy to assign a shortcut key to a macro.
- ♦ If a macro is stored in the Personal Macro Workbook, it will always be available.
- ♦ I need a way to test the application as I develop it. For certain, I don't want to be testing it using the same workbook in which I'm developing the code.

Mental note: Create a dummy workbook for testing purposes.

♦ If I develop the code properly, VBA won't display any errors.

Mental note: Wishful thinking . . .

The approach

Although I still didn't know exactly how to proceed, I could devise a preliminary, skeleton plan that describes the general tasks required:

1. Identify the active workbook.
2. Get a list of all the sheet names in the workbook.
3. Count the sheets.
4. Sort them (somehow).
5. Rearrange the sheets in the sorted order.

What you need to know

I saw a few holes in the plan. I knew that I had to determine the following:

- ♦ How to identify the active workbook
- ♦ How to count the sheets in the active workbook
- ♦ How to get a list of the sheet names
- ♦ How to sort the list
- ♦ How to rearrange the sheets according to the sorted list



Tip

When you lack critical information about specific methods or properties, you can consult this book or the online help. You may eventually discover what you need to know. Your best bet, however, is to turn on the macro recorder and see what it spits out when you perform some relevant actions.

Some preliminary recording

Here's an example of using the macro recorder to learn about VBA. I started with a workbook that contained three worksheets. Then I turned on the macro recorder and specified my Personal Macro Workbook as the destination for the macro. With the macro recorder running, I dragged the third worksheet to the first sheet position. Here's what the macro recorder spat out:

```
Sub Macro1()  
    Sheets("Sheet3").Select  
    Sheets("Sheet3").Move Before:=Sheets(1)  
End Sub
```

I searched the online help for *Move*, and discovered that it's a method that moves a sheet to a new location in the workbook. It also takes an argument that specifies the location for the sheet. Very relevant to the task at hand.

Next I needed to find out how many sheets were in the active workbook. I searched for the word *Count* and found out that it's a property of a collection. I activated the Immediate window in the VBE and typed the following statement:

```
? ActiveWorkbook.Count
```

Error! After a little more thought, I realized that I needed to get a count of the sheets within a workbook. So I tried this:

```
? ActiveWorkbook.Sheets.Count
```

Success. Figure 9-8 shows the result. More useful information.

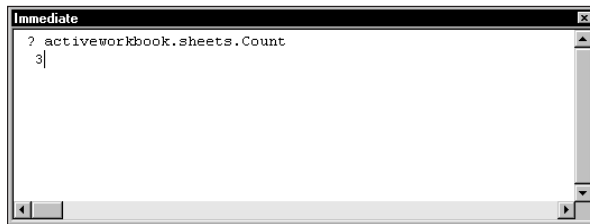


Figure 9-8: Using VBE's Immediate window to test a statement

What about the sheet names? Time for another test. I entered the following statement in the Immediate window:

```
? ActiveWorkbook.Sheets(1).Name
```

This told me that the name of the first sheet is *Sheet3*, which is correct. More good information to keep in mind.

Then I remembered something about the *For Each-Next* construct: It is useful for cycling through each member of a collection. After consulting the online help, I created a short procedure to test it:

```
Sub Test()  
    For Each Sht In ActiveWorkbook.Sheets  
        MsgBox Sht.Name  
    Next Item  
End Sub
```

Another success. This macro displayed three message boxes, each showing a different sheet name.

Finally, it was time to think about sorting options. From the online help, I learned that the `Sort` method applies to a `Range` object. So one option was to transfer the sheet names to a range and then sort the range, but that seemed like overkill for this application. I thought a better option was to dump the sheet names into an array of strings and then sort the array by using VBA code.

Initial setup

Now I knew enough to get started writing some serious code. Before doing so, however, I needed to do some initial setup work. To re-create my steps, follow these instructions:

1. Create an empty workbook with five worksheets, named **Sheet1**, **Sheet2**, **Sheet3**, **Sheet4**, and **Sheet5**.
2. Move the sheets around randomly so that they aren't in any particular order.
3. Save the workbook as **Test.xls**.
4. Activate the VBE and select the **Personal.xls** project in the Project Window.

If **Personal.xls** doesn't appear in the Project window in the VBE, this means that you've never used the Personal Macro Workbook. To have Excel create this workbook for you, simply record a macro (any macro) and specify the Personal Macro Workbook as the destination for the macro.

5. Insert a new VBA module (use the Insert ⇄ Module command).
6. Create an empty procedure called `SortSheets` (see Figure 9-9).

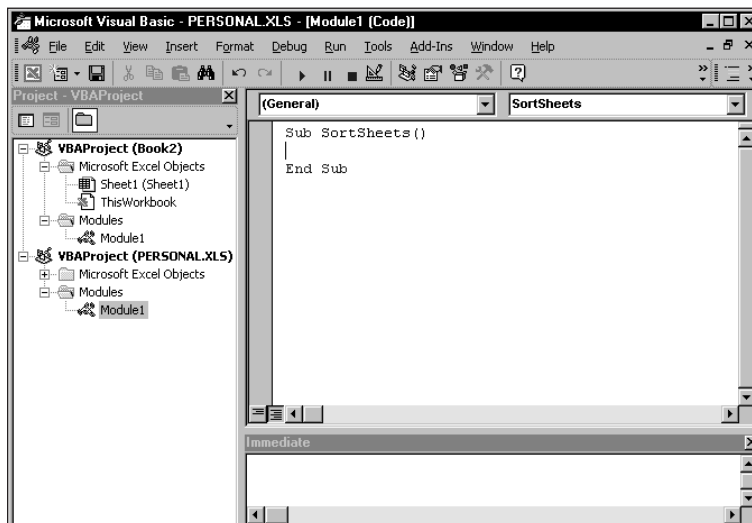


Figure 9-9: An empty procedure in a module located in the Personal Macro Workbook

Actually, you can store this macro in any module in the Personal Macro Workbook. However, it's a good idea to keep each macro in a separate module. That way, you can easily export the module and import it into a different project later on.

7. Activate Excel. Use the Tools ⇨ Macro ⇨ Macros command (Options button) to assign a shortcut key to this macro. The Ctrl+Shift+S key combination is a good choice.

Code writing

Now it's time to write some code. I knew that I needed to put the sheet names into an array of strings. Because I won't know yet how many sheets are in the active workbook, I used a `Dim` statement with empty parentheses to declare the array. I knew that I could use `ReDim` afterward to redimension the array for the proper number of elements.

I entered the following code, which inserts the sheet names into the `SheetNames` array. I also added a `MsgBox` function within the loop just to assure me that the sheets' names were indeed being entered into the array.

```
Sub SortSheets()  
    Dim SheetNames() as String  
    Dim i as Integer  
    Dim SheetCount as Integer  
    SheetCount = ActiveWorkbook.Sheets.Count  
    ReDim SheetNames(1 To SheetCount)  
    For i = 1 To SheetCount  
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name  
        MsgBox SheetNames(i)  
    Next i  
End Sub
```

To test the preceding code, I activated the `Text.xls` workbook and pressed Ctrl+Shift+S. Five message boxes appeared, each displaying the name of a sheet in the active workbook.

I'm a major proponent of testing your work as you go. When you're convinced that your code is working correctly, remove the `MsgBox` statement (these message boxes become annoying after a while).



Tip

Rather than use the `MsgBox` function to test your work, you can use the `Print` method of the `Debug` object to display information in the Immediate window. For this example, use the following statement in place of the `MsgBox` statement:

```
Debug.Print SheetNames(i)
```

You may find this technique less intrusive than using `MsgBox` statements.

At this point, the `SortSheets` procedure simply creates an array of sheet names, corresponding to the sheets in the active workbook. Two steps remain: Sort the

values in the `SheetNames` array, and then rearrange the sheets to correspond to the sorted array.

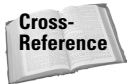
Sort procedure writing

It was time to sort the `SheetNames` array. One option was to insert the sorting code in the `SortSheets` procedure, but I thought a better approach was to write a general-purpose sorting procedure that I could reuse with other projects (sorting arrays is a common operation).

You may be a bit daunted by the thought of writing a sorting procedure. The good news is that it's relatively easy to find commonly used routines that you can use or adapt. The Internet, of course, is a great source for such information.

You can sort an array in many ways. I chose the *bubble sort* method; although it's not a particularly fast technique, it's easy to code. Blazing speed is not really a necessary factor in this particular application.

The bubble sort method uses a nested `For-Next` loop to evaluate each array element. If the array element is greater than the next element, the two elements swap positions. This evaluation is repeated for every pair of items (that is, $n-1$ times).



In Chapter 11, I present some other sorting routines and compare them in terms of speed.

Here's the sorting procedure I developed:

```
Sub BubbleSort(List() As String)
' Sorts the List array in ascending order
Dim First As Integer, Last As Integer
Dim i As Integer, j As Integer
Dim Temp As String
First = LBound(List)
Last = UBound(List)
For i = First To Last - 1
    For j = i + 1 To Last
        If List(i) > List(j) Then
            Temp = List(j)
            List(j) = List(i)
            List(i) = Temp
        End If
    Next j
Next i
End Sub
```

This procedure accepts one argument: a one-dimensional array named `List`. An array passed to a procedure can be of any length. I used the `LBound` and `UBound` functions to define the lower bound and upper bound of the array to the variables `First` and `Last`, respectively.

After I was satisfied that this procedure worked reliably, I modified `SortSheets` by adding a call to the `BubbleSort` procedure, passing the `SheetNames` array as an argument. At this point, my module looked like this:

```
Sub SortSheets()  
    Dim SheetNames() As String  
    Dim SheetCount as Integer  
    Dim i as Integer  
    SheetCount = ActiveWorkbook.Sheets.Count  
    ReDim SheetNames(1 To SheetCount)  
    For i = 1 To SheetCount  
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name  
    Next i  
    Call BubbleSort(SheetNames)  
End Sub  
  
Sub BubbleSort(List() As String)  
    Dim First As Integer, Last As Integer  
    Dim i As Integer, j As Integer  
    Dim Temp As String  
    First = LBound(List)  
    Last = UBound(List)  
    For i = First To Last - 1  
        For j = i + 1 To Last  
            If List(i) > List(j) Then  
                Temp = List(j)  
                List(j) = List(i)  
                List(i) = Temp  
            End If  
        Next j  
    Next i  
End Sub
```

When the `SheetSort` procedure ends, it contains an array that consists of the sorted sheet names in the active workbook. To verify this, you can display the array contents in the Debug window by adding the following code at the end of the `SortSheets` procedure:

```
    For i = 1 To SheetCount  
        Debug.Print SheetNames(i)  
    Next i
```

So far, so good. Now I merely had to write some code to rearrange the sheets to correspond to the sorted items in the `SheetNames` array.

The code that I recorded earlier, again proved useful. Remember the instruction that was recorded when I moved a sheet to the first position in the workbook?

```
Sheets("Sheet3").Move Before:=Sheets(1)
```

After a little thought, I was able to write a For-Next loop that would go through each sheet and move it to its corresponding sheet location, specified in the SheetNames array:

```
For i = 1 To SheetCount
    Sheets(SheetNames(i)).Move Before:=Sheets(i)
Next i
```

For example, the first time through the loop, the loop counter (i) is 1. The first element in the SheetNames array is (in this example) *Sheet1*. Therefore, the expression for the Move method within the loop evaluates to:

```
Sheets("Sheet1").Move Sheets(1)
```

The second time through the loop, the expression evaluates to:

```
Sheets("Sheet2").Move Sheets(2)
```

I then added the new code to the SortSheets procedure:

```
Sub SortSheets()
    SheetCount = ActiveWorkbook.Sheets.Count
    ReDim SheetNames(1 To SheetCount)
    For i = 1 To SheetCount
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name
    Next i
    Call BubbleSort(SheetNames)
    For i = 1 To SheetCount
        ActiveWorkbook.Sheets(SheetNames(i)).Move _
            Before:=ActiveWorkbook.Sheets(i)
    Next i
End Sub
```

I did some testing and it seemed to work just fine for the Test.xls workbook.

Time to clean things up. I declared all the variables used in the procedures, and then added a few comments and blank lines to make the code easier to read. The SortSheets procedure now looked like the following:

```
Sub SortSheets()
    ' This routine sorts the sheets of the
    ' active workbook in ascending order.

    Dim SheetNames() As String
    Dim SheetCount As Integer
    Dim i As Integer

    ' Determine the number of sheets & ReDim array
    SheetCount = ActiveWorkbook.Sheets.Count
    ReDim SheetNames(1 To SheetCount)
```

```
' Fill array with sheet names
For i = 1 To SheetCount
    SheetNames(i) = ActiveWorkbook.Sheets(i).Name
Next i

' Sort the array in ascending order
Call BubbleSort(SheetNames)

' Move the sheets
For i = 1 To SheetCount
    ActiveWorkbook.Sheets(SheetNames(i)).Move _
        ActiveWorkbook.Sheets(i)
Next i
End Sub
```

Everything seemed to be working. To test the code further, I added a few more sheets to *Test.xls* and changed some of the sheet names. It worked like a charm!

More testing

I was tempted to call it a day. However, the fact that the procedure worked with the *Test.xls* workbook didn't mean that it would work with all workbooks. To test it further, I loaded a few other workbooks and retried the routine. I soon discovered that the application was not perfect. In fact, it was far from perfect. I identified the following problems:

- ♦ Workbooks with many sheets took a long time to sort because the screen was continually updated during the move operations.
- ♦ The sorting didn't always work. For example, in one of my tests, a sheet named *SUMMARY* (all uppercase) appeared before a sheet named *Sheet1*. This problem was caused by the `BubbleSort` procedure (an uppercase U is "greater than" a lower case H).
- ♦ If there were no visible workbook windows, pressing the `Ctrl+Shift+S` shortcut key combo caused the macro to fail.
- ♦ If the workbook's structure was protected, the `Move` method failed.
- ♦ The `Move` method does not work properly if sheets are hidden. The sheet is actually moved before the first nonhidden sheet. This unexpected behavior is not documented, so we can only conclude that it is a bug in Excel.
- ♦ After sorting, the last sheet in the workbook became the active sheet. Changing the active sheet is not a good practice; it's better to keep the user's original sheet active.
- ♦ If I interrupted the macro by pressing `Ctrl+Break`, VBA displayed an error message.

Fixing the problems

Fixing the screen-updating problem was a breeze. I inserted the following instruction at the beginning of `SortSheets` to turn screen updating off:

```
Application.ScreenUpdating = False
```

It was also easy to fix the problem with the `BubbleSort` procedure: I used VBA's `UCase` function to convert the sheet names to uppercase. That way, all the comparisons were made using uppercase versions of the sheet names. The corrected line read as follows:

```
If UCase(List(i)) > UCase(List(j)) Then
```



Tip

Another way to solve the “case” problem is to add the following statement to the top of your module:

```
Option Text Compare
```

This statement causes VBA to perform string comparisons based on a case-insensitive text sort order. In other words, *A* is considered the same as *a*.

To prevent the error message that appears when no workbooks are visible, I added some error checking. If no active workbook exists, an error occurred. I used `On Error Resume Next` to ignore the error, and then checked the value of `Err`. If `Err` is not equal to 0, it means that an error occurred. Therefore, the procedure ends. The error-checking code is:

```
On Error Resume Next
SheetCount = ActiveWorkbook.Sheets.Count
If Err <> 0 Then Exit Sub ' No active workbook
```

It occurred to me that I could avoid using `On Error Resume Next`. The following statement is a more direct approach to determining whether a workbook is not visible and doesn't require any error handling:

```
If ActiveWorkbook Is Nothing Then Exit SubOp
```

There's usually a good reason that a workbook's structure is protected. I decided that the best approach was to not attempt to unprotect the workbook. Rather, the code should display a message box warning and let the user unprotect the workbook and re-execute the macro. Testing for a protected workbook structure was easy—the `ProtectStructure` property of a `Workbook` object returns `True` if a workbook is protected. I added the following block of code:

```
' Check for protected workbook structure
If ActiveWorkbook.ProtectStructure Then
    MsgBox ActiveWorkbook.Name & " is protected.", _
        vbCritical, "Cannot Sort Sheets."
Exit Sub
End If
```

Dealing with the problem that occurs with hidden sheets is tricky. One solution is to use an array to keep track of each sheet's hidden status (which is determined by its `Visible` property). Then, write code to unhide the sheets, and re-hide them after the sorting is done. I defined a new array (`SheetHidden`) and used this code to identify the hidden sheets, and unhide them:

```
' Fill array with hidden status of sheets
  For i = 1 To SheetCount
    SheetHidden(i) = Not ActiveWorkbook.Sheets(i).Visible
  ' unhide hidden sheets
    If SheetHidden(i) Then ActiveWorkbook.Sheets(i).Visible
= True
  Next i
```

Then, when the sorting was finished, I used this code to re-hide the sheets that were originally hidden:

```
' Re-hide sheets
  For i = 1 To SheetCount
    If SheetHidden(i) Then ActiveWorkbook.Sheets(i).Visible
= False
  Next i
```

Because screen updating is turned off, un hiding and re-hiding the sheets takes place “transparently.”

To reactivate the original active sheet after the sorting was performed, I wrote code that assigned the original sheet to an object variable (`OldActive`), and then activated that sheet when the routine was finished.

Pressing `Ctrl+Break` normally halts a macro, and VBA usually displays an error message. But because one of my goals was to avoid VBA error messages, I needed to insert a command to prevent this situation. From the online help, I discovered that the `Application` object has an `EnableCancelKey` property that can disable `Ctrl+Break`. So I added the following statement at the top of the routine:

```
Application.EnableCancelKey = xlDisabled
```



Caution

Be very careful when you disable the cancel key. If your code gets caught in an infinite loop, there is no way to break out of it. For best results, insert this statement only after you're sure everything is working properly.

After I made all these corrections, the `SortSheets` procedure looked like Listing 9-1.

Listing 9-1: The final build for the SortSheets procedure

```

Sub SortSheets()
'   This routine sorts the sheets of the
'   active workbook in ascending order.

    Dim SheetNames() As String
    Dim SheetHidden() As Boolean
    Dim i As Integer
    Dim SheetCount As Integer
    Dim VisibleWins As Integer
    Dim Item As Object
    Dim OldActive As Object

    If ActiveWorkbook Is Nothing Then Exit Sub ' No active
workbook
    SheetCount = ActiveWorkbook.Sheets.Count

'   Check for protected workbook structure
    If ActiveWorkbook.ProtectStructure Then
        MsgBox ActiveWorkbook.Name & " is protected.", _
            vbCritical, "Cannot Sort Sheets."
        Exit Sub
    End If

'   Disable Ctrl+Break
    Application.EnableCancelKey = xlDisabled

'   Get the number of sheets
    SheetCount = ActiveWorkbook.Sheets.Count

'   Redimension the arrays
    ReDim SheetNames(1 To SheetCount)
    ReDim SheetHidden(1 To SheetCount)

'   Store a reference to the active sheet
    Set OldActive = ActiveSheet

'   Fill array with sheet names
    For i = 1 To SheetCount
        SheetNames(i) = ActiveWorkbook.Sheets(i).Name
    Next i

'   Fill array with hidden status of sheets
    For i = 1 To SheetCount
        SheetHidden(i) = Not ActiveWorkbook.Sheets(i).Visible
'   unhide hidden sheets
        If SheetHidden(i) Then ActiveWorkbook.Sheets(i).Visible
= True
    Next i

```

Continued

Listing 9-1 (continued)

```
' Sort the array in ascending order
Call BubbleSort(SheetNames)

' Turn off screen updating
Application.ScreenUpdating = False

' Move the sheets
For i = 1 To SheetCount
    ActiveWorkbook.Sheets(SheetNames(i)).Move _
        Before:=ActiveWorkbook.Sheets(i)
Next i

' Re-hide sheets
For i = 1 To SheetCount
    If SheetHidden(i) Then ActiveWorkbook.Sheets(i).Visible
= False
Next i

' Reactivate the original active sheet
OldActive.Activate
End Sub
```

Utility availability

Because the `SortSheets` macro is stored in the Personal Macro Workbook, it is available whenever Excel is running. At this point, the macro can be executed by selecting the macro's name from the Macro dialog box (Alt+F8 displays this dialog box), or by pressing Ctrl+Shift+F8.

If you like, you can also assign this macro to a new toolbar button or to a new menu item. Procedures for doing this are described earlier in this chapter.

Evaluating the project

So there you have it. The utility meets all the original project requirements: It sorts all sheets in the active workbook, it can be executed easily, it's always available, it seems to work for any workbook, and I have yet to see it display a VBA error message.

**Note**

The procedure still has one slight problem: The sorting is strict and may not always be "logical." For example, after sorting, Sheet11 is placed before Sheet2. Most would want Sheet2 to be listed before Sheet11.



The companion CD-ROM contains another version of the sheet sorting utility that overcomes the problem described above—in most cases. This version of the utility parses the sheet names into two components: the left-most text and the right-most numbers (if any). The parsed data is stored on a worksheet, and the procedure uses Excel's built-in sorting to perform the sort using two sort keys. It's still not perfect because it won't properly sort a sheet with a name like *Sheet2Part1*.

In this exercise, I tried to demonstrate the process of developing VBA procedures—a valuable lesson even if you're not yet a VBA veteran. I communicated the following points:

- ♦ Developing a successful procedure is not necessarily a linear process.
- ♦ It's often useful to use short procedures or the Immediate window to test ideas or approaches before incorporating them into your work.
- ♦ Even though a procedure appears to work correctly, appearances can be deceiving. Therefore, it's important to test your work in a realistic situation. For example, despite lots of testing on my part, it took someone else to identify the problem that may occur when sheets are hidden.
- ♦ You can learn a lot by recording your actions and studying the code that is recorded. Although I didn't actually use any of the recorded code, I learned several things by examining the code.
- ♦ A project's original requirements aren't always complete. In this example, I didn't think to require that the original active sheet remain the active sheet after the sorting.

Summary

In this chapter, I presented a comprehensive list of ways to execute Sub procedures, and I described how to use arguments. I also gave an example of developing and debugging procedures.

In the next chapter, I focus on the other type of VBA procedures: Function procedures.



Creating Function Procedures

VBA enables you to create Sub procedures and Function procedures. I covered Sub procedures in the preceding chapter, and in this chapter I discuss Function procedures.



Chapter 11 has many useful and practical examples of Function procedures. You can incorporate many of those techniques into your work.

Sub Procedures versus Function Procedures

You can think of a Sub procedure as a command that can be executed either by the user or by another procedure. Function procedures, on the other hand, usually return a single value (or an array), just as Excel's worksheet functions and VBA's built-in functions do. As with built-in functions, your Function procedures can use arguments.

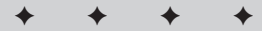
Function procedures are quite versatile and can be used in two situations:

- ◆ As part of an expression in a VBA procedure
- ◆ In formulas that you create in a worksheet

In fact, you can use a Function procedure anywhere that you can use an Excel worksheet function or a VBA built-in function.

10

CHAPTER



In This Chapter

The difference between Sub procedures and Function procedures

How to create custom functions

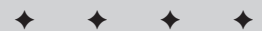
About Function procedures and function arguments

Examples, examples, examples

How to create a function that emulates Excel SUM function

How to debug functions, deal with the Paste Function dialog box, and use add-ins to store custom functions

How to call the Windows API (Application Programming Interface) to perform otherwise impossible feats



Why Create Custom Functions?

You are undoubtedly familiar with Excel's worksheet functions; even novices know how to use the most common worksheet functions, such as `SUM`, `AVERAGE`, and `IF`. By my count, Excel contains more than 300 predefined worksheet functions, plus additional functions available through the Analysis Toolpak add-in. If that's not enough, however, you can create custom functions by using VBA.

With all the functions available in Excel and VBA, you may wonder why you would ever need to create new functions. The answer: to simplify your work. With a bit of planning, custom functions are very useful in worksheet formulas and VBA procedures.

Often, for example, you can create a custom function that can significantly shorten your formulas. And shorter formulas are more readable and easier to work with. I should also point out, however, that custom functions used in your formulas are usually much slower than built-in functions.

As you create applications, you may notice that some procedures repeat certain calculations. In such a case, consider creating a custom function that performs the calculation. Then you can simply call the function from your procedure. A custom function thus can eliminate the need for duplicated code, reducing errors.

Co-workers often can benefit from your specialized functions. And some may be willing to pay you for custom functions that save them time and work.

Although many cringe at the thought of creating custom worksheet functions, the process is not difficult. In fact, I *enjoy* creating custom functions. I especially like how my custom functions appear in the Paste Function dialog box along with Excel's built-in functions, as if I'm reengineering the software in some way.

In this chapter, I tell you what you need to know to start creating custom functions, and I provide lots of examples.

An Introductory Example

Without further ado, here's an example of a VBA Function procedure.

A custom function

The following is a custom function defined in a VBA module. This function, named `Reverse`, uses a single argument. The function reverses the characters in its argument (so that it reads backwards), and returns the result as a string.

```

Function Reverse(InString) As String
' Returns its argument, reversed
  Dim i as Integer, StringLength as Integer
  Reverse = ""
  StringLength = Len(InString)
  For i = StringLength To 1 Step -1
    Reverse = Reverse & Mid(InString, i, 1)
  Next i
End Function

```

I explain how this function works later, in the “Analyzing the custom function” section.



Caution

When you create custom functions that will be used in a worksheet formula, make sure that the code resides in a normal VBA module. If you place your custom functions in a code module for a Sheet or ThisWorkbook, they will not work in your formulas.

Using the function in a worksheet

When you enter a formula that uses the `Reverse` function, Excel executes the code to get the value. Here’s an example of how you would use the function in a formula:

```
=Reverse(A1)
```

See Figure 10-1 for examples of this function in action. The formulas are in column B, and they use the text in column A as their argument. As you can see, it returns its single argument, but its characters are in reverse order.

Actually, the function works pretty much like any built-in worksheet function. You can insert it in a formula by using the Insert ⇄ Function command or the Insert Function button (in the Insert Function dialog box, custom functions are located, by default, in the User Defined category).

	A	B
1	Microsoft Excel	lecxE tfoSorciM
2	Reversed Text	txeT dsreveR
3	NAIVE	EVIAN
4	Was it a rat I saw?	?was I tar a ti saW
5	43%	5434.0
6	TRUE	eurT
7	Never odd or even	neve ro ddo reveN
8		
9		

Figure 10-1: Using a custom function in a worksheet formula

You can also nest custom functions and combine them with other elements in your formulas. For example, the following (useless) formula uses the `Reverse` function twice. The result is the original string:

```
=Reverse(Reverse(A1))
```

Using the function in a VBA procedure

The following VBA procedure, which is defined in the same module as the custom `Reverse` function, first displays an input box to solicit some text from the user. Then the procedure uses VBA's built-in `MsgBox` function to display the user input after it's processed by the `Reverse` function (see Figure 10-2). The original input appears as the caption in the message box.

```
Sub ReverseIt()
    Dim userInput as String
    userInput = InputBox("Enter some text:")
    MsgBox Reverse(userInput), , userInput
End Sub
```

In the example shown in Figure 10-2, the string entered in response to the `InputBox` function was `Excel Power Programming With VBA`. The `MsgBox` function displays the reversed text.



Figure 10-2: Using a custom function in a VBA procedure

Analyzing the custom function

Function procedures can be as complex as you need. Most of the time, they are more complex and much more useful than this sample procedure. Nonetheless, an analysis of this example may help you understand what is happening.

Here's the code, again:

```
Function Reverse(InString) As String
    ' Returns its argument, reversed
    Dim i as Integer, StringLength as Integer
    Reverse = ""
    StringLength = Len(InString)
    For i = StringLength To 1 Step -1
        Reverse = Reverse & Mid(InString, i, 1)
    Next i
End Function
```

What Custom Worksheet Functions Can't Do

As you develop custom functions, it's important to understand a key distinction between functions that you call from other VBA procedures and functions that you use in worksheet formulas. Function procedures used in worksheet formulas must be "passive." For example, code within a Function procedure cannot manipulate ranges or change things on the worksheet. An example may make this clear.

You may be tempted to write a custom worksheet function that changes a cell's formatting. For example, it might be useful to have a formula that uses a custom function to change the color of text in a cell based on the cell's value. Try as you might, however, such a function is impossible to write. No matter what you do, the function will always return an error. Remember, a function simply returns a value. It cannot perform actions with objects.

Notice that the procedure starts with the keyword `Function`, rather than `Sub`, followed by the name of the function (`Reverse`). This custom function uses only one argument (`InString`), enclosed in parentheses. As `String` defines the data type of the function's return value. (Excel uses the variant data type if none is specified.)

The second line is simply a comment (optional) that describes what the function does. This is followed by a `Dim` statement for the two variables (`i` and `StringLength`) used in the procedure.

Then the procedure initializes the result as an empty string. Note that I use the function's name as a variable here. When a function ends, it always returns the current value of the variable that corresponds to the function's name.

Next, VBA's `Len` function determines the length of the input string and assigns this value to the `StringLength` variable.

The next three instructions make up a `For-Next` loop. The procedure loops through each character in the input (backwards) and builds the string. Notice that the `Step` value in the `For-Next` loop is a negative number, causing the looping to proceed in reverse. The instruction within the loop uses VBA's `Mid` function to return a single character from the input string. When the loop is finished, `Reverse` consists of the input string, with the characters rearranged in reverse order. This string is the value that the function returns.

The procedure ends with an `End Function` statement.

Function Procedures

A custom Function procedure has a lot in common with a Sub procedure. (For more information on Sub procedures, see Chapter 9.)

Declaring a function

The syntax for declaring a function is as follows:

```
[Public | Private][Static] Function name ([arglist])[As type]
    [instructions]
    [name = expression]
    [Exit Function]
    [instructions]
    [name = expression]
End Function
```

In which:

Public	(Optional) Indicates that the Function procedure is accessible to all other procedures in all other modules in all active Excel VBA projects.
Private	(Optional) Indicates that the Function procedure is accessible only to other procedures in the same module.
Static	(Optional) Indicates that the values of variables declared in the Function procedure are preserved between calls.
Function	(Required) Is the keyword that indicates the beginning of a procedure that returns a value or other data.
<i>name</i>	(Required) Represents any valid Function procedure name, which must follow the same rules as a variable name. When the function finishes, the result is assigned to its own name.
<i>arglist</i>	(Optional) Represents a list of one or more variables that represent arguments passed to the Function procedure. The arguments are enclosed in parentheses. Use a comma to separate pairs of arguments.
<i>type</i>	(Optional) Is the data type returned by the Function procedure.
<i>instructions</i>	(Optional) Are any number of valid VBA instructions.
Exit Function	(Optional) Is a statement that forces an immediate exit from the Function procedure prior to its completion.
End Function	(Required) Is a keyword that indicates the end of the Function procedure.

The main thing to remember about a custom function written in VBA is that a value is always assigned to its name a minimum of one time, generally when it has completed execution.

To create a custom function, start by inserting a VBA module. (Or you can use an existing module.) Enter the keyword `Function`, followed by the function's name and a list of its arguments (if any) in parentheses. You can also declare the data type of the return value by using the `As` keyword (this is optional, but recommended). Insert the VBA code that performs the work, and make sure that the appropriate value is assigned to the term corresponding to the function's name at least once within the body of the Function procedure. End the function with an `End Function` statement.

Function names must adhere to the same rules for variable names. If you plan to use your custom function in a worksheet formula, make sure the name is not in the form of a cell address (for example, a function named `J21` won't work in a formula). And, avoid using function names that correspond to Excel's built-in function names. If there is a function name conflict, Excel will always use its built-in function.

A function's scope

In Chapter 9, I discussed the concept of a procedure's scope (public or private). The same discussion applies to functions: A function's scope determines whether it can be called by procedures in other modules or in worksheets.

Here are a few things to keep in mind about a function's scope:

- ♦ If you don't declare a function's scope, its default is public.
- ♦ Functions declared `As Private` do not appear in Excel's Paste Function dialog box. Therefore, when you create a function that should be used only in a VBA procedure, you should declare it private so that users don't try to use it in a formula.
- ♦ If your VBA code needs to call a function that's defined in another workbook, set up a reference to the other workbook by using VBE's Tools ⇨ References command.

Executing Function procedures

Although you can execute a Sub procedure in many ways, you can execute a Function procedure in only two ways:

- ♦ Call it from another procedure
- ♦ Use it in a worksheet formula

From a procedure

You can call custom functions from a procedure the same way you call built-in functions. For example, after you define a function called `SumArray`, you can enter a statement like the following:

```
Total = SumArray(MyArray)
```

This statement executes the `SumArray` function with `MyArray` as its argument, returns the function's result, and assigns it to the `Total` variable.

You also can use the `Run` method of the `Application` object. Here's an example:

```
Total = Application.Run ("SumArray", "MyArray")
```

The first argument for the `Run` method is the function name. Subsequent arguments represent the argument(s) for the function. The arguments for the `Run` method can be literal strings (as shown above), numbers, or variables.

In a worksheet formula

Using custom functions in a worksheet formula is like using built-in functions, except that you must ensure that Excel can locate the Function procedure. If the Function procedure is in the same workbook, you don't have to do anything special. If it's in a different workbook, you may have to tell Excel where to find it.

You can do so in three ways:

- ♦ Precede the function's name with a file reference. *For example, if you want to use a function called `CountNames` that's defined in an open workbook named `Myfuncs.xls`, you can use the following reference:*

```
=Myfuncs.xls!CountNames(A1:A1000)
```

If you insert the function with the Paste Function dialog box, the workbook reference is inserted automatically.

- ♦ Set up a reference to the workbook. *You do so with the VBE's Tools ⇄ References command. If the function is defined in a referenced workbook, you don't need to use the worksheet name. Even when the dependent workbook is assigned as a reference, the Paste Function dialog box continues to insert the workbook reference (although it's not necessary).*
- ♦ Create an add-in. *When you create an add-in from a workbook that has Function procedures, you don't need to use the file reference when you use one of the functions in a formula. The add-in must be installed, however. I discuss add-ins in Chapter 21.*

Reinventing the Wheel

Most of Excel's built-in functions are impossible to create in VBA. However, some *can* be duplicated.

Just for fun, I wrote my own version of Excel's UPPER function (which converts a string to all uppercase) and named it UpCase:

```
Function UpCase(InString As String) As String
'   Converts its argument to all uppercase.
  Dim StringLength As Integer
  Dim i As Integer
  Dim ASCIIVa1 As Integer
  Dim CharVal As Integer

  StringLength = Len(InString)
  UpCase = InString
  For i = 1 To StringLength
    ASCIIVa1 = Asc(Mid(InString, i, 1))
    CharVal = 0
    If ASCIIVa1 >= 97 And ASCIIVa1 <= 122 Then
      CharVal = -32
      Mid(UpCase, i, 1) = Chr(ASCIIVa1 + CharVal)
    End If
  Next i
End Function
```

I was curious to see how the custom function differed from the built-in function, so I created a worksheet that called the function 10,000 times, using an argument that was 26 characters long. The worksheet took 13 seconds to calculate. I then substituted Excel's UPPER function and ran the test again. The recalculation time was virtually instantaneous.

I don't claim that my UpCase function is the optimal algorithm for this task, but it's safe to say that a custom function will never match the speed of Excel's built-in functions.

You'll notice that, unlike Sub procedures, your Function procedures do not appear in the Macro dialog box when you issue the Tools ⇨ Macro ⇨ Macros command. In addition, you can't choose a function when you issue the VBE's Run ⇨ Sub/UserForm command (or press F5) if the cursor is located in a Function procedure (you get the Macro dialog box that lets you choose a macro to run). As a result, you need to do a bit of extra up-front work to test your functions as you're developing them. One approach is to set up a simple procedure that calls the function. If the function is designed to be used in worksheet formulas, you'll want to enter a simple formula to test it.

Function Arguments

Keep in mind the following points about Function procedure arguments:

- ♦ Arguments can be variables (including arrays), constants, literals, or expressions.
- ♦ Some functions do not have arguments.
- ♦ Some functions have a fixed number of required arguments (from 1 to 60).
- ♦ Some functions have a combination of required and optional arguments.



Note

If your formula uses a custom worksheet function and it returns #VALUE!, there is an error in your function. The error could be caused by logical errors in your code, by passing incorrect arguments to the function, or by performing an illegal action (such as attempting to change the formatting of a cell). See “Debugging Functions” later in this chapter.

Function Examples

In this section, I present a series of examples, demonstrating how to use arguments effectively with functions. By the way, this discussion also applies to Sub procedures.



All the function examples in this section are available on the companion CD-ROM.

A function with no argument

Like Sub procedures, Function procedures need not have arguments. Excel, for example, has a few built-in functions that don't use arguments, including `RAND()`, `TODAY()`, and `NOW()`. You can create similar functions.

Here's a simple example of a function that doesn't use an argument. The following function returns the `UserName` property of the `Application` object. This name appears in the Options dialog box (General tab) and is stored in the Windows Registry.

```
Function User()  
    ' Returns the name of the current user  
    User = Application.UserName  
End Function
```

When you enter the following formula, the cell returns the name of the current user (assuming that it's listed properly in the Registry):

```
=User()
```

**Note**

When you use a function with no arguments in a worksheet formula, you must include a set of empty parentheses. This requirement is not necessary if you call the function in a VBA procedure, although including the empty parentheses does make it clear that you're calling a function.

To use this function in another procedure, you must assign it to a variable, use it in an expression, or use it as an argument for another function.

The following example calls the `User` function and uses the return value as an argument for the `MsgBox` statement. The concatenation operator (`&`) joins the literal string with the result of the `User` function.

```
Sub ShowUser()  
    MsgBox "Your name is " & User()  
End Sub
```

Another function with no argument

I used to use Excel's `RAND()` function to quickly fill a range of cells with values. But I didn't like the fact that the random numbers change whenever the worksheet is recalculated. So I usually had to convert the formulas to values by using the Edit ⇨ Paste Special command (with the Values option).

Then I realized that I could create a custom function that returned random numbers that didn't change. I used VBA's built-in `Rnd` function, which returns a random number between 0 and 1. The custom function is as follows:

```
Function StaticRand()  
    ' Returns a random number that doesn't  
    ' change when recalculated  
    StaticRand = Rnd()  
End Function
```

If you want to generate a series of random integers between 0 and 1000, you can use a formula such as this:

```
=INT(StaticRand()*1000)
```

The values produced by this formula never change, unlike those created by the built-in `RAND()` function.

Controlling Function Recalculation

When you use a custom function in a worksheet formula, when is it recalculated?

Custom functions behave like Excel's built-in worksheet functions. Normally, a custom function is recalculated only when it needs to be—which is only when any of the function's arguments are modified. You can, however, force functions to recalculate more frequently. Adding the following statement to a Function procedure makes the function recalculate whenever any cell is changed:

```
Application.Volatile True
```

The `Volatile` method of the `Application` object has one argument (either `True` or `False`). Marking a Function procedure as volatile forces the function to be calculated whenever recalculation occurs for any cell in the worksheet.

For example, the custom `StaticRand` function can be changed to emulate Excel's `RAND()` function using the `Volatile` method, as follows:

```
Function NonStaticRand()  
' Returns a random number that  
' changes with each calculation  
Application.Volatile True  
NonStaticRand = Rnd()  
End Function
```

Using the `False` argument of the `Volatile` method causes the function to be recalculated only when one or more of its arguments change as a result of a recalculation (if a function has no arguments, this method has no effect).

To force an entire recalculation, including nonvolatile custom functions, press `Ctrl+Alt+F9`. This key combination, for example, will generate new random numbers for the `StaticRand` function presented in this chapter.

A function with one argument

This section describes a function for sales managers who need to calculate the commissions earned by their sales forces. The calculations in this example are based on the following table:

<i>Monthly Sales</i>	<i>Commission Rate</i>
0–\$9,999	8.0%
\$10,000–\$19,999	10.5%
\$20,000–\$39,999	12.0%
\$40,000+	14.0%

Note that the commission rate is nonlinear, and depends on the month's total sales. Employees who sell more earn a higher commission rate.

There are several ways to calculate commissions for various sales amounts entered into a worksheet. If you're not thinking too clearly, you might waste lots of time and come up with a lengthy formula such as this:

```
=IF(AND(A1>=0,A1<=9999.99),A1*0.08,
IF(AND(A1>=10000,A1<=19999.99),A1*0.105,
IF(AND(A1>=20000,A1<=39999.99),A1*0.12,
IF(A1>=40000,A1*0.14,0))))
```

This is a bad approach for a couple of reasons. First, the formula is overly complex, making it difficult to understand. Second, the values are hard-coded into the formula, making the formula difficult to modify.

A better (non-VBA) approach is to use a lookup table function to compute the commissions. For example,

```
=VLOOKUP(A1,Table,2)*A1
```

Yet another approach (which eliminates the need to use a lookup table) is to create a custom function such as the following:

```
Function Commission(Sales)
    Const Tier1 = 0.08
    Const Tier2 = 0.105
    Const Tier3 = 0.12
    Const Tier4 = 0.14
    ' Calculates sales commissions
    Select Case Sales
        Case 0 To 9999.99: Commission = Sales * Tier1
        Case 10000 To 19999.99: Commission = Sales * Tier2
        Case 20000 To 39999.99: Commission = Sales * Tier3
        Case Is >= 40000: Commission = Sales * Tier4
    End Select
End Function
```

After you enter this function in a VBA module, you can use it in a worksheet formula or call the function from other VBA procedures.

Entering the following formula into a cell produces a result of 3,000 (the amount, 25,000, qualifies for a commission rate of 12 percent):

```
=Commission(25000)
```

Even if you don't need custom functions in a worksheet, creating Function procedures can make your VBA coding much simpler. For example, if your VBA procedure calculates sales commissions, you can use the exact same function and call it from a VBA procedure. Here's a tiny procedure that asks the user for a sales amount and then uses the `Commission` function to calculate the commission due:

```
Sub CalcComm()
    Dim Sales as Long
    Sales = InputBox("Enter Sales:")
    MsgBox "The commission is " & Commission(Sales)
End Sub
```

The `CalcComm` procedure starts by displaying an input box that asks for the sales amount. Then it displays a message box with the calculated sales commission for that amount.

This Sub procedure works, but it is rather crude. Following is an enhanced version that displays formatted values and keeps looping until the user clicks No (see Figure 10-3).

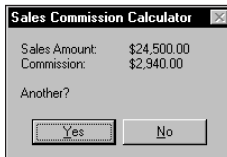


Figure 10-3: Using a function to display the result of a calculation

```
Sub CalcComm()
    Dim Sales As Long
    Dim Msg As String, Ans As String

    ' Prompt for sales amount
    Sales = Val(InputBox("Enter Sales:", _
        "Sales Commission Calculator"))

    ' Build the Message
    Msg = "Sales Amount:" & vbTab & Format(Sales, "$#,##0.00")
    Msg = Msg & vbCrLf & "Commission:" & vbTab
    Msg = Msg & Format(Commission(Sales), "$#,##0.00")
    Msg = Msg & vbCrLf & vbCrLf & "Another?"

    ' Display the result and prompt for another
    Ans = MsgBox(Msg, vbYesNo, "Sales Commission Calculator")
    If Ans = vbYes Then CalcComm
End Sub
```


This function uses two VBA built-in constants: `vbTab` represents a tab (to space the output) and `vbCrLf` specifies a carriage return and line feed (to skip to the next line). VBA's `Format` function displays a value in a specified format (in this case, with a dollar sign, comma, and two decimal places).

In both of these examples, the `Commission` function must be available in the active workbook; otherwise, Excel displays an error message saying that the function is not defined.

A function with two arguments

Imagine that the aforementioned hypothetical sales managers implement a new policy to help reduce turnover: The total commission paid is increased by 1 percent for every year that the salesperson has been with the company.

I modified the custom `Commission` function (defined in the preceding section) so that it takes two arguments. The new argument represents the number of years. Call this new function `Commission2`:

```
Function Commission2(Sales, Years)
'   Calculates sales commissions based on
'   years in service
  Const Tier1 = 0.08
  Const Tier2 = 0.105
  Const Tier3 = 0.12
  Const Tier4 = 0.14
  Select Case Sales
    Case 0 To 9999.99: Commission2 = Sales * Tier1
    Case 1000 To 19999.99: Commission2 = Sales * Tier2
    Case 20000 To 39999.99: Commission2 = Sales * Tier3
    Case Is >= 40000: Commission2 = Sales * Tier4
  End Select
  Commission2 = Commission2 + (Commission2 * Years / 100)
End Function
```

Pretty simple, eh? I just added the second argument (`Years`) to the Function statement and included an additional computation that adjusts the commission.

Here's an example of how you can write a formula using this function (it assumes that the sales amount is in cell A1 and the number of years the salesperson has worked is in cell B1):

```
=Commission2(A1,B1)
```

A function with an array argument

A Function procedure also can accept one or more arrays as arguments, process the array(s), and return a single value. The following function accepts an array as its argument and returns the sum of its elements:

```
Function SumArray(List) As Double
    Dim Item As Variant
    SumArray = 0
    For Each Item In List
        If WorksheetFunction.IsNumber(Item) Then _
            SumArray = SumArray + Item
    Next Item
End Function
```

Excel's `IsNumber` function checks to see whether each element is a number before adding it to the total. Adding this simple error-checking statement eliminates the type mismatch error that occurs when you try to perform arithmetic with a string.

The following procedure demonstrates how to call this function from a Sub procedure. The `MakeList` procedure creates a 100-element array and assigns a random number to each element. Then the `MsgBox` function displays the sum of the values in the array by calling the `SumArray` function.

```
Sub MakeList()
    Dim Nums(1 To 100) As Double
    Dim i as Integer
    For i = 1 To 100
        Nums(i) = Rnd * 1000
    Next i
    MsgBox SumArray(Nums)
End Sub
```

Because the `SumArray` function doesn't declare the data type of its argument (it's a variant), the function also works in your worksheet formulas. For example, the following formula returns the sum of the values in A1:C10:

```
=SumArray(A1:C10)
```

You may notice that, when used in a worksheet formula, the `SumArray` function works very much like Excel's `SUM` function. One difference, however, is that `SumArray` does not accept multiple arguments (`SUM` accepts up to 30 arguments). Be aware that this example is for educational purposes only. Using the `SumArray` function in a formula offers absolutely no advantages over the Excel `SUM` function.

A function with optional arguments

Many of Excel's built-in worksheet functions use optional arguments. An example is the `LEFT` function, which returns characters from the left side of a string. Its syntax is

```
LEFT(text[, num_chars])
```

The first argument is required, but the second is optional. If the optional argument is omitted, Excel assumes a value of 1. Therefore, the following two formulas return the same result:

```
=LEFT(A1,1)  
=LEFT(A1)
```

The custom functions that you develop in VBA also can have optional arguments. You specify an optional argument by preceding the argument's name with the keyword `Optional`. In the argument list, optional arguments must appear after any required arguments.

The following is an example of a custom function that uses an optional argument. This function randomly chooses one cell from an input range and returns the cell's contents. If the second argument is `True`, the selected value changes whenever the worksheet is recalculated (that is, the function is made volatile). If the second argument is `False` (or omitted), the function is not recalculated unless one of the cells in the input range is modified.

```
Function Draw(RngAs Variant, Optional Recalc As Boolean =  
False)  
    '    Chooses one cell at random from a range  
  
    '    Make function volatile if Recalc is True  
    Application.Volatile Recalc  
  
    '    Determine a random cell  
    Draw = Rng(Int((Rng.Count) * Rnd + 1))  
End Function
```

Notice that the second argument for `Draw` includes the `Optional` keyword, along with a default value.

All the following formulas are valid, and the first two have the same effect:

```
=Draw(A1:A100)  
=Draw(A1:A100,False)  
=Draw(A1:A100,True)
```

This function might be useful for choosing lottery numbers, picking a winner from a list of names, and so on.

A function that returns a VBA array

VBA includes a useful function called `Array`. The `Array` function returns a variant that contains an array (that is, multiple values). If you're familiar with array formulas in Excel, you'll have a head start understanding VBA's `Array` function. You enter an array formula into a cell by pressing `Ctrl+Shift+Enter`. Excel inserts brackets around the formula to indicate that it's an array formula. See Chapter 3 for more details on array formulas.

Note

It's important to understand that the array returned by the `Array` function is not the same as a normal array that's made up of elements of the variant data type. In other words, a variant array is not the same as an array of variants.

The `MonthNames` function, which follows, is a simple example that uses VBA's `Array` function in a custom function:

```
Function MonthNames()  
    MonthNames = Array("Jan", "Feb", "Mar", "Apr", _  
        "May", "Jun", "Jul", "Aug", "Sep", "Oct", _  
        "Nov", "Dec")  
End Function
```

The `MonthNames` function returns a horizontal array of month names. You can create a multicell array formula that uses the `MonthNames` function. Here's how to use it: Make sure that the function code is present in a VBA module. Then in a worksheet, select multiple cells in a row (start by selecting 12 cells). Then enter the formula that follows, followed by `Ctrl+Shift+Enter`:

```
=MonthNames()
```

Figure 10-4 shows the result. It's important to understand that a single formula displays its result in 12 cells (in this case, in range B2:M2).

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3													
4													

Figure 10-4: Using the `MonthNames` function in an array formula

What if you'd like to generate a vertical list of month names? No problem, select a vertical range and enter the following formula, followed by Ctrl+Shift+Enter:

```
=TRANSPOSE(MonthNames())
```

This formula uses the Excel TRANSPOSE function to convert the horizontal array to a vertical array.

The following example is a variation on the MonthNames function:

```
Function MonthNames(Optional MIndex)
    Dim AllNames As Variant
    AllNames = Array("Jan", "Feb", "Mar", "Apr", _
        "May", "Jun", "Jul", "Aug", "Sep", "Oct", _
        "Nov", "Dec")
    If IsMissing(MIndex) Then
        MonthNames = AllNames
    Else
        Select Case MIndex
            Case Is >= 1
                ' Determine month value (for example, 13=1)
                MonthVal = ((MIndex - 1) Mod 12)
                MonthNames = AllNames(MonthVal)
            Case Is <= 0 ' Vertical array
                MonthNames = Application.Transpose(AllNames)
        End Select
    End If
End Function
```

Notice that I use VBA's IsMissing function to test for a missing argument. In this situation, it is not possible to specify the default value for the missing argument in the argument list of the function, because the default value is defined within the function. You can use the IsMissing function only if the optional argument is a variant.

This enhanced function uses an optional argument that works as follows:

- ♦ If the argument is missing, the function returns a horizontal array of month names.
- ♦ If the argument is less than or equal to 0, the function returns a vertical array of month names. It uses Excel's TRANSPOSE function to convert the array.
- ♦ If the argument is greater than or equal to 1, it returns the month name that corresponds to the argument value. This procedure adds a slight twist, using the Mod operator to determine the month value. The Mod operator returns the remainder after dividing the first operand by the second. An argument of 13, for example, returns 1. An argument of 24 returns 12, and so on.

You can use this function in a number of ways, as illustrated in Figure 10-5.

The screenshot shows an Excel spreadsheet with columns A through L and rows 1 through 15. The data is as follows:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2												
3		1 Jan		Jan								
4		2 Feb		Feb								
5		3 Mar		Mar								
6		4 Apr		Apr								
7		5 May		May								
8		6 Jun		Jun								
9		7 Jul		Jul								
10		8 Aug		Aug								
11		9 Sep		Sep								
12		10 Oct		Oct								
13		11 Nov		Nov								
14		12 Dec		Dec								
15												

Figure 10-5: Different ways of passing an array or a single value to a worksheet

Range A1:L1 contains the following formula entered as an array. Start by selecting A1:L1, enter the formula, and then end it by pressing Ctrl+Shift+Enter.

```
=MonthNames()
```

Range A3:A14 contains integers from 1 to 12. Cell B3 contains the following (nonarray) formula, which was copied to the 11 cells below it:

```
=MonthNames(A3)
```

Range D3:D14 contains the following formula entered as an array:

```
=MonthNames(-1)
```

Remember, to enter an array formula, you must press Ctrl+Shift+Enter.

Note

The lower bound of an array created using the `Array` function is determined by the lower bound specified with the `Option Base` statement at the top of the module. If there is no `Option Base` statement, the default lower bound is 0.

A function that returns an error value

In some cases, you might want your custom function to return a particular error value. Consider the `Reverse` function, which I presented earlier in this chapter:

```
Function Reverse(InString) As String
    ' Returns its argument, reversed
    Dim i as Integer, StringLength as Integer
    Reverse = ""
    StringLength = Len(InString)
```

```

    For i = StringLength To 1 Step -1
        Reverse = Reverse & Mid(InString, i, 1)
    Next i
End Function

```

When used in a worksheet formula, this function reverses the contents of its single-cell argument (which can be text or a value). Assume that you want this function to work only with text strings. If the argument doesn't contain a string, you want the function to return an error value (#N/A).

You might be tempted simply to assign a string that looks like an Excel formula error value. For example,

```
Reverse = "#N/A"
```

Although the string *looks* like an error value, it is not treated as such by other formulas that may reference it. To return a *real* error value from a function, use VBA's CVerErr function, which converts an error number to a real error.

Fortunately, VBA has built-in constants for the errors that you would want to return from a custom function. These errors are Excel formula error values, not VBA run-time error values. These constants are as follows:

- ♦ xlErrDiv0 (for #DIV/0!)
- ♦ xlErrNA (for #N/A)
- ♦ xlErrName (for #NAME?)
- ♦ xlErrNull (for #NULL!)
- ♦ xlErrNum (for #NUM!)
- ♦ xlErrRef (for #REF!)
- ♦ xlErrValue (for #VALUE!)

To return a #N/A error from a custom function, you can use a statement like this:

```
Reverse = CVerErr(xlErrNA)
```

The revised Reverse function follows. This function uses Excel's IsText function to determine whether the argument contains text. If it does, the function proceeds normally. If the cell doesn't contain text (or is empty), the function returns the #N/A error.

```

Function Reverse(InString) as Variant
'   If a string, returns its argument, reversed
'   Otherwise returns #N/A error
    Dim i as Integer, StringLength as Integer

```

```

If Application.WorksheetFunction.IsText(InString) Then
    Reverse = ""
    StringLength = Len(InString)
    For i = StringLength To 1 Step -1
        Reverse = Reverse & Mid(InString, i, 1)
    Next i
Else
    Reverse = CVErr(xlErrNA)
End If
End Function

```

Note

Notice that I also changed the data type for the function's return value. Because the function can now return something other than a string, I changed the data type to variant.

A function with an indefinite number of arguments

Some of Excel's worksheet functions take an indefinite number of arguments. A familiar example is the SUM function, which has the following syntax:

```
SUM(number1,number2...)
```

The first argument is required, but you can have as many as 29 additional arguments. Here's an example of a SUM function with four range arguments:

```
=SUM(A1:A5,C1:C5,E1:E5,G1:G5)
```

You can even mix and match the argument types. For example, the following example uses three arguments: the first is a range, the second is a value, and the third is an expression.

```
=SUM(A1:A5,12,24*3)
```

You can create Function procedures that have an indefinite number of arguments. The trick is to use an array as the last (or only) argument, preceded by the keyword ParamArray.

Note

ParamArray can apply only to the *last* argument in the procedure's argument list. It is always a variant data type, and it is always an optional argument (although you don't use the Optional keyword).

Following is a function that can have any number of single-value arguments (it doesn't work with multicell range arguments). It simply returns the sum of the arguments.


```
Function SimpleSum(ParamArray arglist() As Variant) As Double
    For Each arg In arglist
        SimpleSum = SimpleSum + arg
    Next arg
End Function
```

The `SimpleSum` function is not nearly as flexible as Excel's `SUM` function. Try it out using various types of arguments, and you'll see that it fails unless each argument is either a value or a reference to a single cell that contains a value.

Emulating Excel's SUM Function

In this section, I present a custom function called `MySum`. Unlike the `SimpleSum` function listed in the previous section, the `MySum` function emulates Excel's `SUM` function perfectly.

Before you look at the code for `MySum`, take a minute to think about Excel's `SUM` function. It is, in fact, very versatile. It can have as many as 30 arguments (even "missing" arguments), and the arguments can be numerical values, cells, ranges, text representations of numbers, logical values, and even embedded functions. For example, consider the following formula:

```
=SUM(B1,5,"6",,TRUE,SQRT(4),A1:A5)
```

This formula, which is a perfectly valid formula, contains all of the following types of arguments, listed here in the order of their presentation:

- ♦ A single cell reference
- ♦ A literal value
- ♦ A string that looks like a value
- ♦ A missing argument
- ♦ A logical `TRUE` value
- ♦ An expression that uses another function
- ♦ A range reference

The `MySum` function (see Listing 10-1) handles all these argument types.



A workbook containing the `MySum` function is available on the companion CD-ROM.

Listing 10-1: MySum function

```

Function MySum(ParamArray args() As Variant) As Variant
' Emulates Excel's SUM function

' Variable declarations
Dim i As Variant
Dim TempRange As Range, cell As Range
Dim ECode As String
MySum = 0

' Process each argument
For i = 0 To UBound(args)
' Skip missing arguments
If Not IsMissing(args(i)) Then
' What type of argument is it?
Select Case TypeName(args(i))
Case "Range"
' Create temp range to handle full row/column
ranges
Set TempRange =
Intersect(args(i).Parent.UsedRange, args(i))
For Each cell In TempRange
If IsError(cell) Then
MySum = cell ' return the error
Exit Function
End If
If cell = True Or cell = False Then
MySum = MySum + 0
Else
If IsNumeric(cell) Or IsDate(cell) Then
-
MySum = MySum + cell
End If
Next cell
Case "Null" 'ignore it
Case "Error" 'return the error
MySum = args(i)
Exit Function
Case "Boolean"
' Check for literal TRUE and compensate
If args(i) = "True" Then MySum = MySum + 1
Case "Date"
MySum = MySum + args(i)
Case Else
MySum = MySum + args(i)
End Select
End If
Next i
End Function

```

As you study the code for `MySum`, keep the following points in mind:

- ♦ Missing arguments (determined by the `IsMissing` function) are simply ignored.
- ♦ The procedure uses VBA's `TypeName` function to determine the type of argument (Range, Error, and so on). Each argument type is handled differently.
- ♦ For a range argument, the function loops through each cell in the range and adds its value to a running total.
- ♦ The data type for the function is variant because the function needs to return an error if any of its arguments is an error value.
- ♦ If an argument contains an error (for example, `#DIV0!`), the `MySum` function simply returns the error — just like Excel's `SUM` function.
- ♦ Excel's `SUM` function considers a text string to have a value of 0 unless it appears as a literal argument (that is, as an actual value, not a variable). Therefore, `MySum` adds the cell's value only if it can be evaluated as a number (VBA's `IsNumeric` function is used for this).
- ♦ For range arguments, the function uses the `Intersect` method to create a temporary range that consists of the intersection of the range and the sheet's used range. This handles cases in which a range argument consists of a complete row or column, which would take forever to evaluate.

You may be curious about the relative speeds of `SUM` and `MySum`. `MySum`, of course, is much slower, but just how much slower depends on the speed of your system and the formulas themselves. On my system, a worksheet with 1,000 `SUM` formulas recalculated instantly. After I replaced the `SUM` functions with `MySum` functions, it took about 12 seconds. `MySum` may be improved a bit, but it can never come close to `SUM`'s speed.

By the way, I hope you understand that the point of this example is not to create a new `SUM` function. Rather, it demonstrates how to create custom worksheet functions that look and work like those built into Excel.

Debugging Functions

When you're using a formula in a worksheet to test a Function procedure, runtime errors do not appear in the all-too-familiar pop-up error box. If an error occurs, the formula simply returns an error value (`#VALUE!`). Luckily, this does not present a problem for debugging functions because you have several possible workarounds:

- ♦ Place `MsgBox` functions at strategic locations to monitor the value of specific variables. *Fortunately, message boxes in Function procedures do pop up when the procedure is executed. But make sure that you have only one formula in the worksheet that uses your function, or message boxes will appear for each formula that is evaluated, a repetition that will quickly become annoying.*

- ♦ Test the procedure by calling it from a Sub procedure, not from a worksheet formula. *Runtime errors are displayed in the usual manner, and you can either fix the problem (if you know it) or jump right into the debugger.*
- ♦ Set a breakpoint in the function, and then step through the function. *You then can access all the standard debugging tools. To set a breakpoint, move the cursor to the statement at which you want to pause execution, and select Debug ⇨ Toggle Breakpoint (or press F9).*
- ♦ Use one or more temporary `Debug.Print` statements in your code to write values to the VBE's Immediate window. For example, if you want to monitor a value inside of a loop, use something like the following routine:

```
Function VowelCount(r)
    Count = 0
    For i = 1 To Len(r)
        Ch = UCase(Mid(r, i, 1))
        If Ch Like "[AEIOU]" Then
            Count = Count + 1
            Debug.Print Ch, i
        End If
    Next i
    VowelCount = Count
End Function
```

In this case, the values of two variables, `Ch` and `i`, are printed to the Immediate window whenever the `Debug.Print` statement is encountered. Figure 10-6 shows the result when the function has an argument of `Mississippi`.



Figure 10-6: Using the Immediate window to display results while a function is running

Dealing with the Insert Function Dialog Box

Excel's Insert Function dialog box is a handy tool. When creating a worksheet formula, this tool lets you select a particular worksheet function from a list of functions (see Figure 10-7). These functions are grouped into various categories to make it easier to locate a particular function. The Insert Function dialog box also displays your custom worksheet functions and prompts you for a function's arguments.

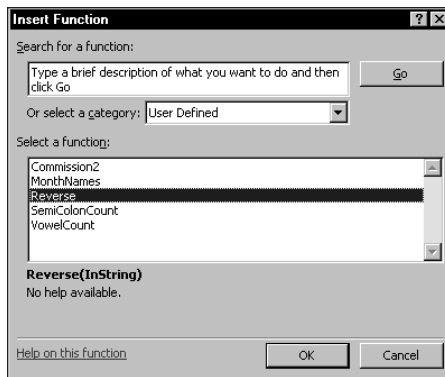


Figure 10-7: Inserting a custom function into a formula

Note

Custom Function procedures defined with the `Private` keyword do not appear in the Paste Function dialog box (although they can still be entered into formulas manually). If you develop a function for exclusive use of your other VBA procedures, you should declare it using the `Private` keyword.

By default, custom functions are listed under the User Defined category, but you can have them appear under a different category if you like. You also can add some text to describe the function (I highly recommend this step).

New Feature

In versions prior to Excel 2002, the Insert Function dialog box was known as the Paste Function dialog box. This dialog box is enhanced in Excel 2002, and has a new look, plus the ability to search for a function by keyword. Unfortunately, this search feature cannot be used to locate custom functions created in VBA.

Specifying a function category

Oddly, Excel does not provide a direct way to assign a custom function to a category. If you would like your custom function to appear in a function category other than User Defined, you need to do so by writing and executing some VBA code.

The following statement assigns the function named `Commission` to the Financial category (category number 1):

```
Application.MacroOptions Macro:="Commission", Category:=1
```

Note

You only need to execute this statement one time (not each time the workbook is opened). From then on, every time the workbook is opened, the function will appear in the category you specified.

Table 10-1 lists the category numbers that you can use. Notice that a few of these categories (10 through 13) are normally not displayed in the Paste Function dialog box. If you assign your function to one of these categories, the category will appear in the dialog box.

Table 10-1
Function Categories

<i>Category Number</i>	<i>Category Name</i>
0	All (no specific category)
1	Financial
2	Date & Time
3	Math & Trig
4	Statistical
5	Lookup & Reference
6	Database
7	Text
8	Logical
9	Information
10	Commands
11	Customizing
12	Macro Control
13	DDE/External
14	User Defined
15	Engineering

Adding a function description

When you select a function in the Insert Function dialog box, a brief description of the function appears (see Figure 10-8). You can specify a description for your custom function two ways: Use the Macro dialog box, or write VBA code.

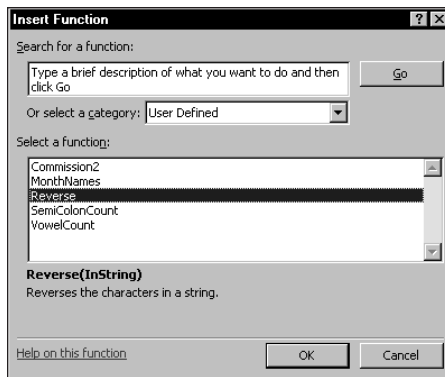


Figure 10-8: Excel's Insert Function dialog box displays brief descriptions of functions.

Note

If you don't provide a description for your custom function, the Paste Function dialog box displays the following text: "Choose the help button for help on this function and its arguments." In most cases, of course, the help description is not accurate.

Describing your function in the Macro dialog box

Follow these steps to provide a description for a custom function:

1. Create the function in the VBE.
2. Activate Excel, and select Tools ⇨ Macro ⇨ Macros (or press Alt+F8).
The Macro dialog box lists available procedures, but your functions will not be in the list.
3. Type the name of your function in the Macro Name box.
4. Click the Options button to display the Macro Options dialog box.
5. Enter the function description in the Description box (see Figure 10-9). The Shortcut key field is irrelevant for functions.

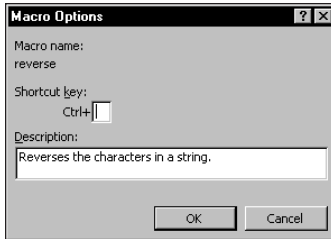


Figure 10-9: Providing a function description in the Macro Options dialog box

6. Click OK, and then click Cancel.

After you perform the preceding steps, the Insert Function dialog box displays the description you entered in Step 5 when the function is selected.



Cross-Reference

For information on creating a custom help topic accessible from the Function Wizard, refer to Chapter 24.

When you use the Insert Function dialog box to enter a function, the Function Arguments dialog box is displayed after you click OK. For built-in functions, the Function Arguments dialog box displays a description for each of the function's arguments. Unfortunately, you cannot provide such descriptions for custom function arguments.



New Feature

Excel 2002 displays the Function Arguments dialog box in place of the Formula Palette dialog box, used in previous versions.

Describing your function with VBA code

Another way to provide a description for a custom function is to write VBA code. The following statement assigns a description for the function named `Commission`:

```
Application.MacroOptions _
    Macro:= "Commission", _
    Description:= "Calculates sales commissions"
```

You need to execute this statement only one time (not each time the workbook is opened).

Using Add-ins to Store Custom Functions

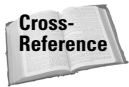
You might prefer to store frequently used custom functions in an add-in file. A primary advantage of doing this is that the functions can be used in formulas without a filename qualifier.

Assume that you have a custom function named `ZapSpaces` and that it's stored in `Myfuncs.xls`. To use this function in a formula in a workbook other than `Myfuncs.xls`, you need to enter the following formula:

```
=Myfuncs.xls!ZapSpaces(A1:C12)
```

If you create an add-in from `Myfuncs.xls` and the add-in is loaded, you can omit the file reference and enter a formula such as the following:

```
=ZapSpaces(A1:C12)
```



I discuss add-ins in Chapter 21.

Using the Windows API

VBA can borrow methods from other files that have nothing to do with Excel or VBA—for example, the DLL (Dynamic Link Library) files that Windows and other software use. As a result, you can do things with VBA that would otherwise be outside the language's scope.

The Windows API (Application Programming Interface) is a set of functions available to Windows programmers. When you call a Windows function from VBA, you're accessing the Windows API. Many of the Windows resources used by Windows programmers are available in DLLs, which store programs and functions and are linked at runtime rather than at compile time.

Excel itself uses several DLLs, for example. The code in many of these DLLs could have been compiled right into the `excel.exe` executable, but the designers chose to store it in DLLs, which are loaded only when needed. This technique makes Excel's main executable file smaller. In addition, it is a more efficient use of memory because the library is loaded only when it's needed.

DLLs are also used to share code. For example, most Windows programs use dialog boxes to open and save files. Windows comes with a DLL that has the code to generate several standard dialog boxes. Programmers thus can call this DLL rather than write their own routines.

If you're a C programmer, you can produce your own DLLs and use them from VBA. Microsoft's Visual Basic language also has the capability to create DLL files that can be called from Excel.

Windows API examples

Before you can use a Windows API function, you must declare the function at the top of your code module. If the code module is not a standard VBA module (that is, it's a code module for a UserForm, Sheet, or ThisWorkbook), you must declare the API function as `Private`.

Declaring an API function is a bit tricky; it must be declared precisely. The declaration statement tells VBA:

- ♦ Which API function you're using
- ♦ In which library the API function is located
- ♦ The API function's arguments

After you declare an API function, you can use it in your VBA code.

Determining the Windows directory

Following is an example of an API function declaration:

```
Declare Function GetWindowsDirectoryA Lib "kernel32" _
    (ByVal lpBuffer As String, ByVal nSize As Long) As Long
```

This function, which has two arguments, returns the name of the directory in which Windows is installed (something that is not normally possible using VBA). After calling the function, the Windows directory is contained in `lpBuffer`, and the length of the directory string is contained in `nSize`.

After inserting the `Declare` statement at the top of your module, you can access the function by calling the `GetWindowsDirectoryA` function. The following is an example of calling the function and displaying the result in a message box:

```
Sub ShowWindowsDir()
    Dim WinPath As String
    Dim WinDir As String
    WinPath = Space(255)
    WinDir = Left(WinPath, GetWindowsDirectoryA _
        (WinPath, Len(WinPath)))
    MsgBox WinDir, vbInformation, "Windows Directory"
End Sub
```

Executing the `ShowWindowsDir` procedure displays a message box with the Windows directory. Usually, Windows is installed in `C:\WINDOWS`, but that is not guaranteed. Windows NT is often installed in `C:\WINNT`, but not always.

Often, you'll want to create a *wrapper* for API functions. In other words, you'll create your own function that uses the API function. This greatly simplifies using the API function. Here's an example of a wrapper VBA function:

```
Function WindowsDir() As String
    ' Returns the Windows directory
    Dim WinPath As String
    WinPath = Space(255)
    WindowsDir = Left(WinPath, GetWindowsDirectoryA _
        (WinPath, Len(WinPath)))
End Function
```

After declaring this function, you can call it from another procedure:

```
Msgbox WindowsDir()
```

You can even use the function in a worksheet formula:

```
=WindowsDir()
```

The reason for using API calls is to perform an action that would otherwise be impossible (or at least very difficult). If your application needs to find the path of the Windows directory, you could search all day and not find a function in Excel or VBA to do the trick. But knowing how to access the Windows API may solve your problem.

Detecting the Shift key

Here's another example: Suppose you've written a VBA macro that will be executed from a toolbar button. Furthermore, suppose you want the macro to perform differently if the user presses the Shift key when the button is clicked. Normally, there is no way to detect whether the Shift key is pressed. But you can use the `GetKeyState` API function to find out. The `GetKeyState` function tells you whether a particular key is pressed. It takes a single argument, `nVirtKey`, which represents the code for the key you are interested in.

The following code demonstrates how to detect whether the Shift key is pressed when the `Button_Click` event-handler procedure is executed. Notice that I define a constant for the Shift key (using a hexadecimal value) and then use this constant as the argument for `GetKeyState`. If `GetKeyState` returns a value less than zero, it means that the Shift key was pressed; otherwise, the Shift key was not pressed.

```
Declare Function GetKeyState Lib "user32" _
    (ByVal nVirtKey As Long) As Integer

Sub Button_Click()
    Const VK_SHIFT As Integer = &H10
    If GetKeyState(VK_SHIFT) < 0 Then
        MsgBox "Shift is pressed"
    Else
        MsgBox "Shift is not pressed"
    End If
End Sub
```



A workbook on the companion CD-ROM demonstrates how to detect the following keys (as well as any combinations): Ctrl, Shift, Alt.

Learning more about API functions

Working with the Windows API functions can be tricky. Many programming reference books list the declarations for common API calls and often provide examples. Usually, you can simply copy the declarations and use the functions without really understanding the details. In reality (at least the reality that I've seen), most Excel programmers take a cookbook approach to API functions. The Internet has hundreds of examples that can be copied and pasted and that work quite reliably.



Chapter 11 has several additional examples of using Windows API functions.



The companion CD-ROM includes a file named `win32api.txt`, a text file that contains Windows API declarations and constants. You can open this file with a text editor and copy the appropriate declarations to a VBA module.



When you work with API calls, system crashes during testing are not uncommon, so save your work often.



If you develop applications that need to work in all versions of Excel, be aware of some potentially serious compatibility issues that arise when you use API calls. For example, if you develop an application using Excel 97 or later that uses API calls, the application will not run with Excel 5 – even if you save the workbook in the Excel 5 format – because Excel 5 is a 16-bit application. Excel 97 and later versions are 32-bit applications. Excel 2002 is a 32-bit application (and uses 32-bit API calls) and Excel 5 is a 16-bit application. Refer to Chapter 26 for additional information and tips on how to circumvent this problem.

Summary

In this chapter, I explained how to create and use custom VBA functions. These functions can be used in worksheet formulas and in other VBA procedures. I also described how to call Windows API functions.

The next chapter contains many examples that demonstrate the techniques discussed in this and previous chapters.



VBA

Programming

Examples and

Techniques

I believe that learning programming concepts is accelerated by a heavy emphasis on examples. And based on the feedback that I've received from readers of previous editions of this book, I have plenty of company. VBA programmers especially benefit from a hands-on approach. A well-thought-out example usually communicates a concept much better than a description of the underlying theory. I decided, therefore, not to write a reference book that painstakingly describes every nuance of VBA. Rather, I prepared numerous examples to demonstrate useful Excel programming techniques.

The previous chapters in this section provide enough information to get you started. The online help system provides all the details I left out. In this chapter, I pick up the pace and present examples that solve practical problems while furthering your knowledge of VBA.

I've categorized this chapter's examples into six groups:

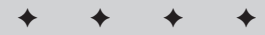
- ◆ Working with ranges
- ◆ Working with workbooks and sheets
- ◆ VBA techniques
- ◆ Functions useful in your VBA procedures
- ◆ Functions you can use in worksheet formulas
- ◆ Windows API calls



Subsequent chapters in this book present additional feature-specific examples: charts, pivot tables, events, UserForms, and so on.

11

CHAPTER



In This Chapter

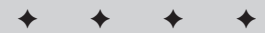
Examples of using VBA to work with ranges

Examples of using VBA to work with workbooks and sheets

Custom functions for use in your VBA procedures and in worksheet formulas

Examples of miscellaneous VBA tricks and techniques

Examples of using Windows API functions



Using the Examples in this Chapter

Not all the examples in this chapter are intended to be standalone programs. They are, however, set up as executable procedures that you can adapt for your own applications.

I urge you to follow along on your computer as you read this chapter. Better yet, modify the examples and see what happens. I guarantee that this hands-on experience will help more than reading a reference book.

Working with Ranges

The examples in this section demonstrate how to manipulate worksheet ranges with VBA.



The examples in this section are available on the companion CD-ROM.

Copying a range

Excel's macro recorder is useful not so much for generating usable code as for discovering the names of relevant objects, methods, and properties. The code that's generated by the macro recorder isn't always the most efficient, but it can usually provide you lots of useful insights.

For example, recording a simple copy-and-paste operation generates five lines of VBA code:

```
Sub Macro1()  
    Range("A1").Select  
    Selection.Copy  
    Range("B1").Select  
    ActiveSheet.Paste  
    Application.CutCopyMode = False  
End Sub
```

Notice that the generated code selects the cells. But in VBA, it's not necessary to select an object to work with it. You would never learn this important point by mimicking the preceding recorded macro code, where two lines incorporate the `Select` method. This procedure can be replaced with the following much simpler routine, which takes advantage of the fact that the `Copy` method can use an argument that represents the destination for the copied range:

```
Sub CopyRange()  
    Range("A1").Copy Range("B1")  
End Sub
```

Both of these macros assume that a worksheet is active and that the operation takes place on the active worksheet. To copy a range to a different worksheet or workbook, simply qualify the range reference for the destination. The following example copies a range from Sheet1 in File1.xls to Sheet2 in File2.xls. Because the references are fully qualified, this example works regardless of which workbook is active.

```
Sub CopyRange2()  
    Workbooks("File1.xls").Sheets("Sheet1").Range("A1").Copy _  
        Workbooks("File2.xls").Sheets("Sheet2").Range("A1")  
End Sub
```

Another way to approach this task is to use object variables to represent the ranges, as the following example demonstrates:

```
Sub CopyRange3()  
    Set Rng1 = Workbooks("File1.xls"). _  
        Sheets("Sheet1").Range("A1")  
    Set Rng2 = Workbooks("File2.xls"). _  
        Sheets("Sheet2").Range("A1")  
    Rng1.Copy Rng2  
End Sub
```

As you might expect, copying is not limited to one single cell at a time. The following procedure, for example, copies a large range. Notice that the destination consists of only a single cell (which represents the upper left cell for the destination).

```
Sub CopyRange4()  
    Range("A1:C800").Copy Range("D1")  
End Sub
```

Moving a range

The VBA instructions for moving a range are very similar to those for copying a range, as the following example demonstrates. The difference is that you use the `Cut` method instead of the `Copy` method. Note that you need to specify only the upper-left cell for the destination range.

The following example moves 18 cells (in A1:C6) to a new location, beginning at cell H1:

```
Sub MoveRange1()  
    Range("A1:C6").Cut Range("H1")  
End Sub
```

Copying a variably sized range

In many cases, you need to copy a range of cells, but you don't know the exact row and column dimensions of the range. For example, you might have a workbook that tracks weekly sales. The number of rows changes weekly as you add new data.

Figure 11-1 shows a very common type of worksheet. This range consists of several rows, and the number of rows changes each week. Because you don't know the exact range address at any given time, writing a macro to copy the range requires some additional coding.

	A	B	C	D
1	Week	Total Sales	New Customers	
2	1	12,434	42	
3	2	9,832	12	
4	3	13,982	45	
5	4	13,722	21	
6	5	7,820	18	
7	6	17,830	54	
8	7	14,984	33	
9				
10				

Figure 11-1: This range can consist of any number of rows.

The following macro demonstrates how to copy this range from Sheet1 to Sheet2 (beginning at cell A1). It uses the `CurrentRegion` property, which returns a `Range` object that corresponds to the block of cells around a particular cell (in this case, A1).

```
Sub CopyCurrentRegion2()
    Range("A1").CurrentRegion.Copy _
        Sheets("Sheet2").Range("A1")
End Sub
```

Note

Using the `CurrentRegion` property is equivalent to choosing the `Edit ⇨ Go To` command, clicking the `Special` button, and selecting the `Current Region` option. To see how this works, record your actions while you issue that command. Generally, the `CurrentRegion` property setting consists of a rectangular block of cells surrounded by one or more blank rows or columns.

Selecting or otherwise identifying various types of ranges

Much of the work you will do in VBA will involve working with ranges—either selecting a range or identifying a range so you can do something with the cells.

New Feature

In previous versions of Excel, recording a macro that selects cells (such as `Ctrl+Shift+→`) was a hit or miss proposition. The macro recorder in Excel 2002 seems to handle these types of selections much better than in previous versions. However, it's always a good idea to check your recorded code very carefully to make sure that the selection code works as you intended.

In addition to the `CurrentRegion` property (discussed above), you should also be aware of the `End` method of the `Range` object. The `End` method takes one argument,

which determines the direction in which the selection is extended. The following statement selects a range from the active cell to the last nonempty cell:

```
Range(ActiveCell, ActiveCell.End(xlDown)).Select
```

As you may expect, three other constants simulate key combinations in the other directions: `xlUp`, `xlToLeft`, and `xlToRight`.



Be careful when using the `End` method. If the active cell is at the perimeter of a range, or the range contains one or more empty cells, the `End` method may not produce the desired results.

The companion CD-ROM includes a workbook that demonstrates several common types of range selections. When you open this workbook, you'll see a new menu command, Selection Demo. This menu contains commands that enable the user to make various types of selections, as shown in Figure 11-2.

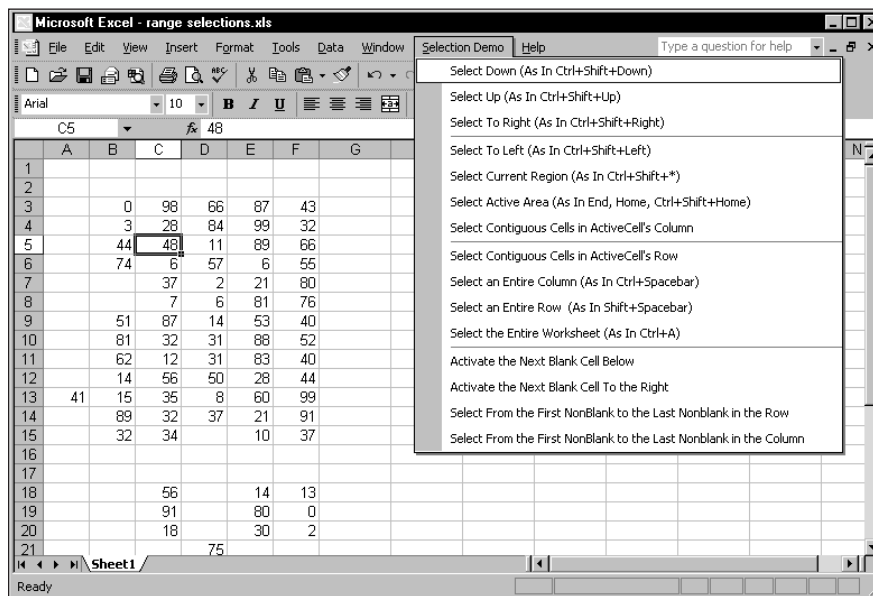


Figure 11-2: This workbook demonstrates how to select variably sized ranges using VBA.

The following macro is in the example workbook. The `SelectCurrentRegion` macro simulates pressing `Ctrl+Shift+*`.

```
Sub SelectCurrentRegion()  
    ActiveCell.CurrentRegion.Select  
End Sub
```

Tips for Working with Ranges

When you work with ranges, keep the following points in mind:

- ◆ Your code doesn't need to select a range to work with it.
- ◆ If your code does select a range, its worksheet must be active. You can use the `Activate` method of the `Worksheets` collection to activate a particular sheet.
- ◆ The macro recorder doesn't always generate the most efficient code. Often, you can create your macro by using the recorder and then edit the code to make it more efficient.
- ◆ It's a good idea to use named ranges in your VBA code. For example, referring to `Range("Total")` is better than `Range("D45")`. In the latter case, if you add a row above row 45, the cell address will change. You would then need to modify the macro so it uses the correct range address (D46).
- ◆ If you rely on the macro recorder when selecting ranges by using shortcut keys (for example, `Ctrl+Shift+→` to select to the end of a row), examine your code carefully. Excel sometimes records hard-coded references to the actual cells you selected.
- ◆ When running a macro that works on each cell in the current range selection, the user might select entire columns or rows. In most cases, you don't want to loop through every cell in the selection. Your macro should create a subset of the selection consisting of only the nonblank cells.
- ◆ Excel allows multiple selections. For example, you can select a range, press `Ctrl`, and select another range. You can test for this in your macro and take appropriate action.

Often, you won't want to actually select the cells. Rather, you'll want to work with them in some way (for example, format them). The cell-selecting procedures can easily be adapted. The following procedure was adapted from `SelectCurrentRegion`. This procedure doesn't select cells; it creates a `Range` object and then applies formatting to the range. The other procedures in the example workbook can also be adapted in this manner.

```
Sub FormatCurrentRegion()  
    Set WorkRange = ActiveCell.CurrentRegion  
    WorkRange.Font.Bold = True  
End Sub
```

Prompting for a cell value

The following procedure demonstrates how to ask the user for a value and then insert it into cell A1 of the active worksheet:

```
Sub GetValue1()  
    Range("A1").Value = InputBox("Enter the value")  
End Sub
```

Figure 11-3 shows how the input box looks.



Figure 11-3: The InputBox function gets a value from the user to be inserted into a cell.

This procedure has a problem, however. If the user clicks the Cancel button in the input box, the procedure deletes any data already in the cell. The following modification checks for the Cancel button clicks and takes no action:

```
Sub GetValue2()
    UserEntry = InputBox("Enter the value")
    If UserEntry <> "" Then Range("A1").Value = UserEntry
End Sub
```

In many cases, you'll need to validate the user's entry in the input box. For example, you may require a number between 1 and 12. The following example demonstrates one way to validate the user's entry. In this example, an invalid entry is ignored and the input box is displayed again. This cycle keeps repeating until the user enters a valid number or clicks Cancel.

```
Sub GetValue3()
    Dim MinVal As Integer, MaxVal As Integer
    Dim UserEntry As String
    Dim Msg As String
    Dim IntEntry As Integer
    MinVal = 1
    MaxVal = 12
    Msg = "Enter a value between " & MinVal & " and " & MaxVal
    Do
        UserEntry = InputBox(Msg)
        If UserEntry = "" Then Exit Sub
        If IsNumeric(UserEntry) Then
            IntEntry = Cint(UserEntry)
            If IntEntry >= MinVal And IntEntry <= MaxVal Then
                Exit Do
            End If
        End If
        Msg = "Your previous entry was INVALID."
        Msg = Msg & vbCrLf
        Msg = Msg & "Enter a value between " & _
            MinVal & " and " & MaxVal
    Loop
    ActiveSheet.Range("A1").Value = UserEntry
End Sub
```

As you can see in Figure 11-4, the code also changes the message displayed if the user makes an invalid entry.

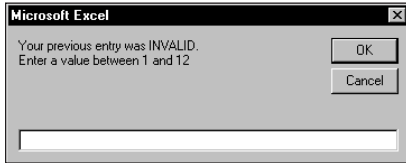


Figure 11-4: Validating a user's entry using the VBA InputBox function

Entering a value in the next empty cell

A common requirement is to enter a value into the next empty cell in a column or row. The following example prompts the user for a name and a value and then enters the data into the next empty row (see Figure 11-5).

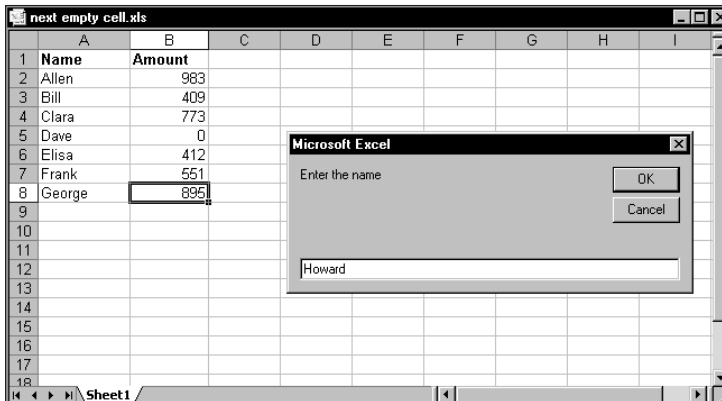


Figure 11-5: A macro for inserting data into the next empty row in a worksheet

```
Sub GetData()
    Dim NextRow As Long
    Dim Entry1 As String, Entry2 As String
    Do
        NextRow = Range("A65536").End(xlUp).Row + 1
        Entry1 = InputBox("Enter the name")
        If Entry1 = "" Then Exit Sub
        Entry2 = InputBox("Enter the amount")
        If Entry2 = "" Then Exit Sub
        Cells(NextRow, 1) = Entry1
        Cells(NextRow, 2) = Entry2
    Loop
End Sub
```

Notice that the loop continues indefinitely. I use `Exit Sub` statements to get out of the loop when the user clicks Cancel.


Note

To keep things simple, this procedure doesn't perform any validation.

Notice the statement that determines the value of the `NextRow` variable. If you don't understand how this works, try the manual equivalent: Activate cell A65536 (the last cell in column A). Then press `End`, followed by `Up Arrow`. At this point, the last nonblank cell in column A will be selected. The `Row` property returns this row number, and it is incremented by 1 in order to get the row of the cell below it (the next empty row).

Note that this technique of selecting the next empty cell has a slight glitch. If the column is completely empty, it will calculate Row 2 as the next empty row.

Pausing a macro to get a user-selected range

You may create a macro that needs to pause while the user specifies a range of cells. The procedure in this section describes how to do this using Excel's `InputBox` function.


Note

Do not confuse Excel's `InputBox` function with VBA's `InputBox` function. Although these two functions have the same name, they are not the same.

The `Sub` procedure that follows demonstrates how to pause a macro and let the user select a cell:

```
Sub GetUserRange()
    Dim UserRange As Range

    Output = 565
    Prompt = "Select a cell for the output."
    Title = "Select a cell"

    ' Display the Input Box
    On Error Resume Next
    Set UserRange = Application.InputBox( _
        Prompt:=Prompt, _
        Title:=Title, _
        Default:=ActiveCell.Address, _
        Type:=8) 'Range selection
    On Error GoTo 0
End Sub
```

```

' Was the Input Box canceled?
  If UserRange Is Nothing Then
    MsgBox "Canceled."
  Else
    UserRange.Range("A1") = Output
  End If
End Sub

```

The input box is shown in Figure 11-6.

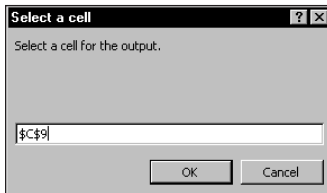


Figure 11-6: Using an input box to pause a macro

Specifying a `Type` argument of 8 is the key to this procedure. Also, note the use of `On Error Resume Next`. This statement ignores the error that occurs if the user clicks the `Cancel` button. If so, the `UserRange` object variable is not defined. This example displays a message box with the text `Canceled`. If the user clicks `OK`, the macro continues. Using `On Error GoTo 0` resumes normal error handling.

By the way, it's not necessary to check for a valid range selection. Excel takes care of this for you.



Caution

Make sure `ScreenUpdating` is turned on. Otherwise, you won't be able to select a cell.

Counting selected cells

You may create a macro that works with the selected range of cells. You can use the `Count` property of the `Range` object to determine how many cells are contained in a range selection (or any range, for that matter). For example, the following statement displays a message box that contains the number of cells in the current selection:

```
MsgBox Selection.Count
```

If the active sheet contains a range named `data`, the following statement assigns the number of cells in the `data` range to a variable named `CellCount`:

```
CellCount = Range("data").Count
```

You can also determine how many rows or columns are contained in a range. The following expression calculates the number of columns in the currently selected range:

```
Selection.Columns.Count
```

And, of course, you can also use the `Rows` property to determine the number of rows in a range. The following statement counts the number of rows in a range named `data` and assigns the number to a variable named `RowCount`:

```
RowCount = Range("data").Rows.Count
```

Determining the type of selected range

Excel supports several types of range selections:

- ♦ A single cell
- ♦ A contiguous range of cells
- ♦ One or more entire columns
- ♦ One or more entire rows
- ♦ The entire worksheet
- ♦ Any combination of the above (that is, a multiple selection)

As a result, when your VBA procedure processes a selected range, you can't make any presumptions about what that range might be.

In the case of a multiple range selection, the `Range` object comprises separate areas. To determine whether a selection is a multiple selection, use the `Areas` method, which returns an `Areas` collection. This collection represents all the ranges within a multiple range selection.

You can use an expression like the following to determine whether a selected range has multiple areas:

```
NumAreas = Selection.Areas.Count
```

If the `NumAreas` variable contains a value greater than one, the selection is a multiple selection.

The `AboutRangeSelection` procedure uses the `AreaType` custom function listed here:

```

Function AreaType(RangeArea As Range) As String
' Returns the type of a range in an area
  Select Case True
    Case RangeArea.Cells.Count = 1
      AreaType = "Cell"
    Case RangeArea.Count = Cells.Count
      AreaType = "Worksheet"
    Case RangeArea.Rows.Count = Cells.Rows.Count
      AreaType = "Column"
    Case RangeArea.Columns.Count = Cells.Columns.Count
      AreaType = "Row"
    Case Else
      AreaType = "Block"
  End Select
End Function

```

This function accepts a `Range` object as its argument and returns one of four strings that describe the area: `Cell`, `Worksheet`, `Column`, `Row`, or `Block`. The function uses a `Select Case` construct to determine which of four comparison expressions is `True`. For example, if the range consists of a single cell, the function returns `Cell`. If the number of cells in the range is equal to the number of cells in the worksheet, it returns `Worksheet`. If the number of rows in the range equals the number of rows in the worksheet, it returns `Column`. If the number of columns in the range equals the number of columns in the worksheet, the function returns `Row`. If none of the `Case` expressions is `True`, the function returns `Block`.


Note

Notice that the comparison doesn't involve absolute numbers. For example, rather than use 65,536 to determine whether the range is a column, it uses `Cells.Count`. Because of this, the function works properly even with Excel 5 and Excel 97 (which contain only 16,384 rows).


On the CD-ROM

A workbook on the companion CD-ROM contains a procedure (named `AboutRangeSelection`) that uses the `AreaType` function to display a message box that describes the current range selection. Figure 11-7 shows an example. Understanding how this routine works will give you a good foundation for working with `Range` objects.


Note

You may be surprised to discover that Excel allows multiple selections to be identical. For example, if you hold down `Ctrl` and click five times in cell `A1`, the selection will have five identical areas. The `AboutRangeSelection` procedure takes this into account.

Looping through a selected range efficiently

A common task is to create a macro that evaluates each cell in a range and performs an operation if the cell meets a certain criterion. Listing 11-1 provides an example of such a macro. In this example, the `SelectiveColor1` procedure applies a red

background to all cells in the selection that have a negative value. The background of other cells is reset.

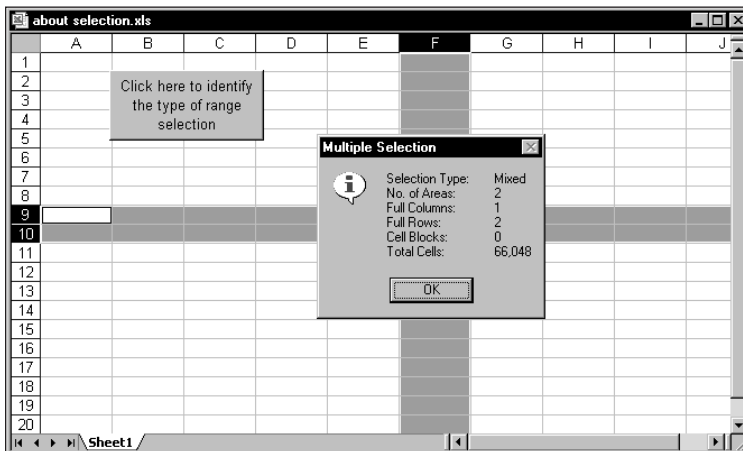


Figure 11-7: The `AboutRangeSelection` procedure analyzes the currently selected range.

Listing 11-1: Coloring all negative cells' backgrounds red

```
Sub SelectiveColor1()
    ' Makes cell background red if the value is negative
    If TypeName(Selection) <> "Range" Then Exit Sub
    Const REDINDEX = 3
    Application.ScreenUpdating = False
    For Each cell In Selection
        If cell.Value < 0 Then
            cell.Interior.ColorIndex = REDINDEX
        Else
            cell.Interior.ColorIndex = xlNone
        End If
    Next cell
End Sub
```

The `SelectiveColor1` procedure certainly works, but it has a serious flaw. For example, what if the selection consists of an entire column? Or ten columns? Or the entire worksheet? The user would probably give up before all the cells were evaluated. A better solution (`SelectiveColor2`) is shown in Listing 11-2.

Listing 11-2: Improving this procedure to include wider, multiple-column ranges

```
Sub SelectiveColor2()  
    ' Makes cell background red if the value is negative  
  
    Dim FormulaCells As Range  
    Dim ConstantCells As Range  
  
    Const REDINDEX = 3  
  
    ' Ignore errors  
    On Error Resume Next  
  
    Application.ScreenUpdating = False  
  
    ' Create subsets of original selection  
    Set FormulaCells = Selection.SpecialCells _  
        (xlFormulas, xlNumbers)  
    Set ConstantCells = Selection.SpecialCells _  
        (xlConstants, xlNumbers)  
  
    ' Process the formula cells  
    If Not FormulaCells Is Nothing Then  
        For Each cell In FormulaCells  
            If cell.Value < 0 Then _  
                cell.Font.ColorIndex = REDINDEX  
        Next cell  
    End If  
  
    ' Process the constant cells  
    If Not ConstantCells Is Nothing Then  
        For Each cell In ConstantCells  
            If cell.Value < 0 Then  
                cell.Interior.ColorIndex = REDINDEX  
            Else  
                cell.Interior.ColorIndex = xlNone  
            End If  
        Next cell  
    End If  
End Sub
```

This procedure performs some extra steps that make it very efficient. I used the `SpecialCells` method to generate two subsets of the selection: One subset includes only the cells with numeric constants; the other subset includes only the cells with numeric formulas. Then I processed the cells in these subsets by using two `For Each-Next` constructs. The net effect: Only nonblank cells are evaluated, speeding up the macro considerably.

Note

The `On Error` statement is necessary because the `SpecialCells` method generates an error if no cells qualify. This statement also handles situations in which a range is not selected when the procedure is executed.

Deleting all empty rows

The following procedure deletes all empty rows in the active worksheet. This routine is fast and efficient because it doesn't check all rows. It checks only the rows in the "used range," which is determined using the `UsedRange` property of the `Worksheet` object.

```
Sub DeleteEmptyRows()
    Dim LastRow As Long, r As Long
    LastRow = ActiveSheet.UsedRange.Rows.Count
    LastRow = LastRow + ActiveSheet.UsedRange.Row - 1
    Application.ScreenUpdating = False
    For r = LastRow To 1 Step -1
        If Application.CountA(Rows(r)) = 0 Then Rows(r).Delete
    Next r
End Sub
```

The first step is to determine the last used row, and assign this row number to the `LastRow` variable. This is not as simple as you may think, because the used range may or may not begin in Row 1. Therefore, `LastRow` is calculated by determining the number of rows in the used range, adding the first row number in the used range, and subtracting 1.

The procedure uses Excel's `COUNTA` worksheet function to determine whether a row is empty. If this function returns 0 for a particular row, then the row is empty. Notice that the procedure works on the rows from bottom to top, and uses a negative step value in the `For-Next` loop. This is necessary because deleting rows causes all subsequent rows to "move up" in the worksheet. If the looping occurred from top to bottom, the counter within the loop would not be accurate after a row is deleted.

Determining whether a range is contained in another range

The following `InRange` function accepts two arguments, both `Range` objects. The function returns `True` if the first range is contained in the second range.

```
Function InRange(rng1, rng2) As Boolean
    ' Returns True if rng1 is a subset of rng2
    InRange = False
    If rng1.Parent.Parent.Name = rng2.Parent.Parent.Name Then
        If rng1.Parent.Name = rng2.Parent.Name Then
            If Union(rng1, rng2).Address = rng2.Address Then
                InRange = True
            End If
        End If
    End If
```

```

        End If
    End If
End Function

```

The `InRange` function may appear a bit more complex than it need be because the code needs to ensure that the two ranges are in the same worksheet and workbook. Notice that the procedure uses the `Parent` property, which returns an object's container object. For example, the following expression returns the name of the worksheet for the `rng1` object reference:

```
rng1.Parent.Name
```

The following expression returns the name of the workbook for `rng1`:

```
rng1.Parent.Parent.Name
```

VBA's `Union` function returns a `Range` object that represents the union of two `Range` objects. The union is the cells that the two ranges have in common. If the address of the union of the two ranges is the same as the address of the second range, that means the first range is contained within the second range.

Determining a cell's data type

Excel provides a number of built-in functions that can help determine the type of data contained in a cell. These include `ISTEXT`, `ISLOGICAL`, and `ISERROR`. In addition, VBA includes functions such as `IsEmpty`, `IsDate`, and `IsNumeric`.

The following `CellType` function accepts a range argument and returns a string (*Blank, Text, Logical, Error, Date, Time, or Value*) that describes the data type of the upper-left cell in the range. You can use this function in a worksheet formula or from another VBA procedure.

```

Function CellType(Rng)
' Returns the cell type of the upper left
' cell in a range
Application.Volatile
Set Rng = Rng.Range("A1")
Select Case True
Case IsEmpty(Rng)
    CellType = "Blank"
Case WorksheetFunction.IsText(Rng)
    CellType = "Text"
Case WorksheetFunction.IsLogical(Rng)
    CellType = "Logical"
Case WorksheetFunction.IsErr(Rng)
    CellType = "Error"
Case IsDate(Rng)
    CellType = "Date"
Case InStr(1, Rng.Text, ":") <> 0
    CellType = "Time"
Case IsNumeric(Rng)

```

```

        CellType = "Value"
    End Select
End Function

```

Notice the use of the `Set Rng` statement. The `CellType` function accepts a range argument of any size but this statement causes it to operate only on the upper-left cell in the range.

Reading and writing ranges

Many spreadsheet tasks involve transferring the values from an array to a range, or from a range to an array. For some reason, Excel reads from ranges much faster than it writes to ranges. The `WriteReadRange` procedure shown in Listing 11-3 demonstrates the relative speeds of writing and reading a range.

This procedure creates an array and then uses `For-Next` loops to write the array to a range and then read the range back into the array. It calculates the time required for each operation by using the `Excel Timer` function.

Listing 11-3: Benchmarking read and write operations involving ranges

```

Sub WriteReadRange()
    Dim MyArray()
    Dim Time1 As Date
    Dim NumElements As Long, i As Long
    Dim WriteTime As String, ReadTime As String
    Dim Msg As String

    NumElements = 60000
    ReDim MyArray(1 To NumElements)

    ' Fill the array
    For i = 1 To NumElements
        MyArray(i) = i
    Next i

    ' Write the array to a range
    Time1 = Timer
    For i = 1 To NumElements
        Cells(i, 1) = MyArray(i)
    Next i
    WriteTime = Format(Timer - Time1, "00:00")

    ' Read the range into the array
    Time1 = Timer
    For i = 1 To NumElements
        MyArray(i) = Cells(i, 1)
    Next i

```

Continued

Listing 11-3: (continued)

```
Next i
ReadTime = Format(Timer - Time1, "00:00")

' Show results
Msg = "Write: " & WriteTime
Msg = Msg & vbCrLf
Msg = Msg & "Read: " & ReadTime
MsgBox Msg, vbOKOnly, NumElements & " Elements"
End Sub
```

On my system, it took 15 seconds to write a 60,000-element array to a range but only 4 seconds to read the range into an array.

A better way to write to a range

The example in the previous section uses a `For-Next` loop to transfer the contents of an array to a worksheet range. In this section, I demonstrate a more efficient way to accomplish this.

Let's start with the example in Listing 11-4, which illustrates the most obvious (but not most efficient) way to fill a range. This example uses a `For-Loop` to insert its values in a range.

Listing 11-4: Filling a range by brute force

```
Sub LoopFillRange()
' Fill a range by looping through cells

Dim CellsDown As Long, CellsAcross As Integer
Dim CurrRow As Long, CurrCol As Integer
Dim StartTime As Date
Dim CurrVal As Long

' Get the dimensions
CellsDown = Val(InputBox("How many cells down?"))
CellsAcross = Val(InputBox("How many cells across?"))

' Record starting time
StartTime = Timer

' Loop through cells and insert values
CurrVal = 1
Application.ScreenUpdating = False
For CurrRow = 1 To CellsDown
    For CurrCol = 1 To CellsAcross
```

```

        ActiveCell.Offset(CurrRow - 1, _
            CurrCol - 1).Value = CurrVal
        CurrVal = CurrVal + 1
    Next CurrCol
Next CurrRow

' Display elapsed time
Application.ScreenUpdating = True
MsgBox Format(Timer - StartTime, "00.00") & " seconds"
End Sub

```

The example in Listing 11-5 demonstrates a faster way to produce the same result. This code inserts the values into an array and then uses a single statement to transfer the contents of an array to the range.

Listing 11-5: Borrowing arrays to fill ranges faster

```

Sub ArrayFillRange()
' Fill a range by transferring an array

    Dim CellsDown As Long, CellsAcross As Integer
    Dim i As Long, j As Integer
    Dim StartTime As Date
    Dim TempArray() As Long
    Dim TheRange As Range
    Dim CurrVal As Long

' Get the dimensions
CellsDown = Val(InputBox("How many cells down?"))
CellsAcross = Val(InputBox("How many cells across?"))

' Record starting time
StartTime = Timer

' Redimension temporary array
ReDim TempArray(1 To CellsDown, 1 To CellsAcross)

' Set worksheet range
Set TheRange = ActiveCell.Range(Cells(1, 1), _
    Cells(CellsDown, CellsAcross))

' Fill the temporary array
CurrVal = 0
Application.ScreenUpdating = False
For i = 1 To CellsDown
    For j = 1 To CellsAcross
        TempArray(i, j) = CurrVal + 1
        CurrVal = CurrVal + 1
    
```

Continued

Listing 11-5 (continued)

```
        Next j
    Next i

    ' Transfer temporary array to worksheet
    TheRange.Value = TempArray

    ' Display elapsed time
    Application.ScreenUpdating = True
    MsgBox Format(Timer - StartTime, "00.00") & " seconds"
End Sub
```

On my system, using the loop method to fill a 500×256 cell range (128,000 cells) took 202.34 seconds. The array transfer method took only 0.77 seconds to generate the same results — more than 250 times faster! The moral of this story? If you need to transfer large amounts of data to a worksheet, avoid looping whenever possible.

Transferring one-dimensional arrays

The example in the preceding section involves a two-dimensional array, which works out nicely for row-and-column-based worksheets.

When transferring a one-dimensional array to a range, the range must be horizontal — that is, one row with multiple *columns*. If you have to use a vertical range instead, you must first transpose the array to make it vertical. You can use Excel's TRANSPOSE function to do this. The following example transfers a 100-element array to a vertical worksheet range (A1:A100):

```
Range(A1:A100).Value = _
    Application.WorksheetFunction.Transpose(MyArray)
```

Transferring a range to a variant array

This section discusses yet another way to work with worksheet data in VBA. The following example transfers a range of cells to a two-dimensional variant array. Then, message boxes display the upper bounds for each dimension of the variant array.

```
Sub RangeToVariant()
    Dim x As Variant
    x = Range("A1:L600")
    MsgBox UBound(x, 1)
    MsgBox UBound(x, 2)
End Sub
```


In this example, the first message box displays 600 (the number of rows in the original range), and the second message box displays 12 (the number of columns). You'll find that transferring the range data to a variant array is virtually instantaneous.

The following example reads a range into a variant array, performs a simple multiplication operation on each element in the array, and then transfers the variant array back to the range:

```
Sub RangeToVariant2()  
    Dim UserRange As Range  
    Dim x As Variant  
    Dim r As Long, c As Integer  
  
    Set UserRange = Range("A1:L600")  
  
    ' Read the data into the variant  
    x = Range("A1:L50")  
  
    ' Loop through the variant array  
    For r = 1 To UBound(x, 1)  
        For c = 1 To UBound(x, 2)  
            ' Multiply by 2  
            x(r, c) = x(r, c) * 2  
        Next c  
    Next r  
  
    ' Transfer the variant back to the sheet  
    Range("A1:L50") = x  
End Sub
```

Again, you'll find that this procedure runs amazingly fast.

Selecting the maximum value in a range

The `GoToMax` procedure in Listing 11-6 activates the worksheet cell that contains the maximum value. The procedure determines the maximum value in the selected range; but if a single cell is selected, it determines the maximum value for the entire worksheet. Next, it uses the `Find` method to locate the value and select the cell.

Listing 11-6: Moving the pointer to the cell containing the greatest value

```
Sub GoToMax()  
    ' Activates the cell with the largest value  
    Dim WorkRange as Range  
    Dim MaxVal as Double
```

Continued

Listing 11-6 (continued)

```

' Exit if a range is not selected
If TypeName(Selection) <> "Range" Then Exit Sub

' If one cell is selected, search entire worksheet;
' Otherwise, search the selected range
If Selection.Count = 1 Then
    Set Workrange = Cells
Else
    Set Workrange = Selection
End If

' Determine the maximum value
MaxVal = Application.Max(Workrange)

' Find it and select it
On Error Resume Next
Workrange.Find(What:=MaxVal, _
    After:=Workrange.Range("A1"), _
    LookIn:=xlValues, _
    LookAt:=xlPart, _
    SearchOrder:=xlByRows, _
    SearchDirection:=xlNext, MatchCase:=False _
    ).Select
If Err <> 0 Then MsgBox "Max value was not found: " _
    & MaxVal
End Sub

```

You'll notice that the arguments for the `Find` method correspond to the controls in Excel's Find and Replace dialog box.

Selecting all cells with a particular format

The example in this section demonstrates how to use the `FindFormat` method to locate and select all cells in a worksheet that contain a particular format. When these cells are selected, you can then do what you want with them—change the formatting, delete them, etc. Figure 11-8 shows an example.



The `FindFormat` property is new to Excel 2002. Consequently, this procedure will not work with earlier versions of Excel.

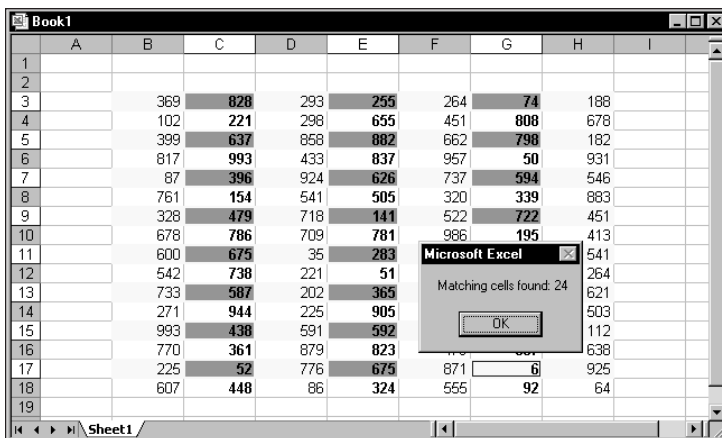


Figure 11-8: Selecting all cells with a particular format

The `SelectByFormat` procedure is as follows:

```

Sub SelectByFormat()
'   Selects cells based on their formatting

'   Make sure version is Excel 2002 or later
If Val(Application.Version) < 10 Then
    MsgBox "This requires Excel 2002 or later."
    Exit Sub
End If

Dim FirstCell As Range, FoundCell As Range
Dim AllCells As Range

'   Specify the formatting to look for
With Application.FindFormat
    .Clear
    .Interior.ColorIndex = 6 'yellow
    .Font.Bold = True
End With

'   Look for the first matching cell
Set FirstCell = Cells.Find(What:="", SearchFormat:=True)

'   If nothing was found, then exit
If FirstCell Is Nothing Then
    MsgBox "No matching cells were found."
    Exit Sub
End If

'   Initialize AllCells

```

```
Set AllCells = FirstCell
Set FoundCell = FirstCell

' Loop until the FirstCell is found again
Do
    Set FoundCell = Cells.FindNext(After:=FoundCell)
    Set AllCells = Union(FoundCell, AllCells)
    If FoundCell.Address = FirstCell.Address Then Exit Do
Loop

' Select the found cells and inform the user
AllCells.Select
MsgBox " Matching cells found: " & AllCells.Count
End Sub
```

The procedure starts by setting properties of the `FindFormat` object. In this example, the formatting to be searched for consists of two components: a yellow interior and bold text. You can, of course, change this to any formatting you like.

The `Find` method is used to locate the first qualifying cell. The `Find` method's `What` argument is set to an empty string. This is because the search involves only formatting, not cell contents. Also, the `SearchFormat` argument is `True` because we are, in fact, searching for formatting.

If the formatting is not found, the user is informed and the code ends. Otherwise, the found cell is assigned to the `AllCells` object variable (which stores all of the found cells). A loop uses the `FindNext` method to continue searching. The search continues until the cell found first is found again. Finally, all of the found cells are selected in the worksheet and the user is given the count.

Note

This procedure will not locate cells that have a particular formatting as a result of Excel's conditional formatting feature.

Working with Workbooks and Sheets

The examples in this section demonstrate various ways to use VBA to work with workbooks and worksheets.



The examples in this section are available on the companion CD-ROM.

Saving all workbooks

The following procedure loops through all workbooks in the `Workbooks` collection, and saves each file that has been saved previously:

```
Public Sub SaveAllWorkbooks()  
    Dim Book As Workbook  
    For Each Book In Workbooks  
        If Book.Path <> "" Then Book.Save  
    Next Book  
End Sub
```

Notice the use of the `Path` property. If a workbook's `Path` property is empty, that means the file has never been saved (it's a new workbook). This procedure ignores such workbooks and only saves the workbooks that have a nonempty `Path` property.

Saving and closing all workbooks

The following procedure loops through the `Workbooks` collection. The code saves and closes all workbooks.

```
Sub CloseAllWorkbooks()  
    Dim Book As Workbook  
    For Each Book In Workbooks  
        If Book.Name <> ThisWorkbook.Name Then  
            Book.Close savechanges:=True  
        End If  
    Next Book  
    ThisWorkbook.Close savechanges:=True  
End Sub
```

Notice that the procedure uses an `If` statement to determine if the workbook is the workbook that contains the code. This is necessary because closing the workbook that contains the procedure would end the code and subsequent workbooks would not be affected.

Accessing workbook properties

Excel's `File` ⇨ `Properties` command displays a dialog box that contains information about the active workbook. You can access the properties from VBA. The following procedure, for example, displays the date and time when the active workbook was saved:

```
Sub LastSaved()  
    Dim SaveTime As String  
    On Error Resume Next  
    SaveTime = ActiveWorkbook. _  
        BuiltinDocumentProperties("Last Save Time").Value  
    If SaveTime = "" Then  
        MsgBox ActiveWorkbook.Name & " has not been saved."  
    Else  
        MsgBox "Saved: " & SaveTime, , ActiveWorkbook.Name  
    End If  
End Sub
```

If the workbook has not been saved, attempting to access the `Last Save Time` property will generate an error. The `On Error` statement causes this error to be ignored. The `If-Then-Else` structure checks the value of the `SaveTime` variable and displays the appropriate message. If this variable is empty, it means the file was not saved. Figure 11-9 shows an example of this procedure's result.



Figure 11-9: Displaying the date and time a workbook was saved



Note

Quite a few other built-in properties are available, but they are not all relevant to Excel. Consult the online help for a complete list of built-in properties.

Synchronizing worksheets

If you use multisheet workbooks, you probably know that Excel cannot “synchronize” the sheets in a workbook. In other words, there is no automatic way to force all sheets to have the same selected range and upper left cell. The VBA macro that follows uses the active worksheet as a base, and then performs the following on all other worksheets in the workbook:

- ♦ Selects the same range as the active sheet
- ♦ Makes the upper left cell the same as the active sheet

Following is the listing for the subroutine:

```
Sub SynchSheets()
' Duplicates the active sheet's active cell upperleft cell
' Across all worksheets
  If TypeName(ActiveSheet) <> "Worksheet" Then Exit Sub
  Dim UserSheet As Worksheet, sht As Worksheet
  Dim TopRow As Long, LeftCol As Integer
  Dim UserSel As String

  Application.ScreenUpdating = False

' Remember the current sheet
  Set UserSheet = ActiveSheet

' Store info from the active sheet
  TopRow = ActiveWindow.ScrollRow
  LeftCol = ActiveWindow.ScrollColumn
  UserSel = ActiveWindow.RangeSelection.Address
```

```
' Loop through the worksheets
For Each sht In ActiveWorkbook.Worksheets
    If sht.Visible Then 'skip hidden sheets
        sht.Activate
        Range(UserSel).Select
        ActiveWindow.ScrollRow = TopRow
        ActiveWindow.ScrollColumn = LeftCol
    End If
Next sht

' Restore the original position
UserSheet.Activate
Application.ScreenUpdating = True
End Sub
```

VBA Techniques

The examples in this section illustrate common VBA techniques that you may be able to adapt to your own projects.



The examples in this section are available on the companion CD-ROM.

Toggling a Boolean property

A Boolean property is one that is either True or False. The easiest way to toggle a Boolean property is to use the `Not` operator, as shown in the following example, which toggles the `WrapText` property of a selection.

```
Sub ToggleWrapText()
' Toggles text wrap alignment for selected cells
If TypeName(Selection) = "Range" Then
    Selection.WrapText = Not ActiveCell.WrapText
End If
End Sub
```

Note that the active cell is used as the basis for toggling. When a range is selected and the property values in the cells are inconsistent (for example, some cells are bold and others are not), it is considered *mixed*, and Excel uses the active cell to determine how to toggle. If the active cell is bold, for example, all cells in the selection are made not bold when you click the Bold toolbar button. This simple procedure mimics the way Excel works, which is usually the best practice.

Note also that this procedure uses the `TypeName` function to check whether the selection is a range. If it isn't, nothing happens.

You can use the `Not` operator to toggle many other properties. For example, to toggle the display of row and column borders in a worksheet, use the following code:

```
ActiveWindow.DisplayHeadings = Not _  
ActiveWindow.DisplayHeadings
```

To toggle the display of grid lines in the active worksheet, use the following code:

```
ActiveWindow.DisplayGridlines = Not _  
ActiveWindow.DisplayGridlines
```

Determining the number of printed pages

If you need to determine the number of printed pages for a worksheet printout, you can use Excel's Print Preview feature and view the page count displayed at the bottom of the screen. The following VBA procedure that follows calculates the number of printed pages for the active sheet by counting the number of horizontal and vertical page breaks:

```
Sub PageCount()  
MsgBox (ActiveSheet.HPageBreaks.Count + 1) * _  
    (ActiveSheet.VPageBreaks.Count + 1)  
End Sub
```

The following VBA procedure loops through all worksheets in the active workbook and displays the total number of printed pages:

```
Sub ShowPageCount()  
Dim PageCount As Integer  
Dim sht As Worksheet  
PageCount = 0  
For Each sht In Worksheets  
    PageCount = PageCount + (sht.HPageBreaks.Count + 1) * _  
        (sht.VPageBreaks.Count + 1)  
Next sht  
MsgBox "Total Pages = " & PageCount  
End Sub
```

Displaying the date and time

If you understand the serial number system that Excel uses to store dates and times, you won't have any problems using dates and times in your VBA procedures.

The `DateAndTime` procedure displays a message box with the current date and time, as depicted in Figure 11-10. This example also displays a personalized message in the message box's title bar.

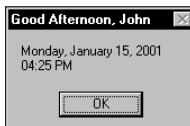


Figure 11-10: A message box displaying the date and time

The procedure shown in Listing 11-7 uses the `Date` function as an argument for the `Format` function. The result is a string with a nicely formatted date. I used the same technique to get a nicely formatted time.

Listing 11-7: Displaying the current date and time

```
Sub DateAndTime()
    TheDate = Format(Date, "Long Date")
    TheTime = Format(Time, "Medium Time")

    ' Determine greeting based on time
    Select Case Time
        Case Is < TimeValue("12:00"): Greeting = "Good Morning, "
    "
        Case Is >= TimeValue("17:00"): Greeting = "Good
Evening, "
        Case Else: Greeting = "Good Afternoon, "
    End Select

    ' Append user's first name to greeting
    FullName = Application.UserName
    SpaceInName = InStr(1, FullName, " ", 1)

    ' Handle situation when name has no space
    If SpaceInName = 0 Then SpaceInName = Len(FullName)
    FirstName = Left(FullName, SpaceInName)
    Greeting = Greeting & FirstName

    ' Show the message
    MsgBox TheDate & vbCrLf & TheTime, vbOKOnly, Greeting
End Sub
```

In the preceding example, I used named formats (“Long Date” and “Medium Time”) to ensure that the macro will work properly regardless of the user’s international settings. You can, however, use other formats. For example, to display the date in `mm/dd/yy` format, you can use a statement like the following:

```
TheDate = Format(Date, "mm/dd/yy")
```

I used a `Select Case` construct to base the greeting displayed in the message box's title bar on the time of day. VBA time values work just as they do in Excel. If the time is less than .5 (noon), it's morning. If it's greater than .7083 (5 p.m.), it's evening. Otherwise, it's afternoon. I took the easy way out and used VBA's `TimeValue` function, which returns a time value from a string.

The next series of statements determines the user's first name, as recorded in the General tab in the Options dialog box. I used VBA's `InStr` function to locate the first space in the user's name. When I first wrote this procedure, I didn't consider a user name that has no space. So when I ran this procedure on a machine with a user's name of *Nobody*, the code failed—which goes to show you that I can't think of everything, and even the simplest procedures can run aground. (By the way, if the user's name is left blank, Excel always substitutes the name *User*.) The solution to this problem was to use the length of the full name for the `SpaceInName` variable so the `Left` function extracts the full name.

The `MsgBox` function concatenates the date and time but uses the built-in `vbCrLf` constant to insert a line break between them. `vbOKOnly` is a predefined constant that returns 0, causing the message box to appear with only an OK button. The final argument is the `Greeting`, constructed earlier in the procedure.

Getting a list of fonts

If you need to get a list of all installed fonts, you'll find that Excel does not provide a direct way to retrieve that information. One approach is to read the font names from the Font control on the Formatting toolbar.

The following procedure displays a list of the installed fonts in column A of the active worksheet. It uses the `FindControl` method to locate the Font control on the Formatting toolbar. If this control is not found (for example, it was removed by the user) a temporary `CommandBar` is created and the Font control is added to it.



Refer to Chapter 22 for more information about working with `CommandBar` controls.

```
Sub ShowInstalledFonts()  
    Dim FontList As CommandBarControl  
    Dim TempBar As CommandBar  
    Dim i As Integer  
  
    Set FontList = Application.CommandBars("Formatting"). _  
        FindControl(ID:=1728)  
  
    ' If Font control is missing, create a temp CommandBar  
    If FontList Is Nothing Then  
        Set TempBar = Application.CommandBars.Add
```

```

        Set FontList = TempBar.Controls.Add(ID:=1728)
    End If

    ' Put the fonts into column A
    Range("A:A").ClearContents
    For i = 0 To FontList.ListCount - 1
        Cells(i + 1, 1) = FontList.List(i + 1)
    Next i

    ' Delete temp CommandBar if it exists
    On Error Resume Next
    TempBar.Delete
End Sub

```

Sorting an array

Although Excel has a built-in command to sort worksheet ranges, VBA doesn't offer a method to sort arrays. One viable, but cumbersome, workaround is to transfer your array to a worksheet range, sort it using Excel's commands, and then return the result to your array. But if speed is essential, it's better to write a sorting routine in VBA.

In this section, I describe four different sorting techniques:

- ♦ *Worksheet Sort* transfers an array to a worksheet range, sorts it, and transfers it back to the array. This procedure accepts an array as its only argument and is limited to arrays with no more than 65,536 elements—the number of rows in a worksheet.
- ♦ *Bubble Sort* is a simple sorting technique (also used in the Chapter 9 sheet-sorting example). Although easy to program, the bubble-sorting algorithm is not the fastest sorting technique, especially when the number of elements is large.
- ♦ *Quick Sort* is a much faster sorting routine than Bubble Sort, but it is also more difficult to understand.
- ♦ *Counting Sort* is lightning fast but also difficult to understand.



The companion CD-ROM includes a workbook application that demonstrates these sorting methods. This workbook is useful for comparing the techniques with arrays of varying sizes.

Figure 11-11 shows the dialog box for this project. I tested the sorting procedures with seven different array sizes, ranging from 100 to 100,000 elements (random numbers). The arrays contained random numbers (of type double).

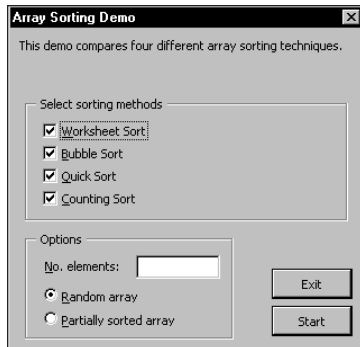


Figure 11-11: Comparing the time required to perform sorts of various array sizes

Table 11-1 shows the results of my tests. A 0.00 entry means that the sort was virtually instantaneous (less than .01 second).

<i>Array Elements</i>	<i>Excel Worksheet Sort</i>	<i>VBA Bubble Sort</i>	<i>VBA Quick Sort</i>	<i>VBA Counting Sort</i>
100	0.05	0.00	0.05	0.00
500	0.06	0.11	0.05	0.00
1,000	0.11	0.44	0.11	0.00
5,000	0.55	8.89	0.77	0.00
10,000	1.16	31.69	1.75	0.06
50,000	6.98	788.62	10.21	0.22
100,000	N/A	N/A	20.60	0.44

I then performed a second series of tests using an array that was almost sorted. These results are shown in Table 11-2.

Table 11-2
Sorting Times in Seconds for Four Sort Algorithms
Using Nearly Sorted Arrays

<i>Array Elements</i>	<i>Excel Worksheet Sort</i>	<i>VBA Bubble Sort</i>	<i>VBA Quick Sort</i>	<i>VBA Counting Sort</i>
100	0.05	0.00	0.00	0.00
500	0.05	0.11	0.00	0.00
1,000	0.11	0.27	0.11	0.00
5,000	0.33	7.09	0.55	0.05
10,000	1.15	32.02	1.70	0.06
50,000	3.35	718.52	9.23	0.22
100,000	N/A	N/A	24.61	0.44

As you can see, none of these algorithms is affected much by whether the array is in random order or partially sorted.

The Worksheet Sort algorithm is amazingly fast, especially when you consider that the array is transferred to the sheet, sorted, and then transferred back to the array. If the array is almost sorted, the Worksheet Sort technique is even faster.

The Bubble Sort algorithm is reasonably fast with small arrays, but for larger arrays (more than 5,000 elements), forget it. The Quick Sort algorithm is a winner, but the Counting Sort wins by a long shot.

Processing a series of files

One reason for using macros, of course, is to repeat an operation a number of times. The example in Listing 11-8 demonstrates how to execute a macro on several different files stored on disk. This example—which may help you set up your own routine for this type of task—prompts the user for a file specification and then processes all matching files. In this case, processing consists of importing the file and entering a series of summary formulas that describe the data in the file.

Listing 11-8: A macro that processes multiple stored files

```
Sub BatchProcess()
    Dim FS As FileSearch
    Dim FilePath As String, FileSpec As String
    Dim i As Integer
```

Continued

Listing 11-8 (continued)

```

' Specify path and file spec
  FilePath = ThisWorkbook.Path & "\"
  FileSpec = "text??.txt"

' Create a FileSearch object
  Set FS = Application.FileSearch
  With FS
    .LookIn = FilePath
    .FileName = FileSpec
    .Execute
' Exit if no files are found
    If .FoundFiles.Count = 0 Then
      MsgBox "No files were found"
      Exit Sub
    End If
  End With

' Loop through the files and process them
  For i = 1 To FS.FoundFiles.Count
    Call ProcessFiles(FS.FoundFiles(i))
  Next i
End Sub

```



This example uses three additional files, which are also provided on the CD-ROM: `Text01.txt`, `Text02.txt`, and `Text03.txt`. You'll need to modify the routine to import other text files. This procedure uses the `FileSearch` object, so it will work in Excel 2000 or later.

The matching files are retrieved by the `FileSearch` object, and the procedure uses a `For-Next` loop to process the files. Within the loop, the processing is done by calling the `ProcessFiles` procedure, which follows. This simple procedure uses the `OpenText` method to import the file and then inserts five formulas. You may, of course, substitute your own routine in place of this one:

```

Sub ProcessFiles(FileName As String)
' Import the file
  Workbooks.OpenText FileName:=FileName, _
    Origin:=xlWindows, _
    StartRow:=1, _
    DataType:=xlFixedWidth, _
    FieldInfo:= _
    Array(Array(0, 1), Array(3, 1), Array(12, 1))
' Enter summary formulas
  Range("D1").Value = "A"
  Range("D2").Value = "B"

```

```

Range("D3").Value = "C"
Range("E1:E3").Formula = "=COUNTIF(B:B,D1)"
Range("F1:F3").Formula = "=SUMIF(B:B,D1,C:C)"
End Sub

```

Some Useful Functions for Use in Your Code

In this section, I present some custom “utility” functions that you may find useful in your own applications and that may provide inspiration for creating similar functions. These functions are most useful when called from another VBA procedure. Therefore, they are declared using the `Private` keyword and thus will not appear in Excel’s Insert Function dialog box.



The examples in this section are available on the companion CD-ROM.

The FileExists function

This function takes one argument (a path with filename) and returns True if the file exists:

```

Private Function FileExists(fname) As Boolean
' Returns TRUE if the file exists
FileExists = (Dir(fname) <> "")
End Function

```

The FileNameOnly function

This function accepts one argument (a path with filename) and returns only the filename. In other words, it strips out the path.

```

Private Function FileNameOnly(pname) As String
' Returns the filename from a path/filename string
Dim i As Integer, length As Integer, temp As String
length = Len(pname)
temp = ""
For i = length To 1 Step -1
If Mid(pname, i, 1) = Application.PathSeparator Then
FileNameOnly = temp
Exit Function
End If
temp = Mid(pname, i, 1) & temp
Next i
FileNameOnly = pname
End Function

```

The `FileNameOnly` function works with any path and filename (even if the file does not exist). If the file exists, the following function is a simpler way to strip off the path and return only the filename.

```
Private Function FileNameOnly2(pname) As String
    FileNameOnly2 = Dir(pname)
End Function
```

The PathExists function

This function accepts one argument (a path) and returns `True` if the path exists:

```
Private Function PathExists(pname) As Boolean
    ' Returns TRUE if the path exists
    Dim x As String
    On Error Resume Next
    x = GetAttr(pname) And 0
    If Err = 0 Then PathExists = True _
        Else PathExists = False
End Function
```

The RangeNameExists function

This function accepts a single argument (a range name) and returns `True` if the range name exists in the active workbook:

```
Private Function RangeNameExists(nname) As Boolean
    ' Returns TRUE if the range name exists
    Dim n As Name
    RangeNameExists = False
    For Each n In ActiveWorkbook.Names
        If UCase(n.Name) = UCase(nname) Then
            RangeNameExists = True
            Exit Function
        End If
    Next n
End Function
```

The SheetExists function

This function accepts one argument (a worksheet name) and returns `True` if the worksheet exists in the active workbook:

```
Private Function SheetExists(sname) As Boolean
    ' Returns TRUE if sheet exists in the active workbook
    Dim x As Object
    On Error Resume Next
    Set x = ActiveWorkbook.Sheets(sname)
```



```

    If Err = 0 Then SheetExists = True _
        Else SheetExists = False
End Function

```

The WorkbookIsOpen function

This function accepts one argument (a workbook name) and returns True if the workbook is open:

```

Private Function WorkbookIsOpen(wbname) As Boolean
' Returns TRUE if the workbook is open
Dim x As Workbook
On Error Resume Next
Set x = Workbooks(wbname)
If Err = 0 Then WorkbookIsOpen = True _
    Else WorkbookIsOpen = False
End Function

```

Testing for Membership in a Collection

The following function procedure is a “generic” function that you can use to determine whether an object is a member of a collection:

```

Private Function IsInCollection(Coln As Object, _
    Item As String) As Boolean
    Dim Obj As Object
    On Error Resume Next
    Set Obj = Coln(Item)
    IsInCollection = Not Obj Is Nothing
End Function

```

This function accepts two arguments: the collection (an object), and the item (a string) that may or may not be a member of the collection. The function attempts to create an object variable that represents the item in the collection. If the attempt is successful, the function returns True; otherwise it returns False.

You can use the `IsInCollection` function in place of three other functions listed in this chapter: `RangeNameExists`, `SheetExists`, and `WorkbookIsOpen`. To determine if a range named `Data` exists in the active workbook, call the `IsInCollection` function with this statement:

```
MsgBox IsInCollection(ActiveWorkbook.Names, "Data")
```

To determine whether a workbook named `Budget` is open, use this statement:

```
MsgBox IsInCollection(Workbooks, "budget.xls")
```

To determine whether the active workbook contains a sheet named `Sheet1`, use this statement.

```
MsgBox IsInCollection(ActiveWorkbook.Worksheets, "Sheet1")
```

Retrieving a value from a closed workbook

VBA does not include a method to retrieve a value from a closed workbook file. You can, however, take advantage of Excel's ability to work with linked files. This section contains a VBA function (`GetValue`, which follows) that retrieves a value from a closed workbook. It does so by calling an XLM macro.

```
Private Function GetValue(path, file, sheet, ref)
'   Retrieves a value from a closed workbook
    Dim arg As String

'   Make sure the file exists
    If Right(path, 1) <> "\" Then path = path & "\"
    If Dir(path & file) = "" Then
        GetValue = "File Not Found"
        Exit Function
    End If

'   Create the argument
    arg = "'" & path & "[" & file & "]" & sheet & "!" & _
        Range(ref).Range("A1").Address(, , xlR1C1)

'   Execute an XLM macro
    GetValue = ExecuteExcel4Macro(arg)
End Function
```

The `GetValue` function takes four arguments:

<code>path</code>	The drive and path to the closed file (e.g., "d:\files")
<code>file</code>	The workbook name (e.g., "budget.xls")
<code>sheet</code>	The worksheet name (e.g., "Sheet1")
<code>ref</code>	The cell reference (e.g., "C4")

The following Sub procedure demonstrates how to use the `GetValue` function. It simply displays the value in cell A1 in Sheet1 of a file named `99Budget.xls`, located in the `XLFiles\Budget` directory on drive C.

```
Sub TestGetValue()
    p = "c:\XLFiles\Budget"
    f = "99Budget.xls"
    s = "Sheet1"
    a = "A1"
    MsgBox GetValue(p, f, s, a)
End Sub
```

Another example follows. This procedure reads 1,200 values (100 rows and 12 columns) from a closed file, and places the values into the active worksheet.

```
Sub TestGetValue2()  
    p = "c:\XLFiles\Budget"  
    f = "99Budget.xls"  
    s = "Sheet1"  
    Application.ScreenUpdating = False  
    For r = 1 To 100  
        For c = 1 To 12  
            a = Cells(r, c).Address  
            Cells(r, c) = GetValue(p, f, s, a)  
        Next c  
    Next r  
    Application.ScreenUpdating = True  
End Sub
```

 **Note**

The `GetValue` function does not work if used in a worksheet formula. Actually, there is no need to use this function in a formula. You can simply create a link formula to retrieve a value from a closed file.

Some Useful Worksheet Functions

The examples in this section are custom functions that can be used in worksheet formulas. Remember, these Function procedures must be defined in a VBA module (not a code module associated with `ThisWorkbook`, a sheet, or a UserForm).

 **On the CD-ROM**

The examples in this section are available on the companion CD-ROM.

Returning cell formatting information

This section contains a number of custom functions that return information about a cell's formatting. These functions are useful if you need to sort data based on formatting (for example, sort such that all bold cells are together).

 **Caution**

You'll find that these functions aren't always updated automatically. This is because changing formatting, for example, doesn't trigger Excel's recalculation engine. To force a global recalculation (and update all of the custom functions), press `Ctrl+Alt+F9`.

The following function returns `TRUE` if its single-cell argument has bold formatting:

```
Function ISBOLD(cell) As Boolean  
    ' Returns TRUE if cell is bold  
    ISBOLD = cell.Range("A1").Font.Bold  
End Function
```

The following function returns TRUE if its single-cell argument has italic formatting:

```
Function ISITALIC(cell) As Boolean
' Returns TRUE if cell is italic
  ISITALIC = cell.Range("A1").Font.Italic
End Function
```

Both of the preceding functions will return an error if the cell has mixed formatting—for example, only some characters are bold. The following function returns TRUE only if all characters in the cell are bold.

```
Function ALLBOLD(cell) As Boolean
' Returns TRUE if all characters in cell
' are bold
  If IsNull(cell.Font.Bold) Then
    ALLBOLD = False
  Else
    ALLBOLD = cell.Font.Bold
  End If
End Function
```

The FILLCOLOR function, which follows, returns an integer that corresponds to the color index of the cell's interior (the cell's fill color). If the cell's interior is not filled, the function returns -4142.

```
Function FILLCOLOR(cell) As Integer
' Returns an integer corresponding to
' cell's interior color
  FILLCOLOR = cell.Range("A1").Interior.ColorIndex
End Function
```

Displaying the date a file was saved or printed

An Excel workbook contains several built-in document properties, accessible from the `BuiltinDocumentProperties` property of the `Workbook` object. The following function returns the date and time that the workbook was last saved:

```
Function LASTSAVED()
  Application.Volatile
  LASTSAVED = ThisWorkbook. _
    BuiltinDocumentProperties("Last Save Time")
End Function
```

The following function is similar, but it returns the date and time when the workbook was last printed or previewed.

```
Function LASTPRINTED()
    Application.Volatile
    LASTPRINTED = ThisWorkbook.
        BuiltInDocumentProperties("Last Print Date")
End Function
```

If you use these functions in a formula, you may need to force a recalculation (Ctrl+Alt+F9) to get the current values of these properties.


Note

Quite a few additional built-in properties are available, but Excel does not use all of them. For example, attempting to access the “Number of Bytes” property will generate an error.

Understanding object parents

As you know, Excel’s object model is a hierarchy: objects are contained in other objects. At the top of the hierarchy is the `Application` object. Excel contains other objects, and these objects contain other objects, and so on. The following hierarchy depicts how a `Range` object fits into this scheme:

```
Application Object
  Workbook Object
    Worksheet Object
      Range Object
```

In the lingo of object-oriented programming, a `Range` object’s parent is the `Worksheet` object that contains it. A `Worksheet` object’s parent is the `Workbook` object that contains the worksheet, and a `Workbook` object’s parent is the `Application` object.

How can this information be put to use? Examine the `SheetName` VBA function that follows. This function accepts a single argument (a range) and returns the name of the worksheet that contains the range. It uses the `Parent` property of the `Range` object. The `Parent` property returns an object: the object that contains the `Range` object.

```
Function SheetName(ref) As String
    SheetName = ref.Parent.Name
End Function
```

The next function, `WorkbookName`, returns the name of the workbook for a particular cell. Notice that it uses the `Parent` property twice. The first `Parent` property returns a `Worksheet` object, and the second `Parent` property returns a `Workbook` object.

```
Function WorkbookName(ref) As String
    WorkbookName = ref.Parent.Parent.Name
End Function
```

The `AppName` function, which follows, carries this exercise to the next logical level, accessing the `Parent` property three times. This function returns the name of the Application object for a particular cell. It will, of course, always return Microsoft Excel.

```
Function AppName(ref) As String
    AppName = ref.Parent.Parent.Parent.Name
End Function
```

Counting cells between two values

The following function, named `COUNTBETWEEN`, returns the number of values in a range (first argument) that fall between values represented by the second and third arguments:

```
Function COUNTBETWEEN(InRange, num1, num2) As Long
    ' Counts number of values between num1 and num2
    With Application.WorksheetFunction
        COUNTBETWEEN = .CountIf(InRange, ">=" & num1) - _
            .CountIf(InRange, ">" & num2)
    End With
End Function
```

Note that this function uses Excel's `COUNTIF` function. In fact, the `COUNTBETWEEN` function is essentially a “wrapper” that can simplify your formulas.

Following is an example formula that uses the `COUNTBETWEEN` function. The formula returns the number of cells in `A1:A100` that are greater than or equal to 10 and less than or equal to 20.

```
=COUNTBETWEEN(A1:A100,10,20)
```

Using this VBA function is simpler than entering the following lengthy formula:

```
=(COUNTIF(A1:A100)>=10)-(COUNTIF(A1:A100)>=20)
```

Counting visible cells in a range

The `COUNTVISIBLE` function, which follows, accepts a range argument and returns the number of visible cells in the range. A cell is not visible if it's in a hidden row or a hidden column.

```
Function COUNTVISIBLE(rng)
' Counts visible cells
Dim CellCount As Long
Dim cell As Range
Application.Volatile
CellCount = 0
Set rng = Intersect(rng.Parent.UsedRange, rng)
For Each cell In rng
    If Not IsEmpty(cell) Then
        If Not cell.EntireRow.Hidden And _
            Not cell.EntireColumn.Hidden Then _
            CellCount = CellCount + 1
    End If
Next cell
COUNTVISIBLE = CellCount
End Function
```

This function loops through each cell in the range, and first checks to see if the cell is empty. If it's not empty, then it checks the hidden properties of the cell's row and column. If either the row or column is hidden, then the `CellCount` variable is incremented.

The `COUNTVISIBLE` function is useful when you're working with AutoFilters or outlines. Both of these features make use of hidden rows.



Tip

Excel's `SUBTOTAL` function (with a first argument of 2 or 3) is also useful for counting visible cells in an AutoFiltered list. The `SUBTOTAL` function, however, doesn't work properly if cells are hidden in a nonfiltered list.

Determining the last nonempty cell in a column or row

In this section, I present two useful functions: `LASTINCOLUMN` returns the contents of the last nonempty cell in a column; `LASTINROW` returns the contents of the last nonempty cell in a row. Each function accepts a range as its single argument. The range argument can be a complete column (for `LASTINCOLUMN`) or a complete row (for `LASTINROW`). If the supplied argument is not a complete column or row, the function uses the column or row of the upper-left cell in the range. For example, the following formula returns the last value in column B:

```
=LASTINCOLUMN(B5)
```

The following formula returns the last value in row 7:

```
=LASTINROW(C7:D9)
```

The `LASTINCOLUMN` function

The `LASTINCOLUMN` function follows:

```

Function LASTINCOLUMN(rng As Range)
    Application.Volatile
    Set LastCell = rng.Parent.Cells(Rows.Count, rng.Column) _
        .End(xlUp)
    LASTINCOLUMN = LastCell.Value
    If IsEmpty(LastCell) Then LASTINCOLUMN = ""
    If rng.Parent.Cells(Rows.Count, rng.Column) <> "" Then _
        LASTINCOLUMN = rng.Parent.Cells(Rows.Count, rng.Column)
End Function

```

This function is rather complicated, so here are a few points that may help you understand it:

- ♦ `Application.Volatile` causes the function to be executed whenever the sheet is calculated.
- ♦ `Rows.Count` returns the number of rows in the worksheet. I used this, rather than hard-code the value 65536, for forward compatibility (a future version of Excel may contain more rows).
- ♦ `rng.Column` returns the column number of the upper left cell in the `rng` argument.
- ♦ Using `rng.Parent` causes the function to work properly even if the `rng` argument refers to a different sheet or workbook.
- ♦ The `End` method (with the `xlUp` argument) is equivalent to activating the last cell in a column and then pressing `End`, followed by `Up Arrow`.
- ♦ The `IsEmpty` function checks if the cell is empty. If so, it returns an empty string. Without this statement, an empty cell would be returned as 0.
- ♦ The final `If` statement checks the last cell in the column. If it is not empty, the function returns the contents of that cell.

The LASTINROW function

The `LASTINROW` function follows. This is very similar to the `LASTINCOLUMN` function.

```

Function LASTINROW(rng As Range)
    Application.Volatile
    Set LastCell = rng.Parent.Cells(rng.Row, Columns.Count) _
        .End(xlToLeft)
    LASTINROW = LastCell.Value
    If IsEmpty(LastCell) Then LASTINROW = ""
    If rng.Parent.Cells(rng.Row, Columns.Count) <> "" Then _
        LASTINROW = rng.Parent.Cells(rng.Row, Columns.Count)
End Function

```


Does a string match a pattern?

The ISLIKE function is very simple (but also very useful). This function returns True if a text string matches a specified pattern.

This function, which follows, is remarkably simple. As you can see, the function is essentially a “wrapper” that lets you take advantage of VBA’s powerful Like operator in your formulas.

```
Function ISLIKE(text As String, pattern As String) As Boolean
'   Returns true if the first argument is like the second
'   If text Like pattern Then ISLIKE = True _
'       Else ISLIKE = False
End Function
```

This ISLIKE function takes two arguments:

text A text string or a reference to a cell that contains a text string

pattern A string that contains wildcard characters according to the following list:

Character(s) in pattern	Matches in <i>text</i>
?	Any single character
*	Zero or more characters
#	Any single digit (0@nd9)
[<i>charlist</i>]	Any single character in <i>charlist</i>
[! <i>charlist</i>]	Any single character not in <i>charlist</i>

The following formula returns TRUE because * matches any number of characters. It returns TRUE if the first argument is any text that begins with "g".

```
=ISLIKE("guitar","g*")
```

The following formula returns TRUE because ? matches any single character. If the first argument were "Unit12", the function would return FALSE.

```
=ISLIKE("Unit1","Unit?")
```

The next formula returns TRUE because the first argument is a single character in the second argument.

```
=ISLIKE("a","[aeiou]")
```

The following formula returns TRUE if cell A1 contains either a, e, i, o, u, A, E, I, O, or U. Using the UPPER function for the arguments makes the formula not case sensitive.

```
=ISLIKE(UPPER(A1),UPPER ("[aeiou]"))
```

The following formula returns TRUE if cell A1 contains a value that begins with 1 and has exactly three digits (that is, any integer between 100 and 199).

```
=ISLIKE(A1,"1###")
```

Extracting the nth element from a string

`ExtractElement` is a custom worksheet function (which can also be called from a VBA procedure) that extracts an element from a text string. For example, if a cell contains the following text, you can use the `ExtractElement` function to extract any of the substrings between the hyphens.

```
123-456-789-0133-8844
```

The following formula, for example, returns 0133, which is the fourth element in the string. The string uses a hyphen (-) as the separator.

```
=ExtractElement("123-456-789-0133-8844",4,"-")
```

The `ExtractElement` function uses three arguments:

<code>Txt</code>	The text string from which you're extracting. This can be a literal string or a cell reference.
<code>n</code>	An integer that represents the element to extract.
<code>Separator</code>	A single character used as the separator.

Note

If you specify a space as the `Separator` character, multiple spaces are treated as a single space, which is almost always what you want. If `n` exceeds the number of elements in the string, the function returns an empty string.

The VBA code for the `ExtractElement` function follows:

```
Function ExtractElement(Txt, n, Separator) As String
' Returns the nth element of a text string, where the
' elements are separated by a specified separator character

    Dim Txt1 As String, TempElement As String
    Dim ElementCount As Integer, i As Integer

    Txt1 = Txt
    ' If space separator, remove excess spaces
    If Separator = Chr(32) Then Txt1 = Application.Trim(Txt1)

    ' Add a separator to the end of the string
    If Right(Txt1, Len(Txt1)) <> Separator Then _
        Txt1 = Txt1 & Separator
```

```

' Initialize
ElementCount = 0
TempElement = ""

' Extract each element
For i = 1 To Len(Txt1)
    If Mid(Txt1, i, 1) = Separator Then
        ElementCount = ElementCount + 1
        If ElementCount = n Then
            Found it, so exit
            ExtractElement = TempElement
            Exit Function
        Else
            TempElement = ""
        End If
    Else
        TempElement = TempElement & Mid(Txt1, i, 1)
    End If
Next i
ExtractElement=""
End Function

```

A multifunctional function

This example describes a technique that may be helpful in some situations: making a single worksheet function act like multiple functions. For example, the following VBA listing is for a custom function called `StatFunction`. It takes two arguments: the range (`rng`) and the operation (`op`). Depending on the value of `op`, the function returns a value computed using any of the following worksheet functions: `AVERAGE`, `COUNT`, `MAX`, `MEDIAN`, `MIN`, `MODE`, `STDEV`, `SUM`, or `VAR`.

For example, you can use this function in your worksheet as follows:

```
=STATFUNCTION(B1:B24,A24)
```

The result of the formula depends on the contents of cell A24, which should be a string such as `Average`, `Count`, `Max`, and so on. You can adapt this technique for other types of functions.

```

Function STATFUNCTION(rng, op)
    Select Case UCase(op)
        Case "SUM"
            STATFUNCTION = WorksheetFunction.Sum(rng)
        Case "AVERAGE"
            STATFUNCTION = WorksheetFunction.Average(rng)
        Case "MEDIAN"
            STATFUNCTION = WorksheetFunction.Median(rng)
        Case "MODE"
            STATFUNCTION = WorksheetFunction.Mode(rng)
        Case "COUNT"
            STATFUNCTION = WorksheetFunction.Count(rng)
    End Select
End Function

```

```

    Case "MAX"
        STATFUNCTION = WorksheetFunction.Max(rng)
    Case "MIN"
        STATFUNCTION = WorksheetFunction.Min(rng)
    Case "VAR"
        STATFUNCTION = WorksheetFunction.Var(rng)
    Case "STDEV"
        STATFUNCTION = WorksheetFunction.StDev(rng)
    Case Else
        STATFUNCTION = CVErr(xlErrNA)
End Select
End Function

```

The SHEETOFFSET function: Version 1

You probably know that Excel's support for "3D workbooks" is limited. For example, if you need to refer to a different worksheet in a workbook, you must include the worksheet's name in your formula. This is not a big problem . . . until you attempt to copy the formula across other worksheets. The copied formulas continue to refer to the original worksheet name, and the sheet references are not adjusted as they would be in a true 3D workbook.

The example discussed in this section is a VBA function (named SHEETOFFSET) that enables you to address worksheets in a relative manner. For example, you can refer to cell A1 on the previous worksheet using this formula:

```
=SHEETOFFSET(-1,A1)
```

The first argument represents the relative sheet, and it can be positive, negative, or zero. The second argument must be a reference to a single cell. You can copy this formula to other sheets, and the relative referencing will be in effect in all the copied formulas.

The VBA code for the SHEETOFFSET function follows:

```

Function SHEETOFFSET(offset, Ref)
' Returns cell contents at Ref, in sheet offset
Application.Volatile
SHEETOFFSET = Sheets(Application.Caller.Parent.Index _
+ offset).Range(Ref.Address)
End Function

```

This function works fine in most cases. However, if your worksheet contains Chart sheets, the function will fail if it attempts to reference a cell on a Chart sheet.

The SHEETOFFSET function: Version 2

The revised SHEETOFFSET function follows. This version is a bit more complex, but it eliminates the problem described in the preceding section. This version of SHEETOFFSET essentially ignores any non-Worksheet sheets in the workbook.

```
Function SHEETOFFSET2(offset, Ref)
' Returns cell contents at Ref, in sheet offset
  Dim WBook As Workbook
  Dim WksCount As Integer, i As Integer
  Dim CallerSheet As String, CallerIndex As Integer
  Application.Volatile

' Create an array consisting only of Worksheets
  Set WBook = Application.Caller.Parent.Parent
  Dim Wks() As Worksheet
  WksCount = 0
  For i = 1 To WBook.Sheets.Count
    If TypeName(WBook.Sheets(i)) = "Worksheet" Then
      WksCount = WksCount + 1
      ReDim Preserve Wks(1 To WksCount)
      Set Wks(WksCount) = WBook.Sheets(i)
    End If
  Next i

' Determine the position of the calling sheet
  CallerSheet = Application.Caller.Parent.Name
  For i = 1 To UBound(Wks)
    If CallerSheet = Wks(i).Name Then CallerIndex = i
  Next i

' Get the value
  SHEETOFFSET2 = Wks(CallerIndex + _
    offset).Range(Ref.Address)
End Function
```

Returning the maximum value across all worksheets

If you need to determine the maximum value in cell B1 across a number of worksheets, you would use a formula such as this:

```
=MAX(Sheet1:Sheet4!B1)
```

This formula returns the maximum value in cell B1 for Sheet1, Sheet4, and all of the sheets in between.

But what if you add a new sheet (Sheet5) after Sheet4? Your formula won't adjust automatically, so you need to edit it to include the new sheet reference:

```
=MAX(Sheet1:Sheet5!B1)
```

The MAXALLSHEETS function, which follows, accepts a single-cell argument, and returns the maximum value in that cell across all worksheets in the workbook. The formula that follows, for example, returns the maximum value in cell B1 for all sheets in the workbook:

```
=MAXALLSHEETS(B1)
```

If you add a new sheet, there's no need to edit the formula:

```
Function MAXALLSHEETS(cell)
    Dim MaxVal As Double
    Dim Addr As String
    Dim Wksht As Object
    Application.Volatile
    Addr = cell.Range("A1").Address
    MaxVal = -9.9E+307
    For Each Wksht In cell.Parent.Parent.Worksheets
        If Wksht.Name = cell.Parent.Name And _
            Addr = Application.Caller.Address Then
            ' avoid circular reference
        Else
            If IsNumeric(Wksht.Range(Addr)) Then
                If Wksht.Range(Addr) > MaxVal Then _
                    MaxVal = Wksht.Range(Addr).Value
            End If
        End If
    Next Wksht
    If MaxVal = -9.9E+307 Then MaxVal = 0
    MAXALLSHEETS = MaxVal
End Function
```

The `For each` statement uses the following expression to access the Workbook:

```
cell.Parent.Parent.Worksheets
```

The parent of the cell is a worksheet, and the parent of the worksheet is the workbook. Therefore, the `For Each-Next` loop cycles among all worksheets in the workbook. The first `If` statement inside of the loop performs a check to see if the cell being checked is the cell that contains the function. If so, that cell is ignored to avoid a circular reference error.


Note

This function can be modified easily to perform other cross-worksheet calculations: Minimum, Average, Sum, and so on.

Returning an array of nonduplicated random integers

The function in this section, `RANDOMINTEGERS`, returns an array of nonduplicated integers. The function is intended to be used in a multicell array formula. Figure 11-12 shows a worksheet that uses the following formula in the range A1:D10:

```
{=RANDOMINTEGERS() }
```

This formula was entered into the entire range using Ctrl+Shift+Enter. The formula returns an array of nonduplicated integers, arranged randomly. Because 40 cells contain the formula, the integers range from 1 to 40.

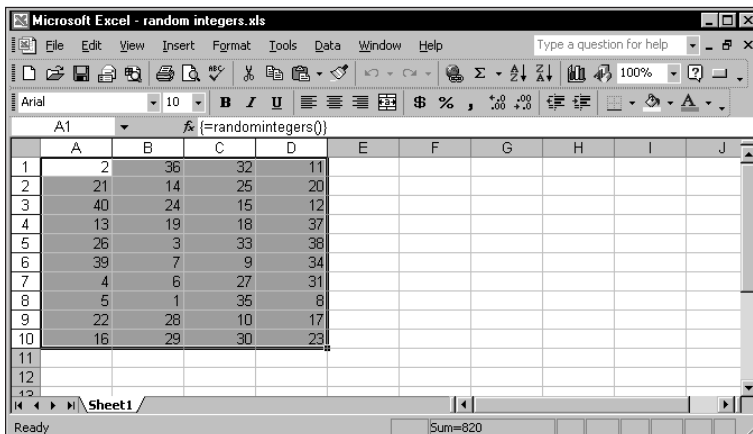


Figure 11-12: An array formula generates nonduplicated consecutive integers, arranged randomly.

The code for RANDOMINTEGERS follows:

```
Function RANDOMINTEGERS()
    Dim FuncRange As Range
    Dim V() As Variant, ValArray() As Variant
    Dim CellCount As Double
    Dim i As Integer, j As Integer
    Dim r As Integer, c As Integer
    Dim Temp1 As Variant, Temp2 As Variant
    Dim RCount As Integer, CCount As Integer
    Randomize

    ' Create Range object
    Set FuncRange = Application.Caller

    ' Return an error if FuncRange is too large
    CellCount = FuncRange.Count
    If CellCount > 1000 Then
        RANDOMINTEGERS = CVErr(xlErrNA)
        Exit Function
    End If

    ' Assign variables
    RCount = FuncRange.Rows.Count
    CCount = FuncRange.Columns.Count
    ReDim V(1 To RCount, 1 To CCount)
```

```

    ReDim ValArray(1 To 2, 1 To CellCount)

    ' Fill array with random numbers
    ' and consecutive integers
    For i = 1 To CellCount
        ValArray(1, i) = Rnd
        ValArray(2, i) = i
    Next i

    ' Sort ValArray by the random number dimension
    For i = 1 To CellCount
        For j = i + 1 To CellCount
            If ValArray(1, i) > ValArray(1, j) Then
                Temp1 = ValArray(1, j)
                Temp2 = ValArray(2, j)
                ValArray(1, j) = ValArray(1, i)
                ValArray(2, j) = ValArray(2, i)
                ValArray(1, i) = Temp1
                ValArray(2, i) = Temp2
            End If
        Next j
    Next i

    ' Put the randomized values into the V array
    i = 0
    For r = 1 To RCount
        For c = 1 To CCount
            i = i + 1
            V(r, c) = ValArray(2, i)
        Next c
    Next r
    RANDOMINTEGERS = V
End Function

```

Randomizing a range

The **RANGERANDOMIZE** function, which follows, accepts a range argument and returns an array that consists of the input range—in random order:

```

Function RANGERANDOMIZE(rng)
    Dim V() As Variant, ValArray() As Variant
    Dim CellCount As Double
    Dim i As Integer, j As Integer
    Dim r As Integer, c As Integer
    Dim Temp1 As Variant, Temp2 As Variant
    Dim RCount As Integer, CCount As Integer
    Randomize

    ' Return an error if rng is too large
    CellCount = rng.Count
    If CellCount > 1000 Then
        RANGERANDOMIZE = CVErr(xlErrNA)
    End If

```



```

        Exit Function
    End If

    ' Assign variables
    RCount = rng.Rows.Count
    CCount = rng.Columns.Count
    ReDim V(1 To RCount, 1 To CCount)
    ReDim ValArray(1 To 2, 1 To CellCount)

    ' Fill ValArray with random numbers
    ' and values from rng
    For i = 1 To CellCount
        ValArray(1, i) = Rnd
        ValArray(2, i) = rng(i)
    Next i

    ' Sort ValArray by the random number dimension
    For i = 1 To CellCount
        For j = i + 1 To CellCount
            If ValArray(1, i) > ValArray(1, j) Then
                Temp1 = ValArray(1, j)
                Temp2 = ValArray(2, j)
                ValArray(1, j) = ValArray(1, i)
                ValArray(2, j) = ValArray(2, i)
                ValArray(1, i) = Temp1
                ValArray(2, i) = Temp2
            End If
        Next j
    Next i

    ' Put the randomized values into the V array
    i = 0
    For r = 1 To RCount
        For c = 1 To CCount
            i = i + 1
            V(r, c) = ValArray(2, i)
        Next c
    Next r
    RANGERANDOMIZE = V
End Function

```

The code is very similar to that for the `RANDOMINTEGERS` function.

Figure 11-13 shows the function in use. The array formula in B2:B11 is:

```
{=RANGERANDOMIZE(A2:A11)}
```

This formula returns the contents of A2:A11, but in random order.

	A	B	C	D	E
1	Original	Randomized			
2	1	8			
3	2	10			
4	3	2			
5	4	7			
6	5	1			
7	6	4			
8	7	3			
9	8	6			
10	9	9			
11	10	5			
12					

Figure 11-13: The `RANGERANDOMIZE` function returns the contents of a range, in random order.

Windows API Calls

One of VBA's most important features is the capability to use functions that are stored in Dynamic Link Libraries (DLLs). The examples in this section use common Windows API calls.

Note

The API declarations that you can use depend on your version of Excel. If you attempt to use a 32-bit API function with 16-bit Excel 5, you'll get an error. Similarly, if you attempt to use a 16-bit API function with 32-bit Excel 95 or later, you'll get an error. The examples in this section are for 32-bit Excel.

Cross-Reference

I discuss this and other compatibility issues in detail in Chapter 25.

Determining file associations

In Windows, many file types are associated with a particular application. This association makes it possible to double-click the file to load it into its associated application.

The following function, named `GetExecutable`, uses a Windows API call to get the full path to the application associated with a particular file. For example, your system has many files with a `.txt` extension—one named `Readme.txt` is probably in your Windows directory right now. You can use the `GetExecutable` function to determine the full path of the application that opens when the file is double-clicked.

Note

Windows API declarations must appear at the top of your VBA module.

```

Function GetExecutable(strFile As String) As String
    Dim strPath As String
    Dim intLen As Integer
    strPath = Space(255)
    intLen = FindExecutableA(strFile, "\", strPath)
    GetExecutable = Trim(strPath)
End Function

```

Figure 11-14 shows the result of calling the `GetExecutable` function, with an argument of `c:\windows\readme.txt`. In this case, the windows `NOTEPAD.EXE` program is associated with the file.



Figure 11-14: Determining the path of the application associated with a particular file

Determining default printer information

The example in this section uses a Windows API function to return information about the active printer. The information is contained in a single text string. The example parses the string and displays the information in a more readable format.

```

Private Declare Function GetProfileStringA Lib "kernel32" _
    (ByVal lpAppName As String, ByVal lpKeyName As String, _
    ByVal lpDefault As String, ByVal lpReturnedString As _
    String, ByVal nSize As Long) As Long

Sub DefaultPrinterInfo()
    Dim strLPT As String * 255
    Dim Result As String
    Call GetProfileStringA _
        ("Windows", "Device", "", strLPT, 254)

    Result = Application.Trim(strLPT)
    ResultLength = Len(Result)

    Comma1 = Application.Find(",", Result, 1)
    Comma2 = Application.Find(",", Result, Comma1 + 1)

    ' Gets printer's name
    Printer = Left(Result, Comma1 - 1)

    ' Gets driver
    Driver = Mid(Result, Comma1 + 1, Comma2 - Comma1 - 1)

    ' Gets last part of device line
    Port = Right(Result, ResultLength - Comma2)

```

```

' Build message
Msg = "Printer:" & Chr(9) & Printer & Chr(13)
Msg = Msg & "Driver:" & Chr(9) & Driver & Chr(13)
Msg = Msg & "Port:" & Chr(9) & Port

' Display message
MsgBox Msg, vbInformation, "Default Printer Information"
End Sub

```

Note

The `ActivePrinter` property of the `Application` object returns the name of the active printer (and lets you change it), but there's no direct way to determine what printer driver or port is being used. That's why this function is useful.

Figure 11-15 shows a sample message box returned by this procedure.



Figure 11-15: Getting information about the active printer using a Windows API call

Determining the current video mode

The example in this section uses Windows API calls to determine a system's current video mode. If your application needs to display a certain amount of information on one screen, knowing the display size helps you scale the text accordingly.

```

'32-bit API declaration
Declare Function GetSystemMetrics Lib "user32" _
    (ByVal nIndex As Long) As Long

Public Const SM_CXSCREEN = 0
Public Const SM_CYSCREEN = 1

Sub DisplayVideoInfo()
    vidWidth = GetSystemMetrics(SM_CXSCREEN)
    vidHeight = GetSystemMetrics(SM_CYSCREEN)

    Msg = "The current video mode is: "
    Msg = Msg & vidWidth & " X " & vidHeight
    MsgBox Msg
End Sub

```

Figure 11-16 shows the message box returned by this procedure when running on a system set to 1600 x 1024 resolution.



Figure 11-16: Using a Windows API call to determine the video display mode

Adding sound to your applications

By itself, Excel doesn't have much to offer in the area of sound—VBA's `Beep` command is about as good as it gets. However, with a few simple API calls, your application can play WAV or MIDI files.



The text-to-speech feature in Excel 2002 extends the sound capability quite a bit. In fact, Excel 2002 can “speak” text by using the `Speak` method of the `Speech` object. The examples in this section focus on playing sound files.

Not all systems support sound. To determine whether a system supports sound, use the `CanPlaySounds` method. Here's an example:

```
If Not Application.CanPlaySounds Then
    MsgBox "Sorry, sound is not supported on your system."
    Exit Sub
End If
```

Playing a WAV file

The following example contains the API function declaration plus a simple procedure to play a sound file called `dogbark.wav`, which is presumed to be in the same directory as the workbook:

```
Private Declare Function PlaySound Lib "winmm.dll" _
    Alias "PlaySoundA" (ByVal lpszName As String, _
    ByVal hModule As Long, ByVal dwFlags As Long) As Long

Const SND_SYNC = &H0
Const SND_ASYNC = &H1
Const SND_FILENAME = &H20000

Sub PlayWAV()
    WAVFile = "dogbark.wav"
    WAVFile = ThisWorkbook.Path & "\" & WAVFile
    Call PlaySound(WAVFile, 0&, SND_ASYNC Or SND_FILENAME)
End Sub
```

In the preceding example, the WAV file is played asynchronously. This means execution continues while the sound is playing. To stop code execution while the sound is playing, use this statement instead:

```
Call PlaySound(WAVFile, 0&, SND_SYNC Or SND_FILENAME)
```

Playing a MIDI file

If the sound file is a MIDI file, you'll need to use a different API call. The `PlayMIDI` procedure starts playing a MIDI file. Executing the `StopMIDI` procedure stops playing the MIDI file. This example uses a file named `xfiles.mid`.

```
Private Declare Function mciExecute Lib "winmm.dll" _
    (ByVal lpstrCommand As String) As Long

Sub PlayMIDI()
    MIDIFile = "xfiles.mid"
    MIDIFile = ThisWorkbook.Path & "\" & MIDIFile
    mciExecute ("play " & MIDIFile)
End Sub

Sub StopMIDI()
    MIDIFile = "xfiles.mid"
    MIDIFile = ThisWorkbook.Path & "\" & MIDIFile
    mciExecute ("stop " & MIDIFile)
End Sub
```

Playing sound from a worksheet function

The `Alarm` function, which follows, is designed to be used in a worksheet formula. It uses a Windows API function to play a sound file when a cell meets a certain condition.

```
Declare Function PlaySound Lib "winmm.dll" _
    Alias "PlaySoundA" (ByVal lpszName As String, _
    ByVal hModule As Long, ByVal dwFlags As Long) As Long

Function ALARM(Cell, Condition)
    Dim WAVFile As String
    Const SND_ASYNC = &H1
    Const SND_FILENAME = &H20000
    If Evaluate(Cell.Value & Condition) Then
        WAVFile = ThisWorkbook.Path & "\sound.wav"
        Call PlaySound(WAVFile, 0&, SND_ASYNC Or SND_FILENAME)
        ALARM = True
    Else
        ALARM = False
    End If
End Function
```

The `Alarm` function accepts two arguments: a cell reference and a “condition” (expressed as a string). The following formula, for example, uses the `Alarm` function to play a WAV file when the value in cell B13 is greater than or equal to 1000.

```
=ALARM(B13,">=1000")
```

The function uses VBA's `Evaluate` function to determine whether the cell's value matches the specified criterion. When the criterion is met (and the alarm has sounded), the function returns `True`; otherwise, it returns `False`.

Reading from and writing to the Registry

Most Windows applications use the Windows Registry database to store settings (see Chapter 4 for some additional information about the Registry). Your VBA procedures can read values from the Registry and write new values to the Registry. Doing so requires the following Windows API declarations:

```
Private Declare Function RegOpenKeyA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sSubKey As String, _
    ByVal hkeyResult As Long) As Long

Private Declare Function RegCloseKey Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long) As Long

Private Declare Function RegSetValueExA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sValueName As String, _
    ByVal dwReserved As Long, ByVal dwType As Long, _
    ByVal sValue As String, ByVal dwSize As Long) As Long

Private Declare Function RegCreateKeyA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sSubKey As String, _
    ByVal hkeyResult As Long) As Long

Private Declare Function RegQueryValueExA Lib "ADVAPI32.DLL" _
    (ByVal hKey As Long, ByVal sValueName As String, _
    ByVal dwReserved As Long, ByVal lValueType As Long, _
    ByVal sValue As String, ByVal lResultLen As Long) As Long
```



I developed two “wrapper” functions that simplify the task of working with the Registry: `GetRegistry` and `WriteRegistry`. These functions are available on the companion CD-ROM. This workbook includes a procedure that demonstrates reading from the Registry and writing to the Registry.

Reading from the Registry

The `GetRegistry` function returns a setting from the specified location in the Registry. It takes three arguments:

<code>RootKey</code>	A string that represents the branch of the Registry to address. This string may be one of the following: <code>HKEY_CLASSES_ROOT</code> <code>HKEY_CURRENT_USER</code> <code>HKEY_LOCAL_MACHINE</code> <code>HKEY_USERS</code>
----------------------	--

	HKEY_CURRENT_CONFIG
	HKEY_DYN_DATA
Path	The full path of the Registry category being addressed.
RegEntry	The name of the setting to retrieve.

Here's an example. If you'd like to find out the current setting for the active window title bar, you can call `GetRegistry` as follows (notice that the arguments are not case sensitive):

```
RootKey = "hkey_current_user"
Path = "Control Panel\Colors"
RegEntry = "ActiveTitle"
MsgBox GetRegistry(RootKey, Path, RegEntry), _
    vbInformation, Path & "\RegEntry"
```

The message box will display three values, representing the RGB value of the color.

Writing to the Registry

The `WriteRegistry` function writes a value to the Registry at a specified location. If the operation is successful, the function returns `True`; otherwise, it returns `False`. `WriteRegistry` takes the following arguments (all of them are strings):

RootKey	A string that represents the branch of the Registry to address. This string may be one of the following:
	HKEY_CLASSES_ROOT
	HKEY_CURRENT_USER
	HKEY_LOCAL_MACHINE
	HKEY_USERS
	HKEY_CURRENT_CONFIG
	HKEY_DYN_DATA
Path	The full path in the Registry. If the path doesn't exist, it is created.
RegEntry	The name of the Registry category to which the value will be written. If it doesn't exist, it is added.
RegVal	The value that you are writing.

Here's an example that writes a value representing the time and date Excel was started to the Registry. The information is written in the area that stores Excel's settings.

An Easier Way to Access the Registry

If you want to use the Windows Registry to store and retrieve settings for your Excel applications, you don't have to bother with the Windows API calls. Rather, you can use VBA's `GetSetting` and `SaveSetting` functions.

These two functions are described in the online help, so I won't cover the details here. However, it's important to understand that these functions work only with the following key name:

```
HKEY_CURRENT_USER\Software\VB and VBA Program Settings
```

In other words, you can't use these functions to access *any* key in the Registry. Rather, these functions are most useful for storing information about your Excel application that you need to maintain between sessions.

```
Sub Auto_Open()  
    RootKey = "hkey_current_user"  
    Path = "software\microsoft\office\10.0\excel\LastStarted"  
    RegEntry = "DateTime"  
    RegVal = Now()  
    If WriteRegistry(RootKey, Path, RegEntry, RegVal) Then  
        msg = RegVal & " has been stored in the registry."  
    Else msg = "An error occurred"  
    End If  
    MsgBox msg  
End Sub
```

If you store this routine in your personal macro workbook, the setting is automatically updated whenever you start Excel.

Summary

In this chapter, I presented dozens of examples to help you better understand the capabilities of VBA.

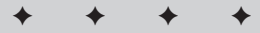
The next chapter focuses on one class of Excel applications: utility programs.



IV

Working with UserForms

The four chapters in this part cover custom dialog boxes (also known as UserForms). Chapter 12 presents some built-in alternatives to creating custom UserForms. Chapter 13 provides an introduction to UserForms and the various controls you can use. Chapters 14 and 15 present many examples of custom dialog boxes, ranging from basic to advanced.



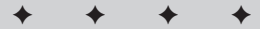
In This Part

Chapter 12
Custom Dialog Box
Alternatives

Chapter 13
Introducing
UserForms

Chapter 14
UserForm Examples

Chapter 15
Advanced UserForm
Techniques



Custom Dialog Box Alternatives

Dialog boxes are, perhaps, the most important user interface element in Windows programs. Virtually every Windows program uses them. And most users have a good understanding of how they work. Excel developers implement custom dialog boxes by creating UserForms.

Before I get into the nitty gritty of creating UserForms, you may find it helpful to understand some of Excel's built-in tools that display dialog boxes. That's the focus of this chapter.

Before You Create That UserForm . . .

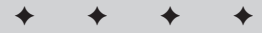
In some cases, you can save yourself the trouble of creating a custom dialog box by using one of several prebuilt dialog boxes:

- ◆ An input box
- ◆ A message box
- ◆ A dialog box for selecting a file to open
- ◆ A dialog box for specifying a filename and location for a save operation
- ◆ A dialog box for specifying a directory
- ◆ A dialog box for data entry

I describe these dialog boxes in the following sections.

Using an Input Box

An input box is a simple dialog box that allows the user to make a single entry. For example, you can use an input box to let the user enter text, a number, or even select a range. There are actually two `InputBox` functions: one from VBA and one from Excel.



In This Chapter

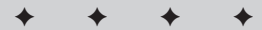
Using an input box to get user input

Using a message box to display messages or get a simple response

Selecting a file from a dialog box

Selecting a directory

Displaying Excel's built-in dialog boxes



VBA's InputBox function

The syntax for VBA's InputBox function is:

```
InputBox(prompt[,title][,default][,xpos][,ypos][,helpfile,context])
```

<i>prompt</i>	Required. The text displayed in the input box.
<i>title</i>	Optional. The caption of the input box window.
<i>default</i>	Optional. The default value to be displayed in the dialog box.
<i>xpos, ypos</i>	Optional. The screen coordinates at the upper left corner of the window.
<i>helpFile, context</i>	Optional. The helpfile and help topic.

The InputBox function prompts the user for a single bit of information. The function always returns a string, so it may be necessary to convert the results to a value.

The prompt may consist of about 1,024 characters (more or less, depending on the width of the characters used). In addition, you can provide a title for the dialog box, a default value, and specify its position on the screen. And you can specify a custom help topic; if you do, the input box includes a Help button.

The following example, whose output is shown in Figure 12-1, uses VBA's InputBox function to ask the user for his or her full name. The code then extracts the first name and displays a greeting, using a message box.

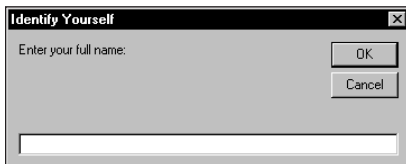


Figure 12-1: VBA's InputBox function at work

```
Sub GetName()
    Dim UserName As String
    Dim FirstSpace As Integer
    Do Until UserName <> ""
        UserName = InputBox("Enter your full name: ", _
            "Identify Yourself")
    
```

```

Loop
FirstSpace = InStr(UserName, " ")
If FirstSpace <> 0 Then
    UserName = Left(UserName, FirstSpace - 1)
End If
MsgBox "Hello " & UserName
End Sub

```

Notice that this `InputBox` function is written in a `Do Until` loop to ensure that something is entered when the input box appears. If the user clicks `Cancel` or doesn't enter any text, `UserName` contains an empty string and the input box reappears. The procedure then attempts to extract the first name by searching for the first space character (using the `InStr` function), and then using the `Left` function to extract all characters before the first space. If a space character is not found, the entire name is used as entered.

As I mentioned, the `InputBox` function always returns a string. If the string returned by the `InputBox` function looks like a number, you can convert it to a value using VBA's `Val` function. Or, you can use Excel's `InputBox` method, described next.

Excel's `InputBox` method

Using Excel's `InputBox` method (rather than VBA's `InputBox` function) offers three advantages:

- ♦ You can specify the data type returned
- ♦ The user can specify a worksheet range by dragging in the worksheet
- ♦ Input validation is performed automatically

The syntax for the `InputBox` method is:

```
object.InputBox(prompt,title,default,left,top,helpFile,context,
type)
```

<i>prompt</i>	Required. The text displayed in the input box.
<i>title</i>	Optional. The caption in the input box window.
<i>default</i>	Optional. The default value to be returned by the function, if the user enters nothing.
<i>left, top</i>	Optional. The screen coordinates at the upper left corner of the window.
<i>helpFile, context</i>	Optional. The helpfile and help topic.
<i>type</i>	Optional. A code for the data type returned, as listed in Table 12-1.

Table 12-1
Codes to Determine the Data Type
Returned by Excel's InputBox Method

<i>Code</i>	<i>Meaning</i>
0	A formula
1	A number
2	A string (text)
4	A logical value (True or False)
8	A cell reference, as a range object
16	An error value, such as #N/A
64	An array of values

Excel's `InputBox` method is quite versatile. To allow more than one data type to be returned, use the sum of the pertinent codes. For example, to display an input box that can accept text or numbers, set type equal to 3 (that is, 1 + 2, or "number" plus "text"). If you use 8 for the type argument, the user can enter a cell or range address manually, or point to a range in the worksheet.

The `EraseRange` procedure, which follows, uses the `InputBox` method to allow the user to select a range to erase (see Figure 12-2). The user can either type the range address manually, or use the mouse to select the range in the sheet.

The `InputBox` method with a type argument of 8 returns a `Range` object (note the `Set` keyword). This range is then erased (by using the `Clear` method). The default value displayed in the input box is the current selection's address. The `On Error` statement ends the procedure if the input box is canceled.

```
Sub EraseRange()
    Dim UserRange As Range
    DefaultRange = Selection.Address
    On Error GoTo Canceled
    Set UserRange = Application.InputBox _
        (Prompt:="Range to erase:", _
        Title:="Range Erase", _
        Default:=DefaultRange, _
        Type:=8)
    UserRange.Clear
    UserRange.Select
Canceled:
End Sub
```

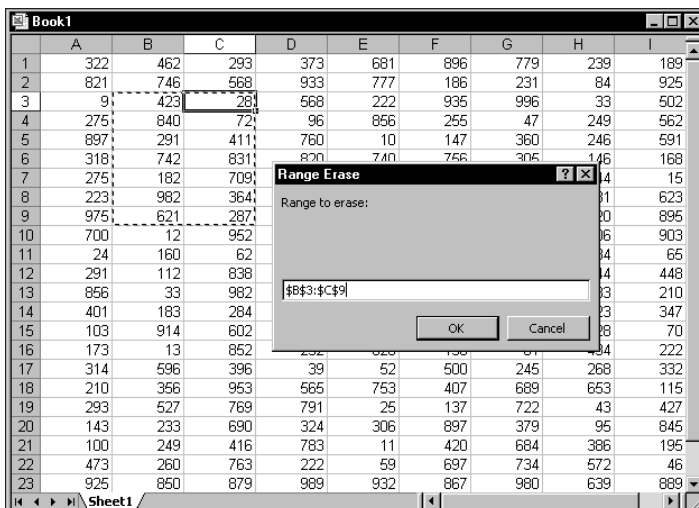



Figure 12-2: Using the `InputBox` method to specify a range

Yet another advantage of using Excel's `InputBox` method is that Excel performs input validation automatically. In the `GetRange` example, if you enter something other than a range address, Excel displays an informative message and lets the user try again (see Figure 12-3).

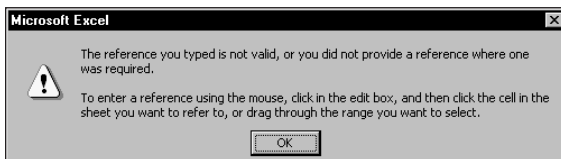


Figure 12-3: Excel's `InputBox` method performs validation automatically.

VBA's `MsgBox` Function

VBA's `MsgBox` function is an easy way to display a message to the user, or to get a simple response (such as OK or Cancel). I use the `MsgBox` function in many of this book's examples as a way to display a variable's value.

The official syntax for `MsgBox` is as follows:

```
MsgBox(prompt[,buttons][,title][,helpfile, context])
```

<i>prompt</i>	Required. The text displayed in the message box.
<i>buttons</i>	Optional. A numeric expression that determines which buttons and icon are displayed in the message box. See Table 12-2.
<i>title</i>	Optional. The caption in the message box window.
<i>helpFile, context</i>	Optional. The helpfile and help topic.

You can easily customize your message boxes because of the flexibility of the *buttons* argument. (Table 12-2 lists the many constants that you can use for this argument.) You can specify which buttons to display, whether an icon appears, and which button is the default.

Table 12-2
Constants Used for Buttons in the MsgBox Function

Constant	Value	Description
<code>vbOKOnly</code>	0	Display OK button only
<code>vbOKCancel</code>	1	Display OK and Cancel buttons
<code>vbAbortRetryIgnore</code>	2	Display Abort, Retry, and Ignore buttons
<code>vbYesNoCancel</code>	3	Display Yes, No, and Cancel buttons
<code>vbYesNo</code>	4	Display Yes and No buttons
<code>vbRetryCancel</code>	5	Display Retry and Cancel buttons
<code>vbCritical</code>	16	Display Critical Message icon
<code>vbQuestion</code>	32	Display Warning Query icon
<code>vbExclamation</code>	48	Display Warning Message icon
<code>vbInformation</code>	64	Display Information Message icon
<code>vbDefaultButton1</code>	0	First button is default
<code>vbDefaultButton2</code>	256	Second button is default
<code>vbDefaultButton3</code>	512	Third button is default
<code>vbDefaultButton4</code>	768	Fourth button is default
<code>vbSystemModal</code>	4096	All applications are suspended until the user responds to the message box (may not work under all conditions)

You can use the `MsgBox` function by itself (to simply display a message) or assign its result to a variable. When `MsgBox` does return a result, it represents the button clicked by the user. The following example displays a message and does not return a result:

```
Sub MsgBoxDemo()
    MsgBox "Click OK to continue"
End Sub
```

To get a response from a message box, you can assign the results of the `MsgBox` function to a variable. In the following code, I use some built-in constants (described in Table 12-3) to make it easier to work with the values returned by `MsgBox`:

```
Sub GetAnswer()
    Ans = MsgBox("Continue?", vbYesNo)
    Select Case Ans
        Case vbYes
            ...[code if Ans is Yes]...
        Case vbNo
            ...[code if Ans is No]...
    End Select
End Sub
```

Table 12-3
Constants Used for MsgBox Return Value

<i>Constant</i>	<i>Value</i>	<i>Button Clicked</i>
<code>vbOK</code>	1	OK
<code>vbCancel</code>	2	Cancel
<code>vbAbort</code>	3	Abort
<code>vbRetry</code>	4	Retry
<code>vbIgnore</code>	5	Ignore
<code>vbYes</code>	6	Yes
<code>vbNo</code>	7	No

Actually, it's not even necessary to use a variable to utilize the result of a message box. The following procedure displays a message box with Yes and No buttons. If the user doesn't click the Yes button, the procedure ends.

```
Sub GetAnswer2()
    If MsgBox("Continue?", vbYesNo) <> vbYes Then Exit Sub
    ...[code if Yes button is not clicked]...
End Sub
```

The following function example uses a combination of constants to display a message box with a Yes button, a No button, and a question mark icon; the second button is designated as the default button (see Figure 12-4). For simplicity, I assigned these constants to the `Config` variable.

```

Private Function ContinueProcedure() As Boolean
    Dim Config As Integer
    Dim Ans As Integer
    Config = vbYesNo + vbQuestion + vbDefaultButton2
    Ans = MsgBox("An error occurred. Continue?", Config)
    If Ans = vbYes Then ContinueProcedure = True _
        Else ContinueProcedure = False
End Function

```

The `ContinueProcedure` function can be called from another procedure. For example, the following statement calls the `ContinueProcedure` function (which displays the message box). If the function returns `False` (that is, the user selects `No`), the procedure ends. Otherwise, the next statement would be executed.

```

If Not ContinueProcedure Then Exit Sub

```

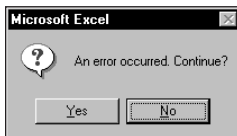


Figure 12-4: The buttons argument of the `MsgBox` function determines which buttons appear.

If you would like to force a line break in the message, use the `vbCrLf` (or `vbNewLine`) constant in the text. The following example displays the message in three lines:

```

Sub MultiLine()
    Dim Msg As String
    Msg = "This is the first line" & vbCrLf
    Msg = Msg & "Second line" & vbCrLf
    Msg = Msg & "Last line"
    MsgBox Msg
End Sub

```

You can also insert a tab character by using the `vbTab` constant. The following procedure uses a message box to display the values in a 20×8 range of cells (see Figure 12-5). It separates the columns by using a `vbTab` constant, and inserts a new line by using the `vbCrLf` constant. The `MsgBox` function accepts a maximum string length of 1,023 characters, which will limit the number of cells you can display.

```

Sub ShowRange()
    Dim Msg As String
    Dim r As Integer, c As Integer
    Msg = ""

```

```

For r = 1 To 20
  For c = 1 To 8
    Msg = Msg & Cells(r, c) & vbTab
  Next c
  Msg = Msg & vbCrLf
Next r
MsgBox Msg
End Sub

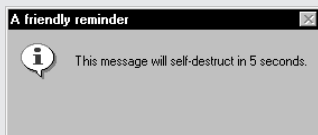
```



Chapter 15 includes a VBA example that emulates the `MsgBox` function.

Another Type of Message Box

Excel can access the Windows Scripting Host (`Wscript`) and display another type of message box by using the `Popup` method of the `Shell` object. This alternative message box differs from the standard message box in two ways: It can dismiss itself after a specified period of time; and it's possible to display the message box with no buttons.



The following example displays a message box. If the user does not dismiss it within five seconds, it is dismissed automatically.

```

Sub PopupDemo()
  Dim WshShell As IWshShell
  Dim Msg As String
  Set WshShell = CreateObject("Wscript.Shell")
  Msg = "This message will self-destruct in 5 seconds."
  Title = "A friendly reminder"
  WshShell.Popup Msg, 5, Title, 7 + vbInformation
  Set WshShell = Nothing
End Sub

```

The first `Set` statement creates the `Shell` object and assigns it to the `WshShell` variable. The first argument for the `Popup` method represents the text to be displayed. The second argument specifies the number of seconds to display the message box. The third argument is the title bar text. The final argument specifies the buttons and icon to be displayed (it works just like the `buttons` argument for the `MsgBox` function).

If you decide to use this alternate message box, be aware that system administrators often disable the Windows Scripting Host because of the threat of viruses. If the Windows Scripting Host is disabled, the code will generate an error.

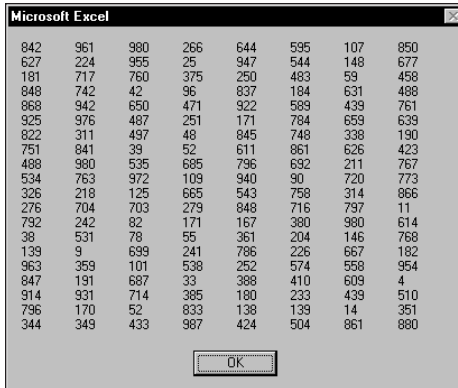


Figure 12-5: This message box displays text with tabs and line breaks.

Excel's GetOpenFilename Method

If your application needs to ask the user for a filename, you can use the `InputBox` function. But this approach often leads to typographical errors. A better approach is to use the `GetOpenFilename` method of the `Application` object, which ensures that your application gets a valid filename (as well as its complete path).

This method displays the normal Open dialog box (displayed when you select the `File` ⇨ `Open` command) but does not actually open the file specified. Rather, the method returns a string that contains the path and filename selected by the user. Then you can do whatever you want with the filename. The syntax for this method is as follows (all arguments are optional):

```
object.GetOpenFilename(FileFilter, FilterIndex, Title,  
ButtonText, MultiSelect)
```

<i>FileFilter</i>	Optional. A string specifying file-filtering criteria.
<i>FilterIndex</i>	Optional. The index numbers of the default file-filtering criteria.
<i>Title</i>	Optional. The title of the dialog box. If omitted, the title is "Open."
<i>ButtonText</i>	For Macintosh only.
<i>MultiSelect</i>	Optional. If True, multiple filenames can be selected. The default value is False.

The *FileFilter* argument determines what appears in the dialog box's Files of type drop-down list. The argument consists of pairs of file filter strings followed by the wildcard file filter specification, with each part and each pair separated by commas. If omitted, this argument defaults to:

```
" All Files (*.*) ,*.*"
```

Notice that the first part of this string (All Files (*.*)) is the text displayed in the Files of type drop-down list. The second part (*.*) actually determines which files are displayed.

The following instruction assigns a string to a variable named *Filt*. This string can then be used as a *FileFilter* argument for the *GetOpenFilename* method. In this case, the dialog box will allow the user to select from four different file types (plus an "all files" option). Notice that I used VBA's line continuation sequence to set up the *Filt* variable; doing so makes it much easier to work with this rather complicated argument.

```
Filt = "Text Files (*.txt),*.txt," & _
      "Lotus Files (*.prn),*.prn," & _
      "Comma Separated Files (*.csv),*.csv," & _
      "ASCII Files (*.asc),*.asc," & _
      "All Files (*.*) ,*.*"
```

The *FilterIndex* argument specifies which *FileFilter* is the default, and the title argument is text that is displayed in the title bar. If the *multiSelect* argument is *True*, the user can select multiple files, all of which are returned in an array.

The following example prompts the user for a filename. It defines five file filters.

```
Sub GetImportFileName()
    Dim Filt As String
    Dim FilterIndex As Integer
    Dim Title As String
    Dim FileName As String

    ' Set up list of file filters
    Filt = "Text Files (*.txt),*.txt," & _
          "Lotus Files (*.prn),*.prn," & _
          "Comma Separated Files (*.csv),*.csv," & _
          "ASCII Files (*.asc),*.asc," & _
          "All Files (*.*) ,*.*"

    ' Display *.* by default
    FilterIndex = 5
```

```

' Set the dialog box caption
Title = "Select a File to Import"

' Get the file name
FileName = Application.GetOpenFilename _
    (FileFilter:=Filt, _
    FilterIndex:=FilterIndex, _
    Title:=Title)

' Exit if dialog box canceled
If FileName = False Then
    MsgBox "No file was selected."
    Exit Sub
End If

' Display full path and name of the file
MsgBox "You selected " & FileName
End Sub

```

Figure 12-6 shows the dialog box that appears when this procedure is executed.

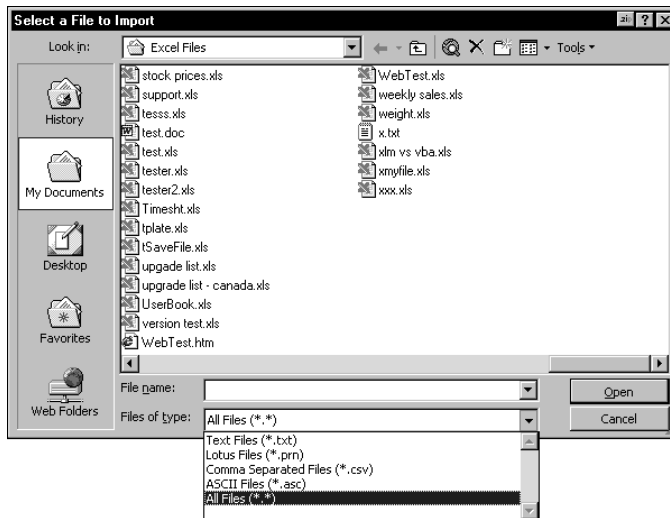


Figure 12-6: The `GetOpenFilename` method displays a customizable dialog box.

The following example is similar to the previous example. The difference is that the user can press `Ctrl` or `Shift` and select multiple files when the dialog box is displayed. Notice that I check for the `Cancel` button click by determining if `FileName` is an array. If the user doesn't click `Cancel`, the result is an array that consists of at least one element. In this example, a list of the selected files is displayed in a message box.


```

Sub GetImportFileName2()
    Dim Filt As String
    Dim FilterIndex As Integer
    Dim FileName As Variant
    Dim Title As String
    Dim i As Integer
    Dim Msg As String
    ' Set up list of file filters
    Filt = "Text Files (*.txt),*.txt," & _
          "Lotus Files (*.prn),*.prn," & _
          "Comma Separated Files (*.csv),*.csv," & _
          "ASCII Files (*.asc),*.asc," & _
          "All Files (*.*),*.*"
    ' Display *.* by default
    FilterIndex = 5

    ' Set the dialog box caption
    Title = "Select a File to Import"

    ' Get the file name
    FileName = Application.GetOpenFilename _
        (FileFilter:=Filt, _
         FilterIndex:=FilterIndex, _
         Title:=Title, _
         MultiSelect:=True)

    ' Exit if dialog box canceled
    If Not IsArray(FileName) Then
        MsgBox "No file was selected."
        Exit Sub
    End If

    ' Display full path and name of the files
    For i = LBound(FileName) To UBound(FileName)
        Msg = Msg & FileName(i) & vbCrLf
    Next i
    MsgBox "You selected:" & vbCrLf & Msg
End Sub

```

Notice that the `FileName` variable is defined as a variant (not a string, as in the previous example). This is done because `FileName` can, potentially, hold an array rather than a single file name.

Excel's GetSaveAsFilename Method

The `GetSaveAsFilename` method is very similar to the `GetOpenFilename` method. It displays a Save As dialog box and lets the user select (or specify) a file. It returns a filename and path but doesn't take any action.

The syntax for this method is:

```
object.GetSaveAsFilename(InitialFilename, FileFilter,
FilterIndex, Title, ButtonText)
```

The arguments are:

<i>InitialFilename</i>	Optional. Specifies the suggested filename.
<i>FileFilter</i>	Optional. A string specifying file-filtering criteria.
<i>FilterIndex</i>	Optional. The index number of the default file-filtering criteria.
<i>Title</i>	Optional. The title of the dialog box.
<i>ButtonText</i>	For Macintosh only.

Prompting for a Directory

If you need to get a filename, the simplest solution is to use the `GetOpenFileName` method, as described above. But if you only need to get a directory name, the solution will depend on which version of Excel you (and your users) have.

This section describes two ways to prompt for a directory. The first method is more complicated but works with Excel 97 and later. The second method is much easier but requires Excel 2002.

Using a Windows API function to select a directory

In this section, I present a function named `GetDirectory` that displays the dialog box shown in Figure 12-7 and returns a string that represents the selected directory. If the user clicks Cancel, the function returns an empty string. This technique will work with Excel 97 and later versions.

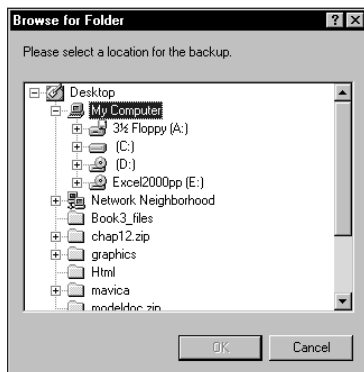


Figure 12-7: Use an API function to display this dialog box.

The `GetDirectory` function takes one argument, which is optional. This argument is a string that will be displayed in the dialog box. If the argument is omitted, the dialog box displays `Select a folder` as the message.



The companion CD-ROM contains a workbook that demonstrates this procedure.

Following are the API declarations required at the beginning of the workbook module. This function also uses a custom data type, called `BROWSEINFO`.

```
'32-bit API declarations
Declare Function SHGetPathFromIDList Lib "shell32.dll" _
    Alias "SHGetPathFromIDListA" (ByVal pidl As Long, ByVal _
    pszPath As String) As Long

Declare Function SHBrowseForFolder Lib "shell32.dll" _
    Alias "SHBrowseForFolderA" (lpBrowseInfo As BROWSEINFO) _
    As Long

Public Type BROWSEINFO
    hOwner As Long
    pidlRoot As Long
    pszDisplayName As String
    lpszTitle As String
    ulFlags As Long
    lpfn As Long
    lParam As Long
    iImage As Long
End Type
```

The `GetDirectory` function follows:

```
Function GetDirectory(Optional Msg) As String
    Dim bInfo As BROWSEINFO
    Dim path As String
    Dim r As Long, x As Long, pos As Integer

    ' Root folder = Desktop
    bInfo.pidlRoot = 0&

    ' Title in the dialog
    If IsMissing(Msg) Then
        bInfo.lpszTitle = "Select a folder."
    Else
        bInfo.lpszTitle = Msg
    End If

    ' Type of directory to return
    bInfo.ulFlags = &H1
```

```

' Display the dialog
x = SHBrowseForFolder(bInfo)

' Parse the result
path = Space$(512)
r = SHGetPathFromIDList(ByVal x, ByVal path)
If r Then
    pos = InStr(path, Chr$(0))
    GetDirectory = Left(path, pos - 1)
Else
    GetDirectory = ""
End If
End Function

```

The simple procedure that follows demonstrates how to use the `GetDirectory` function in your code. Executing this procedure displays the dialog box. When the user clicks OK the `MsgBox` function displays the full path of the selected directory. If the user clicks Cancel, the message box displays *Canceled*.

```

Sub GetAFolder1()
' For Excel 97 or later
Dim Msg As String
Dim UserFile As String
Msg = "Please select a location for the backup."
UserFile = GetDirectory(Msg)
If UserFile = "" Then
    MsgBox "Canceled"
Else
    MsgBox UserFile
End If
End Sub

```


Note

Unfortunately, there is no easy way to specify a default or starting directory.

Using the `FileDialog` object to select a directory

If users of your application all use Excel 2002, you may prefer to use a simpler technique that makes use of the `FileDialog` object.


New Feature

The `FileDialog` object is new to Excel 2002. Therefore, this technique will not work with earlier versions of Excel.

The following procedure displays a dialog box, which allows the user to select a directory. The selected directory name (or *Canceled*) is then displayed using the `MsgBox` function.

```

Sub GetAFolder2()
' For Excel 2002
With Application.FileDialog(msoFileDialogFolderPicker)

```

```
.InitialFileName = Application.DefaultFilePath & "\"
.Title = "Please select a location for the backup"
.Show
If .SelectedItems.Count = 0 Then
    MsgBox "Canceled"
Else
    MsgBox .SelectedItems(1)
End If
End With
End Sub
```

The `FileDialog` object lets you specify the starting directory by specifying a value for the `InitialFileName` property. In this case, the code uses Excel's default file path as the starting directory.

Displaying Excel's Built-In Dialog Boxes

Code that you write in VBA can execute Excel's menu commands. And, if the command leads to a dialog box, your code can "make choices" in the dialog box (although the dialog box itself isn't displayed). For example, the following VBA statement is equivalent to selecting the Edit ⇨ Go To command, specifying range A1:C3, and clicking OK. But the Go To dialog box never appears (which is what you want).

```
Application.Goto Reference:=Range("A1:C3")
```

In some cases, however, you may *want* to display one of Excel's built-in dialog boxes so the end user can make the choices. There are two ways to do this:

- ♦ Access the `Dialogs` collection of the `Application` object.
- ♦ Execute a menu item directly.

I discuss each of these techniques in the sections that follow.

Using the `Dialogs` collection

The `Dialogs` collection of the `Application` object consists of 258 members that represent most of Excel's built-in dialog boxes. Each has a predefined constant to make it easy to specify the dialog box that you need. For example, Excel's Go To dialog box is represented by the constant `xlDialogFormulaGoto`.

Use the `Show` method to actually display the dialog box. Here's an example that displays the Go To dialog box (see Figure 12-8):

```
Application.Dialogs(xlDialogFormulaGoto).Show
```

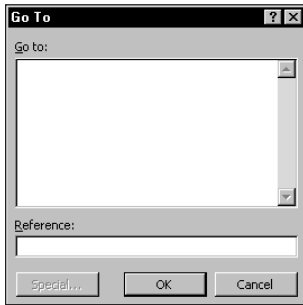


Figure 12-8: This dialog box was displayed with a VBA statement.

When the Go To dialog box is shown, the user can specify a named range or enter a cell address to go to. This dialog box is the one that appears when you choose the Edit ⇨ Go To command (or press F5).

You can also write code to determine how the user dismissed the dialog box. Do this by using a variable. In the following statement, the `Result` variable will be `True` if the user clicked OK, and `False` if the user clicked Cancel or pressed Esc.

```
Result = Application.Dialogs(xlDialogFormulaGoto).Show
```

Contrary to what you might expect, the `Result` variable does *not* hold the range that was specified in the Go To dialog box.

It's important to understand that this feature is not documented very well. The online help is very sketchy, and it doesn't mention the fact that displaying one of Excel's dialog boxes via VBA code may not always work exactly the same as using a menu command to display the dialog box. Consequently, you may have to do some experimentation to make sure your code performs as it should.

In the case of the Go To dialog box, you'll notice that the Special button is grayed out when the dialog is shown using a VBA statement. This button normally displays the Go To Special dialog box. To display the Go To Special dialog box using VBA code, use this statement:

```
Application.Dialogs(xlDialogSelectSpecial).Show
```

Another potential problem is that you can't display some "tabbed" dialog boxes correctly. For example, there is no way to show the Format Cells dialog box with the tabs. Rather, you can only show one tab at a time. The following statement displays the Alignment tab of the Format Cells dialog box (see Figure 12-9):

```
Application.Dialogs(xlDialogAlignment).Show
```

To show other tabs in the Format Cells dialog box, use any of these constants: `xlDialogFormatNumber`, `xlDialogBorder`, `xlDialogCellProtection`, `xlDialogPatterns`, or `xlDialogFontProperties`. Notice that there is no consistency in the naming of these constants.

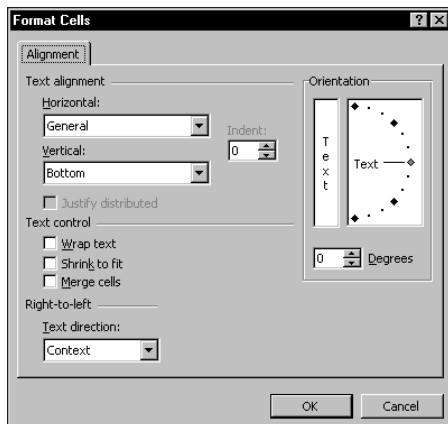


Figure 12-9: The Alignment tab of the Format Cells dialog box

Learning more about built-in dialog boxes

You can get a list of all of the dialog box constants by consulting the online help, or by using the Object Browser. Follow these steps to display the members of the `Dialogs` collection in the Object Browser:

1. In a VBA module, press F2 to bring up the Object Browser.
2. In the Object Browser dialog box, select Excel from the top list.
3. Type `xlDialog` in the second list.
4. Click the binoculars button.



Attempting to display a built-in dialog box in an incorrect context will result in an error. For example, if you select a series in a chart and then attempt to display the `xlDialogFontProperties` dialog box, you'll get an error message because that dialog box is not appropriate for that selection.

Using arguments with built-in dialog boxes

Most of the built-in dialog boxes also accept arguments, which (usually) correspond to the controls on the dialog box. For example, the Cell Protection dialog box (invoked by using the `xlDialogCellProtection` constant) uses two arguments: `locked` and `hidden`. If you want to display that dialog box with both of these options checked, use the following statement:

```
Application.Dialogs(xlDialogCellProtection).Show True, True
```

The arguments for each of the built-in dialog boxes are listed in the online help. To locate the help topic, search for *Built-In Dialog Box Argument Lists*. Unfortunately, the online help provides no explanation of what the arguments are used for!

According to the help file, the Go To dialog box (invoked by using the `xlDialogFormulaGoTo` constant) takes two arguments: reference and corner. The reference argument is used to provide a default range that appears in the Reference box. The corner reference is a logical value that specifies whether to display the reference so it appears in the upper left corner of the window. Here's an example that uses both of these arguments:

```
Application.Dialogs(xlDialogFormulaGoTo). _  
    Show Range("Z100"), True
```

As you may have surmised, successfully using the `Dialogs` collection may require some trial and error.

Executing a menu item directly

The second technique to display a built-in dialog box requires some knowledge of toolbars (officially known as `CommandBar` objects). For now, be aware that you can “execute” a menu item. And you can take advantage of the fact that selecting a menu item displays a dialog box.



I cover `CommandBars` extensively in Chapters 22 and 23.

The following statement, for example, is equivalent to selecting the Go To menu item on the Edit menu:

```
Application.CommandBars("Worksheet Menu Bar"). _  
    Controls("Edit").Controls("Go To...").Execute
```

This statement, when executed, displays the Go To dialog box. Notice that the menu item captions must match exactly (including the ellipses after “Go To”).

Unlike using the `Dialogs` collection, this technique does not allow you to specify default values for the dialog boxes.



The examples in this section use language-specific references to the `CommandBar` controls. Consequently, these statements will work only in English language versions of Excel. For applications that will be used with other language versions of Excel, you can use the `FindControl` method, along with the `Id` property for the command. See Chapter 22 for more information.

In the previous section, I pointed out a problem with accessing the `Dialogs` collection: It's not possible to display a tabbed dialog box. That problem doesn't exist when you execute a menu command. The following statement, for example, displays the Format Cells dialog box (with all of its tabs):

```
Application.CommandBars("Worksheet Menu Bar")._
    Controls("Format").Controls("Cells...").Execute
```

By the way, the `Execute` method also works with toolbar controls that don't display a dialog box. The following statement, for example, is equivalent to clicking the Bold button on the Formatting toolbar:

```
Application.CommandBars("Formatting").Controls("Bold").Execute
```

I can't think of any reason to do this, however. A more efficient way to toggle the Bold property of the selected cells is to use a statement like this:

```
Selection.Font.Bold = Not Selection.Font.Bold
```

Summary

In this chapter, I discussed some built-in tools that may eliminate the need to create a custom `UserForm`.



Introducing UserForms

Excel developers have always had the ability to create custom dialog boxes for their applications. Beginning with Excel 97, things changed substantially. UserForms have replaced the clunky old dialog sheets, and you have *much* more control over your custom dialog boxes. However, for compatibility purposes, Excel 97 and later still support Excel 5/95 dialog sheets. The good news is that it's *much* easier to work with UserForms, and they offer lots of new capabilities.

Excel makes it relatively easy to create custom dialog boxes for your applications. In fact, you can duplicate the look and feel of almost all of Excel's dialog boxes. This chapter provides an introduction and overview of UserForms.

How Excel Handles Custom Dialog Boxes

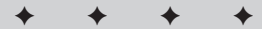
A custom dialog box is created on a UserForm, and you access UserForms in the Visual Basic Editor.

Following is the typical sequence that you will follow when you create a UserForm:

1. Insert a new UserForm into your workbook's VBProject.
2. Write a procedure that will display the UserForm. This procedure will be located in a VBA module (not in the code module for the UserForm).
3. Add controls to the UserForm.
4. Adjust some of the properties of the controls you added.
5. Write "event-handler" procedures for the controls. These procedures, which are located in the code window for the UserForm, are executed when various events (such as a button click) occur.

13

CHAPTER



In This Chapter

Creating, showing, and unloading UserForms

A discussion of the UserForm controls available to you

Setting the properties of UserForm controls

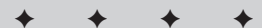
Controlling UserForms with VBA procedures

A hands-on example of creating a UserForm

An introduction to the types of events relevant to UserForms and controls

Customizing your control Toolbox

A handy checklist for creating UserForms



Inserting a New UserForm

To insert a new UserForm, activate the VBE (Alt+F11), select your workbook's project from the Project window, and select Insert ⇨ UserForm. UserForms have names like UserForm1, UserForm2, and so on.



Tip

You can change the name of a UserForm to make it easier to identify. Select the form and use the Properties window to change the Name property (press F4 if the Properties window is not displayed). Figure 13-1 shows the Properties window when an empty UserForm is selected.

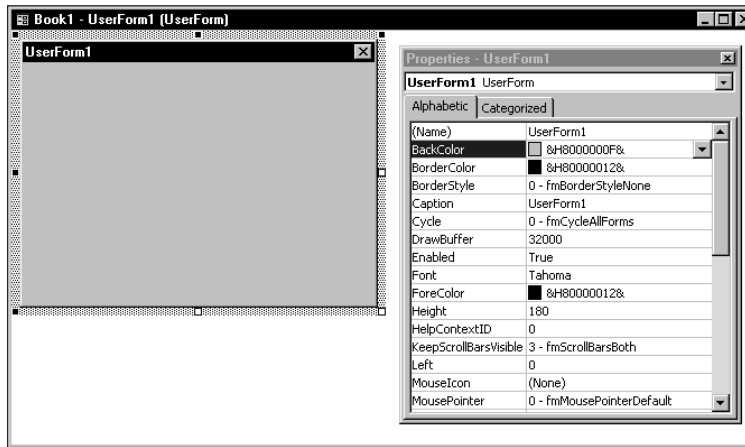


Figure 13-1: The Properties window for an empty UserForm

A workbook can have any number of UserForms, and each UserForm holds a single custom dialog box.

Displaying a UserForm

To display a UserForm, use the `Show` method of the UserForm object. The following procedure, which is contained in a normal VBA module, displays UserForm1:

```
Sub ShowForm
    UserForm1.Show
End Sub
```

When the UserForm is displayed, it remains visible on-screen until it is dismissed. Usually, you'll add a `CommandButton` to the UserForm that executes a procedure that dismisses the UserForm. The procedure can either unload the UserForm (with

the `Unload` command) or hide the `UserForm` (with the `Hide` method of the `UserForm` object). This concept will become clearer later in the chapter.

If the name of the `UserForm` is stored as a string variable, you can use the `Add` method to add the `UserForm` to the `UserForms` collection and then use the `Show` method of the `UserForms` collection. Here's an example that assigns the name of a `UserForm` to the `MyForm` variable and then displays the `UserForm`.

```
MyForm = "UserForm1"  
UserForms.Add(MyForm).Show
```

This technique might be useful if your project contains several `UserForms` and the `UserForm` to be shown is determined by your code.

Adding Controls to a UserForm

To add controls to a `UserForm`, use the `Toolbox` (the `VBE` does not have menu commands that add controls). If the `Toolbox` is not displayed, select `View` ⇄ `Toolbox`. Figure 13-2 shows the `Toolbox`.

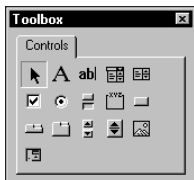


Figure 13-2: Use the `Toolbox` to add controls to a `UserForm`.

Just click the `Toolbox` button that corresponds to the control you want to add, and then click inside the dialog box to create the control (using its default size). Or, you can click the control and then drag in the dialog box to specify the dimensions for the control.

When you add a new control, it is assigned a name that combines the control type with the numeric sequence for that type of control. For example, if you add a `CommandButton` control to an empty `UserForm`, it is named `CommandButton1`. If you then add a second `CommandButton`, it is named `CommandButton2`.

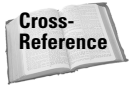
Tip



It's a good idea to rename all the controls that you will be manipulating with your `VBA` code. Doing so lets you refer to meaningful names (such as `ProductListBox`), rather than generic names such as `ListBox1`. To change the name of a control, use the `Properties` window in the `VBA`. Just select the object and enter a new name.

Controls Available to You

In the sections that follow, I briefly describe the controls available to you in the Toolbox.



Your UserForms can also use other ActiveX controls. See “Customizing the Toolbox,” later in this chapter.

CheckBox

A CheckBox control is useful for getting a binary choice: yes or no, true or false, on or off, and so on. When a CheckBox is checked, it has a value of True; when it's not checked, the CheckBox's value is False.

ComboBox

A ComboBox control is similar to a ListBox control. A ComboBox, however, is a drop-down box, and it displays only one item at a time. Another difference is that the user may be allowed to enter a value that does not appear in the list of items.

CommandButton

Every dialog box that you create will probably have at least one CommandButton. Usually, you'll want to have a CommandButton labeled OK and another labeled Cancel.

Frame

A Frame control is used to enclose other controls. You do this either for aesthetic purposes or to logically group a set of controls. A frame is particularly useful when the dialog box contains more than one set of OptionButton controls.

Image control

An Image control is used to display a graphic image, which can come from a file or pasted from the clipboard. You might want to use an Image control to display your company's logo in a dialog box. The graphics image is stored in the workbook. That way, if you distribute your workbook to someone else, it is not necessary to include a copy of the graphics file.



Some graphics files are very large, and using such images can make your workbook increase dramatically in size. For best results, use graphics sparingly, or use small graphics files.

Label

A Label control simply displays text in your dialog box.

ListBox

The ListBox control presents a list of items, and the user can select an item (or multiple items). ListBox controls are very flexible. For example, you can specify a worksheet range that holds the ListBox items, and this range can consist of multiple columns. Or you can fill the ListBox with items using VBA.

MultiPage

A MultiPage control lets you create tabbed dialog boxes, like the one that appears when you choose the Tools ⇨ Options command. By default, a MultiPage control has two pages. To add additional pages, right-click a tab and select New Page from the shortcut menu.

OptionButton

OptionButtons are useful when the user needs to select one item from a small number of choices. OptionButtons are always used in groups of at least two. When an OptionButton is selected, the other OptionButtons in its group are unselected.

If your UserForm contains more than one set of OptionButtons, each set of OptionButtons must have the same `GroupName` property value. Otherwise, all OptionButtons become part of the same set. Alternatively, you can enclose the OptionButtons in a Frame control, which automatically groups the OptionButtons contained in the frame.

RefEdit

The RefEdit control is used when you need to let the user select a range in a worksheet.

ScrollBar

The ScrollBar control is similar to a SpinButton control. The difference is that the user can drag the ScrollBar's button to change the control's value in larger increments. The ScrollBar control is most useful for selecting a value that extends across a wide range of possible values.

SpinButton control

The SpinButton control lets the user select a value by clicking on either of two arrows, one to increase the value and the other to decrease the value. A SpinButton is often used in conjunction with a TextBox control or Label control, which displays the current value of the SpinButton.

TabStrip

A TabStrip control is similar to a MultiPage control, but it's not as easy to use. A TabStrip control, unlike a MultiPage control, does not serve as a container for other objects. Generally, you'll find that the MultiPage control is much more versatile.

TextBox

A TextBox control lets the user input text.

ToggleButton

A ToggleButton control has two states: on or off. Clicking on the button toggles between these two states, and the button changes its appearance. Its value is either True (pressed) or False (not pressed). This is not exactly a “standard” control, and using two OptionButtons or one CheckBox may be a better choice.

Adjusting UserForm Controls

After a control is placed in a dialog box, you can move and resize it using standard mouse techniques.



Tip

You can select multiple controls by Shift-clicking, or by clicking and dragging to lasso a group of controls.

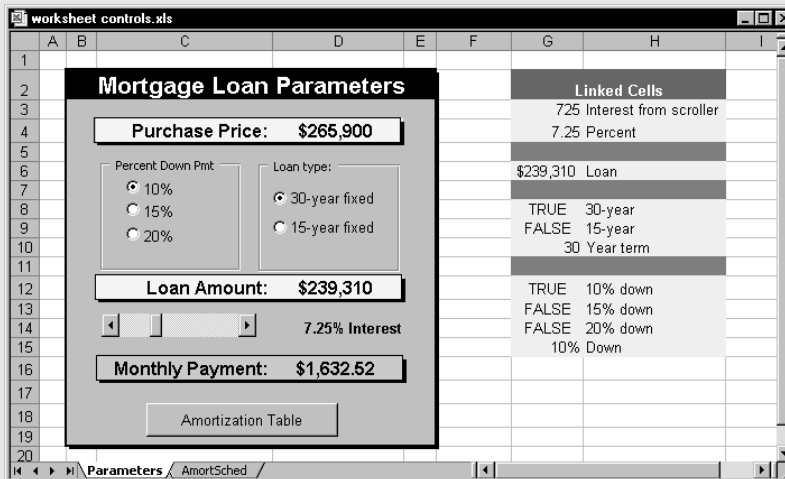
A UserForm may contain vertical and horizontal grid lines that help you align the controls you add. When you add or move a control, it *snaps* to the grid to help you line up the controls. If you don't like to see these grid lines, you can turn them off by choosing Tools ⇨ Options in the VBE. In the Options dialog box, select the General tab and set your desired options in the Form Grid Settings section.

The Format menu in the VBE window provides several commands to help you precisely align and space the controls in a dialog box. Before you use these commands, select the controls you want to work with. These commands work just as you would expect, so I don't explain them here. Figure 13-3 shows a dialog box with several OptionButton controls about to be aligned.

Using Controls on a Worksheet

Many of the UserForm controls can be embedded directly into a worksheet. These controls are accessible from the Control Toolbox toolbar (in Excel, not VBE). Adding such controls to a worksheet requires much less effort than creating a dialog box. In addition, you may not have to create any macros, because you can link a control to a worksheet cell. For example, if you insert a CheckBox control on a worksheet, you can link it to a particular cell by setting its `LinkedCell` property. When the CheckBox is checked, the linked cell displays `TRUE`. When the CheckBox is unchecked, the linked cell displays `FALSE`.

The accompanying figure shows a worksheet that contains some embedded controls.



Adding controls to a worksheet can be a bit confusing, because controls can come from either of two toolbars:

- ♦ *Forms toolbar.* These controls are insertable objects (and are compatible with Excel 5 and Excel 95).
- ♦ *Control Toolbox toolbar.* These are ActiveX controls. These controls are a subset of those that are available for use on UserForms. These controls work only with Excel 97 and later versions, and are not compatible with Excel 5 and Excel 95.

You can use the controls from either of these toolbars, but it's important that you understand the distinctions between them. The controls from the Forms toolbar work much differently than the ActiveX controls.

Continued

Continued

When you use the Control Toolbox toolbar to add a control to a worksheet, Excel goes into *design mode*. In this mode, you can adjust the properties of any controls on your worksheet, add or edit event-handler procedures for the control, or change its size or position. To display the Properties window for an ActiveX control, right-click the control and select Properties from the shortcut menu.

For simple buttons, I often use the Button control on the Forms toolbar because it lets me attach any macro to it. If I use a CommandButton control from the Control Toolbox, clicking it will execute its event-handler procedure (for example, `CommandButton1_Click`) in the code module for the `Sheet` object—you can't attach just any macro to it.

When Excel is in design mode, you can't try out the controls. To test the controls, you must exit design mode by clicking the Exit Design Mode button on the Control Toolbox toolbar.

This workbook, plus another that demonstrates all worksheet controls, are available on the companion CD-ROM.

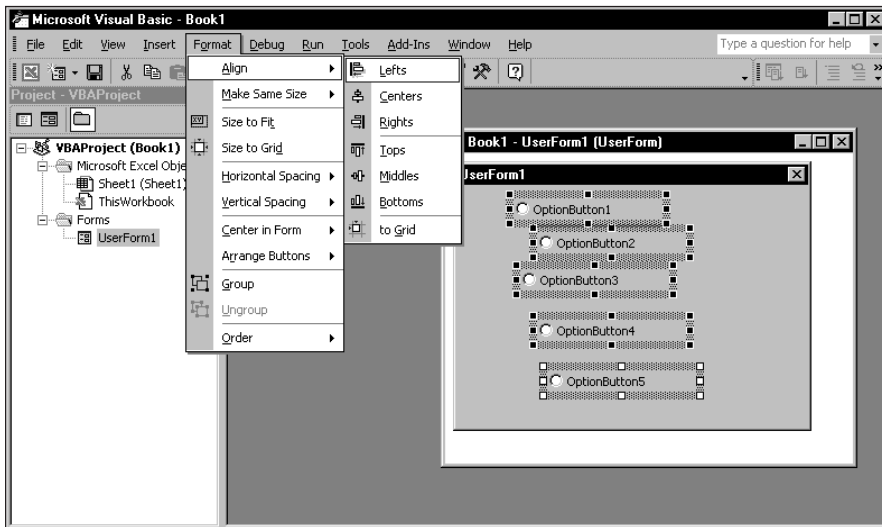


Figure 13-3: Using the Format ⇨ Align command to change the alignment of controls

Tip

When you select multiple controls, the last control you select appears with white handles rather than the normal black handles. The control with the white handles is used as the model against which the other black-handled controls are compared for size or position.

Adjusting a Control's Properties

Every control has a number of properties that determine how the control looks and behaves. You can change a control's properties:

- ♦ At design time when you're developing the UserForm. You use the Properties window for this.
- ♦ During runtime when the UserForm is being displayed for the user. You use VBA instructions to change a control's properties at runtime.

Using the Properties window

In the VBE, the Properties window adjusts to display the properties of the selected item (which can be a control or the UserForm itself). In addition, you can select a control using the drop-down list at the top of the Properties window (see Figure 13-4).

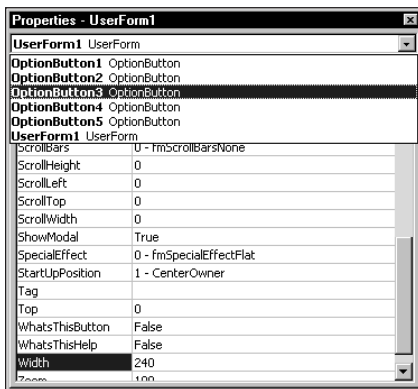


Figure 13-4: Selecting a control (OptionButton3) from the drop-down list at the top of the Properties window

Note

The Properties window has two tabs. The Alphabetic tab displays the properties for the selected object in alphabetical order. The Categorized tab displays them grouped into logical categories. Both tabs contain the same properties, but in a different order.

To change a property, just click it and specify the new property. Some properties can take on a finite number of values, selectable from a list. If so, the Properties window will display a button with a downward pointing arrow. Click the button and you'll be able to select the property's value from the list. For example, the `TextAlign` property can have any of the following values: 1 - `fmTextAlignLeft`, 2 - `fmTextAlignCenter`, or 3 - `fmTextAlignRight`.

A few properties (for example, `Font` and `Picture`) display a small button with an ellipsis when selected. Click the button to display a dialog box associated with the property.

The `Image` control's `Picture` property is worth mentioning because you can either select a graphic file that contains the image, or paste an image from the clipboard. When pasting an image, first copy it to the clipboard, then select the `Picture` property for the `Image` control and press `Ctrl+V` to paste the clipboard contents.

**Note**

If you select two or more controls at once, the Properties window displays only the properties that are common to the selected controls.

**Tip**

The UserForm itself has many properties that you can adjust. These properties are then used as defaults for controls that you add to the UserForm. For example, if you change the UserForm's `Font` property, all controls added to the UserForm will use that font.

Common properties

Although each control has its own unique set of properties, many controls have some common properties. For example, every control has a `Name` property and properties that determine its size and position (`Height`, `Width`, `Left`, and `Right`).

If you're going to manipulate a control using VBA, it's an excellent idea to provide a meaningful name for the control. For example, the first `OptionButton` that you add to a UserForm has a default name of `OptionButton1`. You refer to this object in your code using a statement such as:

```
OptionButton1.Value = True
```

But if you give the `OptionButton` a more meaningful name (such as `obLandscape`), you can use a statement such as:

```
obLandscape.Value = True
```

**Tip**

Many people find it helpful to use a name that also identifies the type of object. In the preceding example, I use "ob" as the prefix to identify the fact that this control is an `OptionButton`.

You can adjust the properties of several controls at once. For example, you may have several `OptionButtons`, and you want them to be left-aligned. You can simply select all of the `OptionButtons`, then change the `Left` property in the Properties box. All of the selected controls will then take on that new `Left` property value.

Learning more about properties

The best way to learn about the various properties for a control is to use the online help. Simply click on a property in the Property window and press F1. Figure 13-5 shows an example of the type of help provided for a property.

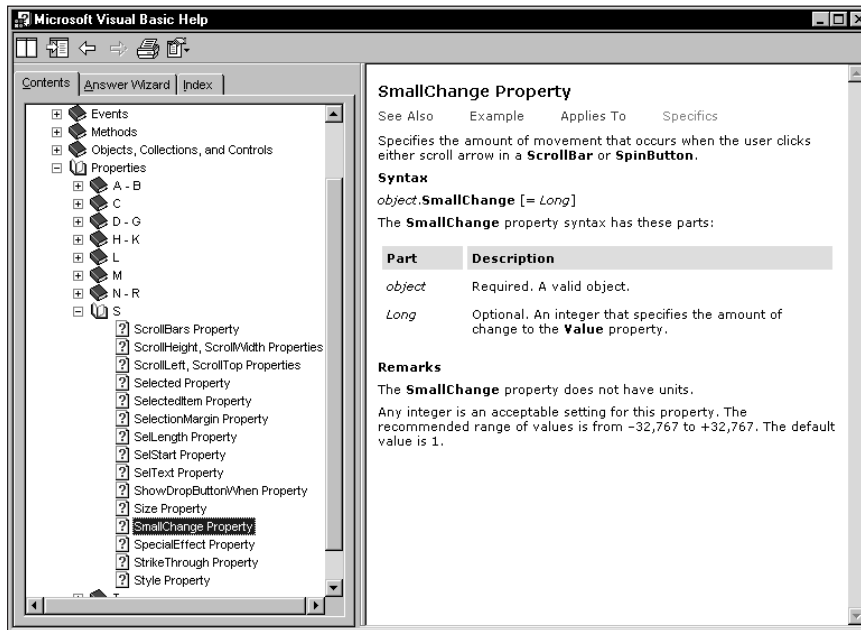


Figure 13-5: The online help provides information about each property for every control.

Accommodating keyboard users

Many users prefer to navigate through a dialog box using the keyboard: The Tab and Shift+Tab keystrokes cycle through the controls, and pressing a hot key operates the control. To make sure that your dialog box works properly for keyboard users, you must be mindful of two issues: tab order and accelerator keys.

Changing the tab order

The tab order determines the sequence in which the controls are activated when the user presses Tab or Shift+Tab. It also determines which control has the initial *focus*. If a user is entering text into a TextBox control, for example, the TextBox has the focus. If the user clicks an OptionButton, the OptionButton has the focus. The control that's first in the tab order has the focus when a dialog box is first displayed.

To set the tab order of your controls, choose View ⇨ Tab Order. You can also right-click the dialog box and choose Tab Order from the shortcut menu. In either case, Excel displays the Tab Order dialog box shown in Figure 13-6. The Tab Order dialog box lists all the controls, the sequence of which corresponds to the order in which controls pass the focus between each other in the UserForm. To move a control, select it and click the arrow keys up or down. You can choose more than one control (click while pressing Shift or Ctrl) and move them all at once.

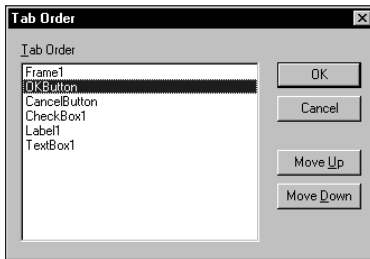


Figure 13-6: Use the Tab Order dialog box to specify the tab order of the controls.

Alternately, you can set an individual control's position in the tab order using the Properties window. The first control in the tab order has a `TabIndex` property of 0. Changing the `TabIndex` property for a control may also affect the `TabIndex` property of other controls. These adjustments are made automatically to ensure that no control has a `TabIndex` greater than the number of controls. If you want to remove a control from the tab order, set its `TabStop` property to `False`.

Note

Some controls, such as `Frame` and `MultiPage`, act as containers for other controls. The controls inside a container have their own tab order. To set the tab order for a group of `OptionButtons` inside a `Frame` control, select the `Frame` control before you choose the View ⇨ Tab Order command.

Setting hot keys

You can assign an accelerator key, or “hot key,” to most dialog box controls. This allows the user to access the control by pressing Alt+ the hot key. Use the `Accelerator` property in the Properties window for this purpose.

Tip

Some controls, such as a `TextBox`, don't have an `Accelerator` property because they don't display a `Caption`. You still can allow direct keyboard access to these controls using a `Label` control. Assign an accelerator key to the `Label`, and put it ahead of the `TextBox` in the tab order.

Testing a UserForm

You'll usually want to test your UserForm while you're developing it. There are three ways that you can test a UserForm without actually calling it from a VBA procedure:

- ♦ Choose the Run ⇨ Run Sub/UserForm command
- ♦ Press F5
- ♦ Click the Run Sub/UserForm button on the Standard toolbar

These three techniques all trigger the UserForm's Initialize event. When a dialog box is displayed in this test mode, you can try out the tab order and the accelerator keys.

Displaying and Closing UserForms

In this section, I provide an overview of using VBA to work with UserForms.

Displaying a UserForm

To display a UserForm from VBA, you create a procedure that uses the `Show` method of the `UserForm` object. You cannot display a UserForm without using at least one line of VBA code. If your UserForm is named `UserForm1`, the following procedure displays the dialog box on that form:

```
Sub ShowDialog()  
    UserForm1.Show  
End Sub
```

This procedure must be located in a standard VBA module, not in the code module for the UserForm.

VBA also has a `Load` statement. Loading a UserForm loads it into memory, but it is not visible until you use the `Show` method. To load a UserForm, use a statement like this:

```
Load UserForm1
```

If you have a complex UserForm, you might want to load it into memory before it is needed so it will appear more quickly when you use the `Show` method. In the majority of situations, however, it's not necessary to use the `Load` statement.

Closing a UserForm

To close a UserForm, use the `Unload` command. For example:

```
Unload UserForm1
```

Or, you can use the following:

```
Unload Me
```

Normally, your VBA code should include the `Unload` command after the UserForm has performed its actions. For example, your UserForm may have a `CommandButton` that serves as an OK button. Clicking this button executes a macro. One of the statements in the macro will unload the UserForm. The UserForm remains visible on the screen until the macro that contains the `Unload` statement finishes.

When a UserForm is unloaded, its controls are reset to their original values. In other words, your code will not be able to access the user's choices after the UserForm is unloaded. If the user's choice must be used later on (after the UserForm is unloaded), you need to store the value in a `Public` variable, declared in a standard VBA module. Or, you could store the value in a worksheet cell.

**Note**

A UserForm is automatically unloaded when the user clicks the Close button (the "x" in the UserForm's title bar). This action also triggers a `UserForm QueryClose` event, followed by a `UserForm Terminate` event.

UserForms also have a `Hide` method. When you invoke this method, the UserForm disappears, but it remains loaded in memory, so your code can still access the various properties of the controls. Here's an example of a statement that hides a UserForm:

```
UserForm1.Hide
```

Or, you can use the following:

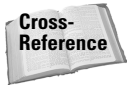
```
Me.Hide
```

If for some reason you would like your UserForm to disappear immediately while its macro is executing, use the `Hide` method at the top of the procedure, and follow it with a `DoEvents` command. For example, in the following procedure, the UserForm disappears immediately when `CommandButton1` is clicked. The last statement in the procedure unloads the UserForm.

```
Private Sub CommandButton1_Click()  
    Me.Hide  
    DoEvents  
    For r = 1 To 10000  
        Cells(r, 1) = r  
    End For  
End Sub
```



```
Next r
Unload Me
End Sub
```



In Chapter 15, I describe how to display a progress indicator, which takes advantage of the fact that a UserForm remains visible while the macro executes.

About event-handler procedures

Once the UserForm is displayed, the user interacts with it—selecting an item from a ListBox, clicking a CommandButton, and so on. In official terminology, the user causes an *event* to occur. For example, clicking a CommandButton raises the `Click` event for the CommandButton. You will need to write procedures that are executed when these events occur. These procedures are sometimes known as *event-handler* procedures.



Event-handler procedures must be located in the code window for the UserForm. However, your event-handler procedure can call another procedure that's located in a standard VBA module.

Your VBA code can change the properties of the controls while the UserForm is displayed (that is, at runtime). For example, you may assign to a ListBox control a procedure that changes the text in a Label when an item is selected. This type of manipulation will become clearer later in this chapter.

Creating a UserForm: An Example

If you've never created a UserForm, you may want to walk through the example in this section. The example includes step-by-step instructions for creating a simple dialog box and developing a VBA procedure to support the dialog box.

This example uses a UserForm to get two pieces of information: a person's name and sex. The dialog box uses a TextBox control to get the name, and three OptionButtons to get the sex (Male, Female, or Unknown). The information collected in the dialog box is then sent to the next blank row in a worksheet.

Creating the UserForm

Figure 13-7 shows the finished UserForm for this example. For best results, start with a new workbook with only one worksheet in it. Then follow these steps:

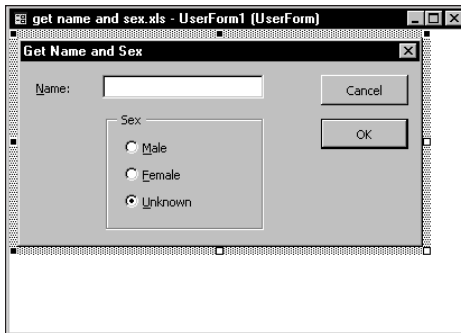


Figure 13-7: This dialog box asks the user to enter a name and a sex.

1. Press Alt+F11 to activate the VBE.
2. In the Project window, select the workbook's project, and choose Insert ⇨ UserForm to add an empty UserForm.
3. The UserForm's `Caption` property will have its default value: `UserForm1`. Use the Properties window to change the UserForm's `Caption` property to **Get Name and Sex** (if the Properties window isn't visible, press F4).
4. Add a Label control and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Accelerator	N
Caption	Name:
TabIndex	0

5. Add a TextBox control and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Name	TextName
TabIndex	1

6. Add a Frame control and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Caption	Sex
TabIndex	2

7. Add an `OptionButton` control inside the Frame and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Accelerator	M
Caption	Male
Name	OptionMale
TabIndex	0

8. Add another `OptionButton` control inside the Frame and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Accelerator	F
Caption	Female
Name	OptionFemale
TabIndex	1

9. Add yet another `OptionButton` control inside the Frame and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Accelerator	U
Caption	Unknown
Name	OptionUnknown
TabIndex	2
Value	True

10. Add a CommandButton control outside the frame and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Caption	OK
Default	True
Name	OKButton
TabIndex	3

11. Add another CommandButton control and adjust the properties as follows:

<i>Property</i>	<i>Value</i>
Caption	Cancel
Cancel	True
Name	CancelButton
TabIndex	4



Tip

When you are creating several controls that are similar, you may find it easier to copy an existing control rather than create a new one. To copy a control, press Ctrl while you drag the control to make a new copy of it. Then adjust the properties on the copied control.

Writing code to display the dialog box

Next, you add a CommandButton to the worksheet. This button will execute a procedure that displays the UserForm. Here's how:

1. Activate Excel (Alt+F11 is the shortcut key combination).
2. Right-click any toolbar, and select Control Toolbox from the shortcut menu. Excel displays its Control Toolbox toolbar, which closely resembles the VBE Toolbox.
3. Use the Control Toolbox toolbar to add a CommandButton to the worksheet. Click the CommandButton tool, then drag in the worksheet to create the button.

If you like, you can change the caption for the worksheet `CommandButton`. To do so, right-click the button and select `CommandButton Object ↪ Edit` from the shortcut menu. You can then edit the text that appears on the `CommandButton`.

4. Double-click the `CommandButton`.

This activates the VBE. More specifically, the code module for the worksheet will be displayed, with an empty event-handler procedure for the worksheet's `CommandButton`.

5. Enter a single statement in the `CommandButton1_Click` procedure (see Figure 13-8). This short procedure uses the `Show` method of an object (`UserForm1`) to display the `UserForm`.



Figure 13-8: The `CommandButton1_Click` procedure is executed when the button on the worksheet is clicked.

Trying it out

The next step is to try out the procedure that displays the dialog box.

Note

When you click the `CommandButton` on the worksheet, you'll find that nothing happens. Rather, the button is selected. That's because Excel is still in Design Mode—which happens automatically when you insert a control using the Control Toolbox toolbar. To exit Design Mode, click the button on the Control Toolbox toolbar labeled Exit Design Mode.

When you exit Design Mode, clicking the button will display the `UserForm` (see Figure 13-9).

When the dialog box is displayed, enter some text into the text box and click OK. You'll find that nothing happens—which is understandable because you haven't yet created any event-handler procedures for the `UserForm`.

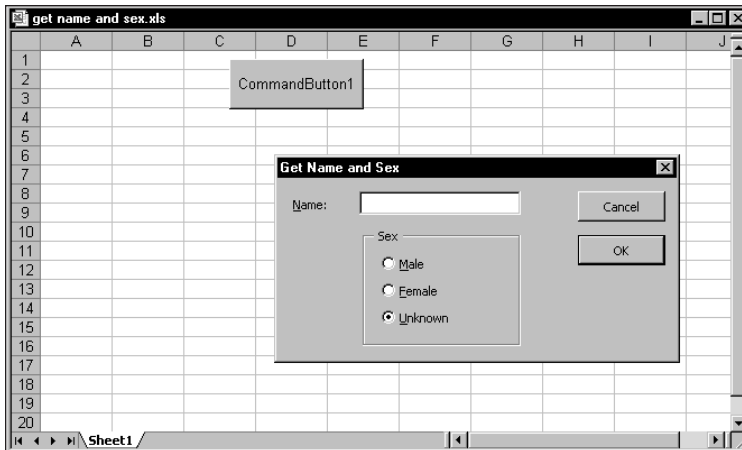


Figure 13-9: The CommandButton's Click event procedure displays the UserForm.

Note

Click the Close button in the UserForm's title bar to get rid of the dialog box.

Adding event-handler procedures

In this section, I explain how to write the procedures that will handle the events that occur when the UserForm is displayed. To continue our example, do the following:

1. Press Alt+F11 to activate the VBE.
2. Make sure the UserForm is displayed, and double-click its Cancel button. This will activate the Code window for the UserForm, and insert an empty procedure named `CancelButton_Click`. Notice that this procedure consists of the object's name, an underscore character, and the event that it handles.
3. Modify the procedure as follows (this is the event-handler for the CancelButton's Click event):

```
Private Sub CancelButton_Click()
    Unload UserForm1
End Sub
```

This procedure, which is executed when the user clicks the Cancel button, simply unloads the UserForm.

4. Press Shift+F7 to redisplay UserForm1 (or click the View Object icon at the top of the Project Explorer window).
5. Double-click the OK button and enter the following procedure (this is the event-handler for the OKButton's Click event):

```

Private Sub OKButton_Click()
'   Make sure Sheet1 is active
    Sheets("Sheet1").Activate

'   Determine the next empty row
    NextRow = _
        Application.WorksheetFunction.CountA(Range("A:A")) + 1
'   Transfer the name
    Cells(NextRow, 1) = TextName.Text

'   Transfer the sex
    If OptionMale Then Cells(NextRow, 2) = "Male"
    If OptionFemale Then Cells(NextRow, 2) = "Female"
    If OptionUnknown Then Cells(NextRow, 2) = "Unknown"

'   Clear the controls for the next entry
    TextName.Text = ""
    OptionUnknown = True
    TextName.SetFocus
End Sub

```

6. Activate Excel and click the CommandButton again to display the UserForm. Run the procedure again.

You'll find that the UserForm controls now function correctly. Figure 13-10 shows how this looks in action.

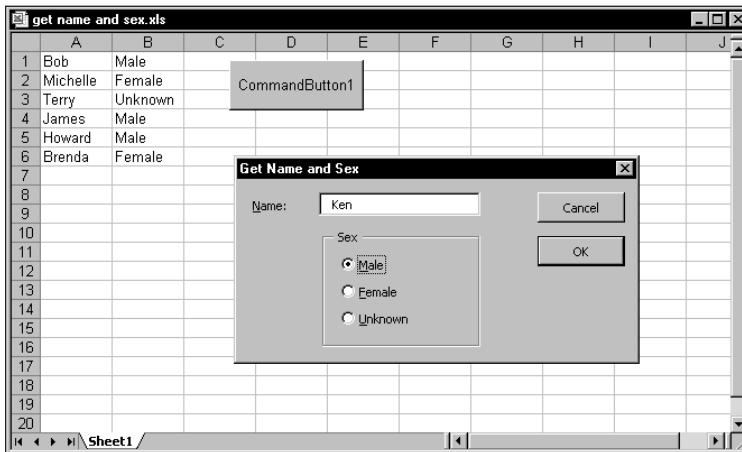


Figure 13-10: Using the custom dialog box

Here's how the `OKButton_Click` procedure works: First, the procedure makes sure that the proper worksheet (Sheet1) is active. It then uses Excel's `COUNTA` function to determine the next blank cell in column A. Next, it transfers the text from the `TextBox` to column A. It then uses a series of `If` statements to determine which

OptionButton was selected, and writes the appropriate text (Male, Female, or Unknown) to column B. Finally, the dialog box is reset to make it ready for the next entry. Notice that clicking OK doesn't close the dialog box. To end data entry (and unload the UserForm), click the Cancel button.

Validating the data

Play around with this example some more, and you'll find that it has a small problem: It doesn't ensure that the user actually enters a name into the text box. The following code is inserted in the `OKButton_Click` procedure before the text is transferred to the worksheet. It ensures that the user enters a name (well, at least some text) in the `TextBox`. If the `TextBox` is empty, a message appears and the focus is set to the `TextBox` so that the user can try again. The `Exit Sub` statement ends the procedure with no further action.

```
' Make sure a name is entered
If TextBox1.Text = "" Then
    MsgBox "You must enter a name."
    TextBox1.SetFocus
    Exit Sub
End If
```

Now it works

After making all these modifications, you'll find that the dialog box works flawlessly (don't forget to test the hot keys). In real life, you'd probably need to collect more information than just name and sex. However, the same basic principles apply. You just need to deal with more UserForm controls.

UserForm Events

Each UserForm control (as well as the UserForm itself) is designed to respond to certain types of events, and these events can be triggered by a user or by Excel. For example, clicking a `CommandButton` generates a `Click` event for the `CommandButton`. You can write code that is executed when a particular event occurs.

Some actions generate multiple events. For example, clicking the upward arrow of a `SpinButton` control generates a `SpinUp` event and also a `Change` event. When a UserForm is displayed using the `Show` method, Excel generates an `Initialize` event and an `Activate` event for the UserForm.



Excel also supports events associated with a `Sheet` object, `Chart` objects, and the `ThisWorkbook` object. I discuss these types of events in Chapter 18.

Learning about events

To find out which events are supported by a particular control:

1. Add a control to a UserForm.
2. Double-click the control to activate the code module for the UserForm. The VBE will insert an empty event-handler procedure for the default event for the control.
3. Click the drop-down list in the upper-right corner of the module window and you'll see a complete list of events for the control (see Figure 13-11).

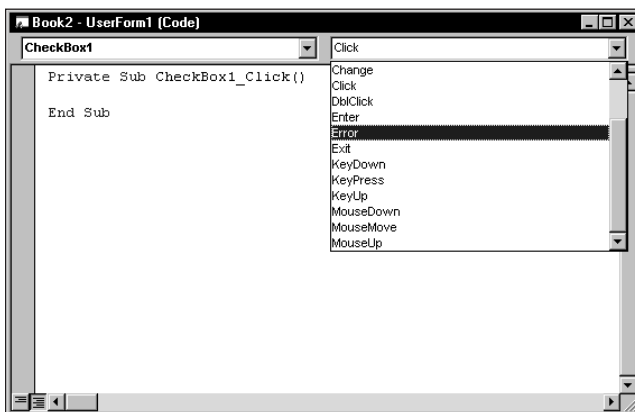


Figure 13-11: The event list for a CheckBox control

4. Select an event from the list, and the VBE will create an empty event-handler procedure for you.

Note

To find out specific details about an event, consult the online help. The help system also lists the events available for each control.

Caution

Event-handler procedures incorporate the name of the object in the procedure's name. Therefore, if you change the name of a control, you'll also need to make the appropriate changes to the control's event-handler procedure(s). The name changes are not performed automatically! To make things easy on yourself, it's a good idea to provide names for your controls before you begin creating event-handler procedures.

UserForm events

Several events are associated with showing and unloading a UserForm:

Initialize	Occurs before a UserForm is loaded or shown, but does not occur if the UserForm was previously hidden.
Activate	Occurs when a UserForm is shown.
Deactivate	Occurs when a UserForm is deactivated, but does not occur if the form is hidden
QueryClose	Occurs before a UserForm is unloaded
Terminate	Occurs after the UserForm is unloaded

Note

Often, it's critical that you choose the appropriate event for your event-handler procedure and that you understand the order in which the events occur. Using the `Show` method invokes the `Initialize` and `Activate` events (in that order). Using the `Load` command invokes only the `Initialize` event. Using the `Unload` command triggers the `QueryClose` and `Terminate` events (in that order). Using the `Hide` method doesn't trigger either of these events.



The companion CD-ROM contains a workbook that monitors all of these events, and displays a message box when an event occurs. If you're confused about UserForm events, studying the code in this example should clear things up.

Example: SpinButton events

To help clarify the concept of events, this section takes a close look at the events associated with a SpinButton control.



The companion CD-ROM contains a workbook that demonstrates the sequence of events that occur for a SpinButton and the UserForm that contains it. The workbook contains a series of event-handler routines — one for each SpinButton and UserForm event. Each of these routines simply displays a message box that tells you the event that just fired.

Table 12-3 lists all of the events for the SpinButton control.

Table 13-1
SpinButton Events

<i>Event</i>	<i>Description</i>
AfterUpdate	Occurs after the control is changed through the user interface
BeforeDragOver	Occurs when a drag-and-drop operation is in progress
BeforeDropOrPaste	Occurs when the user is about to drop or paste data onto the control
BeforeUpdate	Occurs before the control is changed
Change	Occurs when the <code>Value</code> property changes

Event	Description
Enter	Occurs before the control actually receives the focus from a control on the same UserForm
Error	Occurs when the control detects an error and cannot return the error information to a calling program
Exit	Occurs immediately before a control loses the focus to another control on the same form
KeyDown	Occurs when the user presses a key and the object has the focus
KeyPress	Occurs when the user presses any key that produces a typeable character
KeyUp	Occurs when the user releases a key and the object has the focus
SpinDown	Occurs when the user clicks the lower (or left) SpinButton arrow
SpinUp	Occurs when the user clicks the upper (or right) SpinButton arrow

A user can operate a SpinButton control by clicking it with the mouse, or (if the control has the focus) using the up arrow or down arrow keys.

Mouse-initiated events

When the user clicks the upper SpinButton arrow, the following events occur in this precise order:

1. Enter (triggered only if the SpinButton did not already have the focus)
2. Change
3. SpinUp

Keyboard-initiated events

The user can also press Tab to set the focus to the SpinButton, and then use the up arrow key to increment the control. If so, the following events occur (in this order):

1. Enter
2. KeyDown
3. Change
4. SpinUp

What about changes via code?

The SpinButton control can also be changed by VBA code—which also triggers the appropriate event(s). For example, the following statement sets SpinButton1's Value property to zero, and also triggers the Change event for the SpinButton control—but only if the SpinButton's value was not already 0:

```
SpinButton1.Value = 0
```

You might think that you could disable events by setting the EnableEvents property of the Application object to False. Unfortunately, this property only applies to events that involve true Excel objects: Workbooks, Worksheets, and Charts.

Pairing a SpinButton with a TextBox

A SpinButton has a Value property, but this control doesn't have a caption in which to display its value. In many cases, however, you will want the user to see the SpinButton's value. And sometimes you'll want the user to be able to change the SpinButton's value directly instead of clicking the SpinButton repeatedly.

The solution is to pair a SpinButton with a TextBox, which enables the user to specify a value by typing it into the TextBox directly, or by clicking the SpinButton to increment or decrement the value in the TextBox.

Figure 13-12 shows a simple example. The SpinButton's Min property is 1, and its Max property is 100. Therefore, clicking the SpinButton's arrows will change its value to an integer between 1 and 100.

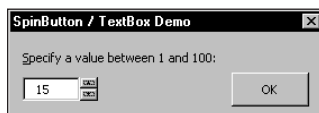


Figure 13-12: This SpinButton is paired with a TextBox.



This workbook is available on the companion CD-ROM.

The code required to “link” a SpinButton with a TextBox is relatively simple. It's basically a matter of writing event-handler procedures to ensure that the SpinButton's Value property is in sync with the TextBox's Text property.

The following procedure is executed whenever the SpinButton's Change event is triggered. That is, the procedure is executed when the user clicks the SpinButton, or changes its value by pressing the up arrow or down arrow.

```
Private Sub SpinButton1_Change()
    TextBox1.Text = SpinButton1.Value
End Sub
```

The procedure simply assigns the `SpinButton`'s `Value` to the `Text` property of the `TextBox` control. Here, the controls have their default names (`SpinButton1` and `TextBox1`). If the user enters a value directly into the `TextBox`, its `Change` event is triggered and the following procedure is executed:

```
Private Sub TextBox1_Change()
    NewVal = Val(TextBox1.Text)
    If NewVal >= SpinButton1.Min And _
        NewVal <= SpinButton1.Max Then _
        SpinButton1.Value = NewVal
End Sub
```

This procedure starts by using VBA's `Val` function to convert the text in the `TextBox` to a value (if the `TextBox` contains a string, the `Val` function returns 0). The next statement determines if the value is within the proper range for the `SpinButton`. If so, the `SpinButton`'s `Value` property is set to the value entered in the `TextBox`.

The example is set up so that clicking the OK button (which is named `OKButton`) transfers the `SpinButton`'s value to the active cell. The event-handler for this `CommandButton`'s `Click` event is as follows:

```
Private Sub OKButton_Click()
    ' Enter the value into the active cell
    If CStr(SpinButton1.Value) = TextBox1.Text Then
        ActiveCell = SpinButton1.Value
        Unload Me
    Else
        MsgBox "Invalid entry.", vbCritical
        TextBox1.SetFocus
        TextBox1.SelStart = 0
        TextBox1.SelLength = Len(TextBox1.Text)
    End If
End Sub
```

This procedure does one final check: It makes sure that the text entered in the `TextBox` matches the `SpinButton`'s value. This is necessary in the case of an invalid entry. For example, should the user enter **3r** into the `TextBox`, the `SpinButton`'s value would not be changed, and the result placed in the active cell would not be what the user intended. Notice that the `SpinButton`'s `Value` property is converted to a string using the `CStr` function. This ensures that the comparison will not generate an error if a value is compared to text. If the `SpinButton`'s value does not match the `TextBox`'s contents, a message box is displayed. Notice that the focus is set to the `TextBox` object, and the contents are selected (using the `SelStart` and `SelLength` properties). This makes it very easy for the user to correct the entry.

About the Tag Property

Every UserForm and control has a `Tag` property. This property doesn't represent anything specific, and, by default, is empty. You can use the `Tag` property to store information for your own use.

For example, you may have a series of `TextBox` controls in a UserForm. The user may be required to enter text into some, but not all of them. You can use the `Tag` property to identify (for your own use) which fields are required. In this case, you can set the `Tag` property to a string such as **Required**. Then when you write code to validate the user's entries, you can refer to the `Tag` property.

The following example is a function that examines all `TextBox` controls on `UserForm1` and returns the number of "required" `TextBox` controls that are empty:

```
Function EmptyCount()  
    Dim ctl As Control  
    EmptyCount= 0  
    For Each ctl In UserForm1.Controls  
        If TypeName(ctl) = "TextBox" Then  
            If ctl.Tag = "Required" Then  
                If ctl.Text = "" Then  
                    EmptyCount = EmptyCount + 1  
                End If  
            End If  
        End If  
    Next ctl  
End Function
```

As you work with UserForms, you will probably think of other uses for the `Tag` property.

Referencing UserForm Controls

When working with controls on a UserForm, the VBA code is usually contained in the code window for the UserForm. You can also refer to UserForm controls from a general VBA module. To do so, you need to *qualify* the reference to the control by specifying the UserForm name. For example, consider the following procedure, which is located in a VBA module. It simply displays the UserForm named `UserForm1`.

```
Sub GetData()  
    UserForm1.Show  
End Sub
```

Assume that `UserForm1` contains a text box (named `TextBox1`), and you want to provide a default value for the text box. You could modify the procedure as follows:

```
Sub GetData()  
    UserForm1.TextBox1.Value = "John Doe"  
    UserForm1.Show  
End Sub
```

Another way to set the default value is to take advantage of the UserForm's Initialize event. You can write code in the `UserForm_Initialize` procedure, which is located in the code module for the UserForm. Here's an example:

```
Private Sub UserForm_Initialize()  
    TextBox1.Value = "John Doe"  
End Sub
```

Notice that, when the control is referenced in the code module for the UserForm, there is no need to qualify the references with the UserForm name. However, qualifying references to controls does have an advantage: You will then be able to take advantage of the Auto List Members feature, which lets you choose the control names from a drop down list. Rather than use the actual name of the UserForm, it is preferable to use `Me`. Then, if you change the name of the UserForm, you will not need to replace the references in your code.

Understanding the Controls Collection

The controls on a UserForm comprise a collection. For example, the following statement displays the number of controls on `UserForm1`:

```
MsgBox UserForm1.Controls.Count
```

There is *not* a collection of each control type. For example, there is no collection of `CommandButton` controls. However, you can determine the type of control using the `TypeName` function. The following procedure uses a `For Each` structure to loop through the `Controls` collection, and then displays the number of `CommandButton` controls on `UserForm1`:

```
Sub CountButtons()  
    Dim cbCount As Integer  
    Dim ctl as Control  
    cbCount = 0  
    For Each ctl In UserForm1.Controls  
        If TypeName(ctl) = "CommandButton" Then _  
            cbCount = cbCount + 1  
    Next ctl  
    MsgBox cbCount  
End Sub
```

Customizing the Toolbox

When a UserForm is active in the VBE, the Toolbox displays the controls that you can add to the UserForm. This section describes ways to customize the Toolbox.

Changing icons or tip text

If you would prefer a different icon or different tip text for a particular tool, right-click the tool and select *Customize xxx* from the shortcut menu (where *xxx* is the control's name). This brings up a new dialog box that lets you change the Tool Tip Text, edit the icon, or load a new icon image from a file.

Adding new pages

The Toolbox, initially, contains a single tab. Right-click this tab and select *New Page* to add a new tab to the Toolbox. You can also change the text displayed on the tab by selecting *Rename* from the shortcut menu.

Customizing or combining controls

A very handy feature lets you customize a control and then save it for future use. You can, for instance, create a *CommandButton* control that's set up to serve as an OK button. For example, you can set the following properties: *Width*, *Height*, *Caption*, *Default*, and *Name*. Then drag the customized *CommandButton* to the Toolbox. This will create a new control. Right-click the new control to rename it or change its icon.

You can also create a new Toolbox entry that consists of multiple controls. For example, you can create two *CommandButtons* that represent a UserForm's OK and Cancel buttons. Customize them as you want and then select them both and drag them to the Toolbox. In this case, you can use this new Toolbox control to add two customized buttons in one fell swoop.

This also works with controls that act as containers. For example, create a *Frame* control and add four customized *OptionButtons*, neatly spaced and aligned. Then drag the *Frame* to the Toolbox to create a customized *Frame* control.



Tip

You might want to place your customized controls on a separate page in the Toolbox. This lets you export the entire page so you can share it with other Excel users. To export a Toolbox page, right-click the tab and select *Export Page*.



On the
CD-ROM

The companion CD-ROM contains a *.PAG* file that contains some customized controls. You can import this file as a new page in your Toolbox. Right-click a tab and select *Import Page*. Then locate the *.PAG* file. Your Toolbox will resemble Figure 13-13.

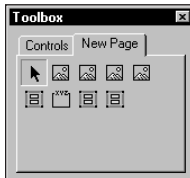


Figure 13-13: The Toolbox, with a new page of controls

Adding new ActiveX controls

UserForms can contain other ActiveX controls developed by Microsoft or other vendors. To add an additional ActiveX control to the toolbox, right-click the Toolbox and select Additional Controls. This will display the dialog box shown in Figure 13-14.

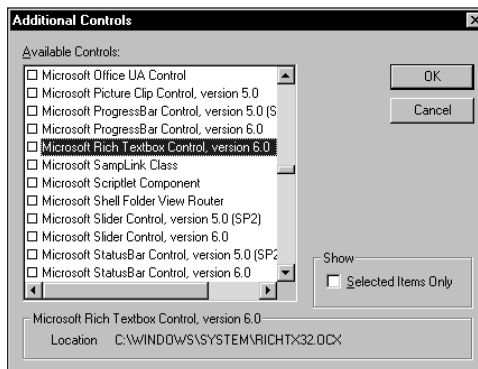


Figure 13-14: The Additional Controls dialog box lets you add other ActiveX controls.

The Additional Controls dialog box lists all ActiveX controls that are installed on your system. Select the control(s) that you want to add, then click OK to add an icon for each selected control.



Not all ActiveX controls that are installed on your system will work in Excel UserForms. In fact, most of them probably won't work. Also, some controls require a license in order to use them in an application. If you (or the users of your application) aren't licensed to use a particular control, an error will occur.

Emulating Excel's Dialog Boxes

The look and feel of Windows dialog boxes differ from program to program. When developing applications for Excel, it's best to try to mimic Excel's dialog box style whenever possible.

In fact, a good way to learn how to create effective dialog boxes is to try to copy one of Excel's dialog boxes down to the smallest detail. For example, make sure that you get all the hot keys defined and be sure that the tab order is the same. To re-create one of Excel's dialog boxes, you need to test it under various circumstances and see how it behaves. I guarantee that your analysis of Excel's dialog boxes will improve your own dialog boxes.

You will find that it's impossible to duplicate some of Excel's dialog boxes. For example, when you choose the Find All option in Excel 2002's Find and Replace dialog box, the dialog box becomes resizable. It is not possible to create a resizable UserForm.

Creating UserForm "Templates"

You might find that when you design a new UserForm, you tend to add the same controls each time. For example, every UserForm might have two CommandButtons that serve as OK and Cancel buttons. In the previous section, I described how to create a new control that combines these two (customized) buttons into a single control. Another option is to create your UserForm "template" and then export it so it can be imported into other projects. An advantage is that the event-handler code for the controls is stored with the template.

Start by creating a UserForm that contains all of the controls and customizations that you would need to re-use in other projects. Then make sure the UserForm is selected and choose File ⇨ Export File (or press Ctrl+E). You'll be prompted for a filename. Then when you start your next project, select File ⇨ Import File to load the saved UserForm.

A UserForm Checklist

Before you unleash a UserForm on end users, be sure that everything is working correctly. The following checklist should help you identify potential problems.

- ♦ Are similar controls the same size?
- ♦ Are the controls evenly spaced?
- ♦ Is the dialog box too overwhelming? If so, you may want to group the controls using a MultiPage control.

- ♦ Can every control be accessed with a hot key?
- ♦ Are any of the hot keys duplicated?
- ♦ Is the tab order set correctly?
- ♦ Will your VBA code take appropriate action if the user presses Esc or clicks the Close button on the UserForm?
- ♦ Are there any misspellings in the text?
- ♦ Does the dialog box have an appropriate caption?
- ♦ Will the dialog box display properly at all video resolutions? Sometimes labels that display properly with a high-resolution display will appear cut-off in VGA display mode.
- ♦ Are the controls grouped logically (by function)?
- ♦ Do ScrollBar and SpinButton controls allow valid values only?
- ♦ Are ListBoxes set properly (Single, Multi, or Extended)?

Summary

In this chapter, I introduced you to custom dialog boxes (UserForms) and provided an overview of the controls you can use in your dialog boxes. I also presented several examples, illustrating how to create UserForms and use them with VBA.

In the next chapter, I offer many more examples of VBA procedures and UserForms.



UserForm Examples

This chapter presents lots of useful and informative examples that introduce you to some additional techniques that involve UserForms. You may be able to adapt these techniques to your own work. All of the examples are available on the CD-ROM that accompanies this book.

Creating a UserForm “Menu”

Sometimes, you may want to use a UserForm as a type of menu. This section presents two ways to do this: using CommandButtons, or using a ListBox.

Using CommandButtons

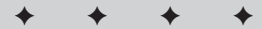
Figure 14-1 shows an example of a UserForm that uses CommandButton controls as a simple menu. Setting up this sort of thing is very easy, and the code behind the UserForm is very straightforward. Each CommandButton has its own event-handler procedure. For example, the following procedure is executed when CommandButton1 is clicked:

```
Private Sub CommandButton1_Click()  
    Call Macro1  
    Unload Me  
End Sub
```

This procedure simply calls Macro1 and closes the UserForm. The other buttons have similar event-handler procedures.

14

CHAPTER



In This Chapter

Using a UserForm for a simple menu

Selecting ranges from a UserForm

Using a UserForm as a splash screen

Changing the size of a UserForm while it's displayed

Zooming and scrolling a sheet from a UserForm

Understanding various techniques that involve a ListBox control

Using the MultiPage control

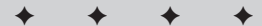




Figure 14-1: This dialog box uses CommandButtons as a menu.

Using a ListBox

Figure 14-2 shows another example that uses a ListBox as a menu. Before the UserForm is displayed, its Initialize event-handler procedure is called. This procedure, which follows, uses the AddItem method to add six items to the ListBox:

```
Private Sub UserForm_Initialize()
    With ListBox1
        .AddItem "Macro1"
        .AddItem "Macro2"
        .AddItem "Macro3"
        .AddItem "Macro4"
        .AddItem "Macro5"
        .AddItem "Macro6"
    End With
End Sub
```

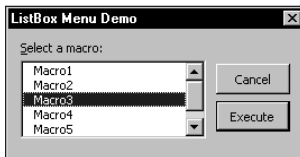


Figure 14-2: This dialog box uses a ListBox as a menu.

The Execute button also has a procedure to handle its click event:

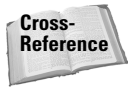
```
Private Sub ExecuteButton_Click()
    Select Case ListBox1.ListIndex
        Case -1
            MsgBox "Select a macro from the list."
            Exit Sub
        Case 0: Call Macro1
        Case 1: Call Macro2
        Case 2: Call Macro3
        Case 3: Call Macro4
```

```

        Case 4: Call Macro5
        Case 5: Call Macro6
    End Select
    Unload Me
End Sub

```

This procedure accesses the `ListIndex` property of the `ListBox` to determine which item is selected (if the `ListIndex` is `-1`, it means nothing is selected). Then the appropriate macro is executed.



Excel, of course, also lets you create “real” menus and toolbars. Refer to Chapters 22 and 23 for details.

Selecting Ranges

Several of Excel’s built-in dialog boxes allow the user to specify a range. For example, the Goal Seek dialog box asks the user to select two ranges. The user can either type the range name directly, or use the mouse to point and click in a sheet.

Your UserForms can also provide this type of functionality, thanks to the `RefEdit` control. The `RefEdit` control doesn’t look exactly like the range selection control used in Excel’s built-in dialogs, but it works the same. If the user clicks the small button on the right side of the control, the dialog box disappears temporarily and a small range selector is displayed (which is exactly what happens with Excel’s built-in dialog boxes).

Figure 14-3 shows a UserForm that contains a `RefEdit` control. This dialog box performs a simple mathematical operation on all nonformula (and nonempty) cells in the selected range. The operation that’s performed corresponds to the selected `OptionButton`.

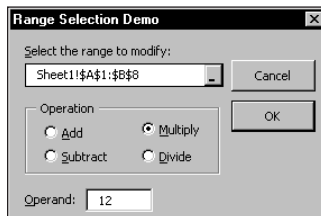


Figure 14-3: The `RefEdit` control shown here allows the user to select a range.

Following are a few things to keep in mind when using a `RefEdit` control:

- ♦ The `RefEdit` control returns a text string that represents a range address. You can convert this string to a `Range` object using a statement such as:

```
Set UserRange = Range(RefEdit1.Text)
```

- ◆ It's a good practice to initialize the RefEdit control to display the current range selection. You can do so in the `UserForm_Initialize` procedure using a statement such as:

```
RefEdit1.Text = ActiveWindow.RangeSelection.Address
```

- ◆ Don't assume that RefEdit will always return a valid range address. Pointing to a range isn't the only way get text into this control. The user can type any text, and edit or delete the displayed text. Therefore, you'll need to make sure the range is valid. The following code is an example of a way to check for a valid range. If an invalid range is detected, the user is given a message and focus is set to the RefEdit control so the user can try again.

```
On Error Resume Next
Set UserRange = Range(RefEdit1.Text)
If Err <> 0 Then
    MsgBox "Invalid range selected"
    RefEdit1.SetFocus
Exit Sub
End If
On Error GoTo 0
```

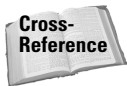
- ◆ The user can also click the worksheet tabs while selecting a range with the RefEdit control. Therefore, you can't assume that the selection will be on the active sheet. However, if a different sheet is selected, the range address will be preceded by a sheet name. For example:

```
Sheet2!$A$1:$C:4
```

- ◆ If you need to get a single cell selection from the user, you can pick out the upper left cell of a selected range by using a statement such as:

```
Set OneCell = Range(RefEdit1.Text).Range("A1")
```

As I discuss in Chapter 12, you can also use VBA's `InputBox` function to allow the user to select a range.



Creating a “Splash Screen”

Some developers like to display some introductory information when the application is opened. This is commonly known as a splash screen. You are undoubtedly familiar with Excel's splash screen, which appears for a few seconds as Excel is loading.

You can create a splash screen for your Excel application with a UserForm. This example is essentially a UserForm that is displayed automatically, and then dismisses itself after five seconds. Follow these instructions to create a splash screen for your project:

1. Create your workbook.
2. Activate the VBE and insert a new UserForm into the project. The code in this example assumes this form is named `UserForm1`.
3. Place any controls you like on `UserForm1`. For example, you may want to insert an Image control that has your company's logo. Figure 14-4 shows an example.

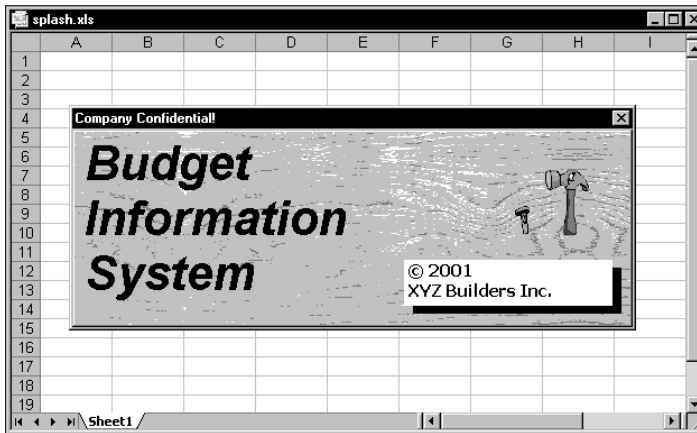


Figure 14-4: This splash screen is displayed briefly when the workbook is opened.

4. Insert the following procedure into the code module for the `ThisWorkbook` object:

```
Private Sub Workbook_Open()
    UserForm1.Show
End Sub
```

5. Insert the following procedure into the code module for `UserForm1` (this assumes a 5-second delay):

```
Private Sub UserForm_Activate()
    Application.OnTime Now + _
        TimeValue("00:00:05"), "KillTheForm"
End Sub
```

6. Insert the following procedure into a general VBA module:

```
Private Sub KillTheForm()
    Unload UserForm1
End Sub
```

When the workbook is opened, the `Workbook_Open` procedure is executed. This procedure displays the UserForm. At that time, its `Activate` event occurs, which triggers the `UserForm_Activate` procedure. This procedure uses the `OnTime` method of the `Application` object to execute a procedure named `KillTheForm` at a particular time. In this case, the time is five seconds after the activation event. The `KillTheForm` procedure simply unloads the UserForm.

7. As an option, you can add a small `CommandButton` named `CancelButton`, set its `Cancel` property to `True`, and insert the following event-handler procedure in the UserForm's code module:

```
Private Sub CancelButton_Click()  
    KillTheForm  
End Sub
```

Doing so lets the user cancel the splash screen before the time has expired by pressing `Esc`. You can stash this small button behind another object so it won't be visible.



Keep in mind that the splash screen is not displayed until the workbook is entirely loaded. In other words, if you would like to display the splash screen to give the user something to look at while the workbook is loading, this technique won't fill the bill.

Disabling a UserForm's Close Button

When a UserForm is displayed, clicking the `Close` button (the `X` in the upper right corner) will unload the form. You might have a situation in which you don't want this to happen. For example, you may require that the UserForm be closed only by clicking a particular `CommandButton`.

Although you can't actually disable the `Close` button, you can prevent the user from closing a UserForm by clicking it. You can do so by monitoring the UserForm's `QueryClose` event.

The following procedure, which is located in the code module for the UserForm, is executed before the form is closed (that is, when the `QueryClose` event occurs):

```
Private Sub UserForm_QueryClose _  
    (Cancel As Integer, CloseMode As Integer)  
    If CloseMode = vbFormControlMenu Then  
        MsgBox "Click the OK button to close the form."  
        Cancel = True  
    End If  
End Sub
```

The `UserForm_QueryClose` procedure uses two arguments. The `CloseMode` argument contains a value that indicates the cause of the `QueryClose` event. If `CloseMode` is equal to `vbFormControlMenu` (a built-in constant), that means the user clicked the Close button. In such a case a message is displayed, the `Cancel` argument is set to `True`, and the form is not actually closed.

Note

Keep in mind that a user can press `Ctrl+Break` to break out of the macro. In this example, pressing `Ctrl+Break` while the UserForm is displayed will cause the UserForm to be dismissed. To prevent this from happening, execute the following statement prior to displaying the UserForm:

```
Application.EnableCancelKey = xlDisabled
```

Make sure your application is debugged before you add this statement. Otherwise, you'll find that it's impossible to break out of an accidental endless loop.

Changing a Dialog Box's Size

Many applications use dialog boxes that change their own size. For example, Excel's AutoFormat dialog box (displayed when you select `Format ⇄ AutoFormat`) increases its height when the user clicks the Options button.

This example demonstrates how to get a UserForm to change its size dynamically. Changing a dialog box's size is done by altering the `Width` or `Height` property of the UserForm object.

Figure 14-5 shows the dialog box as it is first displayed, and Figure 14-6 shows it after the user clicks the Options button. Notice that the button's caption changes, depending on the size of the UserForm.

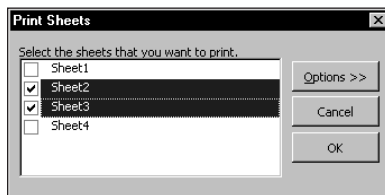


Figure 14-5: A sample dialog box in its standard mode

As you're creating the UserForm, set it to its largest size to enable you to work with the controls. Then use the `UserForm_Initialize` procedure to set it to its default (smaller) size.

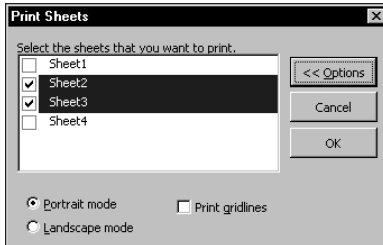


Figure 14-6: The same dialog box enlarged to show some options

This example displays a list of worksheets in the active workbook, and lets the user select which sheets to print. Following is the event-handler that's executed when the CommandButton named `OptionsButton` is clicked:

```
Private Sub OptionsButton_Click()
    If OptionsButton.Caption = "Options >>" Then
        Me.Height = 164
        OptionsButton.Caption = "<< Options"
    Else
        Me.Height = 128
        OptionsButton.Caption = "Options >>"
    End If
End Sub
```

This procedure examines the `Caption` of the `CommandButton`, and sets the `UserForm`'s `Height` property accordingly.

Note

When controls are not displayed because they are outside of the visible portion of the `UserForm`, the accelerator keys for such controls continue to function. In this example, the user can press the `Alt+L` hot key (to select the `Landscape mode` option) even if that option is not visible. To block access to nondisplayed controls, you can write code to disable the controls when they are not displayed.

Zooming and Scrolling a Sheet from a UserForm

When you display a dialog box, it's often helpful if the user can scroll through the worksheet to examine various ranges. Normally, this is impossible while a dialog box is displayed.

Note

Beginning with Excel 2000, a UserForm can be “modeless.” This means that the user doesn’t have to dismiss the dialog box before activating the workbook and doing other work in Excel. The `Show` method of the UserForm object defaults to displaying the form modally. To display a modeless dialog box, use an instruction such as:

```
UserForm1.Show vbModeless
```

The example in this section demonstrates how to use ScrollBar controls to allow sheet scrolling and zooming while a dialog box is displayed. Figure 14-7 shows how the example dialog box is set up. When the UserForm is displayed, the user can adjust the worksheet’s zoom factor (from 10% to 400% by using the ScrollBar at the top). The two ScrollBars in the bottom section of the dialog box allow the user to scroll the worksheet horizontally or vertically.

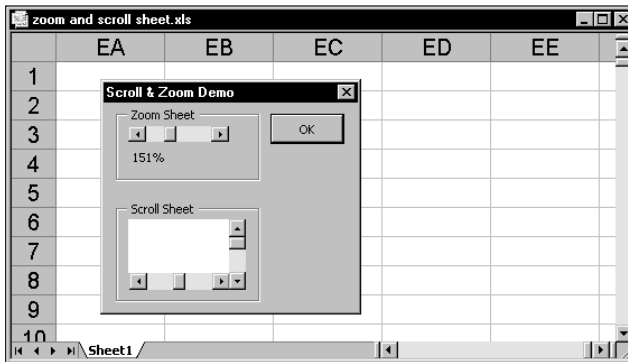


Figure 14-7: Here, ScrollBar controls allow zooming and scrolling of the worksheet.

If you look at the code for this example, you’ll see that it’s remarkably simple. The controls are initialized in the `UserForm_Initialize` procedure, which follows:

```
Private Sub UserForm_Initialize()
    LabelZoom.Caption = ActiveWindow.Zoom
    ' Zoom
    With ScrollBarZoom
        .Min = 10
        .Max = 400
        .SmallChange = 1
        .LargeChange = 10
        .Value = ActiveWindow.Zoom
    End With

    ' Horizontally scrolling
    With ScrollBarColumns
```

```

        .Min = 1
        .Max = 256
        .Value = ActiveWindow.ScrollColumn
        .LargeChange = 25
        .SmallChange = 1
    End With

    ' Vertically scrolling
    With ScrollBarRows
        .Min = 1
        .Max = ActiveSheet.Rows.Count
        .Value = ActiveWindow.ScrollRow
        .LargeChange = 25
        .SmallChange = 1
    End With
End Sub

```

This procedure sets various properties of the ScrollBar controls using values based on the active window.

When the ScrollBarZoom control is used, the ScrollBarZoom_Change procedure (which follows) is executed. This procedure sets the ScrollBar control's Value to the ActiveWindow's Zoom property value. It also changes a label to display the current zoom factor.

```

Private Sub ScrollBarZoom_Change()
    With ActiveWindow
        .Zoom = ScrollBarZoom.Value
        LabelZoom = .Zoom & "%"
    End With
End Sub

```

Worksheet scrolling is accomplished by the two procedures that follow. These procedures set the ScrollRow or ScrollColumns property of the ActiveWindow object equal to the appropriate ScrollBar control value.

```

Private Sub ScrollBarColumns_Change()
    ActiveWindow.ScrollColumn = ScrollBarColumns.Value
End Sub

Private Sub ScrollBarRows_Change()
    ActiveWindow.ScrollRow = ScrollBarRows.Value
End Sub

```

ListBox Techniques

The ListBox control is extremely versatile, but it can be a bit tricky to work with. This section consists of a number of simple examples that demonstrate common techniques that involve the ListBox control.

Note

In most cases, the techniques described in this section also work with a ComboBox control.

About the ListBox control

Following are a few points to keep in mind when working with ListBox controls. Examples in the sections that follow demonstrate many of these points.

- ♦ The items in a ListBox can be retrieved from a range of cells (specified by the `RowSource` property), or they can be added using VBA code (using the `AddItem` method).
- ♦ A ListBox can be set up to allow a single selection or a multiple selection. This is determined by the `MultiSelect` property.
- ♦ If a ListBox is not set up for a multiple selection, the value of the ListBox can be linked to a worksheet cell by using the `ControlSource` property.
- ♦ It's possible to display a ListBox with no items selected (the `ListIndex` property will be `-1`). However, once an item is selected, it's not possible for the user to unselect all items.
- ♦ A ListBox can contain multiple columns (controlled by the `ColumnCount` property), and even a descriptive header (controlled by the `ColumnHeads` property).
- ♦ The vertical height of a ListBox displayed in a UserForm window isn't always the same as the vertical height when the UserForm is actually displayed.
- ♦ The items in a ListBox can be displayed as check boxes if multiple selection is allowed, or as option buttons if a single selection is allowed. This is controlled by the `ListStyle` property.

Note

For complete details on the properties and methods for a ListBox control, consult the online help.

Adding items to a ListBox control

Before displaying a UserForm that uses a ListBox control, you'll probably need to fill the ListBox with items. You can fill a ListBox at design time using items stored in a worksheet range, or at runtime using VBA to add the items to the ListBox.

The two examples in this section presume that:

- ♦ You have a UserForm named `UserForm1`.
- ♦ This UserForm contains a ListBox control named `ListBox1`.
- ♦ The workbook contains a sheet named `Sheet1`, and range `A1:A12` contains the items to be displayed in the ListBox.

Adding items to a ListBox at design time

To add items to a ListBox at design time, the ListBox items must be stored in a worksheet range. Use the `RowSource` property to specify the range that contains the ListBox items. Figure 14-8 shows the Properties window for a ListBox control. The `RowSource` property is set to `Sheet1!A1:A12`. When the UserForm is displayed, the ListBox will contain the 12 items in this range. The items appear in the ListBox at design time, as soon as you specify the range for the `RowSource` property.



Caution

Make sure that you include the worksheet name when you specify the `RowSource` property; otherwise, the ListBox will use the specified range on the active worksheet. In some cases, you may need to fully qualify the range by including the workbook name. For example: `[Book1.xls]Sheet1!A1:A12`

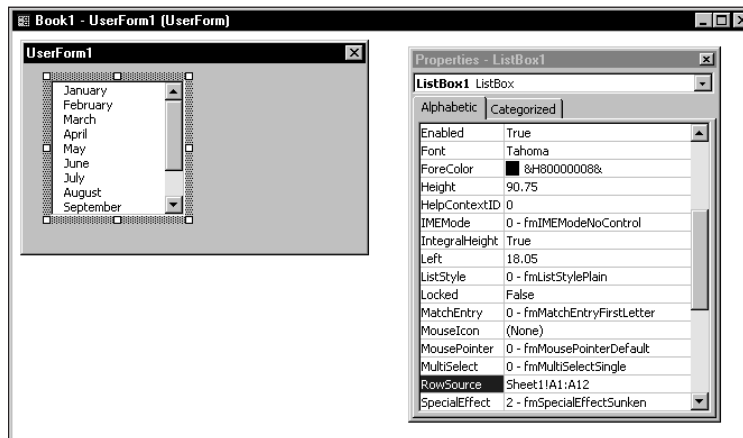


Figure 14-8: Setting the `RowSource` property at design time

Adding items to a ListBox at runtime

To add ListBox items at runtime, you have two choices:

- ♦ Set the `RowSource` property to a range address using code.
- ♦ Write code that uses the `AddItem` method to add the ListBox items.

As you might expect, you can set the `RowSource` property via code rather than with the Properties window. For example, the following procedure sets the `RowSource` property for a ListBox before displaying the UserForm. In this case, the items consist of the cell entries in a range named `Categories` on the `Budget` worksheet.

```
UserForm1.ListBox1.RowSource = "Budget!Categories"
UserForm1.Show
```


If the `ListBox` items are not contained in a worksheet range, you can write VBA code to fill the `ListBox` before the dialog box appears. The procedure fills the `ListBox` with the names of the months using the `AddItem` method.

```
Sub ShowUserForm2()  
    ' Fill the list box  
    With UserForm2.ListBox1  
        .RowSource=""  
        .AddItem "January"  
        .AddItem "February"  
        .AddItem "March"  
        .AddItem "April"  
        .AddItem "May"  
        .AddItem "June"  
        .AddItem "July"  
        .AddItem "August"  
        .AddItem "September"  
        .AddItem "October"  
        .AddItem "November"  
        .AddItem "December"  
    End With  
    UserForm2.Show  
End Sub
```



In the preceding code, notice that I set the `RowSource` property to an empty string. This is to avoid a potential error that occurs if the Properties window has a nonempty `RowSource` setting. If you try to add items to a `ListBox` that has a non-null `RowSource` setting, you'll get a "permission denied" error.

You can also use the `AddItem` method to retrieve `ListBox` items from a range. Here's an example that fills a `ListBox` with the contents of A1:A12 on Sheet1.

```
For Row = 1 To 12  
    UserForm1.ListBox1.AddItem Sheets("Sheet1").Cells(Row, 1)  
Next Row
```

If your data is stored in a one-dimensional array, you can assign the array to the `ListBox` with a single instruction. For example, assume you have an array named `dData` that contains 50 elements. The following statement will create a 50-item list in `ListBox1`:

```
ListBox1.List = dData
```

Adding only unique items to a ListBox

In some cases, you may need to fill a `ListBox` with unique (nonduplicated) items from a list. For example, assume you have a worksheet that contains customer data. One of the columns might contain the state (see Figure 14-9). You would like to fill a `ListBox` with the state name of your customers, but you don't want to include duplicate state names.

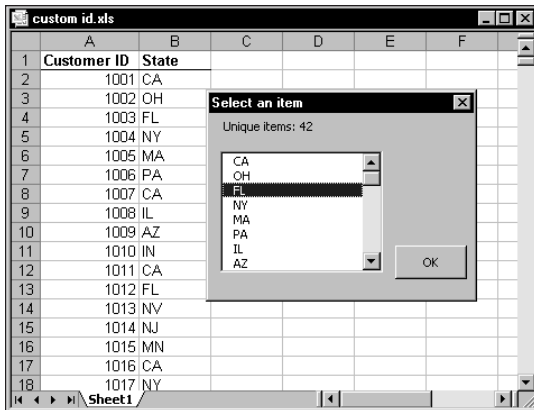


Figure 14-9: A Collection object is used to fill a ListBox with the unique items from Column B.

One technique involves using a Collection object. You can add items to a Collection object with the following syntax:

```
object.Add item, key, before, after
```

The *key* argument, if used, must be a unique text string that specifies a separate key that can be used to access a member of the collection. The important word here is *unique*. If you attempt to add a nonunique key to a collection, an error occurs and the item is not added. We can take advantage of this situation and use it to create a collection that consists only of unique items.

The following procedure demonstrates. It starts by declaring a new Collection object named `NoDuples`. It assumes that a range named `Data` contains a list of items, some of which may be duplicated.

The code loops through the cells in the range and attempts to add the cell's value to the `NoDuples` collection. It also uses the cell's value (converted to a string) for the *key* argument. Using the `On Error Resume Next` statement causes VBA to ignore the error that occurs if the key is not unique. When an error occurs, the item is not added to the collection—which is just what we want. The procedure then transfers the items in the `NoDuples` collection to the ListBox. The UserForm also contains a label that displays the number of unique items.

```
Sub RemoveDuplicates1()
    Dim AllCells As Range, Cell As Range
    Dim NoDuples As New Collection

    On Error Resume Next
    For Each Cell In Range("Data")
        NoDuples.Add Cell.Value, CStr(Cell.Value)
```

```
Next Cell
On Error GoTo 0

' Add the non-duplicated items to a ListBox
For Each Item In NoDupes
    UserForm1.ListBox1.AddItem Item
Next Item

' Display the count
UserForm1.Label1.Caption = _
    "Unique items: " & NoDupes.Count

' Show the UserForm
UserForm1.Show
End Sub
```



A slightly more sophisticated version of this example is available on the CD-ROM.

Determining the selected item

The examples in preceding sections merely display a UserForm with a ListBox filled with various items. These procedures omit a key point: how to determine which item or items were selected by the user.

A small icon of a notepad with the word "Note" written on it.**Note**

This discussion assumes a “single selection” ListBox object—one whose `MultiSelect` property is set to 0.

To determine which item was selected, access the ListBox’s `Value` property. The statement that follows, for example, displays the text of the selected item in `ListBox1`.

```
MsgBox ListBox1.Value
```

If no item is selected, this statement will generate an error.

If you need to know the position of the selected item in the list (rather than the content of that item) you can access the ListBox’s `ListIndex` property. The following example uses a message box to display the item number of the selected ListBox item:

```
MsgBox "You selected item #" & ListBox1.ListIndex
```

If no item is selected, the `ListIndex` property will return -1.

A small icon of a notepad with the word "Note" written on it.**Note**

The numbering of items in a ListBox begins with 0, not 1. Therefore, the `ListIndex` of the first item is 0, and the `ListIndex` of the last item is equivalent to the value of the `ListCount` property minus 1.

Determining multiple selections

Normally, a `ListBox`'s `MultiSelect` property is 0, which means that the user can select only one item in the `ListBox`.

If the `ListBox` allows multiple selections (that is, if its `MultiSelect` property is either 1 or 2), trying to access the `ListIndex` or `Value` properties will result in an error. Instead, you need to use the `Selected` property, which returns an array whose first item has an index of 0. For example, the following statement displays `True` if the first item in the `ListBox` list is selected:

```
MsgBox ListBox1.Selected(0)
```



The companion CD-ROM contains a workbook that demonstrates how to identify the selected item(s) in a `ListBox`. It works for single-selection and multiple-selection `ListBoxes`.

The following code, from the example workbook on the CD-ROM, loops through each item in the `ListBox`. If the item was selected, it appends the item's text to a variable called `Msg`. Finally, the names of all the selected items are displayed in a message box.

```
Private Sub OKButton_Click()  
    Msg = ""  
    For i = 0 To ListBox1.ListCount - 1  
        If ListBox1.Selected(i) Then _  
            Msg = Msg & ListBox1.List(i) & vbCrLf  
    Next i  
    MsgBox "You selected: " & vbCrLf & Msg  
    Unload Me  
End Sub
```

Figure 14-10 shows the result when multiple `ListBox` items are selected.

Multiple lists in a single ListBox

This example demonstrates how to create a `ListBox` in which the contents change depending on the user's selection from a group of `OptionButtons`.

Figure 14-11 shows the sample UserForm. The `ListBox` gets its items from a worksheet range. The procedures that handle the `Click` event for the `OptionButton` controls simply sets the `ListBox`'s `RowSource` property to a different range. One of these procedures follows:

```
Private Sub obMonths_Click()  
    ListBox1.RowSource = "Sheet1!Months"  
End Sub
```

Clicking the `OptionButton` named `obMonths` changes the `RowSource` property of the `ListBox` to use a range named `Months` on `Sheet1`.

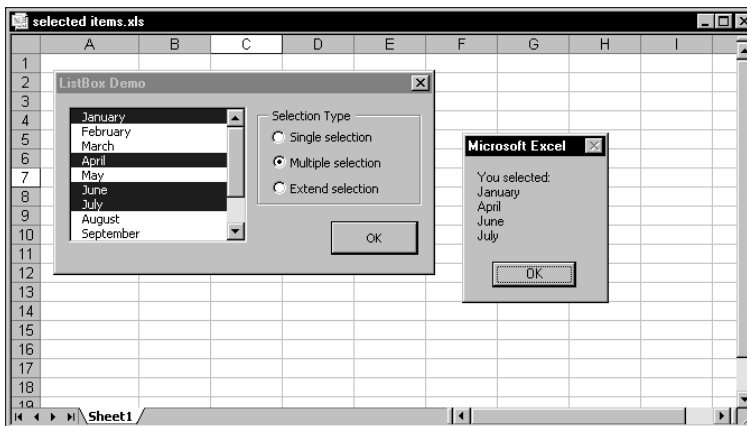


Figure 14-10: This message box displays a list of items selected in a ListBox.

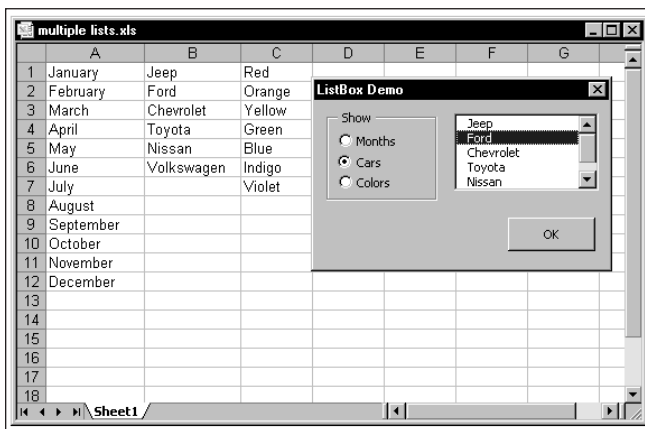


Figure 14-11: The contents of this ListBox depend on the OptionButton selected.

ListBox item transfer

Some applications require a user to select several items from a list. It's often useful to create a new list of the selected items. For an example of this situation, check out the Attach Toolbars dialog box that appears when you click the Attach button in the Customize dialog box (which appears when you choose View ⇨ Toolbars ⇨ Customize).

Figure 14-12 shows a dialog box with two ListBoxes. The Add button adds the item selected in the left ListBox to the right ListBox. The Delete button removes the selected item from the list on the right. A check box determines the behavior when

a duplicate item is added to the list. If the Allow duplicates check box is not checked, a message box appears if the user attempts to add an item that's already on the list.

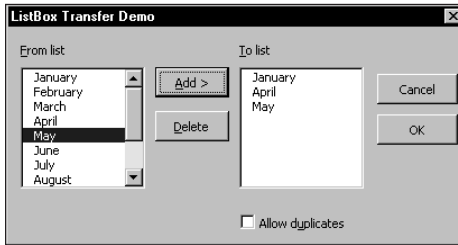


Figure 14-12: Building a list from another list

The code for this example is relatively simple. Here's the procedure that is executed when the user clicks the Add button:

```
Private Sub AddButton_Click()
    If ListBox1.ListIndex = -1 Then Exit Sub
    If Not cbDuplications Then
        ' See if item already exists
        For i = 0 To ListBox2.ListCount - 1
            If ListBox1.Value = ListBox2.List(i) Then
                Beep
                Exit Sub
            End If
        Next i
    End If
    ListBox2.AddItem ListBox1.Value
End Sub
```

The code for the Delete button is even simpler:

```
Private Sub DeleteButton_Click()
    If ListBox2.ListIndex = -1 Then Exit Sub
    ListBox2.RemoveItem ListBox2.ListIndex
End Sub
```

Notice that both of these routines check to make sure that an item is actually selected. If the `ListBox`'s `ListIndex` property is `-1`, no items are selected and the procedure ends.

Moving items in a ListBox

The example in this section demonstrates how to allow the user to move items up or down in a `ListBox`. The VBE uses this type of technique to let you control the tab order of the items in a UserForm.

Figure 14-13 shows a dialog box that contains a ListBox and two CommandButtons. Clicking the Move Up button moves the selected item up in the ListBox; clicking the Move Down button moves the selected item down.



Figure 14-13: The buttons allow the user to move items up or down in the ListBox.

The event-handler procedures for the two CommandButtons follow:

```
Private Sub MoveUpButton_Click()
    If ListBox1.ListIndex <= 0 Then Exit Sub
    NumItems = ListBox1.ListCount
    Dim TempList()
    ReDim TempList(0 To NumItems - 1)
    ' Fill array with list box items
    For i = 0 To NumItems - 1
        TempList(i) = ListBox1.List(i)
    Next i
    ' Selected item
    ItemNum = ListBox1.ListIndex
    ' Exchange items
    TempItem = TempList(ItemNum)
    TempList(ItemNum) = TempList(ItemNum - 1)
    TempList(ItemNum - 1) = TempItem
    ListBox1.List = TempList
    ' Change the list index
    ListBox1.ListIndex = ItemNum - 1
End Sub

Private Sub MoveDownButton_Click()
    If ListBox1.ListIndex = ListBox1.ListCount - 1 Then Exit
Sub
    NumItems = ListBox1.ListCount
    Dim TempList()
    ReDim TempList(0 To NumItems - 1)
    ' Fill array with list box items
    For i = 0 To NumItems - 1
        TempList(i) = ListBox1.List(i)
    Next i
    ' Selected item
    ItemNum = ListBox1.ListIndex
    ' Exchange items
    TempItem = TempList(ItemNum)
```

```

    TempList(ItemNum) = TempList(ItemNum + 1)
    TempList(ItemNum + 1) = TempItem
    ListBox1.List = TempList
    ' Change the list index
    ListBox1.ListIndex = ItemNum + 1
End Sub

```

These procedures work fairly well, but you'll find that for some reason, relatively rapid clicking doesn't always register. For example, you may click the Move Down button three times in quick succession, but the item only moves one or two positions. The solution is to add a new `Db1Click` event-handler for each `CommandButton`. These procedures, which simply call the `Click` procedures, are as follows:

```

Private Sub MoveUpButton_Db1Click _
    (ByVal Cancel As MSForms.ReturnBoolean)
    Call MoveUpButton_Click
End Sub

Private Sub MoveDownButton_Db1Click _
    (ByVal Cancel As MSForms.ReturnBoolean)
    Call MoveDownButton_Click
End Sub

```

Working with multicolumn ListBox controls

A normal `ListBox` has a single column for its contained items. You can, however, create a `ListBox` that displays multiple columns and, optionally, column headers. Figure 14-14 shows an example of a multicolumn `ListBox` that gets its data from a worksheet range.

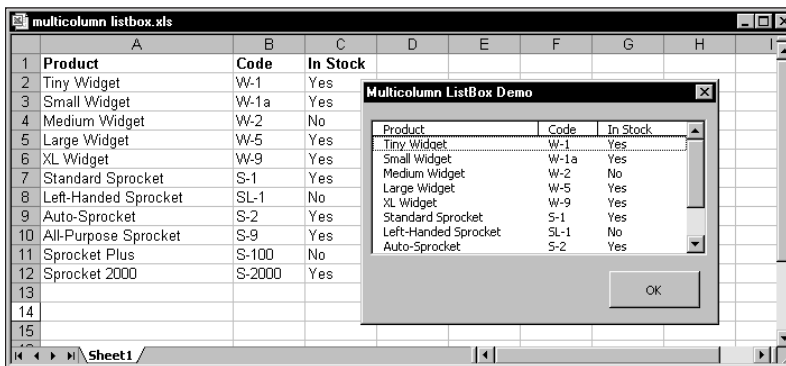


Figure 14-14: This `ListBox` displays a three-column list, with column headers.

To set up a multicolumn ListBox that uses data stored in a worksheet range:

1. Make sure the ListBox's `ColumnCount` property is set to the correct number of columns.
2. Specify the correct multicolumn range in the Excel worksheet as the ListBox's `RowSource` property.
3. If you want to display column heads like the ListBox in Figure 14-14, set the `ColumnHeads` property to `True`. Do not include the column headings on the worksheet in the range setting for the `RowSource` property. VBA will instead automatically use the row directly above the first row of the `RowSource` range.
4. Adjust the column widths by assigning a series of values, specified in points (1/72 of one inch) separated by semicolons, to the `ColumnWidths` property. For example, for a three-column list box, the `ColumnWidths` property might be set to the following text string:
100;40;30
5. Specify the appropriate column as the `BoundColumn` property. The bound column specifies which column is referenced when an instruction polls the ListBox's `Value` property.

To fill a ListBox with multicolumn data without using a range, you first create a two-dimensional array, and then assign the array to the ListBox's `List` property. The following statements demonstrate, using a 12 row by 2 column array named `Data`. The two-column ListBox shows the month names in column 1, and the number of the days in the month in column 2 (see Figure 14-15). Notice that the procedure sets the `ColumnCount` property to 2.

```
Private Sub UserForm_Initialize()  
    ' Fill the list box  
    Dim Data(1 To 12, 1 To 2)  
    For i = 1 To 12  
        Data(i, 1) = Format(DateSerial(2001, i, 1), "mmm")  
    Next i  
    For i = 1 To 12  
        Data(i, 2) = Day(DateSerial(2001, i + 1, 1) - 1)  
    Next i  
    ListBox1.ColumnCount = 2  
    ListBox1.List = Data  
End Sub
```

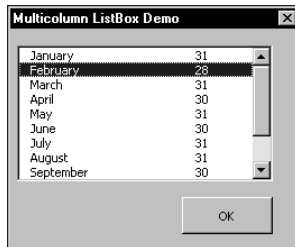


Figure 14-15: A two-column ListBox, filled with data stored in an array

Note

There appears to be no way to specify column headers for the `ColumnHeads` property when the list source is a VBA array.

Using a ListBox to select worksheet rows

The example in this section is actually a useful utility. It displays a ListBox that consists of the entire used range of the active worksheet (see Figure 14-16). The user can select multiple items in the ListBox. Clicking the All button selects all items, and clicking the None button deselects all items. Clicking OK selects those corresponding rows in the worksheet. You can, of course, select multiple noncontiguous rows directly in the worksheet by pressing Ctrl as you click the row borders. However, you may find that selecting rows is easier using this method.

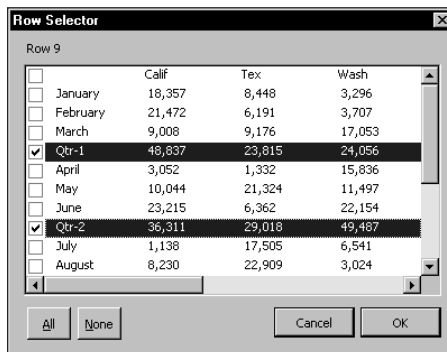


Figure 14-16: This ListBox makes it easy to select rows in a worksheet.

Selecting multiple items is possible because the ListBox's `MultiSelect` property is set to `1 - fmMultiSelectMulti`. The “check boxes” on each item are displayed because the ListBox's `ListStyle` property is set to `1 - fmListStyleOption`.

The `UserForm`'s `Initialize` procedure follows. This procedure creates a `Range` object named `rng` that consists of the active sheet's used range. Additional code sets the `ListBox`'s `ColumnCount` and `RowSource` properties, and adjusts the `ColumnWidths` property such that the `ListBox` columns are proportional to the column widths in the worksheet.

```
Private Sub UserForm_Initialize()
    ColCnt = ActiveSheet.UsedRange.Columns.Count
    Set rng = ActiveSheet.UsedRange
    With ListBox1
        .ColumnCount = ColCnt
        .RowSource = rng.Address
        cw = ""
        For c = 1 To .ColumnCount
            cw = cw & rng.Columns(c).Width & ";"
        Next c
        .ColumnWidths = cw
        .ListIndex = 0
    End With
End Sub
```

The `All` and `None` buttons (named `SelectAllButton` and `SelectNoneButton`, respectively) have simple event-handler procedures, and are as follows:

```
Private Sub SelectAllButton_Click()
    For r = 0 To ListBox1.ListCount - 1
        ListBox1.Selected(r) = True
    Next r
End Sub

Private Sub SelectNoneButton_Click()
    For r = 0 To ListBox1.ListCount - 1
        ListBox1.Selected(r) = False
    Next r
End Sub
```

The `OKButton_Click` procedure follows. This procedure creates a `Range` object named `RowRange` that consists of the rows that correspond to the selected items in the `ListBox`. To determine if a row was selected, the code examines the `Selected` property of the `ListBox` control. Notice that it uses the `Union` function to add additional ranges to the `RowRange` object.

```
Private Sub OKButton_Click()
    Dim RowRange As Range
    RowCnt = 0
    For r = 0 To ListBox1.ListCount - 1
        If ListBox1.Selected(r) Then
            RowCnt = RowCnt + 1
            If RowCnt = 1 Then
                Set RowRange = ActiveSheet.Rows(r + 1)
            End If
        End If
    Next r
End Sub
```

```

Else
    Set RowRange = _
        Union(RowRange, ActiveSheet.Rows(r + 1))
End If
End If
Next r
If Not RowRange Is Nothing Then RowRange.Select
Unload Me
End Sub

```

Using a ListBox to activate to a sheet

The example in this section is just as useful as it is instructive. This example uses a multicolumn ListBox to display a list of sheets within the active workbook. The columns represent:

- ♦ The sheet's name
- ♦ The type of sheet (worksheet, chart, or Excel 5/95 dialog sheet)
- ♦ The number of nonempty cells in the sheet
- ♦ Whether the sheet is visible

Figure 14-17 shows an example of the dialog box.

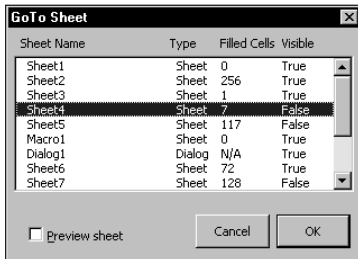


Figure 14-17: This dialog box lets the user activate a sheet.

The code in the `UserForm_Initialize` procedure (which follows) creates a two-dimensional array, and collects the information by looping through the sheets in the active workbook. It then transfers this array to the `ListBox`.

```

Private Sub UserForm_Initialize()
    Dim SheetData() As String
    Set OriginalSheet = ActiveSheet
    ShtCnt = ActiveWorkbook.Sheets.Count
    ReDim SheetData(1 To ShtCnt, 1 To 4)
    ShtNum = 1
    For Each Sht In ActiveWorkbook.Sheets

```

```

If Sht.Name = ActiveSheet.Name Then _
    ListPos = ShtNum - 1
SheetData(ShtNum, 1) = Sht.Name
Select Case TypeName(Sht)
    Case "Worksheet"
        SheetData(ShtNum, 2) = "Sheet"
        SheetData(ShtNum, 3) = _
            Application.CountA(Sht.Cells)
    Case "Chart"
        SheetData(ShtNum, 2) = "Chart"
        SheetData(ShtNum, 3) = "N/A"
    Case "DialogSheet"
        SheetData(ShtNum, 2) = "Dialog"
        SheetData(ShtNum, 3) = "N/A"
End Select
If Sht.Visible Then
    SheetData(ShtNum, 4) = "True"
Else
    SheetData(ShtNum, 4) = "False"
End If
ShtNum = ShtNum + 1
Next Sht
With ListBox1
    .ColumnWidths = "100 pt;30 pt;40 pt;50 pt"
    .List = SheetData
    .ListIndex = ListPos
End With
End Sub

```

The `ListBox1_Click` procedure follows:

```

Private Sub ListBox1_Click()
    If cbPreview Then _
        Sheets(ListBox1.Value).Activate
End Sub

```

The value of the `CheckBox` control (named `cbPreview`) determines whether the selected sheet is previewed when the user clicks an item in the `ListBox`.

Clicking the `OK` button (named `OKButton`) executes the `OKButton_Click` procedure, which follows:

```

Private Sub OKButton_Click()
    Dim UserSheet As Object
    Set UserSheet = Sheets(ListBox1.Value)
    If UserSheet.Visible Then
        UserSheet.Activate
    Else
        If MsgBox("Unhide sheet?", _
            vbQuestion + vbYesNoCancel) = vbYes Then
            UserSheet.Visible = True
            UserSheet.Activate
        Else

```

```

        OriginalSheet.Activate
    End If
End If
Unload Me
End Sub

```

The `OKButton_Click` procedure creates an object variable that represents the selected sheet. If the sheet is visible, it is activated. If it's not visible, the user is presented with a message box asking if it should be unhidden. If the user responds in the affirmative, the sheet is unhidden and activated. Otherwise, the original sheet (stored in an object variable named `OriginalSheet`) is activated.

Double-clicking an item in the `ListBox` has the same result as clicking the OK button. The `ListBox1_DblClick` procedure, which follows, simply calls the `OKButton_Click` procedure.

```

Private Sub ListBox1_DblClick(ByVal Cancel As
MSForms.ReturnBoolean)
    Call OKButton_Click
End Sub

```

Using the MultiPage Control

The `MultiPage` control is very useful for `UserForms` that must display many controls. The `MultiPage` control lets you group the choices, and place each group on a separate tab.

Figure 14-18 shows several examples of a `UserForm` that contains a `MultiPage` control. In this case, the control has three pages, each with its own tab. As you can see, the `MultiPage` control is very versatile, giving you a great deal of control over its appearance and functionality. The figure shows the result of the four settings for the `MultiPage`'s `TabOrientation` property.



Note

The `Toolbox` also contains a control named `TabStrip`. As far as I can tell, the `MultiPage` control is much more versatile, and I can't think of a single reason to use the `TabStrip` control.

Using a `MultiPage` control can be a bit tricky. The following are some things to keep in mind when using this control:

- ♦ The tab (or page) that's displayed up front is determined by the control's `Value` function. A value of 0 displays the first tab, a value of 1 displays the second tab, and so on.
- ♦ By default, a `MultiPage` control has two pages. To add a new page in the `VBE`, right-click a tab and select `New Page` from the shortcut menu.

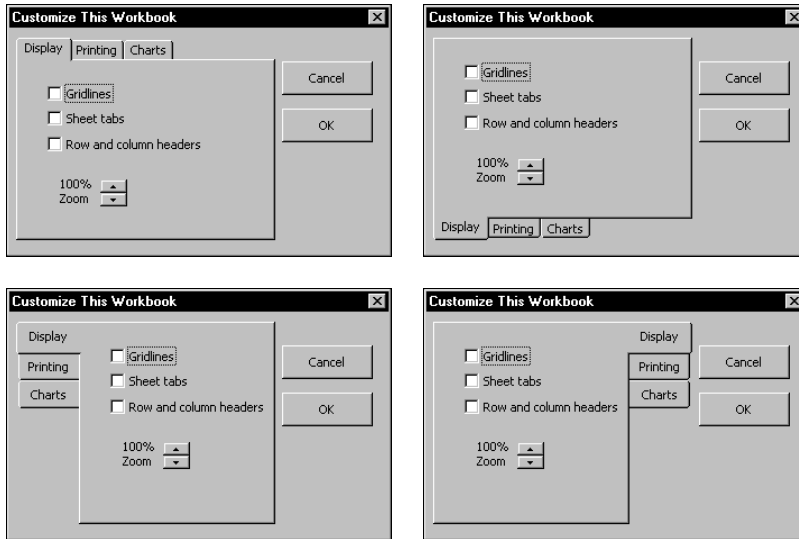


Figure 14-18: MultiPage groups your controls on pages, making them accessible from a tab.

- ♦ When you're working with a MultiPage control, just click a tab to set the properties for that particular page. The Properties window will display the properties that you can adjust.
- ♦ You may find it difficult to select the actual MultiPage control, because clicking the control selects a page within the control. To select the control itself, click its border. Or, you can use the Tab key to cycle among all the controls. Yet another option is to select the MultiPage control from the drop-down list in the Properties window.
- ♦ If your MultiPage control has lots of tabs, you can set its `MultiRow` property to True to display the tabs in more than one row.
- ♦ If you prefer, you can display buttons instead of tabs. Just change the `Style` property to 1. If the `Style` property value is 2, the MultiPage control won't display tabs or buttons.
- ♦ The `TabOrientation` property determines the location of the tabs on the MultiPage control. Figure 14-18 shows the result of each of the four `TabOrientation` property settings.
- ♦ For each page, you can set a transition effect by changing the `TransitionEffect` property. For example, clicking a tab can cause the new page to “push” the former page out of the way. Use the `TransitionPeriod` property to set the speed of the transition effect.



The next chapter contains several examples that use the MultiPage control.

Summary

This chapter provided several UserForm examples that demonstrate common techniques. It also included many examples using the ListBox control.

The next chapter contains additional, more advanced examples of UserForms.



Advanced UserForm Techniques

Displaying a Progress Indicator

One of the most common requests among Excel developers involves progress indicators. A progress indicator is a graphical “thermometer” type display that shows the progress of a task such as a lengthy macro.

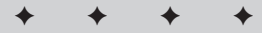
Before Excel 97, creating a progress indicator was a difficult task. But now, it’s relatively easy. In this section, I describe how to create three types of progress indicators for:

- ◆ A macro that’s not initiated by a UserForm (a standalone progress indicator).
- ◆ A macro that is initiated by a UserForm. In this case, the UserForm makes use of a MultiPage control that displays the progress indicator while the macro is running.
- ◆ A macro that is initiated by a UserForm. In this case, the UserForm increases in height and the progress indicator appears at the bottom of the dialog box.

Using a progress indicator requires that you are (somehow) able to gauge how far along your macro may be in completing its given task. How you do this will vary, depending on the macro. For example, if your macro writes data to cells (and you know the number of cells that will be written to), it’s a simple matter to write code that calculates the percent completed.

15

CHAPTER



In This Chapter

Displaying a progress indicator (three techniques)

Creating a “wizard:” an interactive series of dialog boxes

Creating a function that emulates VBA’s MsgBox function

Using modeless UserForms

Handling multiple objects with a single event-handler

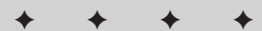
Using a dialog box to select a color

Displaying cell information in a UserForm

Displaying a chart in a UserForm (two techniques)

Displaying a complete spreadsheet in a UserForm

Using an enhanced data form



Displaying Progress in the Status Bar

A simple way to display the progress of a macro is to use Excel's status bar. The advantage is that it's very easy to program. The disadvantage is that most users aren't accustomed to watching the status bar, and would prefer a more visual display.

To write text to the status bar, use a statement such as:

```
Application.StatusBar = "Please wait..."
```

You can, of course, update the status bar as your macro progresses. For example, if you have a variable named `Pct` that represents the percent completed, you can write code that periodically executes a statement such as this:

```
Application.StatusBar = "Processing... " & Pct & "% Completed"
```

When your macro finishes, reset the status bar to its normal state with the following statement:

```
Application.StatusBar = False
```



Caution

It's important to understand that a progress indicator will slow down your macro a bit due to the extra overhead of having to update it. If speed is absolutely critical, you may prefer to forgo a progress indicator.

Creating a standalone progress indicator

This section describes how to set up a UserForm to display the progress of a macro.



On the CD-ROM

This example is available on the companion CD-ROM.

Building the UserForm

Follow these steps to create the UserForm that will be used to display the progress of your task:

1. Insert a new UserForm and change its `Caption` property setting to `Progress`.
2. Add a Frame control and name it `FrameProgress`.
3. Add a Label control inside the Frame and name it `LabelProgress`. Remove the label's caption, and make its background color (`BackColor` property) red. The label's size and placement do not matter for now.

4. Add another label above the frame to describe what's going on (optional).
5. Adjust the UserForm and controls so they look something like Figure 15-1.

You can, of course, apply any other type of formatting to the controls. For example, I changed the `SpecialEffect` property for the `Frame` control shown in Figure 15-1.

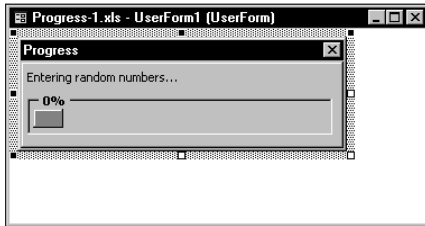


Figure 15-1: This UserForm will serve as a progress indicator.

Creating the event-handler procedures

The trick here involves running a procedure automatically when the UserForm is displayed. One option is to use the `Initialize` event. However, this event occurs *before* the UserForm is actually displayed so it's not appropriate. The `Activate` event, on the other hand, is triggered at the time the UserForm is displayed, so it's perfect for this application.

Insert the following procedure in the code window for the UserForm. This procedure simply calls a procedure named `Main` when the UserForm is displayed. The `Main` procedure, which is stored in a VBA module, is the actual macro that will be running while the progress indicator is displayed.

```
Private Sub UserForm_Activate()  
    Call Main  
End Sub
```

The `Main` procedure follows. This demo routine simply inserts random numbers into the active worksheet. As it does so, it changes the width of the `Label` control and displays the percentage completed in the `Frame`'s caption. This procedure is just for exercising the progress bar; you may, of course, substitute your own for more meaningful purposes.

```
Sub Main()  
' Inserts random numbers on the active worksheet  
Cells.Clear  
Counter = 1  
RowMax = 200  
ColMax = 25  
For r = 1 To RowMax
```

```

        For c = 1 To ColMax
            Cells(r, c) = Int(Rnd * 1000)
            Counter = Counter + 1
        Next c
        PctDone = Counter / (RowMax * ColMax)
        Call UpdateProgress(PctDone)
    Next r
    Unload UserForm1
End Sub

```

The `Main` procedure contains a loop (two loops, actually). Inside of the loop is a call to the `UpdateProgress` procedure. This procedure, which follows, takes one argument: a value between 0 and 100 that represents the progress of the macro.

```

Sub UpdateProgress(Pct)
    With UserForm1
        .FrameProgress.Caption = Format(Pct, "0%")
        .LabelProgress.Width = Pct * (.FrameProgress.Width - 10)
        .Repaint
    End With
End Sub

```

Creating the start-up procedure

All that's missing is a procedure to display the `UserForm`. Enter the following procedure in a VBA module:

```

Sub ShowDialog()
    UserForm1.LabelProgress.Width = 0
    UserForm1.Show
End Sub

```

How it works

When you execute the `ShowDialog` procedure, the `Label` object's width is set to 0. Then the `Show` method of the `UserForm1` object displays the `UserForm` (which is the progress indicator). When the `UserForm` is displayed, its `Activate` event is triggered, which executes the `Main` procedure. The `Main` procedure periodically updates the width of the label. Notice that the procedure uses the `Repaint` method of the `UserForm` object. Without this statement, the changes to the label would not be updated. Before the procedure ends, the last statement unloads the `UserForm`.

To customize this technique, you'll need to figure out how to determine the percentage completed and assign it to the `PctDone` variable.

Showing progress using a MultiPage control

In the preceding example, the macro was not initiated by a `UserForm`. If your lengthy macro is kicked off by presenting a `UserForm`, the technique described in this section is a better solution. It assumes the following:

- ◆ Your project is completed and debugged
- ◆ Your project uses a UserForm (without a MultiPage control) to initiate a lengthy macro
- ◆ You have a way to gauge the progress of your macro



The companion CD-ROM contains an example that demonstrates this technique.

Modifying your UserForm

This step assumes that you have a UserForm all set up. You'll add a MultiPage control. The first page of the MultiPage control will contain all of your original controls. The second page will contain the controls that display the progress indicator. When the macro begins executing, VBA code will change the `Value` property of the MultiPage control. This will effectively hide the original controls and display the progress indicator.

The first step is to add a MultiPage control to your UserForm. Then move all of the existing controls on the UserForm and paste them to Page1 of the MultiPage control.

Next activate Page2 of the MultiPage control and set it up as in Figure 15-2. This is essentially the same combination of controls used in the example in the previous section.

1. Add a Frame control and name it `FrameProgress`.
2. Add a Label control inside of the Frame and name it `LabelProgress`. Remove the label's caption, and make its background color red.
3. Add another label to describe what's going on (optional).

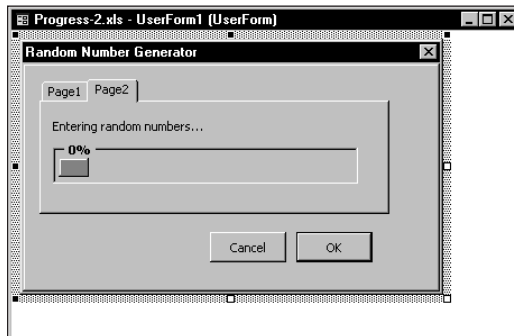


Figure 15-2: Page2 of the MultiPage control will display the progress indicator.

4. Next, activate the `MultiPage` control itself (not a page on the control) and set its `Style` property to **2 - fmTabStyleNone** (this will hide the tabs). The easiest way to select the `MultiPage` control is to use the drop-down list in the Properties window. You'll probably need to adjust the size of the `MultiPage` control to account for the fact that the tabs are not displayed.

Inserting the UpdateProgress procedure

Insert the following procedure in the code module for the UserForm:

```
Sub UpdateProgress(Pct)
    With UserForm1
        .FrameProgress.Caption = Format(Pct, "0%")
        .LabelProgress.Width = Pct * (.FrameProgress.Width - 10)
        .Repaint
    End With
End Sub
```

This procedure will be called from the main macro, and will do the actual updating of the progress indicator.

Modifying your procedure

You'll need to modify the procedure that is executed when the user clicks the OK Button—the Click event-handler procedure for the button, named `OK_Click`. First, insert the following statement at the top of your procedure:

```
MultiPage1.Value = 1
```

This statement activates `Page2` of the `MultiPage` control (the page that displays the progress indicator).

In the next step, you're pretty much on your own. You'll need to write code to calculate the percent completed, and assign this value to a variable named `PctDone`. Most likely, this calculation will be performed inside of a loop. Then insert the following statement, which will update the progress indicator:

```
Call UpdateProgress(PctDone)
```

How it works

This technique is very straightforward and, as you've seen, it involves only one UserForm. The code switches pages of the `MultiPage` control, and converts your normal dialog box into a progress indicator.

Showing progress without using a MultiPage control

The example in this section is similar to the example in the previous section. However, this technique is simpler because it does not use a MultiPage control. Rather, the progress indicator is stored at the bottom of the UserForm—but the UserForm’s height is reduced such that the progress indicator controls are not visible. When it’s time to display the progress indicator, the UserForm’s height is increased, which makes the progress indicator visible.



The companion CD-ROM contains an example that demonstrates this technique.

Figure 15-3 shows the UserForm in the VBE. The `Height` property of the UserForm is 162. However, before the UserForm is displayed, the `Height` is changed to 128 (which means the progress indicator controls are not visible to the user). When the user clicks OK, VBA code changes the `Height` property to 162 using the following statement:

```
Me.Height = 162
```

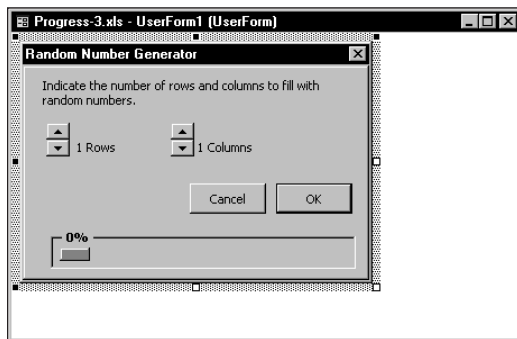


Figure 15-3: The progress indicator will be hidden by reducing the height of the UserForm.

Creating Wizards

Many applications incorporate “wizards” to guide users through an operation. Excel’s Text Import Wizard is a good example. A wizard is essentially a series of dialog boxes that solicit information from the user. Often, the user’s choices in earlier dialog boxes influence the contents of later dialog boxes. In most wizards, the user is free to go forward or backward through the dialog box sequence, or click the Finish button to accept all defaults.

You can, of course, create wizards using VBA and a series of UserForms. However, I've found that the most efficient way to create a wizard is to use a single UserForm and a MultiPage control.

Figure 15-4 shows an example of a simple four-step wizard, which consists of a single UserForm that contains a MultiPage control. Each step of the wizard displays a different page in the MultiPage control.



If you need to create a wizard, the example workbook on the CD-ROM will serve as a good starting point. This is a four-step wizard that collects information and inserts it into a worksheet.

The sections that follow describe how I created the example wizard.

Setting up the MultiPage control

Start with a new UserForm, and add a MultiPage control. By default, this control contains two pages. Right-click the MultiPage tab and insert enough new pages to handle your wizard (one page for each wizard step). The example on the CD-ROM is a four-step wizard, so the MultiPage control has four pages. The names of the MultiPage tabs are irrelevant. The MultiPage control's `Style` property will eventually be set to `2 - fmTabStyleNone`. While working on the UserForm, you'll want to keep the tabs visible to make it easier to access various pages.

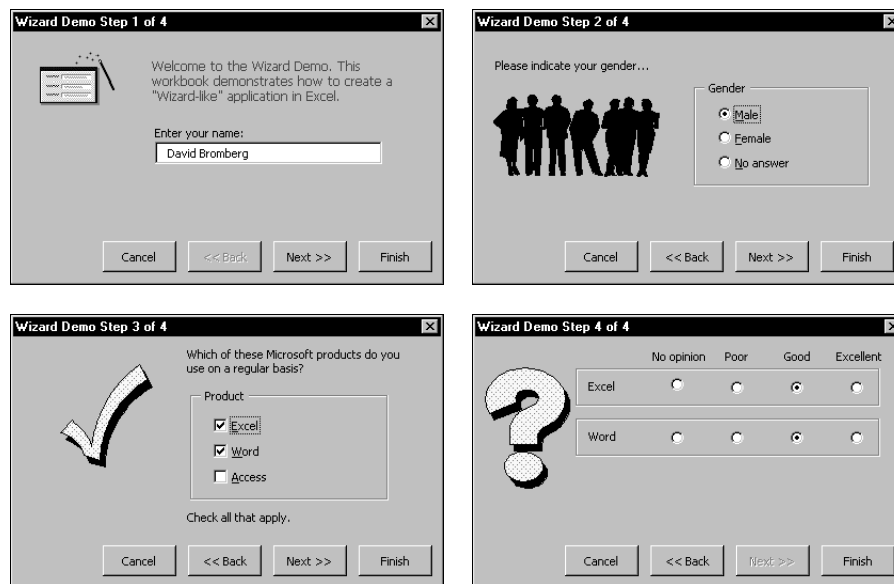


Figure 15-4: This four-step wizard uses a MultiPage control.

Add the desired controls to each page of the MultiPage control. This will, of course, vary depending on your application. You may need to resize the MultiPage control as you work in order to have room for the controls.

Adding the buttons

Next, add the buttons that control the progress of the wizard. These buttons are placed outside of the MultiPage control, since they are used while any of the pages are displayed. Most wizards have four buttons:

- ♦ *Cancel*. Cancels the wizard.
- ♦ *Back*. Returns to the previous step. During Step 1, this button should be disabled.
- ♦ *Next*. Advances to the next step. During the last step, this button should be disabled.
- ♦ *Finish*. Finishes the wizard.

Note

In some cases, the user is allowed to click the Finish button at any time, and accept the defaults for items that were skipped over. In other cases, the wizard requires a user response for some items. If this is the case, the Finish button is disabled until all required input is made. The example on the CD-ROM requires an entry in the TextBox in Step 1.

In the example, these CommandButtons are named `CancelButton`, `BackButton`, `NextButton`, and `FinishButton`.

Programming the buttons

Each of the four wizard buttons requires a procedure to handle its `Click` event. The event-handler for `CancelButton` follows. This procedure uses a `MsgBox` function (see Figure 15-5) to verify that the user really wants to exit. If the user clicks the Yes button, the UserForm is unloaded with no action taken. This type of verification, of course, is optional.

```
Private Sub CancelButton_Click()  
    Msg = "Cancel the wizard?"  
    Ans = MsgBox(Msg, vbQuestion + vbYesNo, APPNAME)  
    If Ans = vbYes Then Unload Me  
End Sub
```

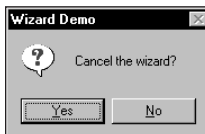


Figure 15-5: Clicking the Cancel button displays a message box.

The event-handler procedures for the Back and Next buttons follow:

```
Private Sub BackButton_Click()  
    MultiPage1.Value = MultiPage1.Value - 1  
    UpdateControls  
End Sub  
  
Private Sub NextButton_Click()  
    MultiPage1.Value = MultiPage1.Value + 1  
    UpdateControls  
End Sub
```

These two procedures are very simple. They change the `Value` property of the `MultiPage` control, and then call another procedure named `UpdateControls` (which follows).

The `UpdateControls` procedure in Listing 15-1 is responsible for enabling and disabling the `BackButton` and `NextButton` controls.

Listing 15-1: These procedures enable the key controls in the wizard.

```
Sub UpdateControls()  
    Select Case MultiPage1.Value  
        Case 0  
            BackButton.Enabled = False  
            NextButton.Enabled = True  
        Case MultiPage1.Pages.Count - 1  
            BackButton.Enabled = True  
            NextButton.Enabled = False  
        Case Else  
            BackButton.Enabled = True  
            NextButton.Enabled = True  
    End Select  
  
    ' Update the caption  
    Me.Caption = APPNAME & " Step " & MultiPage1.Value + 1 & " of " & MultiPage1.Pages.Count  
  
    ' The Name field is required  
    If tbName.Text = "" Then  
        FinishButton.Enabled = False  
    Else  
        FinishButton.Enabled = True  
    End If  
End Sub
```

The procedure changes the UserForm's caption to display the current step and the total number of steps (APPNAME is a public constant, defined in Module1). It then examines the name field on the first page (a TextBox named tbName). This is a "required" field, so the Finish button can't be clicked if it's empty. If the TextBox is empty, the FinishButton is disabled; otherwise, it's enabled.

Programming dependencies

In most wizards, a user's response on a particular step may affect what's displayed in a subsequent step. In the CD-ROM example, the user indicates which products he or she uses in Step 3, and then rates those products in Step 4. The OptionButtons for a product's rating are visible only if the user has indicated a particular product.

Programmatically, this is accomplished by monitoring the MultiPage's Change event. Whenever the value of the MultiPage is changed (by clicking the Back or Next button), the MultiPage1_Change procedure is executed. If the MultiPage control is on the last tab (Step 4), the procedure examines the values of the CheckBox controls in Step 3 and makes the appropriate adjustments in Step 4.

In this example, the code uses two arrays of controls — one for the product CheckBox controls (Step 3), and one for the Frame controls (Step 4). The code uses a For-Next loop to hide the Frames for the products that are not used, and adjusts their vertical positioning. If none of the check boxes in Step 3 is checked, everything in Step 4 is hidden except a TextBox that displays Click Finish to exit (if a name is entered in Step 1) or A name is required in Step 1 (if a name is not entered in Step 1). The MultiPage1_Change procedure is shown in Listing 15-2.

Listing 15-2: Bringing up the page corresponding to the user's choice

```
Private Sub MultiPage1_Change()  
    ' Set up the Ratings page?  
    If MultiPage1.Value = 3 Then  
        ' Create an array of CheckBox controls  
        Dim ProdCB(1 To 3) As MSForms.CheckBox  
        Set ProdCB(1) = cbExcel  
        Set ProdCB(2) = cbWord  
        Set ProdCB(3) = cbAccess  
  
        ' Create an array of Frame controls  
        Dim ProdFrame(1 To 3) As MSForms.Frame  
        Set ProdFrame(1) = FrameExcel  
        Set ProdFrame(2) = FrameWord  
        Set ProdFrame(3) = FrameAccess
```

Continued

Listing 15-2 (continued)

```

TopPos = 22
FSpace = 8
AtLeastOne = False

' Loop through all products
For i = 1 To 3
    If ProdCB(i) Then
        ProdFrame(i).Visible = True
        ProdFrame(i).Top = TopPos
        TopPos = TopPos + ProdFrame(i).Height + FSpace
        AtLeastOne = True
    Else
        ProdFrame(i).Visible = False
    End If
Next i

' Uses no products?
If AtLeastOne Then
    lblHeadings.Visible = True
    Image4.Visible = True
    lblFinishMsg.Visible = False
Else
    lblHeadings.Visible = False
    Image4.Visible = False
    lblFinishMsg.Visible = True
    If tbName = "" Then
        lblFinishMsg.Caption = _
            "A name is required in Step 1."
    Else
        lblFinishMsg.Caption = _
            "Click Finish to exit."
    End If
End If
End If
End Sub

```

Performing the task

When the user clicks the Finish button, the wizard performs its task: transferring the information from the UserForm to the next empty row in the worksheet. This procedure, shown in Listing 15-3, is very straightforward. It starts by determining the next empty worksheet row and assigns this value to a variable (*r*). The remainder of the procedure simply translates the values of the controls and enters data into the worksheet.

Listing 15-3: Inserting the acquired data into the worksheet

```
Private Sub FinishButton_Click()  
    r = Application.WorksheetFunction._  
        CountA(Range("A:A")) + 1  
  
    ' Insert the name  
    Cells(r, 1) = tbName.Text  
  
    ' Insert the gender  
    Select Case True  
        Case obMale: Cells(r, 2) = "Male"  
        Case obFemale: Cells(r, 2) = "Female"  
        Case obNoAnswer: Cells(r, 2) = "Unknown"  
    End Select  
  
    ' Insert usage  
    Cells(r, 3) = cbExcel  
    Cells(r, 4) = cbWord  
    Cells(r, 5) = cbAccess  
  
    ' Insert ratings  
    If obExcel1 Then Cells(r, 6) = ""  
    If obExcel2 Then Cells(r, 6) = 0  
    If obExcel3 Then Cells(r, 6) = 1  
    If obExcel4 Then Cells(r, 6) = 2  
    If obWord1 Then Cells(r, 7) = ""  
    If obWord2 Then Cells(r, 7) = 0  
    If obWord3 Then Cells(r, 7) = 1  
    If obWord4 Then Cells(r, 7) = 2  
    If obAccess1 Then Cells(r, 8) = ""  
    If obAccess2 Then Cells(r, 8) = 0  
    If obAccess3 Then Cells(r, 8) = 1  
    If obAccess4 Then Cells(r, 8) = 2  
  
    ' Unload the form  
    Unload Me  
End Sub
```

Final steps

Once you've tested your wizard and everything seems to be working, then you can set the MultiPage control's `Style` property to **2 - fmTabStyleNone**.

Emulating the MsgBox Function

VBA's `MsgBox` function is a bit unusual since, unlike most functions, it displays a dialog box. But, like other functions, it also returns a value: an integer that represents which button the user clicked.

This example discusses a custom function that I created that emulates VBA's `MsgBox` function. On first thought, creating such a function might seem rather easy. Think again! The `MsgBox` function is extraordinarily versatile, due to the arguments it accepts. Consequently, creating a function to emulate `MsgBox` is no small feat.

The point of this exercise is not to create an alternative messaging function. Rather, it's to demonstrate how to develop a relatively complex function that also incorporates a UserForm. However, some people might like the idea of being able to customize their messages. If so, you'll find that this function is very easy to customize. For example, you can change the font, colors, button text, and so on.

I named my pseudo-`MsgBox` function `MyMsgBox`. The emulation is not perfect. `MyMsgBox` has the following limitations:

- ♦ It does not support the `Helpfile` argument (which adds a Help button that, when clicked, opens a Help file).
- ♦ It does not support the `Context` argument (which specifies the context ID for the Help file).
- ♦ It does not support the “system modal” option, which puts everything in Windows on hold until you respond to the dialog.

The syntax for `MyMsgBox` is:

```
MyMsgBox(prompt[, buttons] [, title])
```

This syntax is exactly the same as the `MsgBox` syntax, except that it doesn't use the last two optional arguments (`Helpfile` and `Context`). `MyMsgBox` also uses the same pre-defined constants as `MsgBox`: `vbOKOnly`, `vbQuestion`, `vbDefaultButton1`, and so on.

**Note**

You might want to examine the `MsgBox` listing in the online help to become familiar with its arguments.

MyMsgBox code

The `MyMsgBox` function makes use of a UserForm named `MyMsgBoxForm`. The function itself, which follows, is very short. The bulk of the work is done in the `UserForm_Initialize` procedure.



The complete code for the `MyMsgBox` function is too lengthy to list here, but it's available in a workbook on the companion CD-ROM.

```
Public Prompt1 As String
Public Buttons1 As Integer
Public Title1 As String
Public UserClick As Integer

Function MyMsgBox(ByVal Prompt As String, _
    Optional ByVal Buttons As Integer, _
    Optional ByVal Title As String) As Integer
    Prompt1 = Prompt
    Buttons1 = Buttons
    Title1 = Title
    MyMsgBoxForm.Show
    MyMsgBox = UserClick
End Function
```

Figure 15-6 shows `MyMsgBox` in action (I used a different font for the message text).

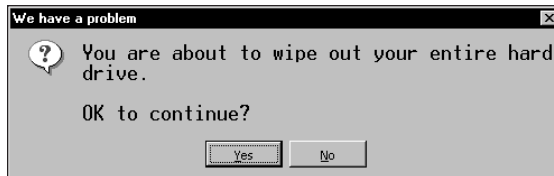


Figure 15-6: The result of the `MsgBox` emulation function (using a different font)

Here's the code I used to execute the function:

```
Prompt = "You are about to wipe out your entire hard drive."
Prompt = Prompt & vbCrLf & vbCrLf & "OK to continue?"
Buttons = vbQuestion + vbYesNo
Title = "We have a problem"
Ans = MyMsgBox(Prompt, Buttons, Title)
```

How it works

Notice the use of four `Public` variables. The first three (`Prompt1`, `Buttons1`, and `Title1`) represent the arguments that are passed to the function. The other variable (`UserClick`) represents the values returned by the function. The `UserForm_Initialize` procedure needs a way to get this information and send it back to the function, and using `Public` variables is the only way to accomplish that.

The UserForm (shown in Figure 15-7) contains four Image controls (one for each of the four possible icons), three CommandButton controls, and a TextBox control.

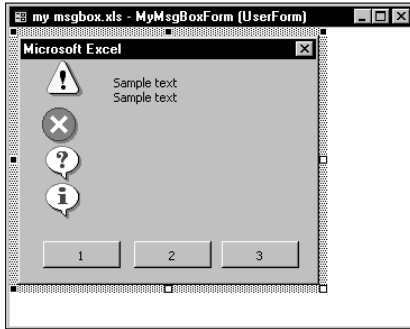


Figure 15-7: The UserForm for the MyMsgBox function.

The code in the `UserForm_Initialize` procedure examines the arguments and does the following:

- ♦ Determines which, if any, image to display (and hides the others)
- ♦ Determines which button(s) to display (and hides the others)
- ♦ Determines which button is the default button
- ♦ Centers the buttons in the dialog box
- ♦ Determines the captions for the CommandButtons
- ♦ Determines the position of the text within the dialog box
- ♦ Determines how wide to make the dialog box (it uses an API call to get the video resolution)
- ♦ Determines how tall to make the dialog box
- ♦ Displays the UserForm

Three additional event-handler procedures are included (one for each CommandButton). These routines determine which button was clicked, and returns a value for the function by setting a value for the `UserClick` variable.

Interpreting the second argument (*buttons*) is a bit challenging. This argument can consist of a number of constants added together. For example, the second argument can be something like:

```
VbYesNoCancel + VbQuestion + VbDefaultButton3
```


This argument creates a three-button `MsgBox` with “(Yes, No, and Cancel),” displays the Question icon, and makes the third button the default button. The actual argument is 547 (3 + 32 + 512). The challenge was pulling three pieces of information from a single number. The solution involves converting the argument to a binary number, and then having the interpreter examine specific bits. For example, 547 in binary is 1000100011. Binary digits 4 through 6 determine the image displayed, digits 8 through 10 determine which buttons to display, and digits 1 and 2 determine which button is the default button.

Using the `MyMsgBox` function

To use this function in your own project, export the `MyMsgBoxMod` module and the `MyMsgBoxForm` UserForm. Then import these two files into your project.

A Modeless Dialog Box

Most dialog boxes that you encounter are *modal* dialog boxes, which must be dismissed from the screen before the user can do anything with the underlying application. Some dialogs, however, are *modeless*, which means the user may continue to work in the application while the dialog box is displayed.

**Note**

Excel 2000 was the first version of Excel to support modeless custom dialog boxes. Therefore, this feature will not work with earlier versions of Excel.

To display a modeless UserForm, use a statement such as:

```
UserForm1.Show vbModeless
```

The word `vbModeless` is a built-in constant that has a value of 0. Therefore, the following statement works identically:

```
UserForm1.Show 0
```

Figure 15-8 shows a modeless dialog box that displays information about the active cell. When the dialog box is displayed, the user is free to move the cell cursor and activate other sheets.

**On the CD-ROM**

This example is available on the companion CD-ROM.

The trick here is determining when to update the information in the dialog box. To do so, the example monitors two workbook events: `SheetSelectionChange` and `SheetActivate`. These event-handler procedures are located in the code module for the `ThisWorkbook` object.

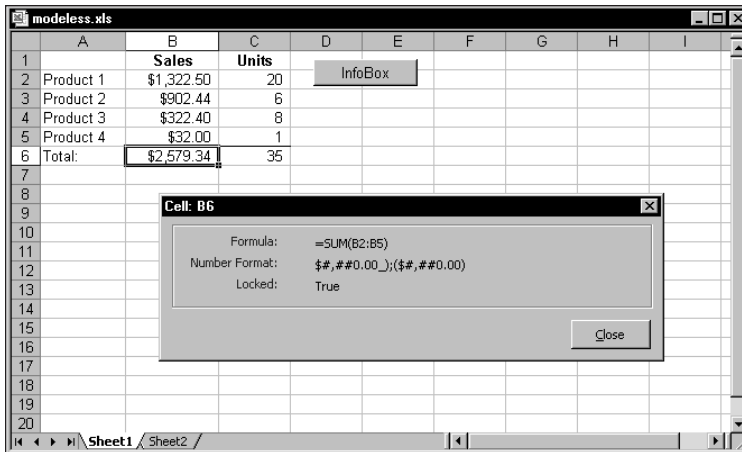
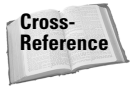


Figure 15-8: This modeless dialog box remains visible while the user continues working.



Refer to Chapter 18 for additional information about events.

The event-handler procedures follow:

```
Private Sub Workbook_SheetSelectionChange _
    (ByVal Sh As Object, ByVal Target As Range)
    Call UpdateBox
End Sub

Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    Call UpdateBox
End Sub
```

These procedures call the UpdateBox procedure, which follows:

```
Sub UpdateBox()
    With UserForm1
        ' Make sure a worksheet is active
        If TypeName(ActiveSheet) <> "Worksheet" Then
            .lblFormula.Caption = "N/A"
            .lblNumFormat.Caption = "N/A"
            .lblLocked.Caption = "N/A"
        End If
    End With
End Sub
```

```

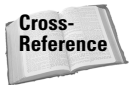
        .Caption = "Cell: " & ActiveCell.Address(False, False)
    ' Formula
    If ActiveCell.HasFormula Then
        .lblFormula.Caption = ActiveCell.Formula
    Else
        .lblFormula.Caption = "(none)"
    End If
    ' Number format
    .lblNumFormat.Caption = ActiveCell.NumberFormat
    ' Locked
    .lblLocked.Caption = ActiveCell.Locked
End With
End Sub

```

The `UpdateBox` procedure changes the UserForm's caption to show the active cell's address, then it updates the three Label controls (`lblFormula`, `lblNumFormat`, and `lblLocked`).

Following are a few points to help you understand how this example works:

- ♦ The UserForm is displayed “modeless” so that you can still access the worksheet while it's displayed. Modeless UserForms are not supported in Excel 97 or earlier versions.
- ♦ Code at the top of the procedure checks to make sure that the active sheet is a worksheet. If the sheet is not a worksheet, the Label controls are assigned the text *N/A*.
- ♦ The UserForm has a check box (Auto update). When checked, the UserForm is updated automatically.
- ♦ The workbook uses a class module to monitor two events for all open workbooks: the `SheetSelectionChange` event and the `SheetActivate` event. As a result, the code to display the information about the current cell is executed automatically whenever these events occur in any workbook (assuming that the Auto update option is in effect). Some actions (such as changing a cell's number format) do not trigger either of these events. Therefore, the UserForm also contains an Update button.



Cross-Reference

Refer to Chapter 29 for more information about class modules.

- ♦ The counts displayed for the cell precedents and dependents field include cells in the active sheet only. This is a limitation of the `Precedents` and `Dependents` properties.
- ♦ The information is displayed in Label controls on the UserForm. Because the length of the information will vary, VBA code is used to size and vertically space the labels — and also change the height of the UserForm if necessary.

Figure 15-9 shows a much more sophisticated version of this example (it's also on the CD-ROM). This version displays quite a bit of additional information about the selected cell. Long-time Excel users may notice the similarity with the Info window — a feature that was removed from Excel several years ago. The code is too lengthy to display here, but you can view the well-commented code in the example workbook.

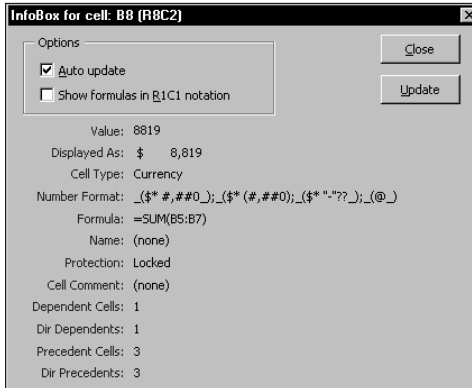


Figure 15-9: This UserForm displays information about the active cell.

Multiple Buttons, One Event-Handler

Every `CommandButton` on a UserForm must have its own procedure to handle its `Click` event. For example, if you have two `CommandButtons`, you'll need at least two event-handler procedures:

```
Private Sub CommandButton1_Click()
' Code goes here
End Sub

Private Sub CommandButton2_Click()
' Code goes here
End Sub
```

In other words, you cannot assign a macro to execute when *any* `CommandButton` is clicked. Each `Click` event-handler is “hard-wired” to its `CommandButton`. You can, however, have each event-handler call another all-inclusive macro in the event-handler procedures, but you'll need to pass an argument to indicate which button was clicked. In the following examples, clicking either `CommandButton1` or `CommandButton2` both execute the `ButtonClick` procedure, and the single argument tells the `ButtonClick` procedure which button was clicked.

```
Private Sub CommandButton1_Click()  
Call ButtonClick(1)  
End Sub  
  
Private Sub CommandButton2_Click()  
Call ButtonClick(2)  
End Sub
```

If your UserForm has many CommandButtons, setting up all of these event-handlers can get tedious. You might prefer to have a single procedure that could determine which button was clicked, and take the appropriate action.

This section describes a way around this limitation by using a Class Module to define a new class.



This example is available on the companion CD-ROM.

Procedure

The following steps describe how to re-create the example workbook:

1. Create your UserForm as usual, and add several CommandButtons (the example on the CD contains 16 CommandButtons). This example assumes the form is named UserForm1.
2. Insert a class module into your project (use Insert ⇄ Class Module), give it the name BtnClass, and enter the following code. You will need to customize the ButtonGroup_Click procedure.

```
Public WithEvents ButtonGroup As MsForms.CommandButton  
  
Private Sub ButtonGroup_Click()  
Msg = "You clicked " & ButtonGroup.Name & vbCrLf _  
& vbCrLf  
Msg = Msg & "Caption: " & ButtonGroup.Caption _  
& vbCrLf  
Msg = Msg & "Left Position: " & ButtonGroup.Left _  
& vbCrLf  
Msg = Msg & "Top Position: " & ButtonGroup.Top  
MsgBox Msg, vbInformation, ButtonGroup.Name  
End Sub
```

3. Insert a normal VBA module and enter the following code. This routine simply displays the UserForm:

```
Sub ShowDialog()  
UserForm1.Show  
End Sub
```

4. In the code module for the UserForm, enter the code in Listing 15-4. This procedure is kicked off by the UserForm's Initialize event. Notice that the code excludes a button named OKButton from the "button group." Therefore, clicking the OKButton does not execute the ButtonGroup_Click procedure.

Listing 15-4: Establishing the Buttons() object array

```
Dim Buttons() As New BtnClass

Private Sub UserForm_Initialize()
    Dim ButtonCount As Integer
    Dim ctl As Control

    ' Create the Button objects
    ButtonCount = 0
    For Each ctl In UserForm1.Controls
        If TypeName(ctl) = "CommandButton" Then
            If ctl.Name <> "OKButton" Then 'Skip the OKButton
                ButtonCount = ButtonCount + 1
                ReDim Preserve Buttons(1 To ButtonCount)
                Set Buttons(ButtonCount).ButtonGroup = ctl
            End If
        End If
    Next ctl
End Sub
```

After performing these steps, you can execute the ShowDialog procedure to display the UserForm. Clicking any of the CommandButtons (except the OKButton) executes the ButtonGroup_Click procedure. Figure 15-10 shows an example of the message displayed when a button is clicked.

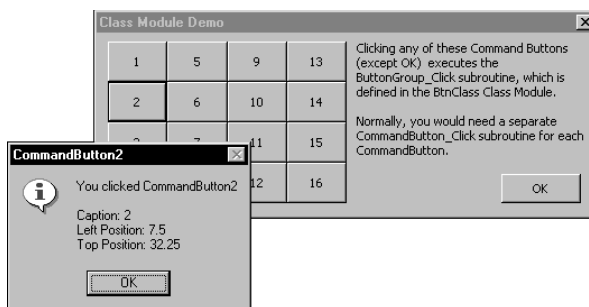


Figure 15-10: The ButtonGroup_Click procedure describes the button that was clicked.

Adapting this technique

You can adapt this technique to work with other types of controls. You'll need to change the type name in the `Public WithEvents` declaration. For example, if you have `OptionButtons` instead of `CommandButtons`, use a declaration statement like this:

```
Public WithEvents ButtonGroup As MsForms.OptionButton
```

A Color Picker Dialog

This example is similar to the example in the previous section, but a bit more complex. The example workbook demonstrates a technique to display a UserForm that allows the user to select a color from the Workbook's color palette (which consists of 56 colors).

The example is actually a function (named `GetAColor`) that displays a UserForm and returns a color value.



This example is available on the companion CD-ROM.

The `GetAColor` function follows:

```
Public ColorValue As Variant
Dim Buttons(1 To 56) As New ColorButtonClass

Function GetAColor() As Variant
' Displays a UserForm and returns a
' color value - or False if no color is selected
Dim ctl As Control
Dim ButtonCount As Integer
ButtonCount = 0
For Each ctl In UserForm1.Controls
' The 56 color buttons have their
' Tag property set to "ColorButton"
If ctl.Tag = "ColorButton" Then
    ButtonCount = ButtonCount + 1
    Set Buttons(ButtonCount).ColorButton = ctl
' Get colors from the active workbook's palette
Buttons(ButtonCount).ColorButton.BackColor = _
    ActiveWorkbook.Colors(ButtonCount)
End If
Next ctl
UserForm1.Show
GetAColor = ColorValue
End Function
```

The UserForm contains 56 CommandButton controls, which are colored using the colors in the active workbook's palette.

You can access the `GetAColor` function with a statement such as the following:

```
UserColor = GetAColor()
```

Executing this statement displays the UserForm and assigns a color value to the `UserColor` variable. The color corresponds to the color selected by the user.

Figure 15-11 shows the UserForm (it looks better in color), which contains 56 CommandButton controls. The `BackColor` property of each button corresponds to one of the colors in the workbook's color palette. Clicking a button unloads the UserForm and provides a value for the function to return.

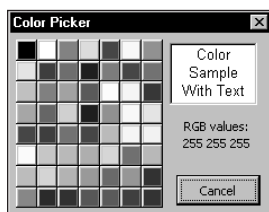


Figure 15-11: This dialog box lets the user select a color by clicking a button.

The example file on the accompanying CD-ROM contains the following:

- ♦ A UserForm (UserForm1) that contains a dialog box with 56 CommandButtons (plus a few other accoutrements).
- ♦ A class module (ColorButtonClass) that defines a ColorButton class.
- ♦ A VBA module (Module1) that contains a Function procedure (GetAColor).
- ♦ Two examples that demonstrate the GetAColor Function procedure.

The `GetAColor` procedure sets up the UserForm and displays it. It later returns the color value of the selected button. If the user clicks Cancel, `GetAColor` returns False. As the user moves the mouse pointer over the color buttons, the Color Sample image displays the color.

The code behind this UserForm is rather lengthy, so it's not listed here. You can, however, open the workbook from the CD-ROM and examine the code.

Displaying a Chart in a UserForm

With Excel 5 or Excel 95, it was very easy to display a “live” chart in a custom dialog box (using a dialog sheet): Just copy a chart and paste it into your dialog sheet. Oddly, there is no direct way to display a chart in a UserForm. You can, of course, copy the chart and paste it to the `Picture` property of an Image control, but this creates a static image of the chart and will not display any changes to the chart. Although UserForms are vastly superior to the old dialog sheets, this is one area that Microsoft seems to have overlooked.

Note

You can still use dialog sheets in Excel 97 or later. Therefore, you are certainly free to use a dialog sheet to display a live chart in a dialog box.

This section describes two methods to display a chart in a UserForm.

Method 1: Save the chart as a file

Just because Microsoft doesn’t allow a live chart to be displayed in a UserForm, doesn’t mean it can’t be done! Figure 15-12 shows a UserForm with a chart displayed in an Image object. The chart actually resides on a worksheet, and the UserForm always displays the current chart. This technique works by copying the chart to a temporary graphics file, then setting the Image control’s `Picture` property to the temporary file.

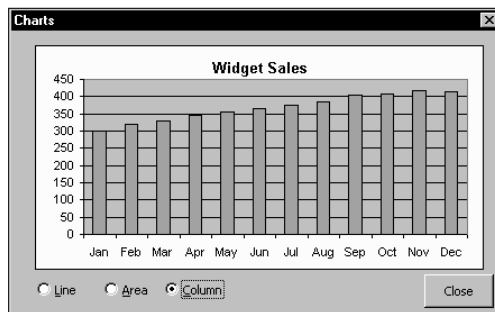


Figure 15-12: With a bit of trickery, a UserForm can display “live” charts.

General steps

To display a chart in a UserForm, follow these general steps:

1. Create your chart or charts as usual.
2. Insert a UserForm and then add an Image control.

3. Write VBA code to save the chart as a GIF file, and then set the Image control's `Picture` property to the GIF file. You need to use VBA's `LoadPicture` function to do this.
4. Add other bells and whistles as desired. For example, the UserForm in the demo file contains controls that let you change the chart type. Alternatively, you could write code to display multiple charts.

Saving a chart as a GIF file

The following code demonstrates how to create a GIF file (named `temp.gif`) from a chart (in this case, the first chart object on the sheet named `Data`):

```
Set CurrentChart = Sheets("Data").ChartObjects(1).Chart
Fname = ThisWorkbook.Path & "\temp.gif"
CurrentChart.Export FileName:=Fname, FilterName:="GIF"
```

When this code is executed, you'll see a pop-up window that displays the progress. In response to a common question, I'm not aware of any way to suppress this progress display.

Changing the Image control's Picture property

If the Image control on the UserForm is named `Image1`, the following statement loads the image (represented by the `Fname` variable) into the Image control:

```
Image1.Picture = LoadPicture(Fname)
```

**Note**

This technique works fine, but you may notice a slight delay as the chart is saved and then retrieved. On a fast system, however, this delay is barely noticeable.

Method 2: Use the OWC ChartSpace control

As I mentioned in Chapter 13, a UserForm may contain other controls that aren't normally included in the Toolbox. Microsoft includes the "Office Web Components" (OWC) with Office 2002, and you can use the Web Component controls in your UserForms. Figure 15-13 shows an example of a UserForm that contains a `ChartSpace` control.

**Note**

This technique does not allow you to display an existing Excel chart on a UserForm. Rather, you must write code that creates the chart in the `ChartSpace` control.

Making the ChartSpace control available

The first step is to add the `ChartSpace` control to your Toolbox. Right-click the toolbox to display the Additional Controls dialog box. Scroll down the list and place a check mark next to Microsoft Office Chart 10.0 (if you're using Excel 2000, the item will be named Microsoft Office Chart 9.0). Click OK, and your Toolbox will have a new icon.

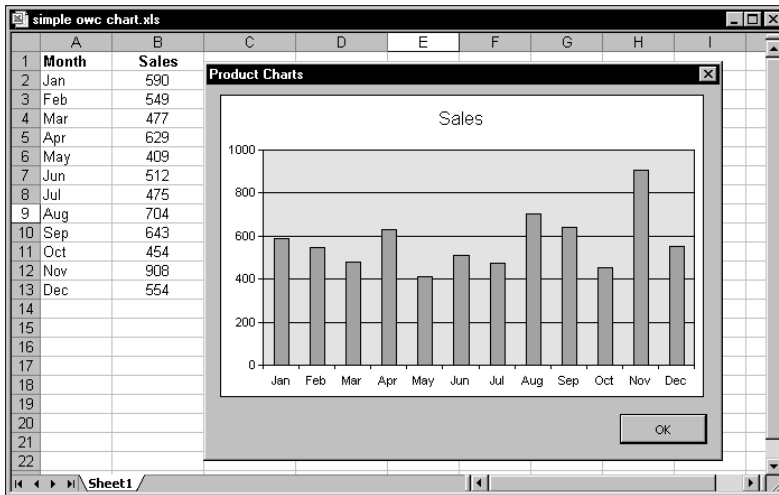


Figure 15-13: This UserForm contains a Spreadsheet control.

Adding the ChartSpace control to a UserForm

Adding a ChartSpace control to your UserForm works just like any of the standard controls. When the control is added, you won't see a chart displayed. It is, after all, just a chart space control. You'll need to write code that creates the actual chart.

Creating the chart

The following code, which is located in the UserForm code module, creates a chart using data stored on a worksheet. The category labels are in A2:A13, and the chart data is in B2:B13. It assumes that the ChartSpace object is named ChartSpace1.

```
Sub CreateChart()
    Dim Chart1 As ChChart 'WCChart
    Dim Series1 As ChSeries 'WCSeries
    Dim r As Integer
    Dim XValues(1 To 12)
    Dim DataValues(1 To 12)

    ' Add a chart to the ChartSpace
    Set Chart1 = ChartSpace1.Charts.Add

    ' Give it a title
    With Chart1
        .HasTitle = True
        .Title.Caption = Range("B1")
    End With
End Sub
```

```

For r = 2 To 13
    XValues(r - 1) = Cells(r, 1)
    DataValues(r - 1) = Cells(r, 2)
Next r

' Create a chart series
Set Series1 = Chart1.SeriesCollection.Add

' Specify chart type and data
With Series1
    .Type = chChartTypeColumnClustered
    .SetData chDimCategories, chDataLiteral, XValues
    .SetData chDimValues, chDataLiteral, DataValues
End With
End Sub

```

The code starts with variable declaration. If you're using Excel 2000, note that the objects have a different type name. For example, the chart object is of type `WCChart` (not `chChart`). Similarly, the chart series object is of type `WCSeries` (not `chSeries`). Two arrays are declared: one to hold the category labels (`XValues`), and one to hold the data (`DataValues`).

The `Set` statement creates a `Chart` object within the `ChartSpace`. This `Chart` object is named `Chart1`. The next block of statements sets the chart's title, using the label in cell B1. A `For-Next` loop reads the worksheet data into the arrays.

The next `Set` statement adds a series to the chart, and the `Series` object is named `Series1`. The `With-End With` block of code specifies the chart type (a standard column chart), and specifies the data for the series.

You'll find documentation for the OWC objects on your hard drive. These help files are installed when the OWC is installed. Or, you can use the Object Browser to learn more about the properties and methods of these controls.

**Note**

It's important to understand that the object model for creating a chart in the OWC does not correspond to the object model for creating a chart in Excel. Chapter 18 explains how to use VBA to manipulate "real" Excel charts.

Figure 15-14 shows a slightly more sophisticated version of this example. In this case, the user can choose which data will appear in the chart; this version also includes an option to export the chart as a GIF file.

**On the CD-ROM**

This application is available on the companion CD-ROM. You'll find two versions on the CD: one for Excel 2000 (using OWC 9.0), and one for Excel 2002 (using OWC 10.0).

Using the Office Web Components

The Office Web Components were designed to create interactive Web pages. The components include a Spreadsheet, a Chart, and a Pivot Table. When you create an application that uses the OWC, anyone who uses your application must have the OWC installed on his or her computer.

The OWC is included with Microsoft Office 2000 and Microsoft Office 2002. Installation is not automatic. In other words, you can't assume that all Microsoft Office 2000 users have the OWC installed on their system (they may have chosen not to install it). To confuse matters even more, the Small Business Edition of Microsoft Office 2000 does not even include the OWC.

Therefore, you should use caution before deciding to include any OWC controls in your Excel application. If your application will have general distribution, you'll probably want to avoid using the OWC.

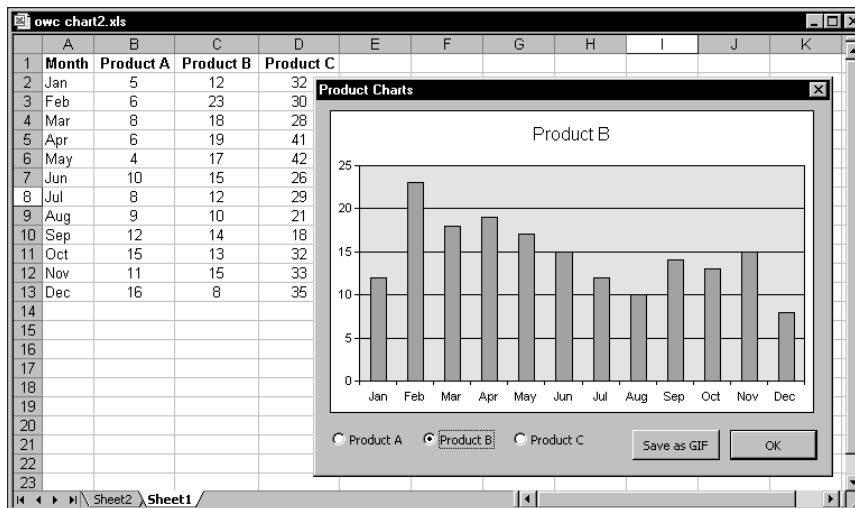


Figure 15-14: This UserForm contains a ChartSpace control (part of the Office Web Components).

Displaying a Spreadsheet in a UserForm

Not content to simply display a chart in a UserForm? How about an entire spreadsheet?

Figure 15-15 shows an example of a UserForm that contains a Microsoft Office Spreadsheet 10.0 control. This control can contain an entire interactive spreadsheet, complete with formulas and formatting. In fact, this Spreadsheet control has a significant advantage over a standard Excel sheet: Its dimensions are 18,278 columns by 262,144 rows. This is nearly 300 times as many cells as a standard Excel worksheet!

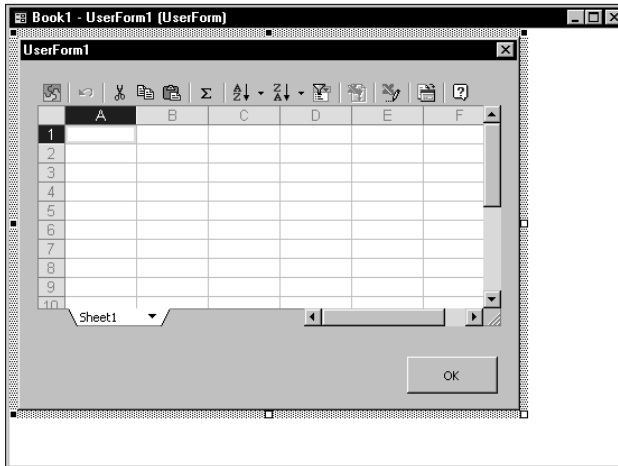


Figure 15-15: This UserForm contains a Spreadsheet control.

Making the Spreadsheet control available

First, you'll need to add the Spreadsheet control to your Toolbox. Right-click the toolbox to display the Additional Controls dialog box. Scroll down the list and place a check mark next to Microsoft Office Spreadsheet 10.0 (if you're using Excel 2000, the item will be named Microsoft Office Spreadsheet 9.0). Click OK to add the new icon to your Toolbox.

Adding the Spreadsheet control to a UserForm

Adding a Spreadsheet control to your UserForm works just like any of the standard controls. When the control is added to the UserForm, you'll see a three-sheet spreadsheet. As you'll see, this spreadsheet can be customized quite a bit.

A simple example

This example uses a Spreadsheet control to create a simple loan payment calculator in a UserForm. The finished product is shown in Figure 15-16. The user can enter loan information into column B, and the monthly payment is calculated (using a formula) and displayed in the bottom right cell.

Note

This example is primarily for illustration only. Using a Spreadsheet control is overkill. It is much more efficient to use EditBox controls to get the information, and calculate the loan payment using VBA code.

Loan Payment Calculator	
Loan amount:	22,500
Interest rate (APR):	7.25%
No. of monthly payments:	60
Monthly Payment:	\$448.19
<input type="button" value="Cancel"/> <input type="button" value="Paste Payment"/>	

Figure 15-16: This UserForm uses a Spreadsheet control for a simple loan payment calculator.

To create this UserForm, start with a new workbook and follow the steps presented next. Make sure you've added the Spreadsheet control to your Toolbox.

1. Insert a new UserForm, and add a Spreadsheet control. Don't change its default name (Spreadsheet1).

By default, the spreadsheet displays with a toolbar, row and column headings, scroll bars, and a sheet selector tab. To keep the interface as clean as possible, we'll get rid of these items later.

2. Select any cell in the Spreadsheet control, then right-click and choose Commands and Options from the shortcut menu.

You'll see the tabbed dialog box shown in Figure 15-17.

3. Click the Workbook tab and delete Sheet2 and Sheet3. Then remove the check marks from Horizontal scrollbar, Vertical scrollbar, Sheet selector, and Toolbar.
4. In column A, enter the text shown in Figure 15-16. Then adjust the width of column A so it's wide enough to handle the text.
5. Enter some number into B1:B3. Then enter the following formula into cell B5:

$$=PMT(B2/12, B3, -B1)$$
6. Select B1:B3, and click the Format tab in the Commands and Options dialog box. Click the "key" icon to unlock the selected cells (the other cells will remain locked, which is the default).
7. Click the Sheet tab in the Commands and Options dialog box. In the Viewable range box, enter A1:B5.

This essentially hides all of the unused rows and columns.

8. Next, remove the check mark from the check boxes labeled Row headers and Column headers.
9. Finally, add two CommandButton controls. One, named CancelButton, will be the Cancel button. The other (named PasteButton) will execute code that pastes the calculated result to the active cell in the Excel worksheet.

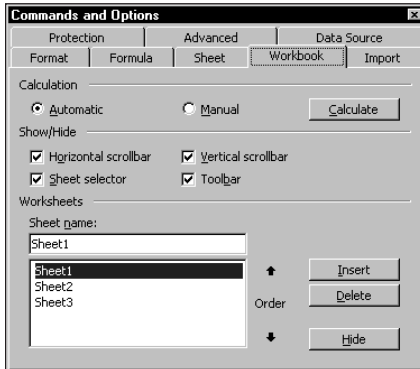


Figure 15-17: Use this dialog box to customize the Spreadsheet control.

Now it's time to add some VBA code. In the preceding steps, the three input cells were unlocked. Locking cells, however, has no effect unless the sheet is protected (just like Excel). Therefore, we'll add some code to protect the sheet when the UserForm is initialized. You could protect the sheet at design time (using the Commands and Options dialog box), but that makes it impossible to edit the sheet — and it's easy to forget to protect it again after you make changes. Protecting the sheet at runtime ensures that the sheet will be protected and the user can only change the input cells.

The simple code that follows does the job:

```
Private Sub UserForm_Initialize()
    Spreadsheet1.ActiveSheet.Protect
End Sub
```

The UserForm button labeled Paste Payment, when clicked, executes the following code:

```
Private Sub PasteButton_Click()
    ActiveCell.Value = Spreadsheet1.Range("B5")
    Unload Me
End Sub
```


This procedure simply puts the contents of cell B5 (from the Spreadsheet control) into the active cell on the Excel worksheet, and then unloads the UserForm.

Finally, we'll need an event-handler procedure for the Cancel button:

```
Private Sub CancelButton_Click()  
    Unload Me  
End Sub
```

I really can't think of too many good reasons to use a Spreadsheet control in a UserForm. However, it's nice to know that this feature is available should you need it.

An Enhanced Data Form

Next, here is one of the more complex UserForms you'll encounter. I designed it as a replacement for Excel's Data Form, shown in Figure 15-18. You'll recall this is the dialog box that appears when you select Data ⇄ Form.

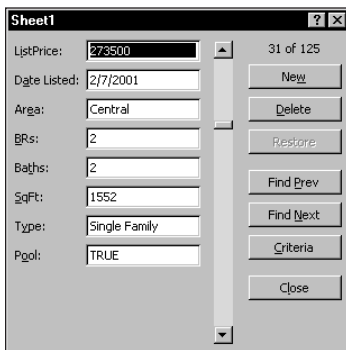
The image shows a screenshot of the 'Data Form' dialog box in Microsoft Excel. The dialog box is titled 'Sheet1' and has a standard Windows window border with a question mark and close button in the top right. On the left side, there are several input fields with labels: 'ListPrice:' (containing '273500'), 'Date Listed:' (containing '2/7/2001'), 'Area:' (containing 'Central'), 'BRs:' (containing '2'), 'Baths:' (containing '2'), 'SqFt:' (containing '1552'), 'Type:' (containing 'Single Family'), and 'Pool:' (containing 'TRUE'). On the right side, there are several buttons: 'New', 'Delete', 'Restore', 'Find Prev', 'Find Next', 'Criteria', and 'Close'. A vertical scrollbar is located between the input fields and the buttons, with the text '31 of 125' displayed at the top right of the dialog box.

Figure 15-18: Excel's Data Form

Like Excel's Data Form, my Enhanced Data Form works with a list in a worksheet. But as you can see in Figure 15-19, it has a dramatically different appearance and offers several advantages.



Figure 15-19: The author's Enhanced Data Form

Description

The Enhanced Data Form features the following enhancements:

- ♦ It handles any number of records and fields. Excel's Data Form is limited to 32 fields.
- ♦ The dialog box is always the same size, with scrollable fields. Excel's Data Form's dialog isn't scrollable, and can take up the entire screen!
- ♦ The record displayed in the dialog is always visible on-screen, and is highlighted so you know exactly where you are. Excel's Data Form doesn't scroll the screen for you, and does not highlight the current record.
- ♦ At startup, the dialog box always displays the record at the active cell. Excel's Data Form always starts with the first record in the database.
- ♦ When you close the dialog, the current record is selected for you. Excel's Data Form doesn't change your selection when you exit.
- ♦ It lets you insert a new record at any position in the database. Excel's Data Form adds new records only at the end of the database.
- ♦ It includes an Undo button for Data Entry, Insert Record, Delete Record, and New Record. Excel's Data Form includes only a Restore button.
- ♦ Search criteria are stored in a separate panel, so you always know exactly what you're searching for. The search criteria are not always apparent in Excel's Data Form.
- ♦ Supports approximate matches while searching (*, ?, and #). Excel's Data Form does not.
- ♦ The complete VBA source code is available, so you can customize it to your needs. Data Form is not written in VBA and cannot be customized.

Note

The Enhanced Data Form is a commercial product (sort of). It can be used and distributed freely, but access to the complete VBA source is available only for a modest fee.

Installing the add-in

To try out the Enhanced Data Form, install the add-in:

1. Copy the dataform.xla file from the CD-ROM to a directory on your hard drive.
2. In Excel, select Tools ⇨ Add-Ins.
3. In the Add-Ins dialog box, click Browse and locate the dataform.xla in the directory from Step 1.

Using the Enhanced Data Form

When the Enhanced Data Form add-in is installed, a new menu command is available: Data ⇨ JWalk Enhanced Data Form. You can use the Enhanced Data Form to work with any worksheet database.

Summary

This chapter provides several more advanced examples of UserForms. Studying the code provided will help you become a master of UserForms.

This chapter concludes Part IV. Subsequent chapters include additional UserForm examples.

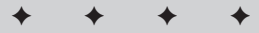


Advanced Programming Techniques

The six chapters in this part cover additional topics that are often considered advanced. The first three chapters discuss how to develop utilities and how to use VBA to work with pivot tables and charts. Chapter 19 covers the topic of event-handling, which enables you to execute procedures automatically when certain events occur. Chapter 20 describes how to work with other applications, and Chapter 21 discusses the topic of add-ins.

P A R T

V



In This Part

Chapter 16
Developing Excel
Utilities with VBA

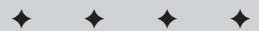
Chapter 17
Working with Pivot
Tables

Chapter 18
Working with Charts

Chapter 19
Understanding
Excel's Events

Chapter 20
Interacting with Other
Applications

Chapter 21
Creating and Using
Add-Ins



Developing Excel Utilities with VBA

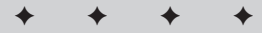
This chapter is about Excel utilities. A *utility*, in general, is something that enhances software, adding useful features or making existing features more accessible. As you'll see, creating utilities for Excel is an excellent way to make a great product even better.

About Excel Utilities

A utility isn't an end product, such as a quarterly report. Rather, it's a tool that helps you produce an end product (such as a quarterly report). An Excel utility is (almost always) an add-in that enhances Excel with new features or capabilities.

Excel is an extraordinary program that gets new features with every release. But as good as Excel is, many users soon develop a wish list of features that they would like to see added to the software. For example, some users who turn off the grid-line display want a feature that toggles this attribute so that they don't have to go through the tedious Tools ⇄ Options command. Users who work with dates might want a pop-up calendar feature to facilitate entering dates into cells. And some users desire an easier way to export a range of data to a separate file.

Utilities don't need to be complicated. Some of the most useful ones are actually very simple. For example, the following VBA procedure is a utility that toggles the grid-line display in the active window:



In This Chapter

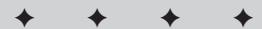
About Excel utilities and utilities in general

Why use VBA to develop utilities

What you need to know to develop good utilities

Step-by-step details for developing a useful Excel utility to manipulate text in cells

Where to go for more Excel utilities



```
Sub ToggleGridDisplay()  
    ActiveWindow.DisplayGridlines = Not  
        Not ActiveWindow.DisplayGridlines  
End Sub
```

You can store this macro in your Personal Macro Workbook so that it's always available. For quicker access, you can assign the macro to a toolbar button, a new menu item, a right-click shortcut menu, or a keystroke combination.



Several of the examples in Part IV are actually utilities, or easily can be turned into utilities.

Using VBA to Develop Utilities

When I received the beta version of Excel 5, I was blown away by VBA's potential. VBA was light-years ahead of Excel's powerful XLM macro language, and it made Excel the clear leader among spreadsheets in terms of programming.

In an effort to learn VBA, I wrote a collection of Excel utilities using only VBA. I figured that I would learn the language more quickly if I gave myself a tangible goal. The result was a product I call the Power Utility Pak for Excel, which is available to you at no charge as a benefit of buying this book. Use the coupon in the back of the book to order your copy.

I learned several things from my initial efforts on this project:

- ♦ VBA can be difficult to grasp at first, but it becomes easier with practice.
- ♦ Experimentation is the key to mastering VBA. Every project usually involves dozens of small coding experiments that eventually lead to a finished product.
- ♦ VBA enables you to extend Excel in a way that is entirely consistent with Excel's look and feel, including menus, toolbars, and dialog boxes.
- ♦ Excel can do almost anything. When you reach a dead end, chances are there's another path that leads to a solution.

Few other software packages include such an extensive set of tools that enable the end user to extend the software.

What Makes a Good Utility?

An Excel utility, of course, should ultimately make your job easier or more efficient. But if you're developing utilities for other users, what makes an Excel utility valuable? I've put together a list of elements that are common to good utilities:

- ♦ *It adds something to Excel.* This may be a new feature, a way to combine existing features, or just a way to make an existing feature easier to use.
- ♦ *It's general in nature.* Ideally, a utility should be useful under a wide variety of conditions. Of course, it's more difficult to write a general-purpose utility than it is to write one that works in a highly defined environment.
- ♦ *It's flexible.* The best utilities provide many options to handle various situations.
- ♦ *It looks, works, and feels like an Excel command.* Although it's tempting to add your own special touch to utilities, other users will find them easier to use if they look and act like familiar Excel commands.
- ♦ *It provides help for the user when needed.* In other words, it requires documentation that's thorough and accessible.
- ♦ *It traps errors.* An end user should never see a VBA error message. Any error messages that appear should be ones that you write.
- ♦ *Its effects are undoable.* Users who don't like the result caused by your utility should be able to reverse their path.

Text Tools: The Anatomy of a Utility

In this section, I describe an Excel utility that I developed (and is part of my Power Utility Pak). The Text Tools utility enables the user to manipulate text in a selected range of cells. Specifically, this utility enables the user to do the following:

- ♦ Change the case of the text (uppercase, lowercase, or proper case)
- ♦ Add characters to the beginning or the end, or at a specific character position
- ♦ Remove characters from the beginning or the end, or from a specific position within the string
- ♦ Remove excess spaces (or all spaces)

Background

Excel has many text functions that can manipulate text strings in useful ways. For example, you can uppercase the text in a cell, delete characters from text, remove spaces, and so on. But to perform any of these operations, you have to write formulas, copy them, convert the formulas to values, and paste the values over the original text. In other words, Excel doesn't make it particularly easy to modify text. Wouldn't it be nice if Excel had some text manipulation tools that didn't require formulas?

By the way, many good utility ideas come from statements that begin, “Wouldn’t it be nice if . . .”

Project goals for Text Tools

The first step in designing a utility is to envision exactly how you want the utility to work. Here’s my original plan, stated in the form of ten goals:

- ♦ It will have the same look and feel of other Excel commands. In other words, it will have a dialog box that looks like Excel’s dialog boxes.
- ♦ It will be accessible from the Tools menu.
- ♦ It will operate with the current selection of cells (including multiple selections), and it will enable the user to modify the range selection while the dialog box is displayed.
- ♦ Its main features will consist of tools to change the case of text, add new text to the strings, delete a fixed number of characters from the text, and remove spaces from the text in each cell.
- ♦ It also will enable the user to display key statistics about selected cells.
- ♦ It will enable the user to request the preceding types of changes to nontext cells as well as to text cells.
- ♦ It will have no effect on cells that contain formulas.
- ♦ It will be fast and efficient. For example, if the user selects an entire range, the utility should ignore the empty cells in the column.
- ♦ It will enable the user to undo the changes.
- ♦ It will have online help available.

How it works

When the Text Tools workbook opens, it creates a new menu item on the Tools menu: Text Tools. Selecting this item executes the `StartTextTools` procedure, which checks to make sure that Excel is in the proper context (a worksheet is active and it is not protected) and then displays the main Text Tools dialog box.

The user can specify various modifications and click the Apply button to perform them. The changes are visible in the worksheet, and the dialog box remains displayed. Each operation can be undone, or the user can perform additional text modifications. Clicking the Help button displays a help dialog box, and clicking the Exit button dismisses the dialog box.

Figure 16-1 shows an example of the Text Tools utility in use.

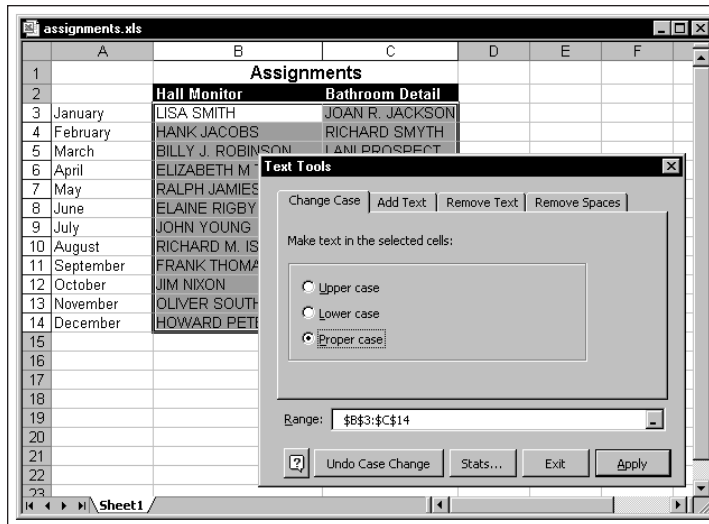


Figure 16-1: Using the Text Tools utility to change text to proper case

The Text Tools workbook

The Text Tools workbook consists of the following components:

- ♦ *One worksheet.* Every workbook must have at least one worksheet. I take advantage of this fact and use the worksheet named `HelpSheet` to store user help text.
- ♦ *Two VBA modules.* One (`modMenus`) contains the code to create and delete the menu item; the other (`modMain`) contains the code to display the main UserForm. The code that does the actual work is stored in the code modules for the UserForms.
- ♦ *Two UserForms.* One (`FormMain`) is the main dialog box; the other (`FormMenus`) is used to display help.



The Text Tools utility is available on the CD-ROM that accompanies this book. This is a standalone version of the tool that is included with the Power Utility Pak.

The FormMain UserForm

When I create a utility, I usually begin by designing the user interface, which in this case is the main dialog box. Creating the dialog box forces me to think through the project one more time.

The MainForm UserForm contains a MultiPage control, with four pages that correspond to the main features in the utility. Figure 16-2 shows the four pages of the MultiPage control.

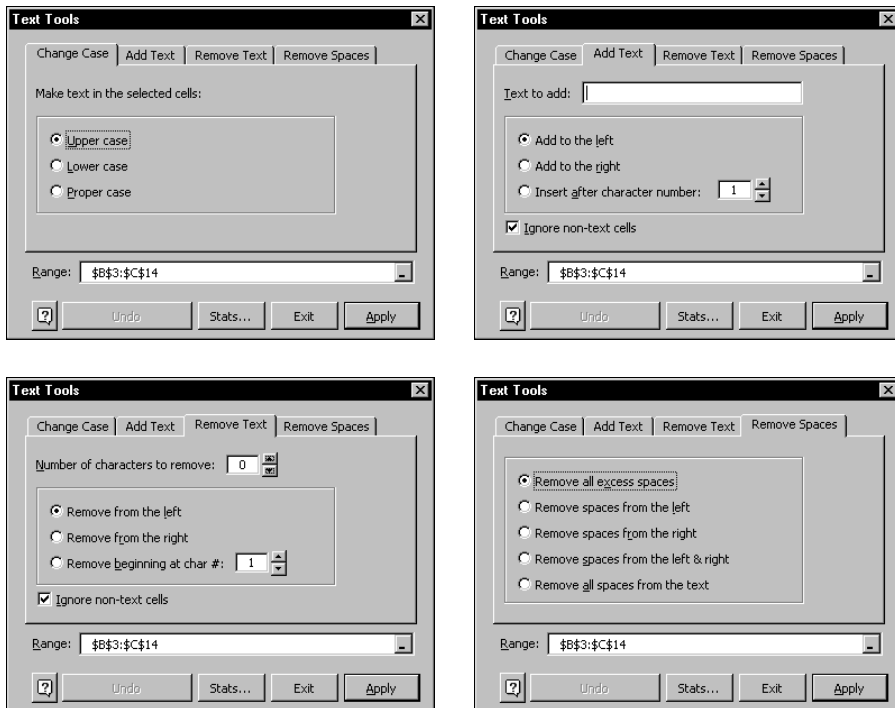


Figure 16-2: The MainForm UserForm contains a MultiPage control with four pages.

The controls contained in the MultiPage control are very straightforward, so I won't explain them (you can refer to the code for details). The MainForm UserForm also contains additional controls outside of the MultiPage control:

- ♦ *A RefEdit control.* The UserForm_Initialize procedure displays the address of the current range selection. And, of course, the RefEdit control allows the user to select a different range at any time.
- ♦ *Help button.* This is a CommandButton control that displays an image. Clicking the button displays the FormHelp UserForm.
- ♦ *Undo button.* Clicking this button reverses the effect of the most recent text manipulation.
- ♦ *Stats button.* Clicking this CommandButton displays a message box that shows key statistics for the text in the selected cells.

- ♦ *Exit button.* Clicking this CommandButton unloads the UserForm.
- ♦ *Apply button.* Clicking this CommandButton applies the text manipulation options specified in the current page of the MultiPage control.


Note

You may notice that this utility violates one of my design “rules” outlined earlier in this chapter (see “What Makes a Good Utility?”). Unlike most of Excel’s built-in dialog boxes, the MainForm dialog box does not have an OK or Cancel button, and clicking the Apply button does *not* dismiss the dialog box. The original version of Text Tools had an OK button and was designed so that clicking OK performed the task and closed the dialog box. User feedback, however, convinced me to change the design. Many people, it turns out, like to perform several different manipulations at one time. Therefore, I changed the utility to accommodate user preferences.

The modMain module

The modMain module contains a simple procedure that kicks off the utility.

Declarations

Following are the declarations at the top of the modMain module:

```
Public Const APPNAME As String = "Text Tools"

'Custom data type for undoing
Type OrigData
    OldText As Variant
    Address As String
End Type
```

I declare a public constant containing a string that stores the name of the application. This string is used in the message boxes, and also is used as the caption for the menu item that’s created (see “Create menu and delete menu procedures” later in this chapter).

I also create a custom data type named OrigData. As you’ll see, this data type is used to store information so an operation can be undone.

The StartTextTools procedure

The StartTextTools procedure follows:

```
Sub StartTextTools()
    If ValidContext(True, True, False, False, False, True) Then _
        FormMain.Show
End Sub
```

As you can see, it’s rather simple. It calls a custom Boolean function (ValidContext) that determines whether the current context is appropriate for the utility. If ValidContext returns True, then the FormMain UserForm appears.

This function takes six arguments (each Boolean):

- ♦ `VisWin`. If True, the function determines whether at least one window is visible.
- ♦ `Wksht`. If True, the function determines whether a worksheet is active.
- ♦ `RngSel`. If True, the function determines whether a range is selected.
- ♦ `MultSel`. If True, the function determines whether the selected range is a multiple selection.
- ♦ `Chart`. If True, the function determines whether a chart or Chart sheet is selected.
- ♦ `Prot`. If True, the function determines whether the contents of the active sheet are protected.

The values of these arguments determine what gets checked by the `ValidContext` function. For example, if the first argument (`VisWin`) is True, the function checks to see whether at least one window is visible. If the second argument (`Wksht`) is True, the function checks to see whether a worksheet is active. If any of these requested checks come up negative, the `ValidContext` function does two things: It displays a message box that describes the problem (see Figure 16-3) and returns False to the calling procedure.

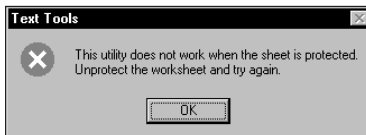


Figure 16-3: The `ValidContext` function displays this message if the worksheet is protected.

The Text Tools utility requests the following checks from the `ValidContext` function:

- ♦ `VisWin`. At least one window must be visible.
- ♦ `Wksht`. A worksheet must be active.
- ♦ `Prot`. The sheet may not be protected.

Note

The Text Tools utility doesn't require a range selection; it uses the `RangeSelection` property to determine the selected range in the `UserForm_Initialize` procedure for `FormMain`. It also works well with a multiple range selection.

I wrote the `ValidContext` function to be a “general-purpose” function that can be used in other applications. In other words, there is nothing in the function that

makes it specific to the Text Tools utility. All of the utilities in my Power Utility Pak use this function.

The ValidContext function is shown in Listing 16-1.

Listing 16-1: Certifying that the utility can run in the current context of the worksheet

```
Function ValidContext(VisWin, Wksht, RngSel, MultSel, _
    Chart, Prot) As Boolean
    Dim VisWinCnt As Integer
    Dim Win As Window

    Const MsgVisWin As String = _
        "A workbook must be active in order to use this utility."
    Const MsgWksht As String = _
        "A worksheet must be active in order to use this utility."
    Const MsgRngSel As String = _
        "This utility requires a range selection." & vbCrLf & _
        "Select a range and try again."
    Const MsgMultSel As String = _
        "This utility does not allow a multiple range selection." _
        & vbCrLf & "Select a single range and try again."
    Const MsgChart As String = _
        "Select a chart or Chart sheet before using this utility."
    Const MsgProt As String = _
        "This utility does not work when the sheet is protected." _
        & vbCrLf & "Unprotect the worksheet and try again."

    ValidContext = True

    ' Check for a visible window?
    If VisWin Then
        VisWinCnt = 0
        For Each Win In Application.Windows
            If Win.Visible Then VisWinCnt = VisWinCnt + 1
        Next
        If VisWinCnt = 0 Then
            MsgBox MsgVisWin, vbCritical, APPNAME
            ValidContext = False
            Exit Function
        End If
    End If

    ' Check for a worksheet?
    If Wksht Then
        If TypeName(ActiveSheet) <> "Worksheet" Then
            MsgBox MsgWksht, vbCritical, APPNAME
            ValidContext = False
        End If
    End If
End Function
```

Continued

Listing 16-1 (continued)

```

        Exit Function
    End If
End If

' Check for a range selection?
If RngSel Then
    If TypeName(Selection) <> "Range" Then
        MsgBox MsgRngSel, vbCritical, APPNAME
        ValidContext = False
        Exit Function
    End If
End If

' Check for multiple selection?
If MultSel Then
    If TypeName(Selection) = "Range" Then
        If Selection.Areas.Count > 1 Then
            MsgBox MsgMultSel, vbCritical, APPNAME
            Exit Function
        End If
    End If
End If

' Check for a chart selection?
If Chart Then
    If ActiveChart Is Nothing Then
        MsgBox MsgChart, vbCritical, APPNAME
        ValidContext = False
        Exit Function
    End If
End If

' Check for protected sheet?
If Prot Then
    If ActiveSheet.ProtectContents Then
        MsgBox MsgProt, vbCritical, APPNAME
        ValidContext = False
        Exit Function
    End If
End If
End Function

```

The ApplyButton_Click procedure

All work done by the Text Tools utility is performed by VBA code contained in the code module for the `FormMain` object. The `ApplyButton_Click` procedure in Listing 16-2 is executed when the user clicks the Apply button.

Listing 16-2: Applying the chosen changes without dismissal of the dialog box

```

Private Sub ApplyButton_Click()
' Perform the selected operation
  Dim i As Integer
  Dim WorkRange As Range

' Validate Range reference
  If Not ValidReference(RefEdit1.Text) Then
    MsgBox "Invalid range.", vbInformation, APPNAME
    Application.ScreenUpdating = True
    With RefEdit1
      .SelStart = 0
      .SelLength = 100
      .SetFocus
    End With
    Exit Sub
  End If

' Figure out what to do
  Application.ScreenUpdating = False
  Select Case MultiPage1.Value
    Case 0: Call ChangeCaseTab
    Case 1: Call AddTextTab
    Case 2: Call RemoveTextTab
    Case 3: Call RemoveSpacesTab
  End Select
  Application.ScreenUpdating = True
End Sub

```

The `ApplyButton_Click` procedure is relatively simple. First, it calls a custom function (`ValidReference`) to determine whether the `RefEdit` control contains a valid range address. If not, it displays a message, selects the text in the `RefEdit` control, and makes a quick exit.

The `ValidReference` function follows. This function returns `True` if its single argument contains a valid range reference. It relies on the fact that VBA generates an error when you try to create an invalid `Range` object.

```

Function ValidReference(ref As String) As Boolean
' Returns True if ref is a valid range reference
  Dim x As Range
  On Error Resume Next
  Set x = Range(ref)
  If Err = 0 Then ValidReference = True _
    Else ValidReference = False
End Function

```

The reason that the `ApplyButton_Click` procedure is so short is because it calls other procedures, depending on the value of the `MultiPage` control. And, the value of the `MultiPage` control determines which task the user is requesting. (Remember, the first page of a `MultiPage` control has a value of 0, not 1.) These “task” procedures are described and listed in the following section.

Notice that the `ApplyButton_Click` procedure does not unload the `UserForm`. Therefore, the user can perform other text manipulations. Clicking the `Exit` button is the only way to unload the `UserForm`. The `Click` event-handler for this button follows:

```
Private Sub ExitButton_Click()  
    Unload Me  
End Sub
```

The “task” procedures

In this section, I describe the four procedures that actually perform the work for the `Text Tools` utility.

Changing the case of text

The first page of the `MultiPage` control (see Figure 16-4) enables the user to change the case of text in the selected cells. The text can be converted to `UPPERCASE`, lowercase, or Proper Case.

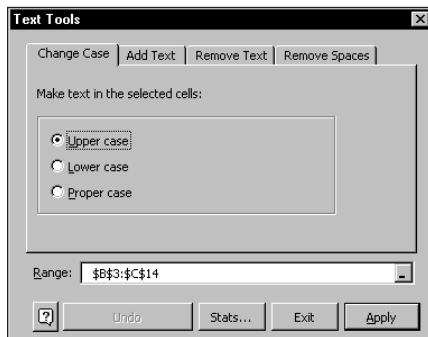


Figure 16-4: This page enables the user to change the case of text.

The `ApplyButton_Click` procedure calls the `ChangeCaseTab` procedure if the `MultiPage`'s `Value` property is 0 (that is, the first page is active). Listing 16-3 shows the complete `ChangeCaseTab` procedure.

Listing 16-3: Altering the case of text in cells

```
Sub ChangeCaseTab()  
    Dim WorkRange As Range  
    Dim Cell As Range  
    Dim CellCount As Long  
  
    Set WorkRange = CreateWorkRange(Range(RefEdit1.Text), _  
        True)  
    If WorkRange Is Nothing Then Exit Sub  
  
    CellCount = 0  
    ReDim LocalUndo(CellCount)  
  
    ' Process the cells  
    For Each Cell In WorkRange  
    ' Store info for undoing  
        CellCount = CellCount + 1  
        ReDim Preserve LocalUndo(CellCount)  
        LocalUndo(CellCount).OldText = Cell.Value  
        LocalUndo(CellCount).Address = Cell.Address  
  
    ' Change the case  
        Select Case True  
            Case ChangeCaseProper  
                Cell.Value = Application.Proper(Cell.Value)  
            Case ChangeCaseUpper  
                Cell.Value = UCase(Cell.Value)  
            Case ChangeCaseLower  
                Cell.Value = LCase(Cell.Value)  
        End Select  
    Next Cell  
  
    ' Update the Undo button  
    UndoButton.Enabled = True  
    UndoButton.Caption = "Undo Case Change"  
End Sub
```

A key element in this procedure is the creation of a Range object named WorkRange. The WorkRange object contains a subset of the user's range selection that consists of only the nonempty cells that contain text and not a formula. If no cell qualifies, the function returns Nothing.

The CreateWorkRange function (which creates and returns a Range object) accepts two arguments:

- r A Range object. In this case, it's the range selected by the user and displayed in the RefEdit control.
- TextOnly If True, the created object excludes nontext cells.

The `CreateWorkRange` function in Listing 16-4 is a general-purpose function that is not specific to the Text Tools utility.

Listing 16-4: The `CreateWorkRange` function

```
Function CreateWorkRange(r As Range, TextOnly As Boolean) As Range
' Creates a range object that consists of nonempty and
' nonformula cells. If TextOnly is True, the object
' excludes numeric cells

Set CreateWorkRange = Nothing
Select Case r.Count
    Case 1 ' one cell is selected
        If r.HasFormula Then Exit Function
        If TextOnly Then
            If IsNumeric(r.Value) Then
                Exit Function
            Else
                Set CreateWorkRange = r
            End If
        Else
            If Not IsEmpty(r) Then Set CreateWorkRange = r
        End If

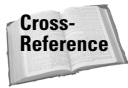
    Case Else 'More than one cell is selected
        On Error Resume Next
        If TextOnly Then
            Set CreateWorkRange = _
                r.SpecialCells(xlConstants, xlTextValues)
            If Err <> 0 Then Exit Function
        Else
            Set CreateWorkRange = _
                r.SpecialCells(xlConstants, xlTextValues +
xlNumbers)
            If Err <> 0 Then Exit Function
        End If
    End Select
End Function
```


Note

The `CreateWorkRange` function makes heavy use of the `SpecialCells` property. To learn more about the `SpecialCells` property, try recording a macro while making various selections in Excel's Go To Special dialog box. You can display this dialog box by pressing F5 and then clicking the Special button in the Go To dialog box.

You'll notice a quirk when you use the Go To Special dialog box. Normally it operates on the current range selection. For example, if an entire column is selected, then the result is a subset of that column. But if a single cell is selected, it operates on the entire worksheet. Because of this, the `CreateWorkRange` function checks the number of cells in the range passed to it.

Once the `WorkRange` object is created, the `ChangeCaseTab` procedure continues to process each cell in the `WorkRange`. Before the procedure ends, it enables the Undo button and adds a descriptive caption.



Later in this chapter, I discuss how the Undo feature works.

Adding text

The second page of the `MultiPage` control (see Figure 16-5) enables the user to add characters to the contents of the selected cells. The text can be added at the beginning, at the end, or after a specified character position.

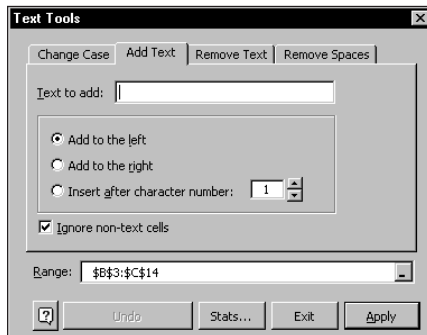


Figure 16-5: This page enables the user to add text to the contents of the selected cells.

The `ApplyButton_Click` procedure calls the `AddTextTab` procedure if the `MultiPage`'s `Value` is 1 (that is, the second page is active). Listing 16-5 presents the complete `AddTextTab` procedure.

Listing 16-5: Inserting properly filtered text into cells by way of the dialog box

```
Sub AddTextTab()
    Dim WorkRange As Range
    Dim Cell As Range
    Dim NewText As String
```

Continued

Listing 16-5 (continued)

```

Dim InsPos As Integer
Dim CellCount As Long

Set WorkRange = _
    CreateWorkRange(Range(RefEdit1.Text), cbIgnoreNonText1)
If WorkRange Is Nothing Then Exit Sub

NewText = TextToAdd.Text
If NewText = "" Then Exit Sub

' Check for potential invalid formulas
If OptionAddToLeft And Left(NewText, 1) Like "[=+-]" Then
    MsgBox "That text would create an invalid formula.", _
        vbInformation, APPNAME
    With TextToAdd
        .SelStart = 0
        .SelLength = Len(.Text)
        .SetFocus
    End With
    Exit Sub
End If

' Add text to the middle?
If OptionAddToMiddle Then
    InsPos = Val(InsertPos.Caption)
    If InsPos = 0 Then Exit Sub
End If

' Loop through the cells
CellCount = 0
ReDim LocalUndo(CellCount)
For Each Cell In WorkRange
    With Cell
        ' Store info for undoing
        CellCount = CellCount + 1
        ReDim Preserve LocalUndo(CellCount)
        With LocalUndo(CellCount)
            .OldText = Cell.Value
            .Address = Cell.Address
        End With

        If OptionAddToLeft Then .Value = NewText & .Value
        If OptionAddToRight Then .Value = .Value & NewText
        If OptionAddToMiddle Then
            If InsPos > Len(.Value) Then
                .Value = .Value & NewText
            Else
                .Value = Left(.Value, InsPos) & NewText & _
                    Right(.Value, Len(.Value) - InsPos)
            End If
        End If
    End With

```

```

        End If
    End With
Next Cell

' Update the Undo button
UndoButton.Enabled = True
UndoButton.Caption = "Undo Add Text"
End Sub

```

This procedure is similar in structure to `ChangeCaseTab`. Notice that this procedure catches an error that would occur if the user tried to insert a plus, minus, or equals sign as the first character of a cell. Such an insertion would cause Excel to interpret the cell contents as an invalid formula.

Removing text

The third page of the `MultiPage` control (see Figure 16-6) enables the user to remove text from the selected cells. A specific number of characters can be removed from the beginning or end, or starting at a specified character position.

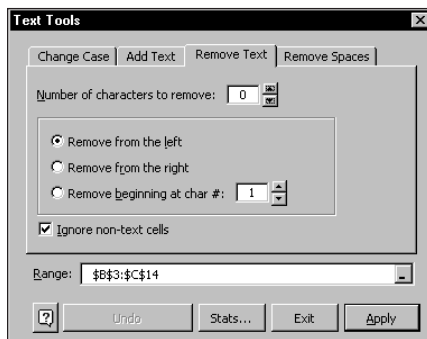


Figure 16-6: This page enables the user to remove characters from the selected text.

The `ApplyButton_Click` procedure calls the `RemoveTextTab` procedure if the `MultiPage`'s `Value` property is 2 (that is, the third page is active). Listing 16-6 presents the complete `RemoveTextTab` procedure.

Listing 16-6: Removing text from cells by way of the dialog box

```

Sub RemoveTextTab()
    Dim WorkRange As Range
    Dim Cell As Range

```

Continued

Listing 16-6 (continued)

```

Dim NumToDel As Integer
Dim CellCount As Long

Set WorkRange = _
    CreateWorkRange(Range(RefEdit1.Text), cbIgnoreNonText2)
If WorkRange Is Nothing Then Exit Sub

NumToDel = Val(CharstoDelete.Caption)
If NumToDel = 0 Then Exit Sub

' Process the cells
ReDim LocalUndo(0)
CellCount = 0
For Each Cell In WorkRange
    With Cell
        ' Store info for undoing
        CellCount = CellCount + 1
        ReDim Preserve LocalUndo(CellCount)
        LocalUndo(CellCount).OldText = .Value
        LocalUndo(CellCount).Address = .Address

        If Len(Cell.Value) <= NumToDel Then _
            NumToDel = Len(.Value)
        Select Case True
            Case OptionDeleteFromLeft
                .Value = Right(.Value, Len(.Value) - NumToDel)
            Case OptionDeleteFromRight
                .Value = Left(.Value, Len(.Value) - NumToDel)
            Case OptionDeleteFromMiddle
                .Value = RemoveChars(.Value, _
                    Cint(BeginChar.Caption), NumToDel)
        End Select
    End With
Next Cell

' Update the Undo button
UndoButton.Enabled = True
UndoButton.Caption = "Undo Remove Text"
End Sub

```

The `RemoveTextTab` procedure is, again, similar in structure to the other procedures called by `ApplyButton_Click`. If the characters are to be removed from the middle of the text, it calls a Function procedure, `RemoveChars`, to do the work.

The `RemoveChars` function procedure follows. This procedure removes a specified number of characters (*n*), beginning at a specified character position (*b*) from a string (*t*).


```

Private Function RemoveChars(t, b, n) As String
    Dim k As Integer
    Dim Temp As String
    Temp = ""
    For k = 1 To Len(t)
        If k < b Or k >= b + n Then
            Temp = Temp & Mid(t, k, 1)
        End If
    Next k
    RemoveChars = Temp
End Function

```

Removing spaces

The fourth page of the MultiPage control (see Figure 16-7) enables the user to remove spaces from the selected cells.



Figure 16-7: This page enables the user to remove spaces from the selected text.

The `ApplyButton_Click` procedure calls the `RemoveSpacesTab` procedure if the `MultiPage`'s value is 3 (that is, the fourth page is active). Listing 16-7 shows the complete `RemoveSpacesTab` procedure.

Listing 16-7: Filtering unnecessary spaces from textual cells

```

Sub RemoveSpacesTab()
    Dim WorkRange As Range
    Dim Cell As Range
    Dim CellCount As Long

    Set WorkRange = CreateWorkRange _
        (Range(RefEdit1.Text), True)
    If WorkRange Is Nothing Then Exit Sub

```

Continued

Listing 16-7 (continued)

```

' Process the cells
CellCount = 0
ReDim LocalUndo(CellCount)

For Each Cell In WorkRange
    With Cell
' Store info for undoing
        CellCount = CellCount + 1
        ReDim Preserve LocalUndo(CellCount)
        LocalUndo(CellCount).OldText = .Value
        LocalUndo(CellCount).Address = .Address
        Select Case True
            Case OptionRemoveExcess
                .Value = _
                    Application.WorksheetFunction.Trim(.Value)
            Case OptionRemoveLeft
                .Value = LTrim(.Value)
            Case OptionRemoveRight
                .Value = RTrim(.Value)
            Case OptionRemoveBoth
                .Value = Trim(.Value)
            Case OptionRemoveAllSpaces
                .Value = RemoveSpaces(.Value)
        End Select
    End With
Next Cell

' Update the Undo button
UndoButton.Enabled = True
UndoButton.Caption = "Undo Remove Spaces"

```

Notice that the first option (Remove all excess spaces) uses an Excel worksheet function. The second and third options use VBA functions. The final option (Remove all spaces from the text) uses a custom function, which follows:

```

Private Function RemoveSpaces(t) As String
' Removes all spaces from a string
    Dim NumChars As Integer
    Dim i As Integer
    NumChars = Len(t)
    RemoveSpaces = ""
    For i = 1 To NumChars
        If Mid(t, i, 1) <> " " Then _
            RemoveSpaces = RemoveSpaces & Mid(t, i, 1)
    Next i
End Function

```

The undo technique

Unlike Excel's Undo feature, the undo technique used in the Text Tools utility is a single level. In other words, the user can undo only the most recent operation. Refer to the sidebar "Undoing a VBA Procedure" for additional information about using Undo with your applications.

In the Text Tools utility, recall that the `modMain` VBA module declared a custom data type named `OrigData`. This declaration is as follows:

```
Type OrigData
    OldText As Variant
    Address As String
End Type
```

The `OrigData` datatype consists of two elements: `OldText` (contains the previous cell contents) and `Address` (the range address of the cell).

Each of the four "task" procedures creates an array (named `LocalUndo`) of type `OrigData`. Then before each cell is modified, the following code is executed:

```
' Store info for undoing
CellCount = CellCount + 1
ReDim Preserve LocalUndo(CellCount)
LocalUndo(CellCount).OldText = .Value
LocalUndo(CellCount).Address = .Address
```

The last step in each of these four procedures updates the Undo button on the `FormMain` UserForm. For example, the code in the `RemoveTextTab` procedures is as follows:

```
' Update the Undo button
UndoButton.Enabled = True
UndoButton.Caption = "Undo Remove Text"
```

When each of these procedures finishes, the `LocalUndo` array is filled with data that contains, for each cell, its previous contents and address. If the user clicks the Undo button, the `UndoButton_Click` procedure is executed. This procedure follows:

```
Private Sub UndoButton_Click()
    Dim i As Integer
    Application.ScreenUpdating = False

    ' Restore the previous contents
    For i = 1 To UBound(LocalUndo)
        Range(LocalUndo(i).Address).Value =
LocalUndo(i).OldText
    Next i
    Application.ScreenUpdating = True
```

```
' Update the Undo button
UndoButton.Caption = "Undo"
UndoButton.Enabled = False
End Sub
```

This procedure simply loops through the `LocalUndo` array and inserts the previous contents of each cell.



The companion CD-ROM contains an example that demonstrates how to enable the Edit ⇨ Undo command after a VBA procedure is executed.

The ShowStats procedure

Clicking the Stats button displays a message box that contains information about the contents of the selected cells. Figure 16-8 shows an example.

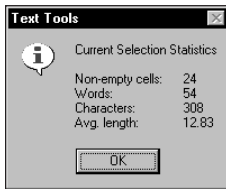


Figure 16-8: Clicking the Stats button shows a message box like this one.

Undoing a VBA Procedure

Computer users have become accustomed to the ability to “undo” an operation. Almost every operation you perform in Excel can be undone. Even better, beginning with Excel 97, the program features multiple levels of undo.

If you program in VBA, you may have wondered whether it’s possible to undo the effects of a procedure. The answer is *yes*. The qualified answer is *it’s not always easy*.

Making the effects of your VBA procedures undoable isn’t automatic. Your procedure needs to store the previous state so that it can be restored if the user chooses the Edit ⇨ Undo command. How you do this can vary depending on what the procedure does. In extreme cases, you might need to save an entire worksheet. If your procedure modifies a range, for example, you need to save only the contents of that range.

The Application object contains an `OnUndo` method, which lets the programmer specify text to appear on the Edit ⇨ Undo menu, and a procedure to execute if the user selects Edit ⇨ Undo. For example, the following statement causes the Undo menu item to display “Undo my cool macro.” If the user selects Edit ⇨ Undo my cool macro, the `UndoMyMacro` procedure is executed:

```
Application.OnUndo "Undo my cool macro", "UndoMyMacro"
```

Listing 16-8 shows the complete event-handler for the statistics procedure.

Listing 16-8: Displaying information about cells in the worksheet

```
Private Sub StatsButton_Click()
'   Displays statistics about the selection
    Dim WorkRange As Range
    Dim NumWords As Integer
    Dim NumChars As Integer
    Dim CellLength As Integer
    Dim NonBlanks As Integer
    Dim Cell As Range
    Dim Msg As String
    Dim Words As Integer
    Dim Contents As String
    Dim i As Integer

'   Validate range reference
    If Not ValidReference(RefEdit1.Text) Then
        MsgBox "Invalid range.", vbInformation, APPNAME
        With RefEdit1
            .SelStart = 0
            .SelLength = 100
            .SetFocus
        End With
        Exit Sub
    End If

    Set WorkRange = CreateWorkRange(Range(RefEdit1.Text), _
        True)
    If WorkRange Is Nothing Then
        MsgBox _
            "The range contains no non-formula cells with text.", _
            vbInformation, APPNAME
        Exit Sub
    End If

    NonBlanks = WorkRange.Count
    NumWords = 0
    NumChars = 0
    For Each Cell In WorkRange
        CellLength = Len(Cell.Value)
        NumChars = NumChars + CellLength
        Contents = Application.Trim(Cell.Value)
        Words = 1
        For i = 1 To Len(Contents)
            If Mid(Contents, i, 1) = " " Then _
                Words = Words + 1
        Next i
    End For
End Sub
```

Continued

Listing 16-8 (continued)

```

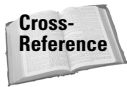
        If Len(Contents) = 0 Then Words = 0 'Accounts for
                                           ' empty cells
        NumWords = NumWords + Words
    Next Cell
    Msg = "Current Selection Statistics" & vbCrLf & vbCrLf
    Msg = Msg & "Nonempty cells:" & Chr(9) & NonBlanks _
        & Chr(13)
    Msg = Msg & "Words:" & Chr(9) & Chr(9) & NumWords _
        & Chr(13)
    Msg = Msg & "Characters:" & Chr(9) & NumChars & Chr(13)
    Msg = Msg & "Avg. length:" & Chr(9) & Format(NumChars _
        / NonBlanks, "#.00")
    MsgBox Msg, vbInformation, APPNAME
    Exit Sub
End Sub

```

The ShowStats procedure is lengthy but quite straightforward. Notice that this procedure validates the range reference (displayed in the RefEdit control) and displays an error if it contains an invalid range.

User help technique

There are many ways to provide online help. The Text Tools utility uses a simple technique that reads text stored in a worksheet, and displays it in a UserForm. Column A contains the help topics, and Column B contains the help text. The help topics are read into a ComboBox control, and the help topics are displayed in a Label control.



Chapter 24 describes this method (and others) of providing user help.

Figure 16-9 shows how the help dialog box (contained in FormHelp) looks when the user clicks the Help button on the FormMain UserForm.

Create menu and delete menu procedures

The only element of Text Tools that I haven't discussed is the menu item used to invoke the utility. When the workbook opens, its Workbook_Open procedure (located in the ThisWorkbook object module) is executed. This procedure is very simple.

```

Private Sub Workbook_Open()
    Call CreateMenu
End Sub

```

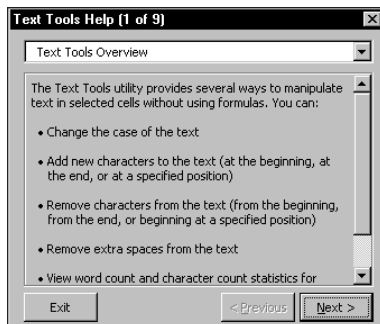
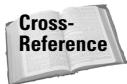


Figure 16-9: User help is displayed in a UserForm with a ComboBox and a Label control.

The `Workbook_BeforeClose` procedure, executed when the workbook is closed, is equally simple.

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)
    Call DeleteMenu
End Sub
```

The `CreateMenu` and `DeleteMenu` procedures are located in the `modMenus` VBA module. `CreateMenu` adds a new menu item to the Tools menu, and the `DeleteMenu` procedure removes that menu item. You can examine this code on your own.



Refer to Chapter 23 for detailed information on menu manipulation techniques.

Evaluation of the project

The previous sections described each component of the Text Tools utility. At this point, it's useful to revisit the original project goals to see whether they were met. The original goals, along with my comments, are as follows:

- ♦ *It will have the same look and feel of other Excel commands. In other words, it will have a dialog box that looks like Excel's dialog boxes.* As I noted earlier, the Text Tools utility deviates from Excel's normal look and feel by using an Apply button rather than an OK button. In light of the enhanced usability, I think this is quite reasonable.
- ♦ *It will be accessible from the Tools menu.* Accomplished.
- ♦ *It will operate with the current selection of cells (including multiple selections), and it will enable the user to modify the range selection while the dialog box is displayed.* Accomplished.

- ♦ *Its main features will consist of tools to change the case of text, add new text to the strings, delete a fixed number of characters from the text, and remove spaces from the text in each cell. Accomplished.*
- ♦ *It also will enable the user to display key statistics about the selected cells. Accomplished.*
- ♦ *It will enable the user to request the preceding types of changes on nontext cells as well as text cells. Accomplished.*
- ♦ *It will have no effect on cells that contain formulas. Accomplished.*
- ♦ *It will be fast and efficient. For example, if the user selects an entire range, the utility should ignore empty cells. Accomplished.*
- ♦ *It will enable the user to undo the changes. Accomplished, but in a nonstandard way.*
- ♦ *It will have online help available. Accomplished, but in a nonstandard way.*

Understand the Text Tools utility

If you don't fully understand how this utility works, I urge you to load the workbook and use the Debugger to step through the code. Try it out with different types of selections, including an entire worksheet. You will see that, regardless of the size of the original selection, only the appropriate cells are processed and empty cells are completely ignored. If a worksheet has only one cell with text in it, the utility operates just as quickly whether you select that cell or the entire worksheet.



For the best results, you might want to convert the Text Tools utility workbook to an add-in. Refer to Chapter 21 for more information about creating add-ins.

More About Excel Utilities

I wrap up this chapter with a few closing words about Excel utilities.

You can use the coupon in the back of this book to order a free copy of my Power Utility Pak (see Figure 16-10). This product includes several dozen useful utilities (plus many custom worksheet functions). The complete VBA source code also is available for a small fee. You can get a feel for how the product works by installing the shareware version, available on the companion CD-ROM.

In addition to the Power Utility Pak, several other utility packages exist, and they can be downloaded from the Internet. A good starting point for locating additional Web utilities is my Web site. Visit The Spreadsheet Page at <http://www.j-walk.com/ss>.

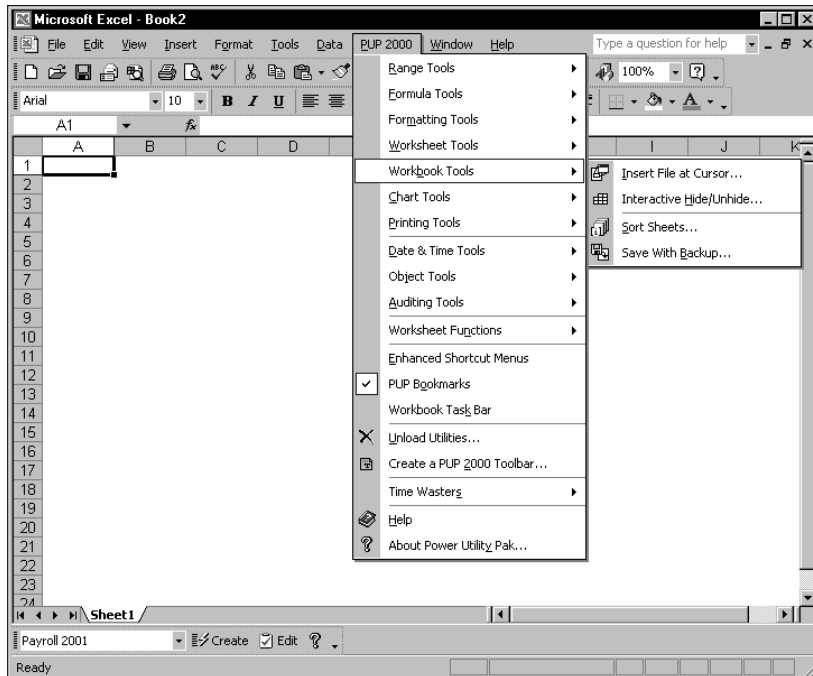


Figure 16-10: The author's Power Utility Pak contains many useful Excel utilities.

Summary

In this chapter, I discussed why you might want to develop Excel utilities with VBA. I also presented and explained the VBA code for my Text Tools utility. As you gain more experience with programming Excel, you'll probably have some ideas for creating your own utilities. This chapter should provide you with enough background information to give you a jump-start.



Working with Pivot Tables

Excel's pivot table feature is, arguably, its most innovative and powerful feature. Pivot tables first appeared in Excel 5, and the feature remains unique to Excel (no other spreadsheet has anything that comes close to it). As you probably know, creating a pivot table from a database or list enables you to summarize data in ways that otherwise would not be possible—and it's amazingly fast. You also can write VBA code to generate and modify pivot tables.

**Note**

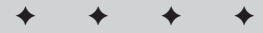
Excel's pivot table feature was enhanced significantly in Excel 2000. It uses more efficient data caching, and it also supports PivotCharts. A PivotChart is a chart linked to a pivot table. Consequently, some of the material in this chapter does not apply to Excel 97 or earlier.

This chapter is not an introduction to pivot tables. It assumes that you're familiar with this feature and understand how to create and modify pivot tables manually.

An Introductory Example

This section gets the ball rolling with a simple example of using VBA to create a pivot table.

Figure 17-1 shows a very simple worksheet database. It contains four fields: SalesRep, Region, Month, and Sales. Each record describes the sales for a particular sales representative in a particular month.

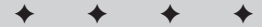


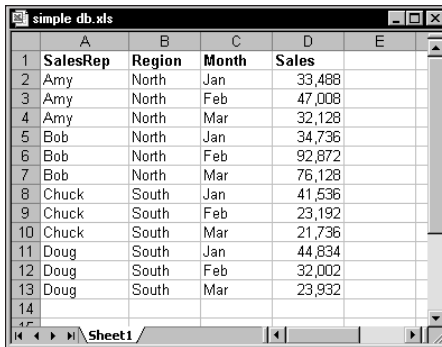
In This Chapter

What you need to know to create pivot tables with VBA

Examples of VBA procedures that create pivot tables

An example of how to use VBA to modify an existing pivot table





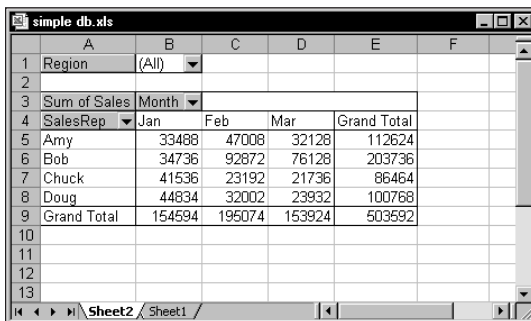
	A	B	C	D	E
1	SalesRep	Region	Month	Sales	
2	Amy	North	Jan	33,488	
3	Amy	North	Feb	47,008	
4	Amy	North	Mar	32,128	
5	Bob	North	Jan	34,736	
6	Bob	North	Feb	92,872	
7	Bob	North	Mar	76,128	
8	Chuck	South	Jan	41,536	
9	Chuck	South	Feb	23,192	
10	Chuck	South	Mar	21,736	
11	Doug	South	Jan	44,834	
12	Doug	South	Feb	32,002	
13	Doug	South	Mar	23,932	
14					

Figure 17-1: This simple database is a good candidate for a pivot table.

Creating a pivot table

Figure 17-2 shows a pivot table created from the data. This pivot table summarizes the sales by sales representative and month. This pivot table is set up with the following fields:

- Region A page field in the pivot table
- SalesRep A row field in the pivot table
- Month A column field in the pivot table
- Sales A data field in the pivot table that uses the Sum function



	A	B	C	D	E	F
1	Region	(All)				
2						
3	Sum of Sales	Month				
4	SalesRep	Jan	Feb	Mar	Grand Total	
5	Amy	33488	47008	32128	112624	
6	Bob	34736	92872	76128	203736	
7	Chuck	41536	23192	21736	86464	
8	Doug	44834	32002	23932	100768	
9	Grand Total	154594	195074	153924	503592	
10						
11						
12						
13						

Figure 17-2: A pivot table created from the data in Figure 17-1

I turned on the macro recorder before I created this pivot table. The code that was generated follows:

```
Sub Macro1()
' Recorded macro
Range("A1").Select
ActiveWorkbook.PivotCaches.Add _
(SourceType:=xlDatabase, _
SourceData:="Sheet1!R1C1:R13C4"). _
CreatePivotTable _
TableDestination:="", _
TableName:="PivotTable1", _
DefaultVersion:=xlPivotTableVersion10

ActiveSheet.PivotTableWizard _
TableDestination:=ActiveSheet.Cells(3, 1)
ActiveSheet.Cells(3, 1).Select

With ActiveSheet.PivotTables("PivotTable1"). _
PivotFields("Region")
.Orientation = xlPageField
.Position = 1
End With

With ActiveSheet.PivotTables("PivotTable1"). _
PivotFields("SalesRep")
.Orientation = xlRowField
.Position = 1
End With

With ActiveSheet.PivotTables("PivotTable1"). _
PivotFields("Month")
.Orientation = xlColumnField
.Position = 1
End With
ActiveSheet.PivotTables("PivotTable1"). _
AddDataField ActiveSheet.PivotTables("PivotTable1"). _
PivotFields("Sales"), "Sum of Sales", xlSum
End Sub
```

How the macro recorder generates code for you depends on how you built the pivot table. In the preceding example, I created a pivot table, which was empty until I dragged in the fields from the PivotTable toolbar. The alternate method is to click the Layout button in the second step of the PivotTable Wizard and lay out the pivot table before it's created.

You can, of course, execute the recorded macro to create another *identical* pivot table. If you do this, make sure the sheet with the data is active when you execute the macro.

Examining the recorded code

VBA code that works with pivot tables can be confusing. To make any sense of the recorded macro, you need to know about a few relevant objects, all of which are thoroughly explained in the online help.

PivotCaches	A collection of PivotCache objects in a Workbook object.
PivotTables	A collection of PivotTable objects in a Worksheet object.
PivotFields	A collection of fields in a PivotTable object.
PivotItems	A collection of individual data items within a field category.
CreatePivotTable	A PivotCache object method that creates a pivot table using the data in a pivot cache.
PivotTableWizard	A Worksheet object method that creates a pivot table. As you'll see in the next section, this method isn't necessary.

Cleaning up the recorded code

As with most recorded macros, the preceding example is not as efficient as it could be. It can be simplified to make it more understandable. Listing 17-1 generates the same pivot table as the procedure previously listed.

Listing 17-1: A more efficient way to generate a pivot table in VBA

```
Sub CreatePivotTable()
    Dim PTCache As PivotCache
    Dim PT As PivotTable

    Set PTCache = ActiveWorkbook.PivotCaches.Add _
        (SourceType:=xlDatabase, _
         SourceData:=Range("A1").CurrentRegion.Address)

    Set PT = PTCache.CreatePivotTable _
        (TableDestination:="", _
         TableName:="PivotTable1")

    With PT
        .PivotFields("Region").Orientation = xlPageField
        .PivotFields("Month").Orientation = xlColumnField
    End With
End Sub
```

```
        .PivotFields("SalesRep").Orientation = xlRowField  
        .PivotFields("Sales").Orientation = xlDataField  
    End With  
End Sub
```

The `CreatePivotTable` procedure is simplified (and may be easier to understand) because it declares two object variables: `PTCache` and `PT`. These take the place of the indexed references to `ActiveSheet.PivotCaches` and `ActiveSheet.PivotTables`. A new `PivotCache` object is created using the `Add` method. Then a new `PivotTable` object is created using the `CreatePivotTable` method of the `PivotCaches` collection. The last section of the code adds the fields to the pivot table and specifies their location within it (page, column, row, or data field).

Notice that the original macro “hard coded” the data range used to create the `PivotCache` object (that is, “Sheet1!R1C1:R13C4”). In the `CreatePivotTable` procedure, the pivot table is based on the current region surrounding Cell A1. This ensures that the macro will continue to work properly when more data is added.

**Note**

The code also could be more general through the use of indices rather than literal strings for the `PivotFields` collections. This way, if the user changes the column headings, the code will still work. For example, more general code would use `PivotFields(1)` rather than `PivotFields("Region")`.

As always, the best way to master this topic is to record your actions within a macro to find out its relevant objects, methods, and properties. Then study the online help topics to understand how everything fits together. In almost every case, you’ll need to modify the recorded macros. Or, once you understand how to work with pivot tables, you can write code from scratch and avoid the macro recorder.

Creating a More Complex Pivot Table

In this section, I present VBA code to create a relatively complex pivot table.

The data

Figure 17-3 shows part of a worksheet database. This table contains 15,840 rows containing hierarchical budget data for a corporation. There are five divisions, and each division contains eleven departments. Each department has four budget categories, and each budget category contains several budget items. Budgeted and actual amounts are included for each of the twelve months.



This workbook is available on the companion CD-ROM.

	A	B	C	D	E	F	G
1	DIVISION	DEPARTMENT	CATEGORY	ITEM	MONTH	BUDGET	ACTUAL
2	N. America	Data Processing	Compensation	Salaries	Jan	2583	3165
3	N. America	Data Processing	Compensation	Benefits	Jan	4496	2980
4	N. America	Data Processing	Compensation	Bonuses	Jan	3768	3029
5	N. America	Data Processing	Compensation	Commissions	Jan	3133	2815
6	N. America	Data Processing	Compensation	Payroll Taxes	Jan	3559	3770
7	N. America	Data Processing	Compensation	Training	Jan	3099	3559
8	N. America	Data Processing	Compensation	Conferences	Jan	2931	3199
9	N. America	Data Processing	Compensation	Entertainment	Jan	2632	2633
10	N. America	Data Processing	Facility	Rent	Jan	2833	2508
11	N. America	Data Processing	Facility	Lease	Jan	3450	2631
12	N. America	Data Processing	Facility	Utilities	Jan	4111	3098
13	N. America	Data Processing	Facility	Maintenance	Jan	3070	2870
14	N. America	Data Processing	Facility	Telephone	Jan	3827	4329
15	N. America	Data Processing	Facility	Other	Jan	3843	3322
16	N. America	Data Processing	Supplies & Services	General Office	Jan	2642	3218
17	N. America	Data Processing	Supplies & Services	Computer Supplies	Jan	3052	4098
18	N. America	Data Processing	Supplies & Services	Books & Subs	Jan	4346	3361
19	N. America	Data Processing	Supplies & Services	Outside Services	Jan	2869	3717
20	N. America	Data Processing	Supplies & Services	Other	Jan	3328	3116
21	N. America	Data Processing	Equipment	Computer Hardware	Jan	3088	2728
22	N. America	Data Processing	Equipment	Software	Jan	4226	2675
23	N. America	Data Processing	Equipment	Photocopiers	Jan	3780	3514
24	N. America	Data Processing	Equipment	Telecommunications	Jan	3893	3664
25	N. America	Data Processing	Equipment	Other	Jan	2851	4380
26	N. America	Human Resources	Compensation	Salaries	Jan	3604	3501
27	N. America	Human Resources	Compensation	Benefits	Jan	2859	4493
28	N. America	Human Resources	Compensation	Bonuses	Jan	3020	2676
29	N. America	Human Resources	Compensation	Commissions	Jan	2759	3954
30	N. America	Human Resources	Compensation	Payroll Taxes	Jan	3941	3166

Figure 17-3: The data in this workbook will be summarized in a pivot table.

The pivot table

Figure 17-4 shows a pivot table created from the data. Notice that the pivot table contains a calculated field named *Variance*, plus four calculated items, Q1, Q2, Q3, and Q4, which calculate quarterly totals.

DEPARTMENT	Data	Jan	Feb	Mar	Q1	Apr	May	Jun
Accounting	Budget (\$)	422455	433317	420522	1276294	417964	411820	41
	Actual (\$)	422662	413163	416522	1252347	420672	431303	42
	Variance (\$)	-207	20154	4000	23947	-2708	-19483	-1
Advertising	Budget (\$)	424590	419331	417949	1261870	420324	427150	42
	Actual (\$)	416008	420828	425437	1262273	417310	419996	42
	Variance (\$)	8582	-1497	-7488	-403	3014	7154	-
Data Processing	Budget (\$)	422197	422057	419659	1263913	417260	422848	42
	Actual (\$)	414743	436990	430545	1284278	424214	411775	42
	Variance (\$)	7454	-16933	-10886	-20365	-6954	11073	-
Human Resources	Budget (\$)	422053	425313	418634	1266000	423038	423514	41
	Actual (\$)	424934	429275	407063	1261262	429187	410258	42
	Variance (\$)	-2681	-3962	11581	4738	-6149	13256	-
Operations	Budget (\$)	413530	427975	419527	1261032	422299	415298	41
	Actual (\$)	415819	406592	426827	1249238	418223	431307	41
	Variance (\$)	-2289	21383	-7300	11794	4076	-16009	-
Public Relations	Budget (\$)	424896	414507	415179	1254582	417100	426223	40
	Actual (\$)	413526	414084	415476	1243086	414040	396652	41
	Variance (\$)	11370	423	-297	11496	3060	29571	-
R&D	Budget (\$)	417771	429880	424066	1271717	421539	417440	42
	Actual (\$)	432019	426644	419595	1278258	427567	412038	42
	Variance (\$)	-14248	3236	4471	-6541	-6028	5402	-
Sales	Budget (\$)	420659	421962	417814	1260435	420302	422409	42
	Actual (\$)	431565	421251	408661	1261477	408912	425620	42
	Variance (\$)	-10906	711	9153	-1042	11390	-3211	-
Security	Budget (\$)	419195	419294	413258	1251747	421700	421875	42
	Actual (\$)	409486	418697	427401	1255584	419771	421266	42
	Variance (\$)	97009	5597	-14243	10163	19229	10609	-

Figure 17-4: A pivot table created from the data in Figure 17-3

The code that created the pivot table

The VBA code that created the pivot table is shown in Listing 17-2.

Listing 17-2: Creating a compartmentalized pivot table

```

Sub CreatePivotTable()
    Dim PTCache As PivotCache
    Dim PT As PivotTable

    Application.ScreenUpdating = False

    ' Delete PivotSheet if it exists
    On Error Resume Next
    Application.DisplayAlerts = False
    Sheets("PivotSheet").Delete
    On Error GoTo 0
    Application.DisplayAlerts = True

```

Continued

Listing 17-2 (continued)

```

' Create a Pivot Cache
Set PTCache = ActiveWorkbook.PivotCaches.Add( _
    SourceType:=xlDatabase, _
    SourceData:=Range("A1").CurrentRegion.Address)

' Add new worksheet
Worksheets.Add
ActiveSheet.Name = "PivotSheet"

' Create the Pivot Table from the Cache
Set PT = PTCache.CreatePivotTable( _
    TableDestination:=Sheets("PivotSheet").Range("A1"), _
    TableName:="BudgetPivot")

With PT
' Add fields
.PivotFields("DEPARTMENT").Orientation = xlRowField
.PivotFields("MONTH").Orientation = xlColumnField
.PivotFields("DIVISION").Orientation = xlPageField
.PivotFields("BUDGET").Orientation = xlDataField
.PivotFields("ACTUAL").Orientation = xlDataField

' Add a calculated field to compute variance
.CalculatedFields.Add "Variance", "=BUDGET-ACTUAL"
.PivotFields("Variance").Orientation = xlDataField

' Add calculated items
.PivotFields("MONTH").CalculatedItems.Add _
    "Q1", "= Jan+Feb+Mar"
.PivotFields("MONTH").CalculatedItems.Add _
    "Q2", "= Apr+May+Jun"
.PivotFields("MONTH").CalculatedItems.Add _
    "Q3", "= Jul+Aug+Sep"
.PivotFields("MONTH").CalculatedItems.Add _
    "Q4", "= Oct+Nov+Dec"

' Move the calculated items
.PivotFields("MONTH").PivotItems("Q1").Position = 4
.PivotFields("MONTH").PivotItems("Q2").Position = 8
.PivotFields("MONTH").PivotItems("Q3").Position = 12
.PivotFields("MONTH").PivotItems("Q4").Position = 16

' Change the captions
.PivotFields("Sum of BUDGET").Caption = "Budget ($)"
.PivotFields("Sum of ACTUAL").Caption = "Actual ($)"
.PivotFields("Sum of Variance").Caption = "Variance ($)"
End With
Application.ScreenUpdating = True
End Sub

```

How it works

The second `CreatePivotTable` procedure in Listing 17-2 starts by deleting the `PivotSheet` worksheet if it already exists. It then creates a `PivotCache` object, inserts a new worksheet named `PivotSheet`, and creates the pivot table. The code then adds the following fields to the pivot table:

Department	A row field
Month	A column field
Division	A page field
Budget	A data field
Actual	A data field

Next, the procedure uses the `Add` method of the `CalculatedFields` collection to create the calculated field `Variance`, which subtracts the `Actual` amount from the `Budget` amount. The code then adds four calculated items to compute the quarterly totals. By default, the calculated items are added to the right side of the pivot table, so additional code is required to move them adjacent to the months to which they refer (for example, Q1 is placed after March). Finally, the code changes the captions displayed in the pivot table. For example, `Sum of Budget` is replaced by `Budget ($)`.

**Note**

I created this procedure by recording my actions while I created and modified the pivot table. Then I cleaned up the code to make it more readable and efficient.

Creating a Pivot Table from an External Database

In the preceding example, the source data was in a worksheet. As you probably know, Excel also enables you to use an external data source to create a pivot table. The example in this section demonstrates how to write VBA code to create a pivot table based on data stored in an Access database file.

**Note**

The database consists of a single table that is identical to the data used in the previous example.

The code that creates the pivot table is shown in Listing 17-3. It assumes that the `budget.mdb` database file is stored in the same directory as the workbook.

Listing 17-3: Generating a pivot table from an external database

```
Sub CreatePivotTableFromDB()  
    Dim PTCache As PivotCache  
    Dim PT As PivotTable  
  
    ' Delete PivotSheet if it exists  
    On Error Resume Next  
    Application.DisplayAlerts = False  
    Sheets("PivotSheet").Delete  
    On Error GoTo 0  
  
    ' Create a Pivot Cache  
    Set PTCache = ActiveWorkbook.PivotCaches.Add _  
        (SourceType:=xlExternal)  
  
    ' Connect to database, and do query  
    DBFile = ThisWorkbook.Path & "\budget.mdb"  
    ConString = "ODBC;DSN=MS Access Database;DBQ=" & DBFile  
  
    QueryString = "SELECT * FROM BUDGET"  
    With PTCache  
        .Connection = ConString  
        .CommandText = QueryString  
    End With  
  
    ' Add new worksheet  
    Worksheets.Add  
    ActiveSheet.Name = "PivotSheet"  
  
    ' Create pivot table  
    Set PT = PTCache.CreatePivotTable( _  
        TableDestination:=Sheets("PivotSheet").Range("A1"), _  
        TableName:="BudgetPivot")  
  
    ' Add fields  
    With PT  
        ' Add fields  
        .PivotFields("DEPARTMENT").Orientation = xlRowField  
        .PivotFields("MONTH").Orientation = xlColumnField  
        .PivotFields("DIVISION").Orientation = xlPageField  
        .PivotFields("BUDGET").Orientation = xlDataField  
        .PivotFields("ACTUAL").Orientation = xlDataField  
    End With  
End Sub
```

Notice that the `SourceType` argument for the `Add` method of the `PivotCaches` collection is specified as `xlExternal`. In the example in the previous section (which used data in a worksheet database), the `SourceType` argument was `xlDatabase`.

The `PivotCache` object needs the following information to retrieve the data from the external file:

- ♦ *A connection string.* This describes the type of data source and the filename. In this example, the connection string specifies an ODBC data source that is a Microsoft Access file named `budget.mdb`.
- ♦ *A query string.* This is a Structured Query Language (SQL) statement that determines which records and fields are returned. In this example, the entire `Budget` table is selected.

This information is passed to the `PivotCache` object by setting the `Connection` and `CommandText` properties. Once the data is stored in the pivot cache, the pivot table is created using the `CreatePivotTable` method.



Note

SQL is a standard language for performing database queries. For more information, consult the online help. Better yet, you might want to purchase a book that deals exclusively with SQL. Several such books are available from Hungry Minds, Inc.

Creating Multiple Pivot Tables

The final example creates a series of pivot tables that summarize data collected in a customer survey. That data is stored in a worksheet database (see Figure 17-5) and consists of 100 rows. Each row contains the respondent's sex, plus a numerical rating using a 1-to-5 scale for each of the 14 survey items.

	A	B	C	D	E	F	G	H	I	J
	Name	Sex	Store locations are convenient	Store hours are convenient	Stores are well-maintained	You are easy to reach by phone	I like your web site	Employees are friendly	Employees are helpful	Employee are knowledgeable
2	Subject1	Male	1	4	4	4	1	1	2	1
3	Subject2	Female	2	5	1	1	4	2	4	3
4	Subject3	Male	1	1	4	2	3	3	2	1
5	Subject4	Male	2	1	3	5	1	2	3	4
6	Subject5	Female	2	2	5	5	4	2	1	5
7	Subject6	Female	2	4	3	3	1	1	4	4
8	Subject7	Female	2	4	5	4	5	3	2	5
9	Subject8	Male	3	2	1	2	3	4	3	1
10	Subject9	Female	3	4	4	4	5	1	4	1
11	Subject10	Male	2	1	5	5	5	1	4	1
12	Subject11	Male	4	3	3	2	1	2	4	2
13	Subject12	Female	2	1	4	5	5	5	3	1
14	Subject13	Female	4	3	4	3	2	5	3	3
15	Subject14	Female	2	3	4	2	1	1	4	2
16	Subject15	Female	1	3	5	1	2	2	4	1
17	Subject16	Male	1	4	1	3	4	3	4	4
18	Subject17	Female	3	4	3	5	5	4	4	3
19	Subject18	Male	1	5	5	3	5	3	4	2
20	Subject19	Female	1	3	5	4	5	5	5	1

Figure 17-5: Creating a series of pivot tables will summarize this survey data.

Figure 17-6 shows a few of the resulting pivot tables. Each pivot table provides a frequency distribution of a survey item, broken down by sex.

	A	B	C	D	E	F	G	H
1		Sex	Data					
2		Female	Male	Total Freq	Total Pct			
3	Store locations are convenient	Freq	Pct	Freq	Pct			
4	Strongly Disagree	20	10.05%	26	13.07%	46	23.12%	
5	Disagree	26	13.07%	22	11.06%	48	24.12%	
6	Undecided	30	15.08%	18	9.05%	48	24.12%	
7	Agree	12	6.03%	40	20.10%	52	26.13%	
8	Strongly Agree	5	2.51%		0.00%	5	2.51%	
9	Grand Total	93	46.73%	106	53.27%	199	100.00%	
10								
11		Sex	Data					
12		Female	Male	Total Freq	Total Pct			
13	Store hours are convenient	Freq	Pct	Freq	Pct			
14	Strongly Disagree	6	1.99%	9	2.99%	15	4.98%	
15	Disagree	10	3.32%	16	5.32%	26	8.64%	
16	Undecided	57	18.94%	48	15.95%	105	34.88%	
17	Agree	60	19.93%	60	19.93%	120	39.87%	
18	Strongly Agree	10	3.32%	25	8.31%	35	11.63%	
19	Grand Total	143	47.51%	158	52.49%	301	100.00%	
20								
21								

Figure 17-6: A VBA procedure created these pivot tables.

The VBA code that created the pivot tables is presented in Listing 17-4.

Listing 17-4: Creating multiple pivot tables from a complex external database

```

Sub MakePivotTables()
' This procedure creates 14 pivot tables
Dim PTCache As PivotCache
Dim PT As PivotTable
Dim SummarySheet As Worksheet
Dim ItemName As String
Dim Row As Integer, i As Integer

Application.ScreenUpdating = False

' Delete Summary sheet if it exists
On Error Resume Next
Application.DisplayAlerts = False
Sheets("Summary").Delete
On Error GoTo 0
Application.DisplayAlerts = True

' Add Summary sheet
Set SummarySheet = Worksheets.Add
ActiveSheet.Name = "Summary"

' Create Pivot Cache
Set PTCache = ActiveWorkbook.PivotCaches.Add( _
    SourceType:=xlDatabase, _
    SourceData:=Sheets("SurveyData").Range("A1"). _
    CurrentRegion.Address)

Row = 1
For i = 1 To 14
    ItemName = Sheets("SurveyData").Cells(1, i + 2)
' Create pivot table
Set PT = PTCache.CreatePivotTable _
    (TableDestination:=SummarySheet.Cells(Row, 1), _
    TableName:=ItemName)
    Row = Row + 11

' Add the fields
With PT.PivotFields(ItemName)
    .Orientation = xlDataField
    .Name = "Freq"
End With

With PT.PivotFields(ItemName)
    .Orientation = xlDataField
    .Name = "Pct"
    .Calculation = xlPercentOfTotal
End With

```

Continued

Listing 17-4 (continued)

```
PT.AddFields RowFields:=Array(ItemName, "Data")
PT.PivotFields("Sex").Orientation = xlColumnField
PT.PivotFields("Data").Orientation = xlColumnField
Next i

' Replace numbers with descriptive text
SummarySheet.Activate
With Columns("A:A")
    .Replace "1", "Strongly Disagree"
    .Replace "2", "Disagree"
    .Replace "3", "Undecided"
    .Replace "4", "Agree"
    .Replace "5", "Strongly Agree"
End With

' Adjust column widths
Columns("A:G").EntireColumn.AutoFit
End Sub
```

Notice that the pivot tables are created within a loop, and all come from a single `PivotCache` object. The `Row` variable keeps track of the start of each pivot table. After the pivot tables are created, the code replaces the numeric categories in the first column with text (for example, *1* is replaced with *Strongly Agree*). Finally, the column widths are adjusted.

Modifying Pivot Tables

An Excel pivot table is designed to be flexible. For example, users can easily change a row field to a column field and hide certain items in the pivot table that are not relevant to their current needs. You may want to provide your own interface to make it even easier for the user to make certain pivot table changes. The example in this section presents a pivot table that can be controlled by a series of `OptionButtons` and two `CheckBox` controls, as shown in Figure 17-7.

The pivot table contains four additional calculated items (Q1, Q2, Q3, and Q4), which compute quarterly totals. The VBA code that's executed when `OptionButton1` (Months Only) is clicked is shown in Listing 17-5. The procedure is straightforward and similar to the event-handler procedures for the other `OptionButtons`.

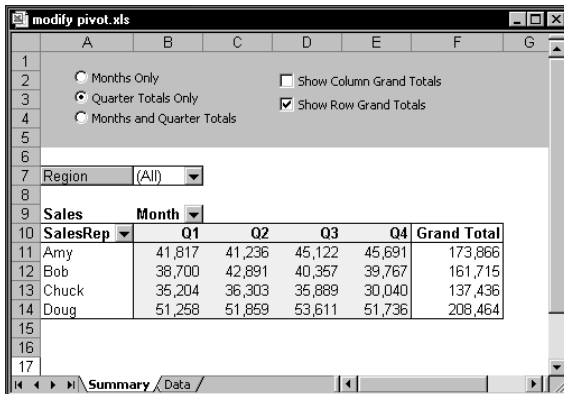


Figure 17-7: The user can use the controls to adjust the pivot table.

Listing 17-5: Responding to a user request to adjust a pivot table option

```
Private Sub OptionButton1_Click()
    ' Months only
    Application.ScreenUpdating = False
    With ActiveSheet.PivotTables(1).PivotFields("Month")
        .PivotItems("Jan").Visible = True
        .PivotItems("Feb").Visible = True
        .PivotItems("Mar").Visible = True
        .PivotItems("Apr").Visible = True
        .PivotItems("May").Visible = True
        .PivotItems("Jun").Visible = True
        .PivotItems("Jul").Visible = True
        .PivotItems("Aug").Visible = True
        .PivotItems("Sep").Visible = True
        .PivotItems("Oct").Visible = True
        .PivotItems("Nov").Visible = True
        .PivotItems("Dec").Visible = True
        .PivotItems("Q1").Visible = False
        .PivotItems("Q2").Visible = False
        .PivotItems("Q3").Visible = False
        .PivotItems("Q4").Visible = False
    End With
End Sub
```

The `CheckBox` controls simply toggle the display of the grand totals. These event-handler procedures follow:

```
Private Sub CheckBox1_Click()  
    ' Column Grand Totals  
    Application.ScreenUpdating = False  
    ActiveSheet.PivotTables(1).ColumnGrand = CheckBox1.Value  
End Sub  
  
Private Sub CheckBox2_Click()  
    ' Row Grand Totals  
    Application.ScreenUpdating = False  
    ActiveSheet.PivotTables(1).RowGrand = CheckBox2.Value  
End Sub
```

Pivot tables, of course, can be modified in many other ways. As I've mentioned, the easiest way to create VBA code that modifies pivot tables is to turn on the macro recorder while you make the changes manually. Then adjust the code and copy it to the event-handler procedures for your controls.

Summary

This chapter provided several examples of how to create and modify pivot tables using VBA code.

In the next chapter, I present VBA techniques to manipulate charts.



Working with Charts

By any standard, Excel's charting feature is impressive. A chart displays data of virtually any type that's stored in a worksheet. Excel supports more than 100 different chart types, and you have almost complete control over nearly every aspect of each chart.

About Charts

Due to its richness, a chart is simply packed with objects, each of which has its own properties and methods. Because of this, manipulating charts with VBA can be a bit of a challenge. In this chapter, I discuss the key concepts that you need to understand in order to write VBA code that generates or manipulates charts. The secret, as you'll see, is a good understanding of the object hierarchy for charts. First, a bit of background about Excel charts.

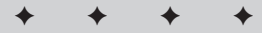
Chart locations

In Excel, a chart can be located in either of two places within a workbook:

- ◆ As an embedded object on a worksheet. A worksheet can contain any number of embedded charts.
- ◆ In a separate chart sheet. A chart sheet holds a single chart.

**Note**

An embedded chart can also reside on an Excel 5/95 dialog sheet. And, as I discuss later in this chapter (see "Storing multiple charts on a chart sheet"), you can also store embedded charts on a chart sheet.



In This Chapter

Essential background information on Excel charts

The difference between embedded charts and chart sheets

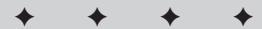
Understanding the Chart object model

Using the macro recorder to help you learn about Chart objects

Examples of common charting tasks using VBA

Examples of more complex charting macros

Some interesting (and useful) chart-making tricks



Most charts are created manually, using the ChartWizard. But, as you'll see, you can also create charts using VBA. And, of course, you can use VBA to modify existing charts.



Tip

The fastest way to create a chart on a new sheet is to select your data and press F11. Excel creates a new chart sheet and uses the default chart type.

A key concept when working with charts is the “active chart.” When the user clicks an embedded chart or activates a chart sheet, a `Chart` object is activated. In VBA, the `ActiveChart` property returns the activated `Chart` object (if any). You can write code to work with this `Chart` object, much like you can write code to work with the `Workbook` object returned by the `ActiveWorkbook` property.

Here's an example. If a chart is activated, the following statement will display the `Name` property for the `Chart` object:

```
MsgBox ActiveChart.Name
```

If a chart is not activated, the preceding statement will generate an error.



Note

As you'll see later in this chapter, it's not necessary to activate a chart in order to manipulate it with VBA.

The Chart object model

To get a feel for the number of objects involved when working with charts, turn on the macro recorder, create a chart, and perform some routine chart editing tasks. You might be surprised by the amount of code Excel generates. When you first start exploring the object model for a `Chart` object, you'll probably be very confused . . . which is not surprising, since the object model *is* very confusing. It's also very deep.

For example, assume that you want to change the title displayed in an embedded chart. The top-level object, of course, is the `Application` object (Excel). The `Application` object contains a `Workbook` object, and the `Workbook` object contains a `Worksheet` object. The `Worksheet` object contains a `ChartObject` object, which contains a `Chart` object. The `Chart` object has a `ChartTitle` object, and the `ChartTitle` object contains a `Characters` object. The `Text` property of the `Characters` object stores the text that's displayed as the chart's title. In other words, the `Characters` object is at the seventh hierarchical object level.

Here's another way to look at this hierarchy for an embedded chart:

```
Application
  Workbook
    Worksheet
      ChartObject
```

```

Chart
  ChartTitle
    Characters

```

Your VBA code must, of course, follow this object model precisely. For example, to set a chart's title to *YTD Sales*, you can write a VBA instruction like this:

```

Worksheets("Sheet1").ChartObjects(1).Chart.ChartTitle. _
  Characters.Text = "YTD Sales"

```

Alternatively, you can access the `Text` property of the `ChartTitle` object:

```

Worksheets("Sheet1").ChartObjects(1).Chart.ChartTitle. _
  .Text = "YTD Sales"

```

Using the `Characters` object is necessary if you need to format individual characters within the text.

This statement assumes the active workbook as the `Workbook` object. The statement works with the first item in the `ChartObjects` collection on the worksheet named `Sheet1`. The `Chart` property returns the actual `Chart` object. The `ChartTitle` property returns the `ChartTitle` object, and the `Characters` property returns the `Characters` object. What you're really interested in is the `Text` property of this `Characters` object.

For a chart sheet, the object hierarchy is a bit different since it doesn't involve the `Worksheet` object or the `ChartObject` object. For example, here's the hierarchy for the `Characters` object for a chart in a chart sheet:

```

Application
  Workbook
    Chart
      ChartTitle
        Characters

```

In terms of VBA, you could use this statement to set the chart title to *YTD Sales*.

```

Sheets("Chart1").ChartTitle.Characters.Text = "YTD Sales"

```

Or, you can set the `Text` property of the `ChartTitle` object directly:

```

Sheets("Chart1").ChartTitle.Text = "YTD Sales"

```

In other words, a chart sheet is actually a `Chart` object and it has no containing `ChartObject` object. Put another way, the parent object for an embedded chart is a `ChartObject` object and the parent object for a chart on a separate chart sheet is a `Workbook` object.

Both of the following statements will display a message box with the word *Chart* in it:

```
MsgBox TypeName(Sheets("Sheet1").ChartObjects(1).Chart)
```

```
Msgbox TypeName(Sheets("Chart1"))
```

Note

When you create a new embedded chart, you're adding to the `ChartObjects` collection contained in a particular worksheet (there is no `Charts` collection for a worksheet). When you create a new chart sheet, you're adding to the `Charts` collection and the `Sheets` collection for a particular workbook.

Recording Chart Macros

Perhaps the best way to become familiar with the `Chart` object model is to turn on the macro recorder while you create and manipulate charts. Even though the macro recorder tends to generate lots of extraneous and inefficient code, the recorded code will still give you insights regarding the objects, properties, and methods you need to know about.

Excel's macro recorder always activates a chart and then uses the `ActiveChart` property to return the actual `Chart` object. In Excel, it's not necessary to select an object (or activate a chart) in order to work with it in VBA. And, as I mentioned, the macro recorder generates lots of extraneous code. Therefore, if efficiency is among your goals, you should *never* actually use unedited recorded macros, especially those that manipulate charts.

Macro recorder output

I turned on the macro recorder while I created a chart (shown in Figure 18-1) and then performed some simple customizations to it.

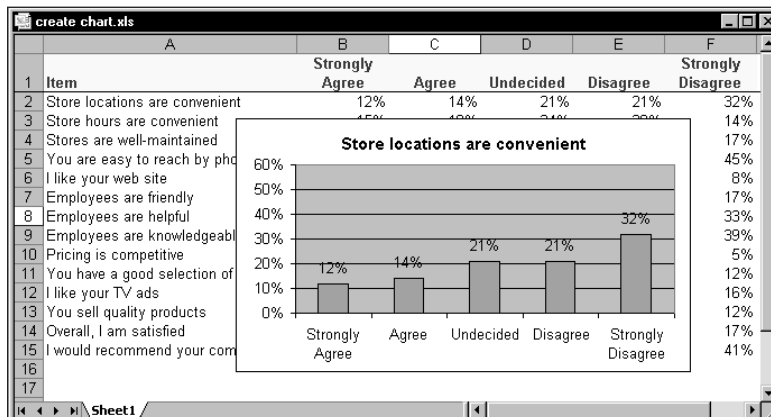


Figure 18-1: This chart was created while Excel's macro recorder was turned on.

Following is a listing of the code generated by the macro recorder:

```
Sub Macro1()
    Range("A1:F2").Select
    Charts.Add
    ActiveChart.ChartType = xlColumnClustered
    ActiveChart.SetSourceData _
        Source:=Sheets("Sheet1").Range("A1:F2"), _
        PlotBy:=xlRows
    ActiveChart.Location _
        Where:=xlLocationAsObject, _
        Name:="Sheet1"
    ActiveChart.HasLegend = False
    ActiveChart.ApplyDataLabels _
        Type:=xlDataLabelsShowValue, LegendKey:=False
    ActiveChart.HasDataTable = False
    ActiveChart.Axes(xlCategory).Select
    Selection.TickLabels.Orientation = xlHorizontal
    ActiveChart.ChartTitle.Select
    Selection.Font.Bold = True
    Selection.AutoScaleFont = True
    With Selection.Font
        .Name = "Arial"
        .Size = 12
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
        .Background = xlAutomatic
    End With
    ActiveChart.PlotArea.Select
    Selection.Top = 18
    Selection.Height = 162
    ActiveChart.ChartArea.Select
    ActiveChart.Axes(xlValue).Select
    With ActiveChart.Axes(xlValue)
        .MinimumScaleIsAuto = True
        .MaximumScale = 0.6
        .MinorUnitIsAuto = True
        .MajorUnitIsAuto = True
        .Crosses = xlAutomatic
        .ReversePlotOrder = False
        .ScaleType = xlLinear
    End With
End Sub
```

The “cleaned up” macro

Much of the code generated for the macro in the previous section is not necessary; it sets values for properties that really don't need to be set. Following is a listing for my edited macro. This performs exactly like the macro in the previous section, but it's significantly shorter and more efficient. Setting the `ScreenUpdating` property to `False` eliminates the screen refreshing.

```
Sub CleanedMacro()
    Application.ScreenUpdating = False
    Charts.Add
    ActiveChart.Location _
        Where:=xlLocationAsObject, Name:="Sheet1"
    With ActiveChart
        .SetSourceData Range("A1:F2")
        .HasTitle = True
        .ChartType = xlColumnClustered
        .HasLegend = False
        .ApplyDataLabels Type:=xlDataLabelsShowValue
        .Axes(xlCategory).TickLabels.Orientation = xlHorizontal
        .ChartTitle.Font.Bold = True
        .ChartTitle.Font.Size = 12
        .PlotArea.Top = 18
        .PlotArea.Height = 162
        .Axes(xlValue).MaximumScale = 0.6
        .Deselect
    End With
    Application.ScreenUpdating = True
End Sub
```


Note

When you create a chart using the `Add` method of the `Charts` collection, the created chart is always a chart sheet. In the preceding code, the `Location` method moves the chart to a worksheet.

The `Location` method of the `Chart` object is interesting, because it essentially creates a new object rather than relocating an existing object. To demonstrate, execute the following code:

```
Sub Test()
    Charts.Add
    MsgBox ActiveChart.Name
    ActiveChart.Location _
        Where:=xlLocationAsObject, Name:="Sheet1"
    MsgBox ActiveChart.Name
End Sub
```

This procedure adds a chart (a chart sheet) and then displays a message box that shows the name of the active chart. Then the `Location` method moves the chart to a worksheet. The next message box displays the name of active chart, which is different from the previous active chart. The original `Chart` object ceases to exist, and is replaced with a new `Chart` object contained in a `ChartObject` object.



A workbook that contains both the recorded macro and the “cleaned up” macro is included on the companion CD-ROM so you can compare the performance.

Common VBA Charting Techniques

In this section, I describe how to perform some common tasks that involve charts.

Activating a chart

When a user clicks on an embedded chart, the chart is activated. Your VBA code can activate an embedded chart using the `Activate` method. Here’s an example:

```
ActiveSheet.ChartObjects("Chart 1").Activate
```

If the chart is on a chart sheet, use a statement like this:

```
Sheets("Chart1").Activate
```

Once a chart is activated, you can refer to it in your code with `ActiveChart`. For example, the following instruction displays the name of the active chart. If there is no active chart, the statement generates an error:

```
MsgBox ActiveChart.Name
```

To modify a chart with VBA, it’s not necessary to activate it. The two procedures that follow have exactly the same effect (they change the embedded chart named `Chart 1` to an area chart). The first procedure activates the chart before performing the manipulations; the second one doesn’t.

```
Sub ModifyChart1()  
    ActiveSheet.ChartObjects("Chart 1").Activate  
    ActiveChart.Type = xlArea  
    ActiveChart.Deselect
```

```
End Sub
```

```
Sub ModifyChart2()  
    ActiveSheet.ChartObjects("Chart 1").Chart.Type = xlArea  
End Sub
```

A chart embedded on a worksheet can easily be converted to a chart sheet. To do so manually, just activate the embedded chart and select `Chart ⇄ Location`. In the `Chart Location` dialog box, select the `As new sheet` option and specify a name. This action essentially copies the `Chart` object (contained in a `ChartObject` object) to a chart sheet and then destroys its containing `ChartObject` object.

You can also convert an embedded chart to a chart sheet with VBA. Here's an example that converts the first `ChartObject` on a worksheet named `Sheet1` to a chart sheet named `MyChart`:

```
Sub ConvertChart1()  
    Sheets("Sheet1").ChartObjects(1).Chart. _  
        Location xlLocationAsNewSheet, "MyChart"  
End Sub
```

The following example does just the opposite of the preceding procedure: It converts the chart on a chart sheet named `MyChart` to an embedded chart on the worksheet named `Sheet1`.

```
Sub ConvertChart2()  
    Charts("MyChart"). _  
        Location xlLocationAsObject, "Sheet1"  
End Sub
```

Note

Using the `Location` method also activates the relocated chart.

When you activate a chart contained in a `ChartObject`, the chart is actually contained in a window that is normally *invisible*. To see an embedded chart in its own window, right-click the `ChartObject` and select `Chart Window` from the shortcut menu. The embedded chart will remain on the worksheet, but the chart will also appear in its own floating window (see Figure 18-2). You can move and resize this window (but you can't maximize it). If you move the window, you'll notice that the embedded chart is still displayed in its original location. Activating any other window will make the `ChartObject` window invisible again.

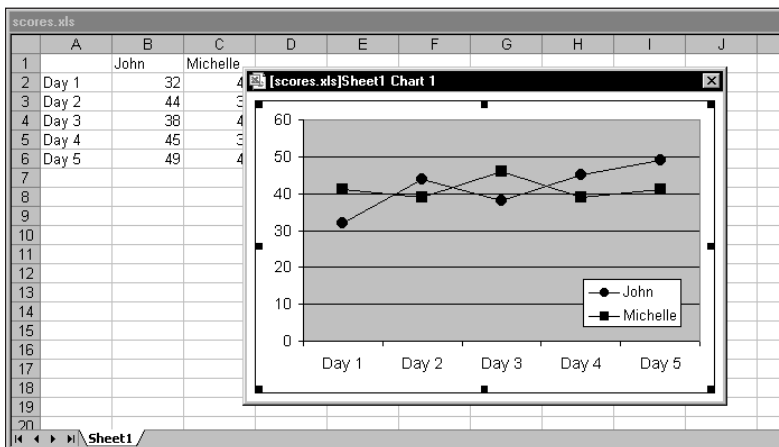


Figure 18-2: Displaying an embedded chart in a window

The following VBA code displays the window for the first `ChartObject` on the active sheet:

```
ActiveSheet.ChartObjects(1).Activate  
ActiveChart.ShowWindow = True
```



For a practical application of using a window to display an embedded chart, see “Printing embedded charts on a full page,” later in this chapter.

Deactivating a chart

When you record a macro that deactivates a chart, you’ll find that the macro recorder generates a statement such as:

```
ActiveWindow.Visible = False
```

This statement does indeed deactivate the chart, but it is certainly not very clear as to why the chart is deactivated. When writing macros that work with charts, you may prefer to use the `Deselect` method to deactivate a chart:

```
ActiveChart.Deselect
```

These two statements have slightly different effects. When an embedded chart is the active chart, executing `Deselect` method does not select any cells on the worksheet. Setting the `Visible` property of the `ActiveWindow` object to `False`, however, causes the previously selected range to be re-selected.

Determining whether a chart is activated

A common type of macro performs some manipulations on the active chart (the chart selected by a user). For example, a macro might change the chart’s type, apply colors, or change the font size.

The question is, how can your VBA code determine if the user has actually selected a chart? By selecting a chart, I mean activating a chart sheet, or activating an embedded chart by clicking it. Your first inclination might be to check the `TypeName` property of the `Selection`, as in this expression:

```
TypeName(Selection) = "Chart"
```

This expression above evaluates to `True` if a chart sheet is active, but it *won’t* be `True` if an embedded chart is selected. Rather, when an embedded chart is selected, the actual selection will be an object within the `Chart` object. For example, the selection might be a `Series` object, a `ChartTitle` object, a `Legend` object, a `PlotArea` object, etc.

The `ChartIsSelected` function, which follows, returns `True` if a chart sheet is active or if an embedded chart is activated, and returns `False` if a chart is not activated:

```
Private Function ChartIsSelected() As Boolean
    ChartIsSelected = Not ActiveChart Is Nothing
End Function
```

This function determines if the `ActiveChart` object is `Nothing`. If so, then a chart is not activated.

Deleting from `ChartObjects` or charts

To delete all `ChartObject` objects on a worksheet, you can simply use the `Delete` method of the `ChartObjects` collection:

```
ActiveSheet.ChartObjects.Delete
```

To delete all chart sheets in the active workbook, use the following statement:

```
ActiveWorkbook.Charts.Delete
```

Normally, deleting sheets causes Excel to display a warning like the one shown in Figure 18-3. The user must reply to this prompt in order for the macro to continue. To eliminate this prompt, use the following series of statements:

```
Application.DisplayAlerts = False
ActiveWorkbook.Charts.Delete
Application.DisplayAlerts = True
```

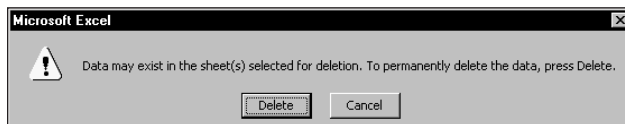


Figure 18-3: Attempting to delete one or more chart sheets results in this message.

Applying chart formatting

The following example applies several different types of formatting to the active chart:

```
Sub ChartMods1()
    With ActiveChart
        .Type = xlArea
        .ChartArea.Font.Name = "Arial"
```

```

        .ChartArea.Font.FontStyle = "Regular"
        .ChartArea.Font.Size = 9
        .PlotArea.Interior.ColorIndex = xlNone
        .Axes(xlValue).TickLabels.Font.Bold = True
        .Axes(xlCategory).TickLabels.Font.Bold = True
        .HasLegend = True
        .Legend.Position = xlBottom
    End With
End Sub

```

A chart must be active, or this routine will generate an error. Also, notice that the code sets the `HasLegend` property to `True`. This is to avoid an error that would occur when trying to set the `Position` property of the `Legend` object if the chart had no legend.

Following is another version of the `ChartMods` procedure. In this case, it works on a specific chart: the one contained in a `ChartObject` named `Chart 1`, located on `Sheet1`. Notice that the chart is never activated.

```

Sub ChartMods2()
    With Sheets("Sheet1").ChartObjects("Chart 1").Chart
        .Type = xlArea
        .ChartArea.Font.Name = "Arial"
        .ChartArea.Font.FontStyle = "Regular"
        .ChartArea.Font.Size = 9
        .PlotArea.Interior.ColorIndex = xlNone
        .Axes(xlValue).TickLabels.Font.Bold = True
        .Axes(xlCategory).TickLabels.Font.Bold = True
        .HasLegend = True
        .Legend.Position = xlBottom
    End With
End Sub

```

Looping through all charts

In some cases, you may need to perform an operation on all charts. This example changes the chart type of every embedded chart on the active sheet. The procedure uses a `For-Next` loop to cycle through each object in the `ChartObjects` collection, then accesses the `Chart` object in each and changes its `ChartType` property. An `Area` chart is specified by using the predefined constant `xlArea`. Consult the online help for other chart type constants.

```

Sub ChangeChartType()
    Dim chtobj as ChartObject
    For Each chtobj In ActiveSheet.ChartObjects
        chtobj.Chart.ChartType = xlArea
    Next chtobj
End Sub

```

The following macro performs the same operation as the preceding procedure, but works on all the chart sheets in the active workbook:

```
Sub ChangeChartType2()  
    Dim cht as Chart  
    For Each cht In ActiveWorkbook.Charts  
        cht.ChartType = xlArea  
    Next cht  
End Sub
```

The following example changes the legend font for all charts on the active sheet. It uses a For-Next loop to process all `ChartObject` objects:

```
Sub LegendMod()  
    Dim chtobj as ChartObject  
    For Each chtobj In ActiveSheet.ChartObjects  
        With chtobj.Chart.Legend.Font  
            .Name = "Arial"  
            .FontStyle = "Bold"  
            .Size = 12  
        End With  
    Next chtobj  
End Sub
```

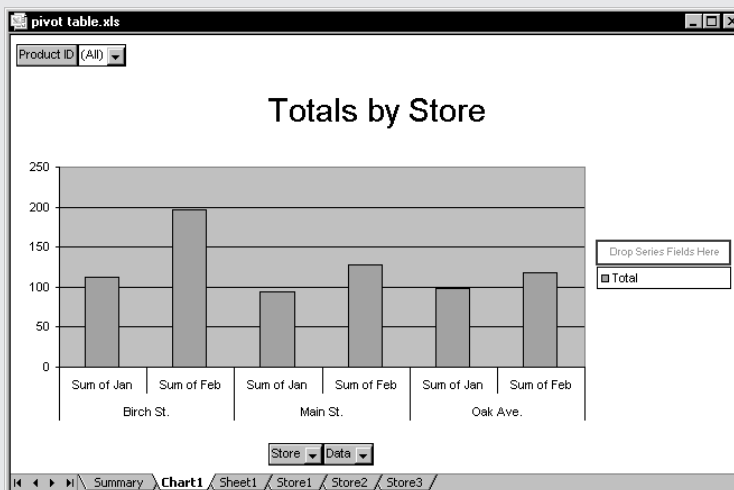
Sizing and aligning ChartObjects

A `ChartObject` object has standard positional and sizing properties that you can access with your VBA code. The following example resizes all `ChartObject` objects on Sheet1 so they match the dimensions of the `ChartObject` named Chart 1. It also arranges the `ChartObject` objects so they appear one after the other along the left side of the worksheet.

```
Sub ResizeAndArrangeChartObjects()  
    Dim W As Double, H As Double  
    Dim TopPos As Double  
    Dim chtobj As ChartObject  
  
    W = ActiveSheet.ChartObjects("Chart 1").Width  
    H = ActiveSheet.ChartObjects("Chart 1").Height  
    TopPos = 0  
    For Each chtobj In ActiveSheet.ChartObjects  
        With chtobj  
            .Width = W  
            .Height = H  
            .Left = 0  
            .Top = TopPos  
        End With  
        TopPos = TopPos + H  
    Next chtobj  
End Sub
```

Working with PivotCharts

Excel 2000 introduced a new facet to charting: PivotCharts. This handy feature lets you create a dynamic chart that's attached to a PivotTable. The PivotChart displays the current layout of the PivotTable graphically. When you create a PivotTable, you have an option of creating a PivotTable alone, or a PivotChart which also includes an associated PivotTable. To create a PivotChart from an existing PivotTable, activate the PivotTable and click the ChartWizard button. The chart is created on a new chart sheet. By default, a new PivotChart always appears on a chart sheet (see the accompanying figure). However, you can use the Chart ⇨ Location command to convert it to an embedded chart.



When Microsoft adds a new feature to Excel, it also needs to augment Excel's object model so the new feature is exposed and can be controlled by VBA. In the case of PivotCharts, you'll find a new object called a `PivotLayout` object, located in the `Chart` object. The best way to become familiar with this object is to record your actions as you modify a PivotChart, and examine the code produced. Then you can learn more about the objects, properties, and methods by consulting the online help.

The `TopPos` variable keeps track of the vertical location for the next chart. Each time through the loop, this variable is incremented by the value of `H` (which is the height of each `ChartObject`).

More Charting Examples

In this section, I describe some additional charting techniques. I discuss two examples that demonstrate how to use VBA to change the data used by a chart.

Using names in a SERIES formula

As you probably know, a chart can consist of any number of series, and the data used by each series is determined by the range references in its `SERIES` formula. For more about this topic, see the sidebar, “Understanding a Chart’s `SERIES` Formula.”

In some cases, using range names in the `SERIES` formulas in a chart can greatly simplify things if you need to change the chart’s source data using VBA. For example, consider the following `SERIES` formula:

```
=SERIES(,Sheet1!$A$1:$A$6,Sheet1!$B$1:$B$6,1)
```

Understanding a Chart’s `SERIES` Formula

The data used in each series in a chart is determined by its `SERIES` formula. When you select a data series in a chart, the `SERIES` formula appears in the formula bar. This is not a “real” formula. In other words, you can’t use it in a cell and you can’t use worksheet functions within the `SERIES` formula. You can, however, edit the arguments in the `SERIES` formula.

A `SERIES` formula has the following syntax:

```
=SERIES(name, category_labels, values, order)
```

name (Optional) The name used in the legend. If the chart has only one series, the name argument is used as the title.

category_labels (Optional) The range that contains the labels for the category axis. If omitted, Excel uses consecutive integers beginning with 1.

values The range that contains the values.

order An integer that specifies the plotting order of the series (relevant only if the chart has more than one series).

Range references in a `SERIES` formula are always absolute, and they always include the sheet name. For example:

```
=SERIES(Sheet1!$B$1,,Sheet1!$B$2:$B$7,1)
```

A range reference can consist of a noncontiguous range. If so, each range is separated by a comma and the argument is enclosed in parentheses. In the following `SERIES` formula, the values range consists of B2:B3 and B5:B7:

```
=SERIES(,,(Sheet1!$B$2:$B$3,Sheet1!$B$5:$B$7),1)
```

You can substitute range names for the range references. If you do so, Excel changes the reference in the `SERIES` formula to include the workbook. For example:

```
=SERIES(Sheet1!$B$1,,budget.xls!MyData,1)
```


You can define range names for the two ranges (for example, `Categories` and `Data`), and then edit the `SERIES` formula so it uses the range names instead of the range references. The edited formula would be:

```
=SERIES(,Sheet1!Categories,Sheet1!Data,1)
```

Once you've defined the names and edited the `SERIES` formula, your VBA code can work with the names, and the changes will be reflected in the chart. For example, the following statement redefines the "refers to" range as `Data`:

```
Range("B1:B12").Name = "Data"
```

After executing this statement, the chart will update itself and use the new definition of `Data`.



Tip

The `Resize` method of the `Range` object is useful for resizing a named range. For example, the following code expands the range named `Data` to include one additional row:

```
With Range("Data")
    .Resize(.Rows.Count + 1, 1).Name = "Data"
End With
```

Specifying the data used by a chart

The examples in this section describe VBA techniques that enable you to change the data used by a chart.

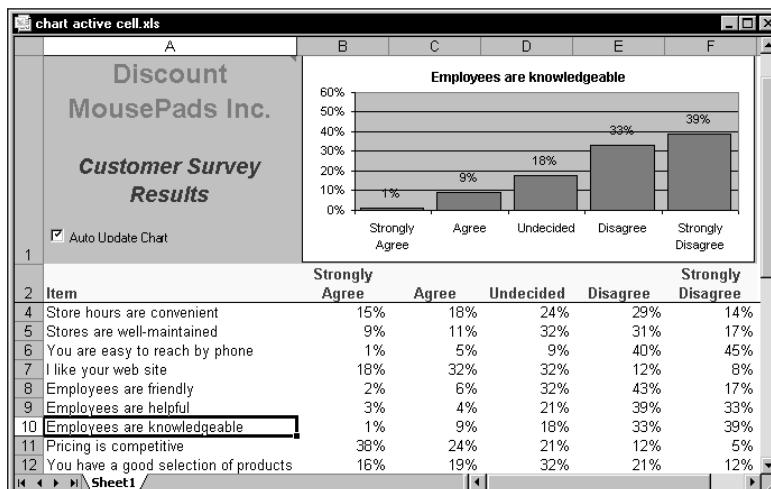


Figure 18-4: This chart always displays the data from the row of the active cell.

Changing chart data based on the active cell

Figure 18-4 displays a chart based on the data in the row of the active cell. As the user moves the cell pointer, the chart is updated automatically.

This example uses an event-handler for the `Worksheet` object. The `SelectionChange` event occurs whenever the user changes the selection by moving the cell pointer. The event-handler procedure for this event (which is located in the code module for the `Sheet1` object) is as follows:

```
Private Sub Worksheet_SelectionChange(ByVal Target _  
    As Excel.Range)  
    Call UpdateChart  
End Sub
```

In other words, every time the user moves the cell cursor, the `Worksheet_SelectionChange` procedure is executed. This procedure calls the `UpdateChart` procedure, which follows:

```
Sub UpdateChart()  
    If Sheets("Sheet1").CheckBox1 Then  
        Set TheChartObj = ActiveSheet.ChartObjects(1)  
        Set TheChart = TheChartObj.Chart  
        UserRow = ActiveCell.Row  
        If UserRow < 3 Or IsEmpty(Cells(UserRow, 1)) Then  
            TheChartObj.Visible = False  
        Else  
            Set CatTitles = Range("A2:F2")  
            Set SrcRange = Range(Cells(UserRow, 1), _  
                Cells(UserRow, 6))  
            Set SourceData = Union(CatTitles, SrcRange)  
            TheChart.SetSourceData _  
                Source:=SourceData, PlotBy:=xlRows  
            TheChartObj.Visible = True  
        End If  
    End If  
End Sub
```

The first step is to determine if the Auto Update Chart check box is checked. If this check box is not checked, nothing happens. The `UserRow` variable contains the row number of the active cell. The `If` statement checks to make sure that the active cell is in a row that contains data (the data starts in row 3). If the cell cursor is in a row that doesn't have data, the `ChartObject` object is hidden. Otherwise, the code creates a `Range` object (`CatTitle`) that holds the category titles and another `Range` object (`SrcRange`) that contains the data for the row. These two `Range` objects are joined using VBA's `Union` function and assigned to a `Range` object named `SourceData`. Finally, the `SourceData` range is assigned to the chart using the `SetSourceData` method of the `Chart` object.

Changing chart data using a ComboBox

The next example uses a ComboBox control on a chart sheet to allow the user to select a chart. Figure 18-5 shows how this looks:

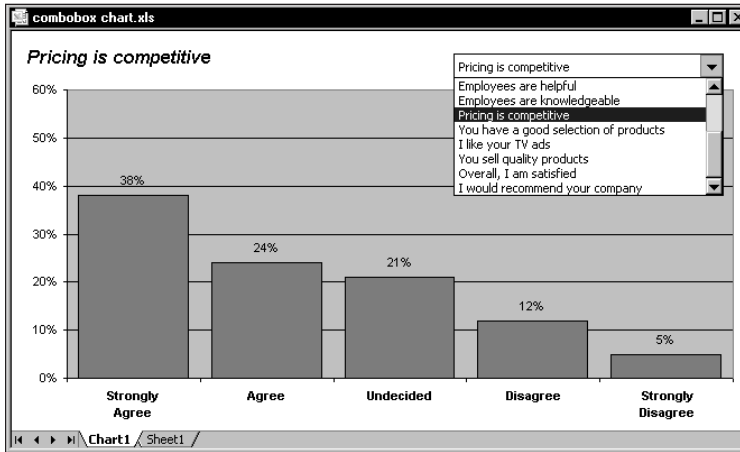


Figure 18-5: Selecting from the ComboBox changes the source data for the chart.

Note

The ComboBox used in this example is from the Forms toolbar (not the Control Toolbox toolbar). For some reason, Excel does not let you add ActiveX controls to a chart sheet.



This workbook is available on the companion CD-ROM.

A macro named `DropDown1_Change` is attached to the ComboBox. When the user makes a selection from the ComboBox, the following procedure is executed:

```
Sub DropDown1_Change()
    ListIndex = Charts(1).DropDowns(1).Value
    Call UpdateChart(ListIndex)
End Sub
```

This procedure calls the `UpdateChart` procedure, and passes an integer that represents the user's choice. Following is the listing of the `UpdateChart` procedure. This is very similar to the `UpdateChart` procedure in the previous section.

```

Sub UpdateChart(Item)
' Updates the chart using the selected dropdown item
Dim TheChart As Chart
Dim DataSheet As Worksheet
Dim CatTitles As Range, SrcRange As Range
Dim SourceData As Range

Set TheChart = Sheets("Chart1")
Set DataSheet = Sheets("Sheet1")

With DataSheet
    Set CatTitles = .Range("A1:F1")
    Set SrcRange = .Range(.Cells(Item + 2, 1), _
        .Cells(Item + 2, 6))
End With
Set SourceData = Union(CatTitles, SrcRange)

With TheChart
    .SetSourceData Source:=SourceData, PlotBy:=xlRows
    .ChartTitle.Left = TheChart.ChartArea.Left
    .Deselect
End With
End Sub

```

Determining a chart's source data: Method 1

Assume you have an embedded chart like the one shown in Figure 18-6. This chart displays data for three months. You would like to write a VBA procedure that extends the chart's source data to use the three additional months. If your VBA code created the chart and is "aware" of the chart's data source, it's fairly simple to extend the range. But if your code needs to work with any arbitrary chart, you'll find that using VBA to determine the source data used by the chart is not an easy task.

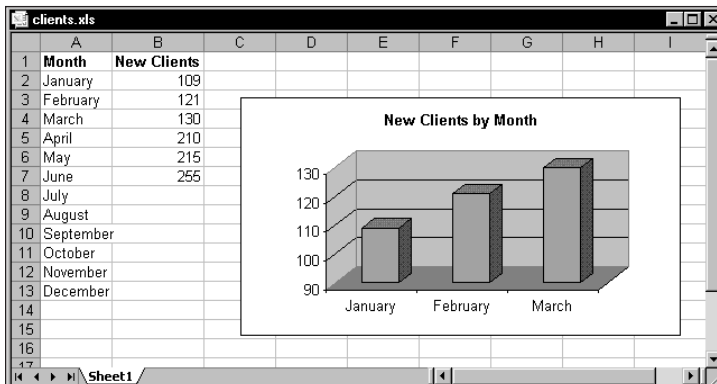


Figure 18-6: What's the best way to determine which ranges are used by this chart?

The Series object

It's my opinion that Excel's object model has a serious flaw: There is no direct way to determine the ranges used in a chart. Let's look at what the object model *does* provide.

The `Series` object is contained in a `Chart` object. The `SeriesCollection` is a collection of `Series` objects for a particular `Chart` object. If a chart plots two data series, it will have two `Series` objects. You can refer to a particular `Series` object by its index number. The following expression, for example, creates an object variable that represents the first `Series` object in the active chart:

```
Set MySeries = ActiveChart.SeriesCollection(1)
```

A `Series` object has many properties, but I'll list three that seem relevant to this discussion:

- ♦ **Formula** property. Returns or sets the `SERIES` formula for the `Series` object. When you select a series in a chart, its `SERIES` formula is displayed in the formula bar. The `Formula` property returns this formula as a string.
- ♦ **Values** property. Returns or sets a collection of all the values in the series. This can be a range on a worksheet or an array of constant values, but not a combination of both.
- ♦ **XValues** property. Returns or sets an array of *x* values for a chart series. The `XValues` property can be set to a range on a worksheet or to an array of values — but it can't be a combination of both.

So if your code needs to determine the data range used by a particular chart series, it's obvious that the `Values` property of the `Series` object is just the ticket. And, you can use the `XValues` property to get the range that contains the *x* values (or category labels). In theory, that certainly seems correct . . . but in practice, it doesn't work. When you assign a range to the `XValues` property, you are actually assigning the `Value` property of each cell in the range (that is, an array of values).

A simple demonstration

To demonstrate why accessing the `Value` property doesn't produce the results you need, start with a new workbook and create the simple chart shown in Figure 18-7. The chart uses `A1:A3` as its `Values` range (and has no `XValues` range).

Insert a VBA module and enter the following procedure:

```
Sub Test1()  
    Dim DataRange As Range  
    Set DataRange = ActiveSheet.Range("A1:A2")  
    ActiveSheet.ChartObjects(1)._  
        Chart.SeriesCollection(1).Values = DataRange  
End Sub
```

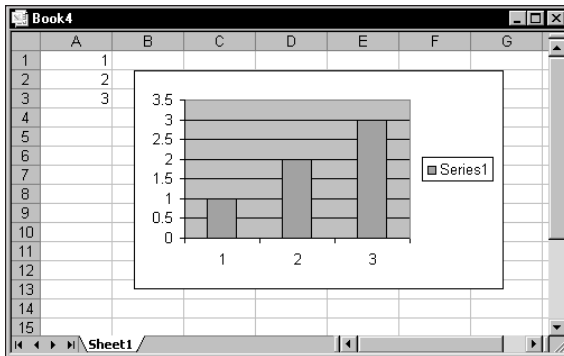


Figure 18-7: Use this chart to discover why `Values` and `XValues` don't work as you might expect.

This procedure changes the source data for the chart's series to use the data in A1:A2. Execute the procedure, and you'll find that the chart will now display only two columns.

Next, try running the following procedure:

```
Sub Test2()
    Dim DataRange As Range
    Set DataRange = Sheets("Sheet1").ChartObjects(1). _
        Chart.SeriesCollection(1).Values
End Sub
```

This procedure attempts to create a `Range` object named `DataRange` from the chart's series. When you execute this procedure, you'll get an error message: **Object required. The problem is, the `Values` property for the `Series` object (the member of the collection named `SeriesCollection`) always returns an array—never a `Range` object. If you don't believe me, execute this statement, which uses VBA's `IsArray` function to determine if its argument is an array:**

```
MsgBox IsArray(Sheets("Sheet1").ChartObjects(1). _
    Chart.SeriesCollection(1).Values)
```

Specifically, the `Values` property returns a variant array. Unfortunately, there is no direct way to get a `Range` object for a `Series` object.

Try executing this procedure:

```
Sub Test3()
    Dim ChartData As Variant
    ChartData = Sheets("Sheet1").ChartObjects(1). _
        Chart.SeriesCollection(1).Values
    For i = 1 To UBound(ChartData)
```

```

        MsgBox ChartData(i)
    Next i
End Sub

```

In this case, `ChartData` is defined as a variant. A `For-Next` loop displays each item in the variant array.


Note

When you set the `Values` property for a `Series` object, you can specify a `Range` object or an array. But when you read this property, it is always an array. In other words, a variant can receive a `Range` object, but it can't give one back.

Creating a custom function

By now, you should know that when Excel has a deficiency, you can often use VBA to create your own solution. That's exactly what I did. This section describes a VBA function that returns a `Range` object for a `Series` object.


Cross-Reference

The next section describes a class module that simplifies this entire process.

The function, named `GetChartRange`, takes three arguments:

- ♦ `cht`: A `Chart` object
- ♦ `series`: An integer that corresponds to the `Series` number in the `SeriesCollection` object
- ♦ `ValsOrX`: A string, either "values" or "xvalues" (not case-sensitive)

The following statements demonstrate how to use the `GetChartRange` function:

```

Set MyChart = ActiveSheet.ChartObjects(1).Chart
Set DataRange = GetChartRange(MyChart, 1, "values")
MsgBox DataRange.Address

```

The first statement above creates an object variable for the `Chart` object of interest. The second statement creates a `Range` object by calling the `GetChartRange` function procedure. The `Range` that's returned by the `DataRange` function will contain the data plotted in the first `Series` on the chart. The third statement simply displays the address for the range.


Caution

The `GetChartRange` procedure works by parsing the `SERIES` formula (a text string), and extracting the range addresses. The `GetChartRange` does have one limitation: It will not work if the chart series uses a noncontiguous range. When a series uses a noncontiguous range, the range references in the `SERIES` formula are enclosed in parentheses and separated by a comma. `GetChartRange` parses the `SERIES` formula by searching for commas. If the `SERIES` formula contains more than three commas, it's using a noncontiguous range . . . and the parsing algorithm doesn't work.



The `GetChartRange` procedure is available on the companion CD-ROM. The workbook also contains procedures to demonstrate the function, as shown in Figure 18-8.

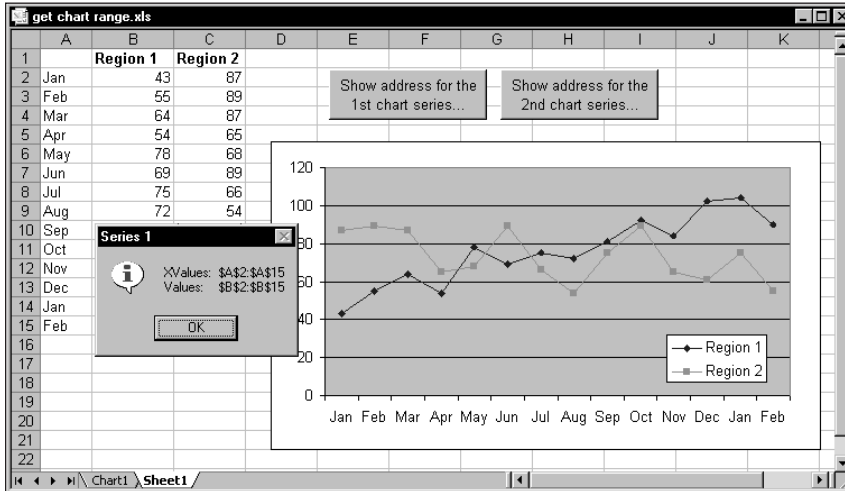


Figure 18-8: The `GetChartRange` procedure determines the ranges used by a chart.

The `GetChartRange` procedure is provided here in Listing 18-1.

Listing 18-1: Parsing Excel's `SERIES` function to find a chart's source range

```
Function GetChartRange(cht As Chart, series As Integer, _
    ValOrX As String) As Range
'   cht: A Chart object
'   series: Integer representing the Series
'   ValOrX: String, either "values" or "xvalues"

    Dim Sf As String
    Dim CommaCnt As Integer
    Dim Commas() As Integer
    Dim ListSep As String * 1
    Dim Temp As String
    Dim i As Integer

    Set GetChartRange = Nothing
    On Error Resume Next
```



```

' Get the SERIES formula
Sf = cht.SeriesCollection(series).Formula

' Check for noncontiguous ranges by counting commas
' Also, store the character position of the commas
CommaCnt = 0
ListSep = Application.International(xlListSeparator)
For i = 1 To Len(Sf)
    If Mid(Sf, i, 1) = ListSep Then
        CommaCnt = CommaCnt + 1
        ReDim Preserve Commas(CommaCnt)
        Commas(CommaCnt) = i
    End If
Next i
If CommaCnt > 3 Then Exit Function

' XValues or Values?
Select Case UCase(ValOrX)
    Case "XVALUES"
        ' Text between 1st and 2nd commas in SERIES Formula
        Temp = Mid(Sf, Commas(1) + 1, Commas(2) - _
            Commas(1) - 1)
        Set GetChartRange = Range(Temp)
    Case "VALUES"
        ' Text between the 2nd and 3rd commas in SERIES Formula
        Temp = Mid(Sf, Commas(2) + 1, Commas(3) - _
            Commas(2) - 1)
        Set GetChartRange = Range(Temp)
End Select
End Function

```

Determining a chart's source data: Method 2

The `GetChartRange` function described in the previous section is handy, but the technique described in this section may be more useful. It uses a class module to create a new object class called `ChartSeries`. The `GetChartRange` function, as you recall, allows you to identify the ranges used in a chart's `SERIES` formula. The `ChartSeries` class is much more versatile, and it enables your code to perform two jobs: identify the ranges used in a `SERIES` formula, and change the ranges.

ChartSeries class properties

When the `ChartSeries` class module is present in your workbook, you can create a new `ChartSeries` object, and use VBA code to access the following properties:

- ◆ Chart (read/write)
- ◆ ChartSeries (read/write)
- ◆ SeriesName (read/write)
- ◆ XValues (read/write)
- ◆ Values (read/write)
- ◆ PlotOrder (read/write)
- ◆ SeriesNameType (read-only)
- ◆ XValueType (read-only)
- ◆ ValueType (read-only)
- ◆ PlotOrderType (read-only)

All of these properties are defined in the `ChartSeries` class module. Notice that some of the properties are read-only. For read-only properties, you can write code to identify the property values, but they cannot be changed.



The code for the `ChartSeries` class is too lengthy to present here. A workbook that demonstrates the use of the `ChartSeries` class is available on the companion CD-ROM. The code is well-documented so you can examine it to see how it works. The class module can be copied to any other workbook.

Using the `ChartSeries` class

Before you use the `ChartSeries` class, make sure that you've copied the `ChartSeries` class module to your workbook. The simple procedure that follows demonstrates how to use the `ChartSeries` class. It assumes that the first worksheet contains a `ChartObject`.

```
Sub ChartSeriesDemo()
    Dim MySeries As New ChartSeries
    MySeries.Chart = Sheets(1).ChartObjects(1).Chart
    MySeries.ChartSeries = 1
    If MySeries.ValueType = "Range" Then
        MsgBox MySeries.Values.Address
    Else
        MsgBox MySeries.Values
    End If
End Sub
```

The procedure starts by declaring the `MySeries` variable as a `ChartSeries` object. Next it assigns the first chart on the first worksheet to the `Chart` property. The next statement specifies the series number (1), and assigns it to the `ChartSeries` property.

The `Select Case` statement accesses the `ValueType` property. This property indicates the type of data used in the series, and returns a string: either *Range* or

Array. If the data is a range, a message box displays the address. If the data is contained in an array, a message box displays the array contents. Figure 18-9 shows the result of running the `ChartSeriesDemo` procedure.

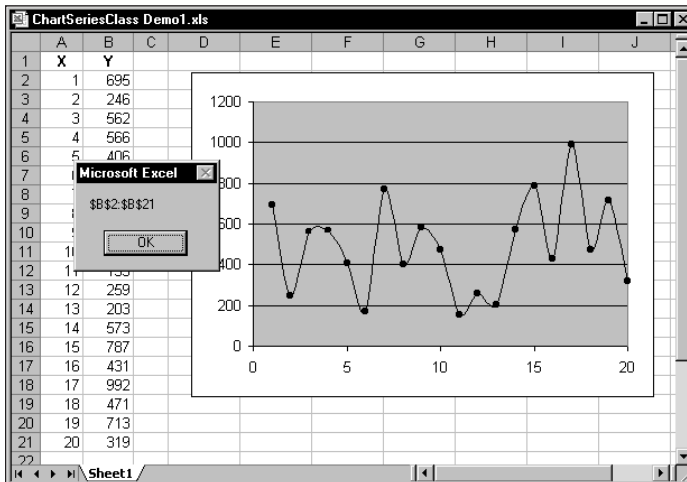


Figure 18-9: Using a class module to identify data used in a chart

Another example of the `ChartSeries` class

Figure 18-10 shows a chart that is “interactive.” The chart plots data stored in columns A and B, and buttons on the chart allow the user to change the chart so it shows more or fewer months of data. Using the `ChartSeries` class makes this type of coding relatively easy.

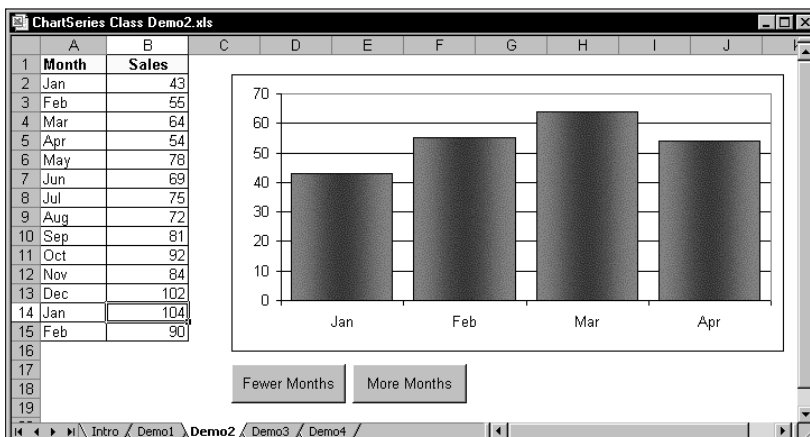


Figure 18-10: Using a class module to change the data used in a chart

When the Fewer Months button is clicked, the following procedure is executed:

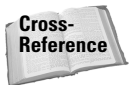
```
Private Sub CommandButton1_Click()
    ' Changes the XValues and Values to display fewer months
    Dim TheChart As Chart
    Dim MySeries As New ChartSeries
    Set TheChart = ActiveSheet.ChartObjects(1).Chart
    With MySeries
        'specify the chart
        .Chart = TheChart
        'specify the series
        .ChartSeries = 1

        'make sure the Xvalues is a range
        If .XValuesType = "Range" Then
            'make sure at least one point is charted
            numrows = .XValues.Rows.Count
            If numrows <> 1 Then _
                Set NewRange = .XValues.Resize(numrows - 1, 1)
            If numrows > 1 Then .XValues = NewRange
        End If

        'make sure the Values is a range
        If .ValuesType = "Range" Then
            'make sure at least one point is charted
            numrows = .Values.Rows.Count
            If numrows <> 1 Then _
                Set NewRange =
                .Values.Resize(numrows - 1, 1)
            If numrows > 1 Then .Values = NewRange
        End If
    End With
End Sub
```

This procedure creates a new `ChartSeries` object. It accesses the `XValues` property (which returns a `Range` object), and then resizes the range by using the `Resize` method of the `Range` object. After the range is reduced by one row, the new range is assigned to the `XValues` property. The code then performs a similar operation on the `Values` property of the `ChartSeries` object.

The code to show more data is very similar. The only difference is that the `XValues` and `Values` ranges are resized to include an additional row.



Refer to Chapter 29 for more information about creating and using class modules.

Displaying arbitrary data labels on a chart

One of the most frequent complaints about Excel's charting is its inflexible data labeling feature. For example, consider the XY chart in Figure 18-11. It might be

useful to display the associated name for each data point. However, you can search all day and you'll never find the Excel command that lets you do this automatically (such a command doesn't exist). Data labels are limited to the values only . . . unless you want to edit each data label manually and replace it with text of your choice.

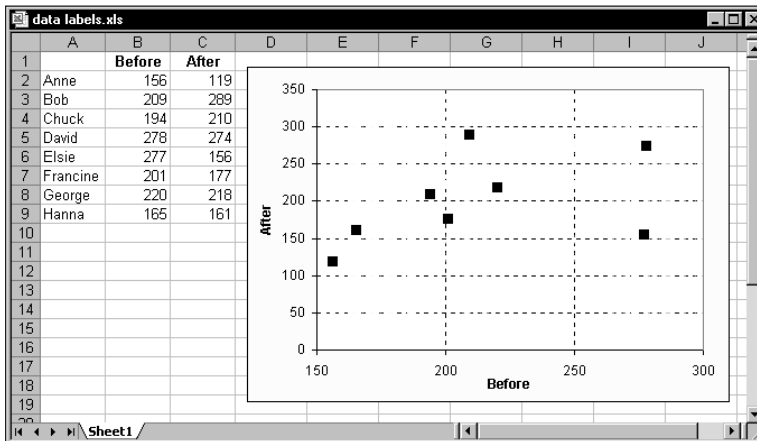


Figure 18-11: An XY chart with no data labels

Listing 18-2 presents a simple procedure that works with the first chart on the active sheet. It prompts the user for a range and then loops through the `Points` collection and changes the `Text` property to the values found in the range.

Listing 18-2: Retrieving data point labels from field names in the worksheet

```
Sub DataLabelsFromRange()
    Dim DLRange As Range
    Dim Cht As Chart
    Dim i As Integer

    ' Specify chart
    Set Cht = ActiveSheet.ChartObjects(1).Chart

    ' Prompt for a range
    On Error Resume Next
    Set DLRange = Application.InputBox _
        (prompt:="Range for data labels?", Type:=8)
    If DLRange Is Nothing Then Exit Sub
    On Error GoTo 0
```

Continued

Listing 18-2 (continued)

```

' Add data labels
Cht.SeriesCollection(1).ApplyDataLabels _
    Type:=xlDataLabelsShowValue, _
    AutoText:=True, _
    LegendKey:=False

' Loop through the Points, and set the data labels
Pts = Cht.SeriesCollection(1).Points.Count
For i = 1 To Pts
    Cht.SeriesCollection(1). _
        Points(i).DataLabel.Text = DLRange(i)
Next i
End Sub

```



This example is available on the companion CD-ROM.

Figure 18-12 shows the chart after running the `DataLabelsFromRange` procedure and specifying A2:A9 as the data range.

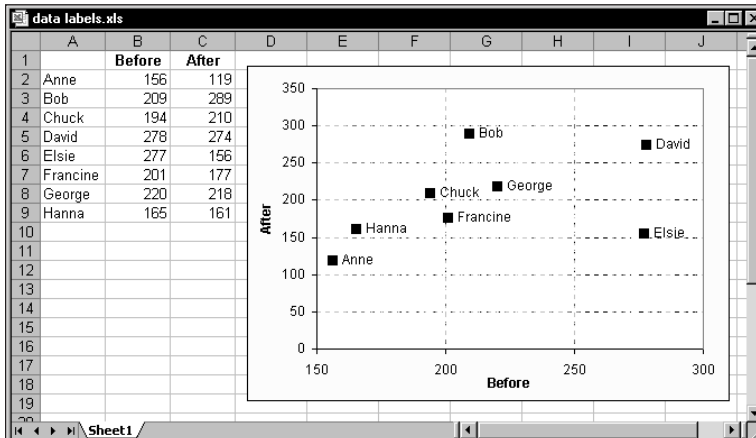


Figure 18-12: This XY chart has data labels, thanks to a VBA procedure.



The preceding procedure is rather crude, and does very little error checking. In addition, it only works with the first `Series` object. The Power Utility Pak (available by using the coupon in the back of the book) includes a much more sophisticated data labeling utility.

Displaying a chart in a UserForm

In Chapter 15, I described a way to display a chart in a UserForm. The technique saves the chart as a GIF file and then loads the GIF file into an Image control on the UserForm.

The example in this section uses that same technique, but adds a new twist: The chart is created on the fly and uses the data in the row of the active cell. Figure 18-13 shows an example.

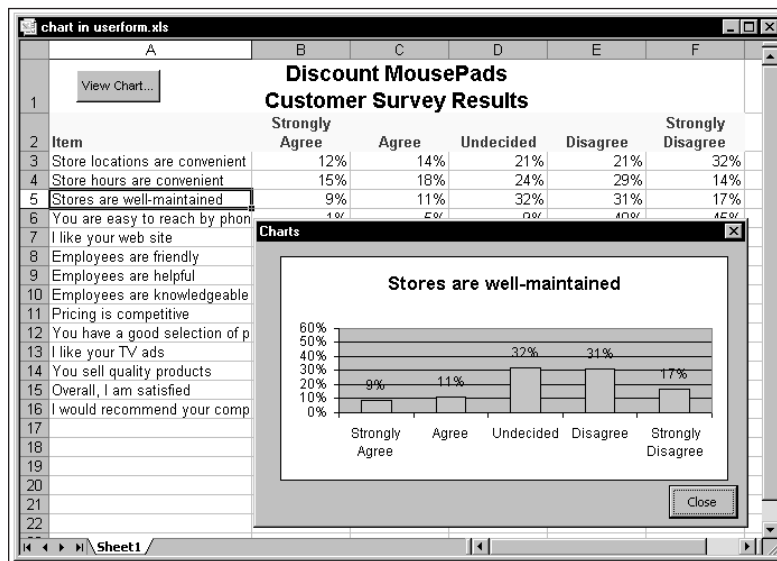


Figure 18-13: The chart in this UserForm is created on the fly from the data in the active row.

The UserForm for this example is very simple. It contains an Image control and a CommandButton (Close). The worksheet that contains the data has a button that executes the following procedure:

```
Sub ShowChart()
    Dim UserRow As Long
    UserRow = ActiveCell.Row
    If UserRow < 2 Or IsEmpty(Cells(UserRow, 1)) Then
        MsgBox _
            "Move the cell cursor to a row that contains data."
    Exit Sub
    End If
    CreateChart UserRow
    UserForm1.Show
End Sub
```

Since the chart is based on the data in the row of the active cell, the procedure warns the user if the cell cursor is in an invalid row. If the active cell is appropriate, ShowChart calls the CreateChart procedure to create the chart, then displays the UserForm.

The CreateChart procedure shown in Listing 18-3 accepts one argument, which represents the row of the active cell. This procedure originated from a macro recording that I cleaned up to make more general.

Listing 18-3: Automatically generating a chart without user interaction

```

Sub CreateChart(r)
    Dim TempChart As Chart
    Dim CatTitles As Range
    Dim SrcRange As Range, SourceData As Range

    Application.ScreenUpdating = False

    Set CatTitles = ActiveSheet.Range("A2:F2")
    Set SrcRange = ActiveSheet.Range(Cells(r, 1), Cells(r, 6))
    Set SourceData = Union(CatTitles, SrcRange)

    ' Add a chart
    Set TempChart = Charts.Add

    ' Fix it up
    With TempChart
        .ChartType = xlColumnClustered
        .SetSourceData Source:=SourceData, PlotBy:=xlRows
        .HasLegend = False
        .ApplyDataLabels Type:=xlDataLabelsShowValue, _
            LegendKey:=False
        .ChartTitle.Font.Size = 14
        .ChartTitle.Font.Bold = True
        .Axes(xlValue).MaximumScale = 0.6
        .Axes(xlCategory).TickLabels.Font.Size = 10
        .Axes(xlCategory).TickLabels.Orientation = _
            xlHorizontal
        .Location Where:=xlLocationAsObject, Name:="Sheet1"
    End With

    ' Adjust the ChartObject's size
    With ActiveSheet.ChartObjects(1)
        .Width = 300
        .Height = 150
        .Visible = False
    End With
End Sub

```



```
End With  
End Sub
```

When the `CreateChart` procedure ends, the worksheet contains a `ChartObject` with a chart of the data in the row of the active cell. However, the `ChartObject` is not visible because `ScreenUpdating` was turned off and its `Visible` property was set to `False`.

The final instruction of the `ShowChart` procedure loads the `UserForm`. Following is a listing of the `UserForm_Initialize` procedure. This procedure saves the chart as a GIF file, deletes the `ChartObject`, and loads the GIF file into the `Image` control.

```
Private Sub UserForm_Initialize()  
    Dim CurrentChart As Chart  
    Dim Fname As String  
  
    Set CurrentChart = ActiveSheet.ChartObjects(1).Chart  
  
    ' Save chart as GIF  
    Fname = ThisWorkbook.Path & Application.PathSeparator _  
        & "temp.gif"  
    CurrentChart.Export FileName:=Fname, FilterName:="GIF"  
    ActiveSheet.ChartObjects(1).Delete  
  
    ' Show the chart  
    Image1.Picture = LoadPicture(Fname)  
    Application.ScreenUpdating = True  
End Sub
```



This workbook is available on the companion CD-ROM.

Understanding Chart Events

Excel supports several events associated with charts. For example, when a chart is activated, it generates an `Activate` event. The `Calculate` event occurs after the chart receives new or changed data. You can, of course, write VBA code that gets executed when a particular event occurs.



Refer to Chapter 19 for additional information about events.

Table 18-1 lists all of the chart events supported by Excel 97 and later versions.

Table 18-1
Events Recognized by the Chart Object

Event	Action that triggers the event
Activate	A chart sheet or embedded chart is activated.
BeforeDoubleClick	An embedded chart is double-clicked. This event occurs before the default double-click action.
BeforeRightClick	An embedded chart is right-clicked. The event occurs before the default right-click action.
Calculate	New or changed data is plotted on a chart.
Deactivate	A chart is deactivated.
DragOver	A range of cells is dragged over a chart.
DragPlot	A range of cells is dragged and dropped onto a chart.
MouseDown	A mouse button is pressed while the pointer is over a chart.
MouseMove	The position of the mouse pointer changes over a chart.
MouseUp	A mouse button is released while the pointer is over a chart.
Resize	A chart is resized.
Select	A chart element is selected.
SeriesChange	The value of a chart data point is changed.

An example of using Chart events

To program an event-handler for an event taking place on a chart sheet, your VBA code must reside in the code module for the `Chart` object. To activate this code module, double-click the `Chart` item in the `Project` window. Then in the code module, select `Chart` from the `Object` drop-down list on the left, and select the event from the `Procedure` drop-down list on the right (see Figure 18-14).

Because there is not a code module for embedded charts, the procedure described in this section works only for chart sheets. You can also handle events for embedded charts, but you must do some initial set-up work that involves creating a class module. This procedure is described later, in “Enabling events for an embedded chart.”

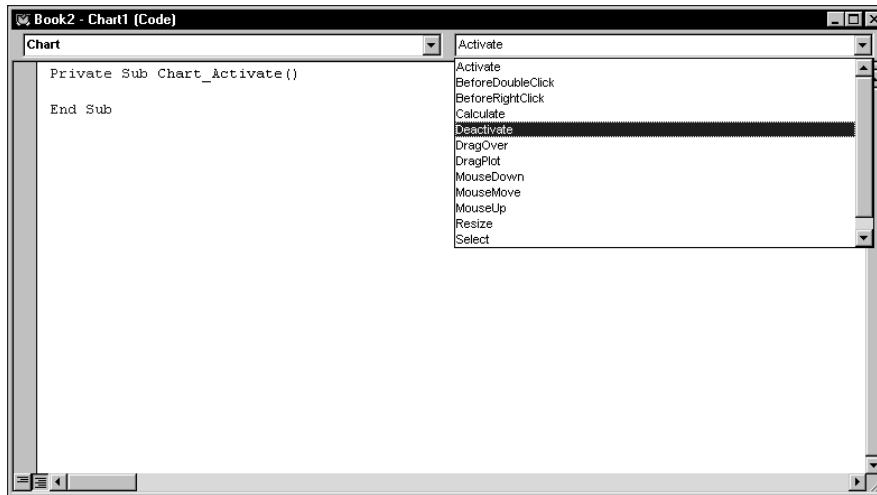


Figure 18-14: Selecting an event in the code module for a `Chart` object

The example that follows simply displays a message when the user activates a chart sheet, deactivates a chart sheet, or selects any element on the chart. I created a workbook with a chart sheet, then I wrote three event-handler procedures named:

<code>Chart_Activate</code>	Executed when the chart sheet is activated.
<code>Chart_Deactivate</code>	Executed when the chart sheet is deactivated.
<code>Chart_Select</code>	Executed when an element on the chart sheet is selected.

The `Chart_Activate` procedure follows:

```
Private Sub Chart_Activate()
    Dim msg As String
    msg = "Hello " & Application.UserName & vbCrLf & vbCrLf
    msg = msg & "You are now viewing the six-month sales "
    msg = msg & "summary for Products 1-3." & vbCrLf & vbCrLf
    msg = msg & _
        "Click an item in the chart to find out what it is."
    MsgBox msg, vbInformation, ActiveWorkbook.Name
End Sub
```

This procedure simply displays a message whenever the chart is activated. See Figure 18-15.

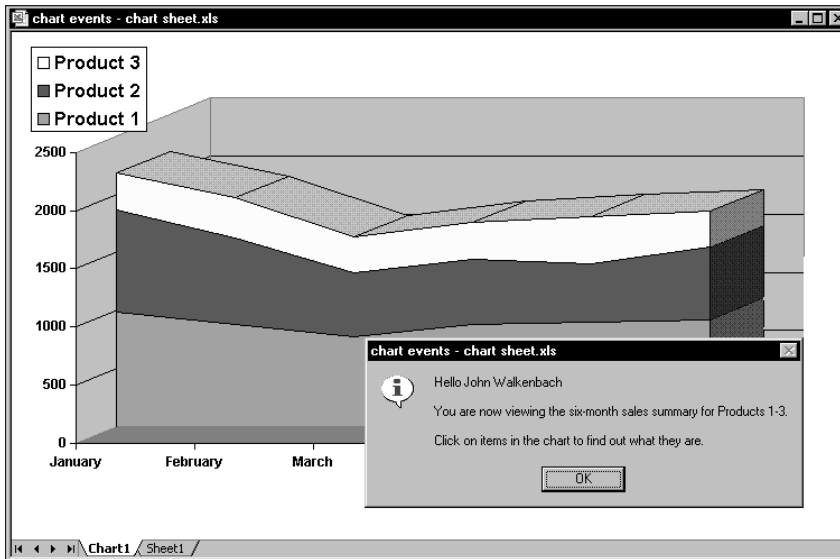


Figure 18-15: Activating the chart causes `Chart_Activate` to display this message.

The `Chart_Deactivate` procedure that follows also displays a message, only when the chart sheet is deactivated:

```

Private Sub Chart_Deactivate()
    Dim msg As String
    msg = "Thanks for viewing the chart."
    MsgBox msg, , ActiveWorkbook.Name
End Sub

```

The `Chart_Select` procedure that follows is executed whenever an item on the chart is selected:

```

Private Sub Chart_Select(ByVal ElementID As Long, _
    ByVal Arg1 As Long, ByVal Arg2 As Long)
    Dim Id As String
    Select Case ElementID
        Case xlChartArea: Id = "ChartArea"
        Case xlChartTitle: Id = "ChartTitle"
        Case xlPlotArea: Id = "PlotArea"
        Case xlLegend: Id = "Legend"
        Case xlFloor: Id = "Floor"
        Case xlWalls: Id = "Walls"
        Case xlCorners: Id = "Corners"
        Case xlDataTable: Id = "DataTable"
        Case xlSeries: Id = "Series"
        Case xlDataLabel: Id = "DataLabel"
        Case xlTrendline: Id = "Trendline"
        Case xlErrorBars: Id = "ErrorBars"
    End Select

```

```

    Case xlXErrorBars: Id = "XErrorBars"
    Case xlYErrorBars: Id = "YErrorBars"
    Case xlLegendEntry: Id = "LegendEntry"
    Case xlLegendKey: Id = "LegendKey"
    Case xlAxis: Id = "Axis"
    Case xlMajorGridlines: Id = "MajorGridlines"
    Case xlMinorGridlines: Id = "MinorGridlines"
    Case xlAxisTitle: Id = "AxisTitle"
    Case xlUpBars: Id = "UpBars"
    Case xlDownBars: Id = "DownBars"
    Case xlSeriesLines: Id = "SeriesLines"
    Case xlHiLoLines: Id = "HiLoLines"
    Case xlDropLines: Id = "DropLines"
    Case xlRadarAxisLabels: Id = "RadarAxisLabels"
    Case xlShape: Id = "Shape"
    Case xlNothing: Id = "Nothing"
    Case Else: Id = "Some unknown thing"
End Select
MsgBox "Selection type:" & Id
End Sub

```

This procedure displays a message box that contains a description of the selected item. When the `Select` event occurs, the `ElementID` argument contains an integer that corresponds to what was selected. The `Arg1` and `Arg2` arguments provide additional information about the selected item (see the online help for details). The `Select Case` structure converts the built-in constants to descriptive strings.

Enabling events for an embedded chart

As I noted in the previous section, `Chart` events are automatically enabled for chart sheets, but not for charts embedded in a worksheet. To use events with an embedded chart, you need to perform the following steps:

Create a class module

In the VB Editor window, select your project in the Project window and select `Insert` ⇨ `Class Module`. This will add a new (empty) class module to your project. If you like, you can use the Properties window to give the class module a more descriptive name.

Declare a public `Chart` object

The next step is to declare a `Public` variable that will be used as the class name. The variable should be of type `Chart`, and it must be declared in the class module using the `WithEvents` keyword. If you omit the `WithEvents` keyword, the object will not respond to events. Following is an example of such a declaration:

```
Public WithEvents myChartClass As Chart
```

Connect the declared object with your chart

Before your event-handler procedures will run, you must connect the declared object in the class module with your embedded chart. You do this by declaring an object of type `Class1` (or whatever your class module is named). This should be a module-level object variable, declared in a regular VBA module (not in the class module). Here's an example:

```
Dim MyChart As New MyChartClass
```

Then you must write code to actually instantiate the object, such as this instruction:

```
Set myChart.myChartClass = ActiveSheet.ChartObjects(1).Chart
```

After the preceding statement is executed, the `myChartClass` object in the class module points to the first embedded chart on the active sheet. Consequently, the event-handler procedures in the class module will execute when the events occur.

Write event-handler procedures for the chart class

In this section, I describe how to write event-handler procedures in the class module. Recall that the class module must contain a declaration such as:

```
Public WithEvents myChartClass As Chart
```

After this new object has been declared using the `WithEvents` keyword, it appears in the Object drop-down list box in the class module. When you select the new object in the Object box, the valid events for that object are listed in the Procedure drop-down box on the right (see Figure 18-16).

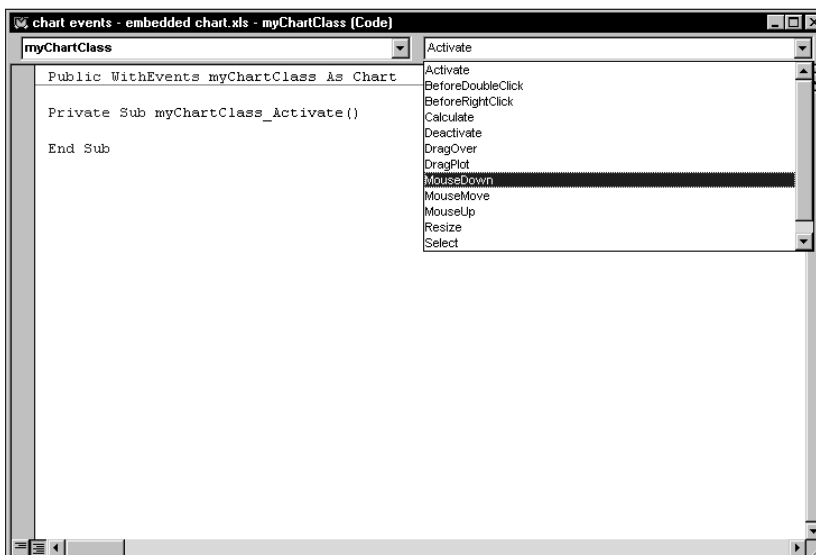


Figure 18-16: The Procedure list displays valid events for the new `Chart` object.

The following example is a simple event-handler procedure that is executed when the embedded chart is activated. This procedure simply pops up a message box that displays the name of the `Chart` object's parent (which is a `ChartObject` object).

```
Private Sub myChartClass_Activate()  
    MsgBox myChartClass.Parent.Name & " was activated!"  
End Sub
```



The companion CD-ROM contains a workbook that demonstrates the concepts described in this section.

Example: Using Chart events with an embedded chart

The example in this section provides a practical demonstration of the information presented in the previous section. The example shown in Figure 18-17 consists of an embedded chart that functions as a clickable image map. Clicking one of the chart columns activates a worksheet that shows detailed data for the region.

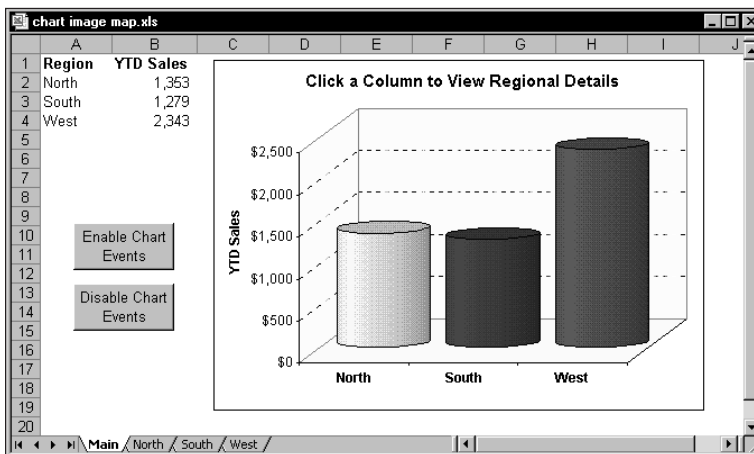


Figure 18-17: This chart serves as a clickable image map.

The workbook is set up with four worksheets. The sheet named `Main` contains the embedded chart. The other sheets are named `North`, `South`, and `West`. Formulas in `B1:B4` sum the data in the respective sheets, and this summary data is plotted in the chart. Clicking a column in the chart triggers an event, and the event-handler procedure activates the appropriate sheet so the user can view the details for the desired region.

The workbook contains a class module named `EmbChartClass`, and also a normal VBA module named `Module1`. For demonstration purposes, the `Main` worksheet also contains two buttons: One executes a procedure named `EnableChartEvents`, the other executes a procedure named `DisableChartEvents` (both are located in `Module1`). In addition, each of the other worksheets contains a button that executes the `ReturntoMain` macro that reactivates the `Main` sheet.

The complete listing of `Module1` follows:

```
Dim SummaryChart As New EmbChartClass

Sub EnableChartEvents()
    ' Called by worksheet button
    Range("A1").Select
    Set SummaryChart.myChartClass = _
        Worksheets(1).ChartObjects(1).Chart
End Sub

Sub DisableChartEvents()
    ' Called by worksheet button
    Set SummaryChart.myChartClass = Nothing
    Range("A1").Select
End Sub

Sub ReturnToMain()
    ' Called by worksheet button
    Sheets("Main").Activate
End Sub
```

The first instruction declares a new object variable `SummaryChart` to be of type `EmbChartClass` — which, as you recall, is the name of the class module. When the user clicks the `Enable Chart Events` button, the embedded chart is assigned to the `SummaryChart` object, which, in effect, enables the events for the chart. Listing 18-4 shows the class module for `EmbChartClass`.

Clicking the chart generates a `MouseDown` event, which executes the `myChartClass_MouseDown` procedure. This procedure uses the `GetChartElement` method to determine what element of the chart was clicked. The `GetChartElement` method returns information about the chart element at specified X and Y coordinates (information that is available via the arguments for the `myChartClass_MouseDown` procedure).

Listing 18-4: Reacting to which column has been clicked on

```
Public WithEvents myChartClass As Chart

Private Sub myChartClass_MouseDown(ByVal Button As Long, _
    ByVal Shift As Long, ByVal X As Long, ByVal Y As Long)
```



```
Dim IDnum As Long
Dim a As Long, b As Long

' The next statement returns values for
' IDnum, a, and b
myChartClass.GetChartElement X, Y, IDnum, a, b

' Was a series clicked?
If IDnum = xlSeries Then
    Select Case b
        Case 1
            Sheets("North").Activate
        Case 2
            Sheets("South").Activate
        Case 3
            Sheets("West").Activate
    End Select
End If
Range("A1").Select
End Sub
```



This workbook is available on the companion CD-ROM.

Charting Tricks

I conclude this chapter by sharing a few charting tricks that I've discovered over the years. Some of these techniques may be useful in your applications, and others are simply for fun. At the very least, studying them may give you some new insights into the object model for charts.

Printing embedded charts on a full page

When an embedded chart is selected, you can print the chart by choosing File ⇨ Print. The embedded chart will be printed on a full page by itself (just as if it were on a chart sheet), yet it will remain an embedded chart.

The following macro prints all embedded charts on the active sheet, and each chart is printed on a full page:

```
Sub PrintEmbeddedCharts()
    For Each chtObj In ActiveSheet.ChartObjects
        chtObj.Chart.Print
    Next chtObj
End Sub
```

Creating a “dead chart”

Normally, an Excel chart uses data stored in a range. Change the data in the range, and the chart is updated automatically. In some cases, you may want to “unlink” the chart from its data ranges and produce a “dead chart” (a chart that never changes). For example, if you plot data generated by various what-if scenarios, you may want to save a chart that represents some baseline so you can compare it with other scenarios.

There are two ways to create such a chart:

- ♦ *Paste it as a picture.* Activate the chart and choose Edit ⇨ Copy. Then press the Shift key and select Edit ⇨ Paste Picture (the Paste Picture command is available only if you press Shift when you select the Edit menu). The result will be a picture of the copied chart.
- ♦ *Convert the range references to arrays.* Click on a chart series and then click the formula bar. Press F9 to convert the ranges to an array. Repeat this for each series in the chart.

The `xl8galry.xls` file uses this technique. This file is a special workbook used by Excel to store its custom chart formats. If you open this workbook, you’ll find 20 chart sheets. Each chart sheet has “dummy” data, which uses an array rather than a range as its source.

**Note**

Another way to create a dead chart is to use VBA to assign an array rather than a range to the `XValues` or `Values` properties of the `Series` object.

Controlling a data series by hiding data

Figure 18-18 shows a chart that displays daily data for 365 days. What if you only want to plot, say, the data for February? You could, of course, redefine the chart’s data range. Or, you could take advantage of Excel’s `AutoFilter` command.

By default, a chart does not display data that’s hidden. Since Excel’s `AutoFilter` feature works by hiding rows that don’t meet your criteria, it’s a simple solution. Select `Data ⇨ Filter ⇨ AutoFilter` to turn on the `AutoFilter` mode. Each row heading in the filtered list displays a drop-down arrow. Click the arrow and select `Custom` from the list. Then enter filter criteria that will select the dates that you want to plot. The setting shown in Figure 18-19, for example, hides all rows except those that have a date in February.

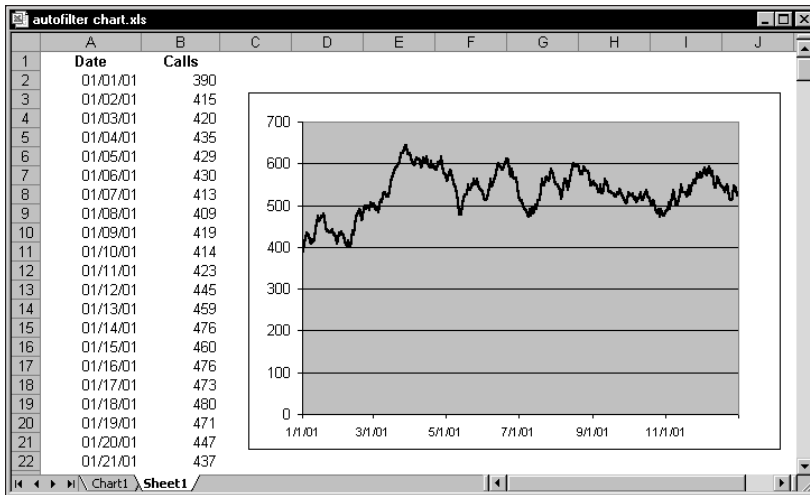


Figure 18-18: You can use Excel's AutoFilter feature to plot only a subset of the data.



This workbook is available on the companion CD-ROM.

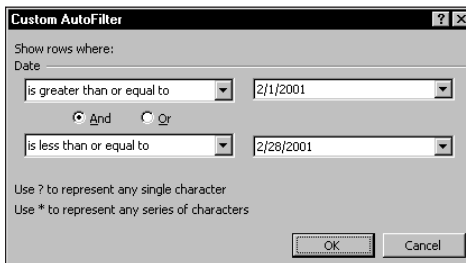


Figure 18-19: Use the Custom AutoFilter dialog box to filter a list.

The resulting chart is shown in Figure 18-20.

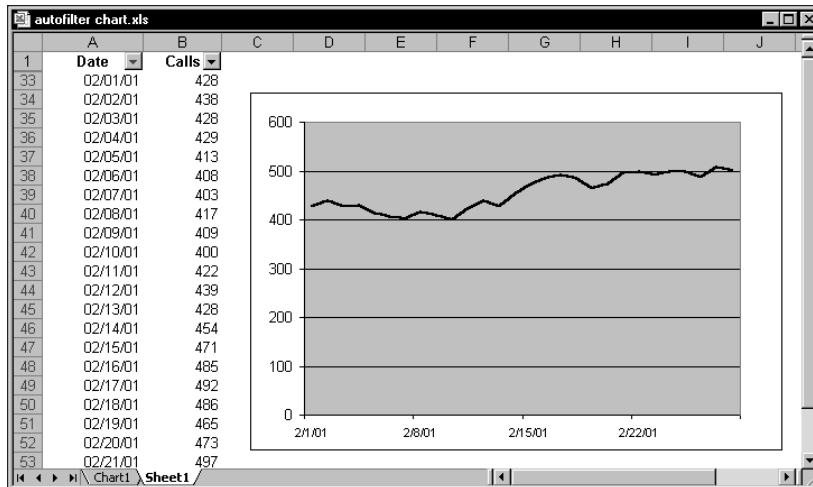


Figure 18-20: Only visible cells are displayed in a chart.

Note

If this technique doesn't seem to be working, you need to change a setting for the chart. Activate the chart, then choose Tools ⇨ Options. In the Options dialog box, click the Chart tab and place a check mark next to Plot visible cells only. Also, to ensure that the chart doesn't disappear when its rows are hidden, set its positioning to Don't move or size with cells. Use the Format ⇨ Selected Chart Area command to change this setting.

Storing multiple charts on a chart sheet

Most Excel users who take the time to think about it would agree that a chart sheet holds a single chart. Most of the time, that's a true statement. However, it's certainly possible to store multiple charts on a single chart sheet. In fact, Excel lets you do this directly. If you activate an embedded chart and then select Chart ⇨ Location, Excel displays its Chart Location dialog box. If you select the As new sheet option and specify an existing chart sheet as the location, the chart will appear on top of the chart in the chart sheet.

Most of the time, you'll want to add embedded charts to an *empty* chart sheet. To create an empty chart sheet, select a single blank cell and press F11.

One advantage of storing multiple charts on a chart sheet is that you can take advantage of the View ⇨ Sized with Window command to automatically scale the charts to the window size and dimensions. Figure 18-21 shows an example of a chart sheet that contains six embedded charts.

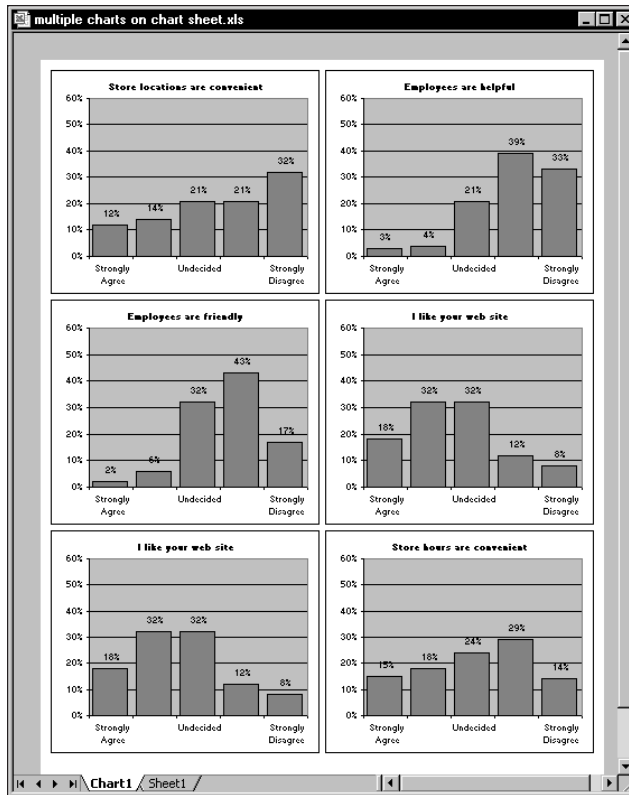


Figure 18-21: This chart sheet contains six embedded charts.



This workbook is available on the companion CD-ROM.

Using linked pictures in a chart

Excel has a feature that lets you display a data table inside of a chart. You can select this option in Step 3 of the ChartWizard. The data table option displays a table that shows the values used in a chart. This is a handy feature, but it's not very flexible. For example, your formatting options are limited, and you have no control over the position of the data table (it always appears below the chart).

An alternative to the data table is to use a linked picture of a range. Figure 18-22 shows an example.

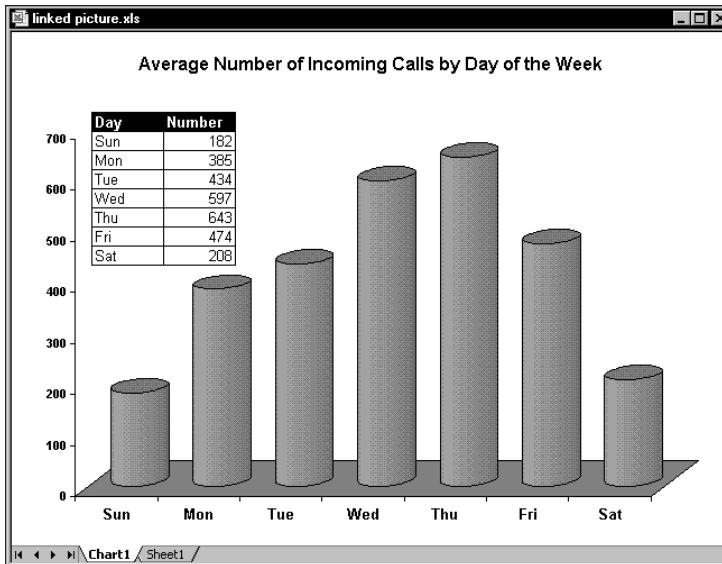


Figure 18-22: This chart contains a linked picture of a range used in the chart.

To create a linked picture in a chart, first create the chart as you normally would. Then:

1. Select the range that you would like to include in the chart.
2. Select Edit ⇨ Copy.
3. Activate the chart.
4. Press Shift, and then select Edit ⇨ Paste Picture. This pastes an unlinked picture of the range.
5. To create the link, select the picture and then type a reference to the range in the formula bar. The easiest way to do this is to type an equals sign, and then reselect the range.

The picture now contains a live link to the range. If you change the values or cell formatting, they will be reflected in the linked picture.



This workbook is available on the companion CD-ROM.

Animated charts

Most people don't realize it, but Excel is capable of performing simple animations. For example, you can animate shapes and charts. Consider the XY chart shown in Figure 18-23.

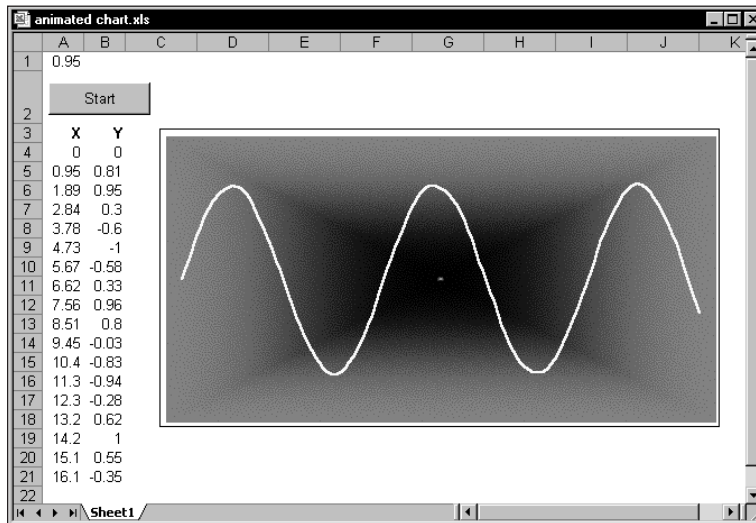


Figure 18-23: A simple VBA procedure will turn this graph into an interesting animation.

The X values (column A) depend on the value in cell A1. The value in each row is the previous row's value, plus the value in A1. Column B contains formulas that calculate the SIN of the corresponding value in column A. The following simple procedure produces an interesting animation. It simply changes the value in cell A1, which causes the values in the X and Y ranges to change.

```
Sub AnimateChart()
    Range("A1") = 0
    For i = 1 To 150
        Range("A1") = Range("A1") + 0.035
    Next i
    Range("A1") = 0
End Sub
```



The companion CD-ROM contains a workbook that includes this animated chart, plus several other animation examples.

Creating a hypocycloid chart

Even if you hated your high school trigonometry class, you'll probably like the example in this section — which relies heavily on trigonometric functions. The workbook shown in Figure 18-24 can display an infinite number of dazzling hypocycloid curves. A hypocycloid curve is the path formed by a point on a circle that rolls inside of another circle. This, as you may recall from your childhood, is the same technique used in Hasbro's popular Spirograph toy.

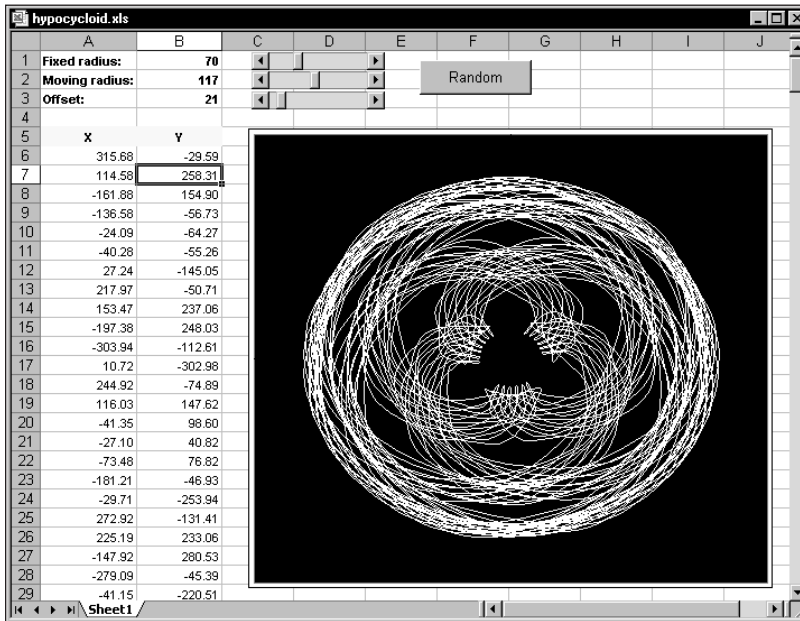


Figure 18-24: This workbook generates an infinite number of hypocycloid curves.



This workbook is available on the companion CD-ROM.

The chart is an XY chart. The X and Y data are generated using formulas stored in columns A and B. The Scrollbar controls at the top let you adjust the three parameters that determine the look of the chart. These controls are linked to cells B1, B2, and B3. These are controls from the Forms toolbar, and are not ActiveX controls. In addition, the chart has a Random button that generates random values for the three parameters.

The workbook contains only one macro (which follows), which is executed when the Random button is clicked. This macro simply generates three random numbers between 1 and 250 and inserts them into the worksheet.

```
Sub Random_Click()  
  Randomize  
  Range("B1") = Int(Rnd * 250)  
  Range("B2") = Int(Rnd * 250)  
  Range("B3") = Int(Rnd * 250)  
End Sub
```

Creating a “clock” chart

Figure 18-25 shows an XY chart formatted to look like a clock. It not only *looks* like a clock, it also functions as a clock. I can't think of a single reason why anyone would need to display a clock like this on a worksheet, but creating the workbook was challenging and you may find it instructive.

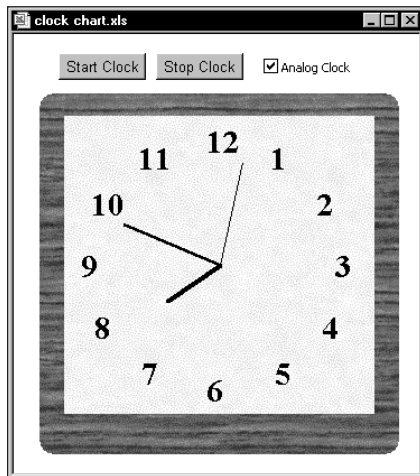


Figure 18-25: This clock is fully functional, and is actually an XY chart in disguise.



This workbook is available on the companion CD-ROM.

Besides the clock chart, the workbook contains a text box that displays the time as a normal string, as shown in Figure 18-26. Normally this is hidden, but it can be displayed by deselecting the Analog clock check box.



Figure 18-26: Displaying a digital clock in a worksheet is much easier, but not as fun to create.

As you explore this workbook from the CD-ROM, here are a few things to keep in mind:

- ♦ The `ChartObject` is named `ClockChart`, and it covers up a range named `DigitalClock`, which is used to display the time digitally.
- ♦ The two buttons on the worksheet are from the Forms toolbar, and each has a macro assigned (`StartClock` and `StopClock`).
- ♦ The check box control (named `cbClockType`) on the worksheet is from the Forms toolbar, not from the Control Toolbox toolbar. Clicking the object executes a procedure named `cbClockType_Click`, which simply toggles the `Visible` property of the `ChartObject`. When it's invisible, the digital clock is revealed.
- ♦ The chart is an XY chart with four `Series` objects. These series represent the hour hand, the minute hand, the second hand, and the 12 numbers.
- ♦ The `UpdateClock` procedure is executed when the Start Clock button is clicked. This procedure determines which clock is visible and performs the appropriate updating.
- ♦ The `UpdateClock` procedure uses the `OnTime` method of the `Application` object. This method lets you execute a procedure at a specific time. Before the `UpdateClock` procedure ends, it sets up a new `OnTime` event that will occur in one second. In other words, the `UpdateClock` procedure is called every second.
- ♦ The `UpdateClock` procedure uses some basic trigonometry to determine the angles at which to display the hands on the clock.
- ♦ Unlike most charts, this one does not use any worksheet ranges for its data. Rather, the values are calculated in VBA and transferred directly to the `Values` and `XValues` properties of the chart's `Series` object.

Drawing with an XY chart

The final example has absolutely no practical value, but you may find it interesting . . . and maybe even a bit entertaining. The worksheet consists of an embedded XY chart, along with a number of controls (these are controls from the Forms toolbar; and are not ActiveX controls).



This workbook is available on the companion CD-ROM.

Clicking one of the arrow buttons draws a line in the chart, the size of which is determined by the “step” value, which is set with one of the Spinner controls. With a little practice (and patience), you can create simple sketches. Figure 18-27 shows an example.

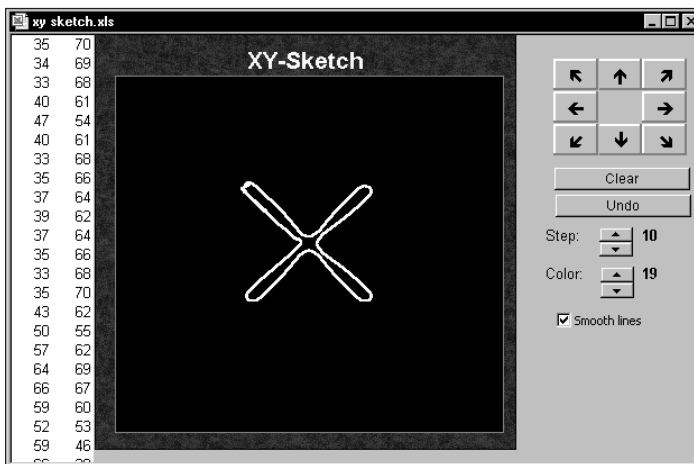


Figure 18-27: This drawing is actually an embedded XY chart.

Clicking an arrow button executes a macro that adds two values to a range: an X value and a Y value. It then redefines two range names (*XRange* and *YRange*) that are used in the chart’s *SERIES* formula. Particularly handy is the multilevel Undo button. Clicking this button simply erases the last two values in the range, and then redefines the range names. Additional accoutrements include the ability to change the color of the line, and display “smoothed” lines.

Summary

In this chapter, I introduced the object model for charts, and showed how to write VBA code to create and manipulate charts.

This chapter included several examples that made use of events. In the next chapter, I cover the concept of events in detail.



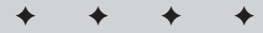
Understanding Excel's Events

In several previous chapters in this book, I presented examples of VBA “event-handler” procedures. An event-handler procedure is a specially named procedure that is executed when a specific event occurs. A simple example is the `CommandButton1_Click` procedure that is executed when the user clicks a `CommandButton` stored on a `UserForm` or on a worksheet.

Excel is capable of monitoring a wide variety of events, and executing your VBA code when a particular event occurs. Following are just a few examples of the types of events that Excel can recognize:

- ◆ A workbook is opened or closed
- ◆ A window is activated
- ◆ A worksheet is activated or deactivated
- ◆ Data is entered into a cell, or the cell is edited
- ◆ A workbook is saved
- ◆ A worksheet is calculated
- ◆ An object is clicked
- ◆ The data in a chart is updated
- ◆ A particular key or key combination is pressed
- ◆ A cell is double-clicked
- ◆ A particular time of day occurs

This chapter provides comprehensive coverage of the concept of Excel events, and I include many examples that you can adapt to your own needs. As you’ll see, understanding events can give your Excel applications a powerful edge.



In This Chapter

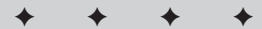
An overview of the types of events Excel can monitor

Essential background information for working with events

Examples of `Workbook` events, `Worksheet` events, `Chart` events, and `UserForm` events

Using `Application` events to monitor all open workbooks

Examples of processing time-based events and keystroke events



Event Types That Excel Can Monitor

Excel is programmed to monitor many different events that occur. These events may be classified as the following:

- ♦ *Workbook events.* Events that occur for a particular workbook. Examples of such events include `Open` (the workbook is opened or created), `BeforeSave` (the workbook is about to be saved), and `NewSheet` (a new sheet is added).
- ♦ *Worksheet events.* Events that occur for a particular worksheet. Examples include `Change` (a cell on the sheet is changed), `SelectionChange` (the user moves the cell indicator), and `Calculate` (the worksheet is recalculated).
- ♦ *Chart events.* Events that occur for a particular chart. These events include `Select` (an object in the chart is selected) and `SeriesChange` (a value of a data point in a series is changed). To monitor events for an embedded chart, you use a class module as demonstrated in Chapter 17.
- ♦ *Application events.* Events that occur for the application (Excel). Examples include `NewWorkbook` (a new workbook is created), `WorkbookBeforeClose` (any workbook is about to be closed), and `SheetChange` (a cell in any open workbook is altered). To monitor Application-level events, you need to use a class module.
- ♦ *UserForm events.* Events that occur for a particular UserForm or an object contained on the UserForm. For example, a UserForm has an `Initialize` event (occurs before the UserForm is displayed), and a `CommandButton` on a UserForm has a `Click` event (occurs when the button is clicked).
- ♦ *Events not associated with objects.* The final category consists of two useful Application-level events that I call “On-” events: `OnTime` and `OnKey`. These work in a different manner than other events.

This chapter is organized according to the preceding list. Within each section, I provide examples to demonstrate some of the events.

What You Should Know about Events

This section provides some essential information relevant to working with events and writing event-handler procedures.

Understanding event sequences

As you’ll see, some actions trigger multiple events. For example, when you insert a new worksheet into a workbook, this action triggers three Application-level events:

- ♦ `WorkbookNewSheet`: Occurs when a new worksheet is added.
- ♦ `SheetDeactivate` event: Occurs when the active worksheet is deactivated.
- ♦ `SheetActivate` event: Occurs when the newly added worksheet is activated.

Note

Event sequencing is a bit more complicated than you might think. The events listed above are Application-level events. When adding a new worksheet, additional events occur at the `Workbook` level and at the `Worksheet` level.

At this point, just keep in mind that events fire in a particular sequence, and knowing what the sequence is can be critical when writing event-handler procedures. Later in this chapter, I describe how to determine the order of the events that occur for a particular action (see “Monitoring Application-level events”).

Where to put event-handler procedures

VBA newcomers often wonder why their event-handler procedures aren't being executed when the corresponding event occurs. The answer is almost always because these procedures are located in the wrong place.

In the VB Editor window, each project is listed in the Projects window. The project components are arranged in a collapsible list, as shown in Figure 19-1.

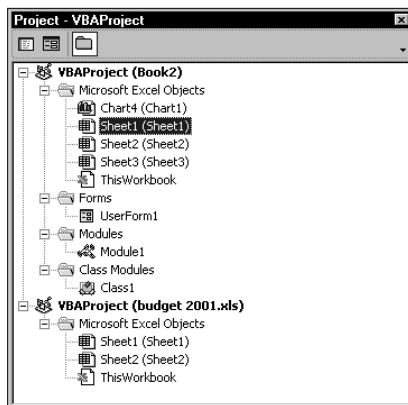


Figure 19-1: The components for each VBA Project are listed in the Project window.

Each of the following components has its own code module:

- ♦ `Sheet` objects (for example, `Sheet1`, `Sheet2`, and so on).
- ♦ `Chart` objects (that is, chart sheets).
- ♦ `ThisWorkbook` object.

- ♦ General VBA modules. You never put event-handler procedures in a general (that is, nonobject) module.
- ♦ Class modules.

Even though the event-handler procedure must be located in the correct module, the procedure can call other standard procedures stored in other modules. For example, the following event-handler procedure, located in the module for the `ThisWorkbook` object, calls a procedure named `WorkbookSetup`, which could be stored in a regular VBA module:

```
Private Sub Workbook_Open()  
    Call WorkbookSetup  
End Sub
```

Disabling events

By default, all events are enabled. To disable all events, execute the following VBA instruction:

```
Application.EnableEvents = False
```

To enable events, use:

```
Application.EnableEvents = True
```

**Note**

Disabling events does *not* apply to events triggered by UserForm controls—for example, the `Click` event generated by clicking a `CommandButton` control on a UserForm.

Why would you need to disable events? The main reason is to prevent an infinite loop of cascading events.

For example, suppose that cell A1 of your worksheet must always contain a value less than or equal to 12. You can write some code that is executed whenever data is entered into a cell to validate the cell's contents. In this case, you are monitoring the `Change` event for a `Worksheet` using a procedure named `Worksheet_Change`. Your procedure checks the user's entry, and if the entry isn't less than or equal to 12, it displays a message and then clears that entry. The problem is, clearing the entry with your VBA code generates a new `Change` event, so your event-handler procedure is executed again. This is not what you want to happen, so you need to disable events before you clear the cell, and then enable events again so you can monitor the user's next entry.

Another way to prevent an infinite loop of cascading events is to declare a `Static Boolean` variable at the beginning of your event-handler procedure, such as this:

```
Static AbortProc As Boolean
```


Programming Events in Older Versions of Excel

Versions of Excel prior to Office 97 also supported events, but the programming techniques required to take advantage of those were quite different from those described in this chapter.

For example, if you have a procedure named `Auto_Open` stored in a regular VBA module, this procedure will be executed when the workbook is opened. Beginning with Excel 97, the `Auto_Open` procedure is supplemented by the `Workbook_Open` event-handler procedure, stored in the code module for the `ThisWorkbook` object, and executed prior to `Auto_Open`.

Before Excel 97, it was often necessary to explicitly set up events. For example, if you needed to execute a procedure whenever data was entered into a cell, you would need to execute a statement such as:

```
Sheets("Sheet1").OnEntry = "ValidateEntry"
```

This statement instructs Excel to execute the procedure named `ValidateEntry` whenever data is entered into a cell. With Excel 97 and later, you simply create a procedure named `Worksheet_Change` and store it in the code module for the `Sheet1` object.

For compatibility reasons, Excel 97 and later versions still support the older event mechanism (although they no longer are documented in the online help system). If you're developing applications that will be used only with Excel 97 or later, you'll definitely want to use the techniques described in this chapter.

Whenever the procedure needs to make its own changes, set the `AbortProc` variable to `True` (otherwise, make sure it is set to `False`). Insert the following code at the top of the procedure:

```
If AbortProc Then  
    AbortProc = False  
    Exit Sub  
End if
```

The event procedure is reentered, but the `True` state of `AbortProc` causes the procedure to end. In addition, `AbortProc` is reset back to `False`.



For a practical example of validating data, see "Validating data entry," later in this chapter.



Disabling events in Excel applies to all workbooks. For example, if you disable events in your procedure and then open another workbook that has, say, a `Workbook_Open` procedure, that procedure will not execute.

Entering event-handler code

Every event-handler procedure has a predetermined name. Following are some examples of event-handler procedure names:

```
Worksheet_SelectionChange  
Workbook_Open  
Chart_Activate  
Class_Initialize
```

You can declare the procedure by typing it manually, but a much better approach is to let the VB Editor do it for you.

Figure 19-2 shows the code module for the `ThisWorkbook` object. To insert a procedure declaration, select `Workbook` from the objects list on the left. Then select the event from the procedures list on the right. When you do so, you'll get a procedure "shell" that contains the procedure declaration line and an `End Sub` statement.

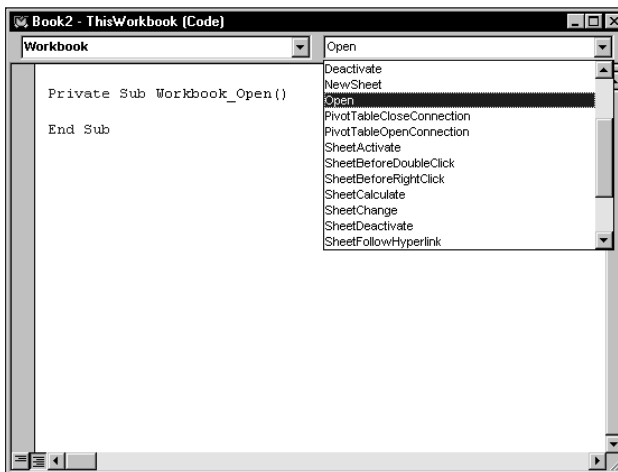


Figure 19-2: The best way to create an event procedure is to let the VB Editor do it for you.

For example, if you select `Workbook` from the objects list and `Open` from the procedures list, the VB Editor will insert the following (empty) procedure:

```
Private Sub Workbook_Open()  
  
End Sub
```

Your code, of course, goes between these two statements.

Event-handler procedures that use arguments

Some event-handler procedures use an argument list. For example, you may need to create an event-handler procedure to monitor the `SheetActivate` event for a workbook. If you use the technique described in the previous section, the VB Editor will create the following procedure:

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)

End Sub
```

This procedure uses one argument (`Sh`), which represents the sheet that was activated. In this case, `Sh` is declared as an `Object` datatype rather than a `Worksheet` datatype. That's because the activated sheet can also be a chart sheet.

Your code can, of course, make use of the data passed as an argument. The following procedure is executed whenever a sheet is activated. It displays the type and name of the activated sheet by using VBA's `TypeName` function and accessing the `Name` property of the object passed in the argument:

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    MsgBox TypeName(Sh) & vbCrLf & Sh.Name
End Sub
```

Several event-handler procedures use a Boolean argument named `Cancel`. For example, the declaration for a workbook's `BeforePrint` event is as follows:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
```

The value of `Cancel` passed to the procedure is `False`. However, your code can set `Cancel` to `True`, which will cancel the printing. The following example demonstrates:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
    Msg = "Have you loaded the 5164 label stock?"
    Ans = MsgBox(Msg, vbYesNo, "About to print...")
    If Ans = vbNo Then Cancel = True
End Sub
```

The `Workbook_BeforePrint` procedure is executed before the workbook is printed. This routine displays the message box shown in Figure 19-3. If the user clicks the `No` button, `Cancel` is set to `True` and nothing is printed.

Note

The `BeforePrint` event also occurs when the user previews a worksheet.



Figure 19-3: You can cancel the print operation by changing the `Cancel` argument.

Unfortunately, Excel does not provide a sheet-level `BeforePrint` event. Therefore, your code cannot determine what is about to be printed.

Workbook-Level Events

Workbook-level events are events that occur within a particular workbook. Table 19-1 lists the workbook events, along with a brief description of each. Workbook event-handler procedures are stored in the code module for the `ThisWorkbook` object.

Table 19-1
Workbook Events

<i>Event</i>	<i>Action that triggers the event</i>
<code>Activate</code>	A workbook is activated.
<code>AddinInstall</code>	A workbook is installed as an add-in.
<code>AddinUninstall</code>	A workbook is uninstalled as an add-in.
<code>BeforeClose</code>	A workbook is about to be closed.
<code>BeforePrint</code>	A workbook (or anything in it) is about to be printed or previewed.
<code>BeforeSave</code>	A workbook is about to be saved.
<code>Deactivate</code>	A workbook is deactivated.
<code>NewSheet</code>	A new sheet is created in a workbook.
<code>Open</code>	A workbook is opened.
<code>PivotTableCloseConnection*</code>	An external data source connection for a pivot table is closed.
<code>PivotTableOpenConnection*</code>	An external data source connection for a pivot table is opened.
<code>SheetActivate</code>	Any sheet is activated.
<code>SheetBeforeDoubleClick</code>	Any worksheet is double-clicked. This event occurs before the default double-click action.

Event	Action that triggers the event
SheetBeforeRightClick	Any worksheet is right-clicked. This event occurs before the default right-click action.
SheetCalculate	Any worksheet is calculated (or recalculated).
SheetChange	Any worksheet is changed by the user or by an external link.
SheetDeactivate	Any sheet is deactivated.
SheetFollowHyperlink	A hyperlink on a sheet is clicked.
SheetPivotTableUpdate*	A pivot table is updated with new data.
SheetSelectionChange	The selection on any worksheet is changed.
WindowActivate	Any workbook window is activated.
WindowDeactivate	Any workbook window is deactivated.
WindowResize	Any workbook window is resized.

* These events occur only in Excel 2002, and are not supported in previous versions.



If you need to monitor events for *any* workbook, you need to work with Application-level events (see “Application Events,” later in this chapter). The remainder of this section presents examples of using *Workbook*-level events. All of the example procedures that follow must be located in the code module for the `ThisWorkbook` object. If you put them into any other type of code module, they won't work.

The Open event

One of the most common events that is monitored is the `Open` event for a workbook. This event is triggered when the workbook (or add-in) is opened, and executes the `Workbook_Open` procedure. A `Workbook_Open` procedure can do almost anything, and often is used for tasks such as:

- ♦ Displaying welcome messages
- ♦ Opening other workbooks
- ♦ Setting up custom menus or toolbars
- ♦ Activating a particular sheet or cell
- ♦ Ensuring that certain conditions are met. For example, a workbook may require that a particular add-in is installed.
- ♦ Setting up certain automatic features. For example, you can define key combinations (see “The `OnKey` event” later in this chapter).

- ◆ Setting a worksheet's `ScrollArea` property (which isn't stored with the workbook).
- ◆ Setting `UserInterfaceOnly` protection for worksheets, so your code can operate on protected sheets. This setting is an argument for the `Protect` method and is not stored with the workbook.

**Caution**

If the user holds down the Shift key when opening a workbook, the workbook's `Workbook_Open` procedure will not execute.

Following is a simple example of a `Workbook_Open` procedure. It uses VBA's `Weekday` function to determine the day of the week. If it's Friday, a message box appears, reminding the user to perform a weekly file backup. If it's not Friday, nothing happens.

```
Private Sub Workbook_Open()
    If Weekday(Now) = vbFriday Then
        Msg = "Today is Friday. Make sure that you "
        Msg = Msg & "do your weekly backup!"
        MsgBox Msg, vbInformation
    End If
End Sub
```

The Activate event

The following procedure is executed whenever the workbook is activated. This procedure simply maximizes the active window.

```
Private Sub Workbook_Activate()
    ActiveWindow.WindowState = xlMaximized
End Sub
```

The SheetActivate event

The following procedure is executed whenever the user activates any sheet in the workbook. If the sheet is a worksheet, the code simply selects cell A1. If the sheet is not a worksheet, nothing happens. This procedure uses VBA's `TypeName` function to ensure that the activated sheet is a worksheet (as opposed to a chart sheet).

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    If TypeName(Sh) = "Worksheet" Then _
        Range("A1").Select
End Sub
```

An alternative method to avoid the error that occurs when you try to select a cell on a chart sheet is to simply ignore the error.

```
Private Sub Workbook_SheetActivate(ByVal Sh As Object)
    On Error Resume Next
    Range("A1").Select
End Sub
```

The NewSheet event

The following procedure is executed whenever a new sheet is added to the workbook. The sheet is passed to the procedure as an argument. Since a new sheet can be either a worksheet or a chart sheet, this procedure determines the sheet type. If it's a worksheet, the code inserts a date and time stamp in cell A1.

```
Private Sub Workbook_NewSheet(ByVal Sh As Object)
    If TypeName(Sh) = "Worksheet" Then _
        Range("A1") = "Sheet added " & Now()
End Sub
```

The BeforeSave event

The `BeforeSave` event occurs before the workbook is actually saved. As you know, using the `File` ⇨ `Save` command sometimes brings up the `Save As` dialog box. This happens if the workbook has never been saved, or if it was opened in read-only mode.

When the `Workbook_BeforeSave` procedure is executed, it receives an argument (`SaveAsUI`) that lets you identify if the `Save As` dialog box will be displayed. The following example demonstrates:

```
Private Sub Workbook_BeforeSave _
    (ByVal SaveAsUI As Boolean, Cancel As Boolean)
    If SaveAsUI Then
        MsgBox "Click OK to display the Save As dialog box."
    End If
End Sub
```

When the user attempts to save the workbook, the `Workbook_BeforeSave` procedure is executed. If the save operation will bring up Excel's `Save As` dialog box, the `SaveAsUI` variable is `True`. The procedure above checks this variable and displays a message only if the `Save As` dialog box will be displayed. If the procedure sets the `Cancel` argument to `True`, the file will not be saved.

The Deactivate event

The following example demonstrates the `Deactivate` event. This procedure is executed whenever the workbook is deactivated, and essentially never lets the user deactivate the workbook. When the `Deactivate` event occurs, the code re-activates the workbook and displays a message.

```
Private Sub Workbook_Deactivate()  
    Me.Windows(1).Activate  
    MsgBox "Sorry, you may not leave this workbook"  
End Sub
```

Note

I do not recommend using procedures—such as this one—that attempt to “take over” Excel. It can be very frustrating and confusing for the user. Rather, I would recommend training the user how to use your application correctly.

This simple example illustrates the importance of understanding event sequences. If you try out this procedure, you’ll see that it works well if the user attempts to activate another workbook. However, it’s important to understand that the workbook `Deactivate` event is also triggered by the following actions:

- ♦ Closing the workbook
- ♦ Opening a new workbook
- ♦ Minimizing the workbook

In other words, this procedure may not perform as it was originally intended. It does prevent the user from activating a different workbook directly, but he or she can close the workbook, open a new one, or minimize the workbook. The message box will still appear, but the actions will occur anyway.

The BeforePrint event

The `BeforePrint` event occurs when the user requests a print or a print preview, but before the printing or previewing actually occurs. The event uses a `Cancel` argument, so your code can cancel the printing or previewing by setting the `Cancel` variable to `True`. Unfortunately, there is no way to determine if the `BeforePrint` event was triggered by a print request or a preview request.

Before Excel 2002, users were often dismayed to discover that it was not possible to print a workbook’s full path in the page header or footer. Excel 2002 solves this problem by adding a new option to the Header and Footer dialog boxes (accessed from the Page Setup dialog box).

If you’re still using an older version of Excel, the only solution is to write code that inserts the workbook’s path into the header or footer. The `Workbook_BeforePrint` event is perfect for this. The following code demonstrates:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)  
    For Each sht In ThisWorkbook.Sheets  
        sht.PageSetup.LeftFooter = _  
            "&8" & ThisWorkbook.FullName  
    Next sht  
End Sub
```


This procedure loops through each sheet in the workbook and sets the `LeftFooter` property of the `PageSetup` object to the `FullName` property of the workbook (which is the filename and path). It also sets the font size to 8 points.

Note

This example exposes an inconsistency in Excel's object model. To change the font size of header or footer text, you must use a string that contains a special formatting code. In the example above, "&8" is the code for 8-point font. Ideally, there should be a `Font` object available for page headers and footers. To find out the other formatting codes available, consult the online help (or record a macro while you access the Page Setup dialog box).

Tip

When testing `BeforePrint` event-handlers, you can save time (and paper) by previewing rather than actually printing.

The BeforeClose event

The `BeforeClose` event occurs before a workbook is closed. This event is often used in conjunction with a `Workbook_Open` event-handler. For example, you might use the `Workbook_Open` procedure to create a custom menu for your workbook, and then use the `Workbook_BeforeClose` procedure to delete the custom menu when the workbook is closed. That way, the custom menu is available only when the workbook is open.

As you know, if you attempt to close a workbook that hasn't been saved, Excel displays a prompt asking if you want to save the workbook before closing, as shown in Figure 19-4.

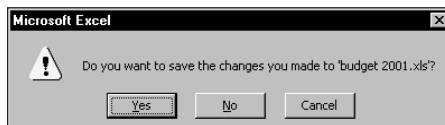


Figure 19-4: When this message appears, `Workbook_BeforeClose` has already done its thing.

Caution

A potential problem can arise because by the time the user sees this message, the `BeforeClose` event has already occurred—which means that your `Workbook_BeforeClose` procedure has already executed.

Consider this scenario: You need to display a custom menu when a particular workbook is open. Therefore, your workbook uses a `Workbook_Open` procedure to create the menu when the workbook is opened, and it uses a `Workbook_BeforeClose` procedure to remove the menu when the workbook is closed. These two event-handler procedures follow. Both of these call other procedures, which are not shown here.

```
Private Sub Workbook_Open()  
    Call CreateMenu  
End Sub  
  
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Call DeleteMenu  
End Sub
```

As I noted above, Excel's "Do you want to save . . ." prompt occurs *after* the `Workbook_BeforeClose` event-handler runs. So if the user clicks `Cancel`, the workbook remains open, but the custom menu item has already been deleted!

One solution to this problem is to bypass Excel's prompt and write your own code in the `Workbook_BeforeClose` procedure to ask the user to save the workbook. The following code demonstrates:

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Dim Msg As String  
    If Me.Saved Then  
        Call DeleteMenu  
        Exit Sub  
    Else  
        Msg = "Do you want to save the changes you made to "  
        Msg = Msg & Me.Name & "?"  
        Ans = MsgBox(Msg, vbQuestion + vbYesNoCancel)  
        Select Case Ans  
            Case vbYes  
                Me.Save  
                Call DeleteMenu  
            Case vbNo  
                Me.Saved = True  
                Call DeleteMenu  
            Case vbCancel  
                Cancel = True  
        End Select  
    End If  
End Sub
```

This procedure checks the `Saved` property of the `Workbook` object to determine if the workbook has been saved. If so, no problem—the `DeleteMenu` procedure is executed and the workbook is closed. But if the workbook has not been saved, the procedure displays a message box that duplicates the one that Excel would normally show. If the user clicks `Yes`, the workbook is saved, the menu is deleted, and the workbook is closed. If the user clicks `No`, the code sets the `Saved` property of the `Workbook` object to `True` (but doesn't actually save the file), and deletes the menu. If the user clicks `Cancel`, the `BeforeClose` event is canceled and the procedure ends without deleting the menu.

Worksheet Events

The events for a `Worksheet` object are some of the most useful. As you'll see, monitoring these events can make your applications perform feats that would otherwise be impossible.



Note

The events in this section apply only to worksheets. There are no specific trappable events for Excel 5/95 dialog sheets or XLM macro sheets.

Table 19-2 lists the worksheet events, with a brief description of each.

Table 19-2
Worksheet Events

<i>Event</i>	<i>Action that triggers the event</i>
Activate	The worksheet is activated.
BeforeDoubleClick	The worksheet is double-clicked.
BeforeRightClick	The worksheet is right-clicked.
Calculate	The worksheet is calculated (or recalculated).
Change	Cells on the worksheet are changed by the user or by an external link.
Deactivate	The worksheet is deactivated.
FollowHyperlink	A hyperlink on the sheet is clicked.
PivotTableUpdate*	A pivot table on the sheet is updated.
SelectionChange	The selection on the worksheet is changed.

* This event occurs only in Excel 2002, and is not supported in previous versions.

Remember that the code for a worksheet event must be stored in the code module for the specific worksheet.



Tip

To quickly activate the code module for a worksheet, right-click the sheet tab, and choose `View Code`.

The Change event

The `Change` event is triggered when any cell in a worksheet is changed by the user or by an external link. The `Change` event is not triggered when a calculation generates a different value for a formula, or when an object is added to the sheet.

When the `Worksheet_Change` procedure is executed, it receives a `Range` object as its `Target` argument. This `Range` object represents the changed cell or range that triggered the event. The following example displays a message box that shows the address of the `Target` range:

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    MsgBox "Range " & Target.Address & " was changed."
End Sub
```

To get a better feel for the types of actions that generate a `Change` event for a worksheet, enter the preceding procedure in the code module for a `Worksheet` object. After entering this procedure, activate Excel and make some changes to the worksheet using various techniques. Every time the `Change` event occurs, you'll see a message box that displays the address of the range that was changed.

When I ran this procedure, I discovered some interesting quirks. Some actions that should trigger the event don't, and other actions that should not trigger the event do!

- ♦ Changing the formatting of a cell does not trigger the `Change` event (as expected), but using the `Edit ⇄ Clear Formats` command *does* trigger the event.
- ♦ Adding, editing, or deleting a cell comment does not trigger the `Change` event.
- ♦ Pressing `Del` generates an event even if the cell is empty to start with.
- ♦ Cells that are changed by using Excel commands may or may not trigger the `Change` event. For example, the `Data ⇄ Form` command and the `Data ⇄ Sort` command do not trigger the event. But the `Tools ⇄ Spelling` command and the `Edit ⇄ Replace` command do trigger the `Change` event.
- ♦ If your VBA procedure changes a cell, it *does* trigger the `Change` event.

As you can see from the preceding list, it's not a good idea to rely on the `Change` event to detect cell changes for critical applications.

**Note**

To add to the confusion, triggers for the `Change` event vary, depending on the version of Excel. For versions earlier than Excel 2002, filling a range using the `Edit ⇄ Fill` command does not generate a `Change` event. Nor does using the `Edit ⇄ Delete` command to delete cells.

Monitoring a specific range for changes

The `Change` event occurs when any cell on the worksheet is changed. But in most cases all you care about are changes made to a specific cell or range. When the `Worksheet_Change` event-handler procedure is called, it receives a `Range` object as its argument. This `Range` object represents the cell or cells that were changed.

Assume that your worksheet has a range named `InputRange`, and you would like to monitor changes made only within this range. There is no `Change` event for a `Range` object, but you can perform a quick check within the `Worksheet_Change` procedure. The following procedure demonstrates:

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    Dim VRange As Range
    Set VRange = Range("InputRange")
    If Not Intersect(Target, VRange) Is Nothing Then _
        MsgBox "A changed cell is in the input range."
End Sub
```

This example uses a `Range` object variable named `VRange`, which represents the worksheet range that you are interested in monitoring for changes. The procedure uses VBA's `Intersect` function to determine if the `Target` range (passed to the procedure in its argument) is contained in `VRange`. The `Intersect` function returns an object that consists of all the cells that are contained in both of its arguments. If the `Intersect` function returns `Nothing`, then the ranges have no cells in common. The `Not` operator is used so the expression returns `True` if the ranges *do* have at least one cell in common. Therefore, if the changed range has any cells in common with the range named `InputRange`, a message box is displayed. Otherwise, the procedure ends and nothing happens.

Tracking cell changes in a comment

The following example adds a notation to the cell's comment each time the cell is changed (as determined by the `Change` event). The state of a `CheckBox`, embedded on the worksheet, determines if the change is added to the comment. Figure 19-5 shows an example of a comment for a cell that has been changed several times.

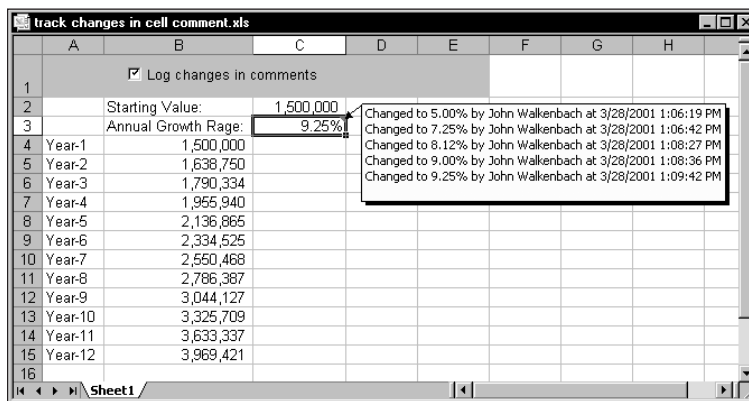


Figure 19-5: The `Worksheet_Change` procedure appends the comment with each cell change.



This example is available on the companion CD-ROM.

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    If CheckBox1 Then
        For Each cell In Target
            With cell
                On Error Resume Next
                OldText = .Comment.Text
                If Err <> 0 Then .AddComment
                NewText = OldText & "Changed to " & cell.Text & _
                    " by " & Application.UserName & " at " & Now &
vbLf
                .Comment.Text NewText
                .Comment.Visible = True
                .Comment.Shape.Select
                Selection.AutoSize = True
                .Comment.Visible = False
            End With
        Next cell
    End If
End Sub
```

Because the object passed to the `Worksheet_Change` procedure can consist of a multicell range, the procedure loops through each cell in the `Target` range. If the cell doesn't already contain a comment, one is added. Then new text is appended to the existing comment text (if any).



This example is primarily for instructional purposes. If you really need to track changes in a worksheet, Excel's `Tools` ⇨ `Track Changes` feature does a much better job.

Validating data entry

Excel's Data Validation feature is a useful tool, but it suffers from a potentially serious problem. When you paste data to a cell that uses data validation, the pasted value not only fails to get validated, it also deletes the validation rules associated with the cell! This fact makes the Data Validation feature practically worthless for critical applications. In this section, I demonstrate how you can make use of the `Change` event for a worksheet to create your own data validation procedure.



The companion CD-ROM contains two versions of this example. One uses the `EnableEvents` property to prevent cascading `Change` events, the other uses a `Static` variable (see "Disabling events," earlier in this chapter).

Listing 19-1 presents a procedure that is executed when a cell is changed by the user. The validation is restricted to the range named `InputRange`. Values entered into this range must be integers between 1 and 12.

Listing 19-1: Determining whether a cell entry is to be validated

```
Private Sub Worksheet_Change(ByVal Target As Excel.Range)
    Dim VRange As Range, cell As Range
    Dim Msg As String
    Dim ValidateCode As Variant
    Set VRange = Range("InputRange")
    For Each cell In Target
        If Union(cell, VRange).Address = VRange.Address Then
            ValidateCode = EntryIsValid(cell)
            If ValidateCode = True Then
                Exit Sub
            Else
                Msg = "Cell " & cell.Address(False, False) _
                    & ":"
                Msg = Msg & vbCrLf & vbCrLf & ValidateCode
                MsgBox Msg, vbCritical, "Invalid Entry"
                Application.EnableEvents = False
                cell.ClearContents
                cell.Activate
                Application.EnableEvents = True
            End If
        End If
    Next cell
End Sub
```

The `Worksheet_Change` procedure creates a `Range` object (named `VRange`) that represents the worksheet range that is validated. Then it loops through each cell in the `Target` argument, which represents the cell or cells that were changed. The code determines if each cell is contained in the range to be validated. If so, it passes the cell as an argument to a custom function (`EntryIsValid`), which returns `True` if the cell is a valid entry.

If the entry is not valid, the `EntryIsValid` function returns a string that describes the problem, and the user is informed via a message box (see Figure 19-6). When the message box is dismissed, the invalid entry is cleared from the cell and the cell is activated. Notice that events are disabled before the cell is cleared. If events were not disabled, clearing the cell would produce a `Change` event that causes an endless loop.

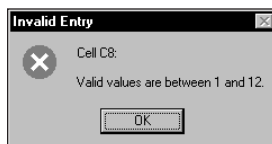


Figure 19-6: This message box describes the problem when the user makes an invalid entry.

The `EntryIsValid` function procedure is presented in Listing 19-2.

Listing 19-2: Validating an entry just made into a restricted range

```
Private Function EntryIsValid(cell) As Variant
' Returns True if cell is an integer between 1 and 12
' Otherwise it returns a string that describes the problem

' Numeric?
If Not WorksheetFunction.IsNumber (cell) Then
    EntryIsValid = "Non-numeric entry."
    Exit Function
End If
' Integer?
If Cint(cell) <> cell Then
    EntryIsValid = "Integer required."
    Exit Function
End If
' Between 1 and 12?
If cell < 1 Or cell > 12 Then
    EntryIsValid = "Valid values are between 1 and 12."
    Exit Function
End If
' It passed all the tests
EntryIsValid = True
End Function
```

The SelectionChange event

The following procedure demonstrates the `SelectionChange` event. It's executed whenever the user makes a new selection on the worksheet.

```
Private Sub Worksheet_SelectionChange(ByVal Target _
As Excel.Range)
    Cells.Interior.ColorIndex = xlNone
    With ActiveCell
        .EntireRow.Interior.ColorIndex = 36
        .EntireColumn.Interior.ColorIndex = 36
    End With
End Sub
```

This procedure shades the row and column of the active cell, which makes it very easy to identify the active cell. The first statement removes the background color for all cells in the worksheet. Next, the entire row and column of the active cell is shaded light yellow. Figure 19-7 shows the shading in effect; trust me, it's yellow.

	A	B	C	D	E	F	G	H	I
1		Project-1	Project-2	Project-3	Project-4	Project-5	Project-6	Project-7	Project-8
2	Jan-2001	4436	921	1271	3169	742	4242	3107	3116
3	Feb-2001	4414	60	3644	4207	1552	915	1634	2321
4	Mar-2001	1077	2980	1325	11	4493	4754	287	3559
5	Apr-2001	4032	2596	3408	3938	2513	2084	2084	3021
6	May-2001	4271	1133	3985	1638	3834	409	3639	4581
7	Jun-2001	2347	1623	1052	1872	4055	497	2485	1352
8	Jul-2001	4389	4070	4251	3385	1477	401	311	908
9	Aug-2001	907	3871	878	2777	107	4074	4872	2634
10	Sep-2001	2019	1483	821	829	3522	3986	4097	1306
11	Oct-2001	935	2546	4969	4398	4290	1701	1740	2246
12	Nov-2001	4156	227	2579	2923	567	3470	2969	1253
13	Dec-2001	1349	4959	4605	2779	2032	4877	1523	727
14	Jan-2002	4828	3453	595	4445	2298	3095	746	1078
15	Feb-2002	1380	1277	2107	2129	4295	2063	3737	2342
16	Mar-2002	1003	3283	383	4746	202	2879	2316	383
17	Apr-2002	313	1891	4245	3393	1102	1604	4820	1132
18	May-2002	222	2938	4788	3848	2549	1432	3976	60
19	Jun-2002	936	163	3321	2820	2262	2829	27	2468
20	Jul-2002	2281	2601	487	1230	1782	3724	3972	3129
21	Aug-2002	938	1038	248	3067	2423	3062	2664	2737
22	Sep-2002	2965	3292	1257	2668	2574	2269	758	1487

Figure 19-7: Moving the cell cursor causes the active cell's row and column to be shaded.



On the
CD-ROM

This example is available on the companion CD-ROM.



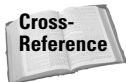
Caution

You won't want to use the procedure if your worksheet contains background shading, because it will be wiped out.

The BeforeRightClick event

When the user right-clicks in a worksheet, Excel displays a shortcut menu. If, for some reason, you'd like to prevent the shortcut menu from appearing in a particular sheet, you can trap the `RightClick` event. The following procedure sets the `Cancel` argument to `True`, which cancels the `RightClick` event and thereby cancels the shortcut menu. Instead, a message box is displayed.

```
Private Sub Worksheet_BeforeRightClick _
    (ByVal Target As Excel.Range, Cancel As Boolean)
    Cancel = True
    MsgBox "The shortcut menu is not available."
End Sub
```

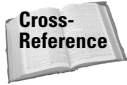


Cross-
Reference

Chapter 24 describes other methods to disable shortcut menus.

Chart Events

By default, events are enabled only for charts that reside on a `Chart` sheet. To work with events for an embedded chart, you need to create a class module.



Refer to Chapter 18 for examples that deal with `Chart` events. Chapter 18 also describes how to create a class module to enable events for embedded charts.

Table 19-3 contains a list of the chart events, and a brief description of each.

Table 19-3
Events Recognized by a Chart Sheet

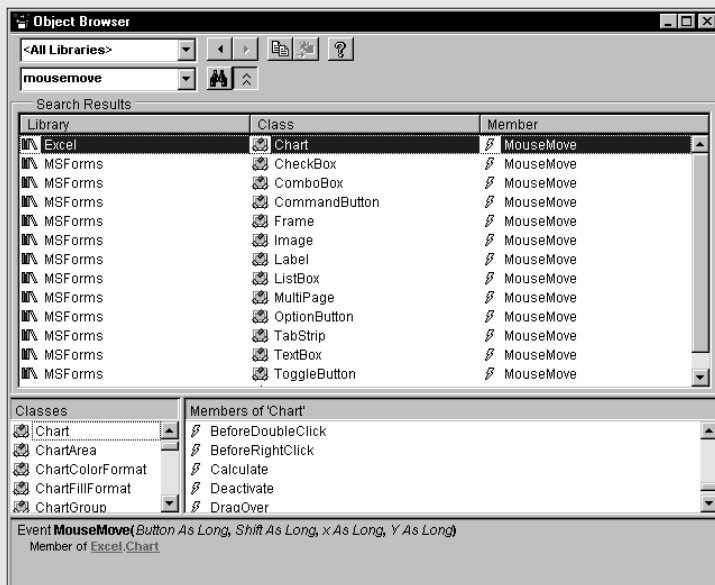
<i>Event</i>	<i>Action that triggers the event</i>
Activate	The chart sheet or embedded chart is activated.
BeforeDoubleClick	The chart sheet or an embedded chart is double-clicked. This event occurs before the default double-click action.
BeforeRightClick	The chart sheet or an embedded chart is right-clicked. The event occurs before the default right-click action.
Calculate	New or changed data is plotted on a chart.
Deactivate	The chart is deactivated.
DragOver	A range of cells is dragged over a chart.
DragPlot	A range of cells is dragged and dropped onto a chart.
MouseDown	A mouse button is pressed while the pointer is over a chart.
MouseMove	The position of the mouse pointer changes over a chart.
MouseUp	A mouse button is released while the pointer is over a chart.
Resize	The chart is resized.
Select	A chart element is selected.
SeriesChange	The value of a chart data point is changed.

Application Events

In previous sections, I discussed `Workbook` events and `Worksheet` events. Those events are monitored for a particular workbook. If you would like to monitor events for all open workbooks or all worksheets, you use `Application` level events.

Using the Object Browser to Locate Events

The Object Browser is a useful tool that can help you learn about objects and their properties and methods. It can also help you find out which objects support a particular event. For example, say you'd like to find out which objects support the `MouseMove` event. Activate the VB Editor and press F2 to display the Object Browser window. Make sure `<All Libraries>` is selected and then type **MouseMove** and click the binoculars icon (see the accompanying figure).



The Object Browser displays a list of matching items. Events are indicated with a small yellow lightning bolt. From this list, you can see which objects support the `MouseMove` event. Most of the objects located are controls in the `MSForms` library, home of the `UserForm` control. But you can also see that Excel's `Chart` object supports the `MouseMove` event.

Notice how the list is divided into three columns: `Library`, `Class`, and `Members`. The match for the item you're searching for may appear in any of these columns. This brings up a crucial point: The name of an event or term belonging to one library or class may be the same as that for another belonging to a different library or class — although they probably do not share the same functionality. So be sure to click each item in the Object Browser list and check the status bar at the bottom of the list for the syntax. You might find, for instance, that one class or library treats an event differently.

Note

Creating event-handler procedures to handle `Application` events always requires a class module and some set-up work.

Table 19-4 lists the `Application` events, with a brief description of each.

Table 19-4
Events Recognized by the Application Object

<i>Event</i>	<i>Action that triggers the event</i>
<code>NewWorkbook</code>	A new workbook is created.
<code>SheetActivate</code>	Any sheet is activated.
<code>SheetBeforeDoubleClick</code>	Any worksheet is double-clicked. This event occurs before the default double-click action.
<code>SheetBeforeRightClick</code>	Any worksheet is right-clicked. This event occurs before the default right-click action.
<code>SheetCalculate</code>	Any worksheet is calculated (or recalculated).
<code>SheetChange</code>	Cells in any worksheet are changed by the user or by an external link.
<code>SheetDeactivate</code>	Any sheet is deactivated.
<code>SheetFollowHyperlink</code>	A hyperlink is clicked.
<code>SheetPivotTableUpdate*</code>	Any pivot table is updated.
<code>SheetSelectionChange</code>	The selection changes on any worksheet except a chart sheet.
<code>WindowActivate</code>	Any workbook window is activated.
<code>WindowDeactivate</code>	Any workbook window is deactivated.
<code>WindowResize</code>	Any workbook window is resized.
<code>WorkbookActivate</code>	Any workbook is activated.
<code>WorkbookAddinInstall</code>	A workbook is installed as an add-in.
<code>WorkbookAddinUninstall</code>	Any add-in workbook is uninstalled.
<code>WorkbookBeforeClose</code>	Any open workbook is closed.
<code>WorkbookBeforePrint</code>	Any open workbook is printed.
<code>WorkbookBeforeSave</code>	Any open workbook is saved.
<code>WorkbookDeactivate</code>	Any open workbook is deactivated.
<code>WorkbookNewSheet</code>	A new sheet is created in any open workbook.

Event	Action that triggers the event
WorkbookOpen	A workbook is opened.
WorkbookPivotTable CloseConnection*	An external data source connection for any pivot table is closed.
WorkbookPivotTable OpenConnection*	An external data source connection for any pivot table is opened.

* These events occur only in Excel 2002, and are not supported in previous versions.

Enabling Application-level events

To make use of Application-level events, you need to:

1. Create a new class module.
2. Set a name for this class module in the Properties window under *Name*.
By default, VBA gives each new class module a default name such as `Class1`, `Class2`, etc. You may prefer a more meaningful name.
3. In the class module, declare a public `Application` object using the `WithEvents` keyword. For example:

```
Public WithEvents XL As Application
```
4. Create a variable that you will use to refer to the declared `Application` object in the class module. This should be a module-level object variable, declared in a regular VBA module (not in the class module). For example:

```
Dim X As New Class1
```
5. Connect the declared object with the `Application` object. This is often done in a `Workbook_Open` procedure. For example:

```
Set X.XL = Application
```
6. Write event-handler procedures in the class module.



This procedure is virtually identical to that required to use events with an embedded chart. See Chapter 18.

Determining when a workbook is opened

The example in this section keeps track of every workbook that is opened by storing information in a text file. I started by inserting a new class module, and naming it `AppClass`. The code in the class module is:

```

Public WithEvents AppEvents As Application

Private Sub AppEvents_WorkbookOpen _
    (ByVal Wb As Excel.Workbook)
    Call UpdateLogFile(Wb)
End Sub

```

This declares `AppEvents` as an `Application` object with events. The `AppEvents_WorkbookOpen` procedure will be called whenever a workbook is opened. This event-handler procedure calls `UpdateLogFile`, and passes the `Wb` variable, which represents the workbook that was opened. I then added a VBA module and inserted the following code:

```

Dim AppObject As New AppClass

Sub Init()
    ' Called by Workbook_Open
    Set AppObject.AppEvents = Application
End Sub

Sub UpdateLogFile(Wb)
    txt = Wb.FullName
    txt = txt & "," & Date & "," & Time
    txt = txt & "," & Application.UserName
    FName = ThisWorkbook.Path & "\logfile.txt"
    Open FName For Append As #1
    Write #1, txt
    Close #1
    MsgBox txt
End Sub

```

Notice at the top that the `AppObject` variable is declared as type `AppClass`; this is the name of the class module. The call to `Init` is in the `Workbook_Open` procedure, which is in the code module for `ThisWorkbook`. This procedure is as follows:

```

Private Sub Workbook_Open()
    Call Init
End Sub

```

The `UpdateLogFile` procedure opens a text file, or creates it if it doesn't exist. It then writes key information about the workbook that was opened: The filename and full path, the date, the time, and the user name.

The `Workbook_Open` procedure calls the `Init` procedure. Therefore, when the workbook opens, the `Init` procedure creates the object variable.



This example is available on the companion CD-ROM. Make sure you copy the file to your hard drive before using it. The text file is written to the same directory as the workbook, so the code will fail if the workbook is stored on a CD-ROM drive.

Monitoring Application-level events

To get a feel for the event generation process, you might find it helpful to see a list of events that get generated as you go about your work.

The companion CD-ROM contains a workbook that displays each Application-level event as it occurs. Actually, there are two versions of this workbook. The version for Excel 2000 and later displays the events in a modeless UserForm, as shown in Figure 19-8. The version for Excel 97 displays each event in a message box (Excel 97 does not support modeless UserForms).

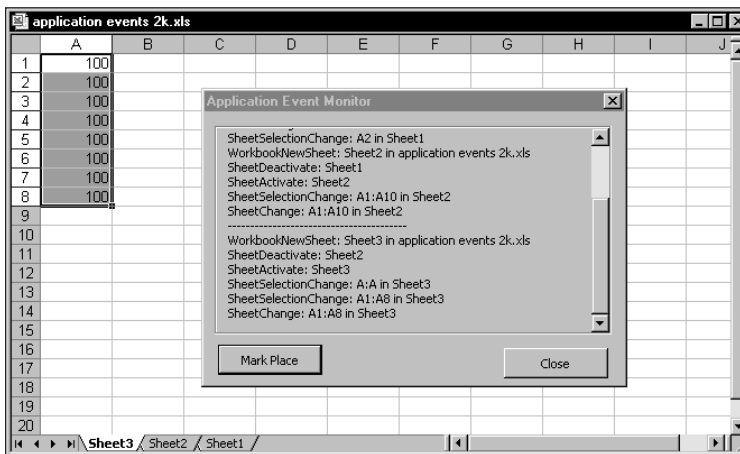


Figure 19-8: This workbook uses a class module to monitor all Application-level events.

The workbook contains a class module with 21 procedures defined, one for each Application-level event. Here's an example of one of them:

```
Private Sub XL_NewWorkbook(ByVal Wb As Excel.Workbook)
    LogEvent "NewWorkbook: " & Wb.Name
End Sub
```

Each of these procedures calls the `LogEvent` procedure and passes an argument that consists of the event name and the object. The `LogEvent` procedure follows:

```
Sub LogEvent(txt)
    EventNum = EventNum + 1
    With UserForm1
        With .lblEvents
            .AutoSize = False
            .Caption = .Caption & vbCrLf & txt
            .Width = UserForm1.FrameEvents.Width - 20
            .AutoSize = True
        End With
    End With
End Sub
```

```

        End With
        .FrameEvents.ScrollHeight = .lblEvents.Height + 20
        .FrameEvents.ScrollTop = EventNum * 20
    End With
End Sub

```

The `LogEvent` procedure updates the `UserForm` by modifying the `Caption` property of the `Label` control named `lblEvents`. The procedure also adjusts the `ScrollHeight` and `ScrollTop` properties of the `Frame` named `FrameEvents`, which contains the `Label`. Adjusting these properties causes the most recently added text to be visible while older text scrolls out of view.

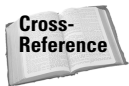
UserForm Events

A `UserForm` supports quite a few events, and each control placed on a `UserForm` has its own set of events. Table 19-5 lists the `UserForm` events that you can trap.

Table 19-5
Events Recognized by a UserForm

<i>Event</i>	<i>Action that triggers the event</i>
Activate	The <code>UserForm</code> is activated.
AddControl	A control is added at runtime.
BeforeDragOver	A drag-and-drop operation is in progress while the pointer is over the form.
BeforeDropOrPaste	When the user is about to drop or paste data; i.e., when the user has released the mouse button.
Click	A mouse click while the pointer is over the form.
Db1Click	A mouse double-click while the pointer is over the form.
Deactivate	The <code>UserForm</code> is deactivated.
Error	A control detects an error and cannot return the error information to a calling program.
Initialize	The <code>UserForm</code> is about to be shown.
KeyDown	A key is pressed.
KeyPress	The user presses any ANSI key.
KeyUp	A key is released.
Layout	A <code>UserForm</code> changes size.

Event	Action that triggers the event
MouseDown	A mouse button is pressed.
MouseMove	The mouse is moved.
MouseUp	A mouse button is released.
QueryClose	Occurs before a UserForm closes.
RemoveControl	A control is removed from the UserForm at runtime.
Resize	The UserForm is resized.
Scroll	The UserForm is scrolled.
Terminate	The UserForm is terminated.
Zoom	The UserForm is zoomed.



Many of the examples in Chapters 13 through 15 demonstrate event-handling for UserForms and UserForm controls.

Events Not Associated with an Object

The events that I discussed previously in this chapter are all associated with an object (Application, Workbook, Sheet, etc.). In this section, I discuss two additional “rogue” events: `OnTime` and `OnKey`. These events are not associated with an object. Rather, these events are accessed using methods of the `Application` object.



Unlike the other events discussed in this chapter, you program these “On-” events in a general VBA module.

The `OnTime` event

The `OnTime` event occurs at a specified time of day. The following example demonstrates how to program Excel so it beeps and then displays a message at 3:00 p.m.:

```
Sub SetAlarm()
    Application.OnTime TimeValue("15:00:00"), "DisplayAlarm"
End Sub

Sub DisplayAlarm()
    Beep
    MsgBox "Wake up. It's time for your afternoon break!"
End Sub
```

In this example, the `SetAlarm` procedure uses the `OnTime` method of the `Application` object to set up the `OnTime` event. This method takes two arguments: the time (3:00 p.m., in the example) and the procedure to execute when the time occurs (`DisplayAlarm` in the example). After `SetAlarm` is executed, the `DisplayAlarm` procedure will be called at 3:00 p.m., bringing up the message in Figure 19-9.



Figure 19-9: This message box was programmed to display at a particular time of day.

If you want to schedule an event relative to the current time—for example, 20 minutes from now—you can write an instruction like this:

```
Application.OnTime Now + TimeValue("00:20:00"), "DisplayAlarm"
```

You can also use the `OnTime` method to schedule a procedure on a particular day. The following statement runs the `DisplayAlarm` procedure at 12:01 a.m. on April 1, 2002:

```
Application.OnTime DateSerial(2002, 4, 1) + _  
    TimeValue("00:00:01"), "DisplayAlarm"
```

Note

The `OnTime` method has two additional arguments. If you plan to use this method, you should refer to the online help for complete details.

Cross-Reference

The analog clock example in Chapter 18 uses the `OnTime` event to cause a procedure to execute every second.

The OnKey event

While you're working, Excel constantly monitors what you type. Because of this, you can set up a keystroke or a key combination that, when pressed, executes a particular procedure.

The following example uses the `OnKey` method to set up an `OnKey` event. This event reassigns the `PgDn` and `PgUp` keys. After the `Setup_OnKey` procedure is executed, pressing `PgDn` executes the `PgDn_Sub` procedure, and pressing `PgUp` executes the `PgUp_Sub` procedure. The net effect is that pressing `PgDn` moves the cursor down one row and pressing `PgUp` moves the cursor up one row.

```
Sub Setup_OnKey()  
    Application.OnKey "{PgDn}", "PgDn_Sub"  
    Application.OnKey "{PgUp}", "PgUp_Sub"  
End Sub  
  
Sub PgDn_Sub()  
    On Error Resume Next  
    ActiveCell.Offset(1, 0).Activate  
End Sub  
  
Sub PgUp_Sub()  
    On Error Resume Next  
    ActiveCell.Offset(-1, 0).Activate  
End Sub
```

 **Note**

Notice that the key codes are enclosed in curly brackets, not parentheses. For a complete list of the keyboard codes, consult the online help. Search for `OnKey`.

In the preceding examples, I used `On Error Resume Next` to ignore any errors that were generated. For example, if the active cell is in the first row, trying to move up one row causes an error. Also, if the active sheet is a chart sheet, an error will occur because there is no such thing as an active cell in a chart sheet.

By executing the following procedure, you cancel the `OnKey` events and return these keys to their normal functionality:

```
Sub Cancel_OnKey()  
    Application.OnKey "{PgDn}"  
    Application.OnKey "{PgUp}"  
End Sub
```

Contrary to what you might expect, using an empty string as the second argument for the `OnKey` method does *not* cancel the `OnKey` event. Rather, it causes Excel to simply ignore the keystroke and do nothing at all. For example, the following instruction tells Excel to ignore `Alt+F4` (the percent sign represents the `Alt` key):

```
Application.OnKey "%{F4}", ""
```

 **Cross-Reference**

Although you can use the `OnKey` method to assign a shortcut key for executing a macro, it's better to use the Macro Options dialog box for this task. For more details, see "Executing a procedure with a `Ctrl`+shortcut key combination" in Chapter 9.

Summary

This chapter described how to write code that executes when a particular event occurs.

In the next chapter, I discuss some VBA techniques that you can use to control other applications from Excel.



Interacting with Other Applications

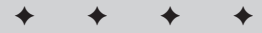
In the early days of personal computing, interapplication communication was rare. In the pre-multitasking era, users had no choice but to use one program at a time. Interapplication communication was usually limited to importing files; even copying information and pasting it into another application — something that virtually every user now takes for granted — was impossible.

Nowadays, most software is designed to support at least some type of communication with other applications. At the very least, most Windows programs support the clipboard for copy-and-paste operations between applications. Many Windows products support Dynamic Data Exchange (DDE), and other products (especially the newer products) also support Automation. In this chapter, I outline the ways in which your Excel applications can interact with other applications. Of course, I also provide several examples.

Starting Another Application

It's often useful to start up another application from Excel. For example, you may want to execute a communications program or even a DOS batch file from Excel. Or, as an application developer, you may want to make it easy for a user to access the Windows Control Panel.

VBA's `Shell` function makes launching other programs relatively easy. Listing 20-1 presents a procedure that starts the Windows Character Map application, which enables the user to insert a special character.



In This Chapter

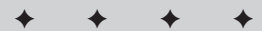
Starting or activating another application from Excel

Displaying Windows Control Panel dialogs

Using Automation to control another application

A simple example of using ADO to retrieve data

Using `SendKeys` as a last resort



Listing 20-1: Launching a Windows utility application

```

Sub RunCharMap()
    On Error Resume Next
    Program = "Charmap.exe"
    TaskID = Shell(Program, 1)
    If Err <> 0 Then
        MsgBox "Cannot start " & Program, vbCritical, "Error"
    End If
End Sub

```

You'll recognize the application this procedure launches in Figure 20-1.

By the way, if you're using Excel 2002, the Windows Character Map program is no longer necessary. You can take advantage of the new Insert ⇨ Symbol command.

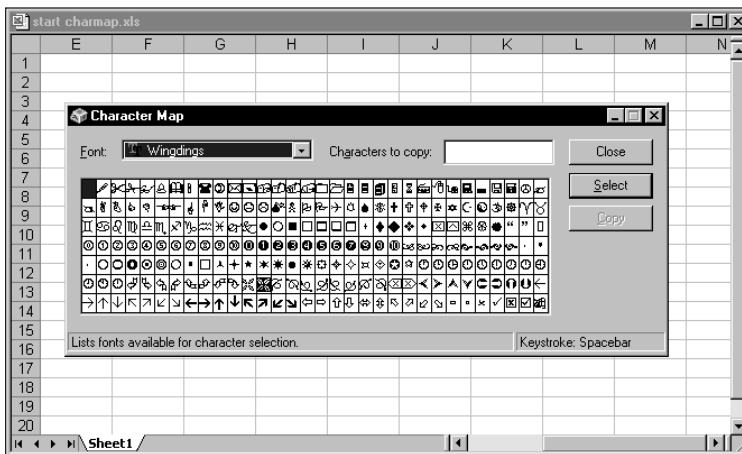


Figure 20-1: Running the Windows Character Map program from Excel

The `Shell` function returns a task identification number for the application. You can use this number later to activate the task. The second argument for the `Shell` function determines how the application is displayed (1 is the code for a normal size window, with the focus).

If the `Shell` function is not successful, it generates an error. Therefore, this procedure uses an `On Error` statement to display a message if the file cannot be found or some other error occurs.

It's important to understand that your VBA code does not pause while the application that was started with the `Shell` function is running. In other words, the `Shell`

function runs the application *asynchronously*. If the procedure has more instructions after the `Shell` function is executed, they are executed concurrently with the newly loaded program. If any instruction requires user intervention (for example, displaying a message box), Excel's title bar flashes while the other application is active.

In some cases, you may want to launch an application with the `Shell` function, but you need your VBA code to “pause” until the application is closed. For example, the launched application may generate a file that is used later in your code. Although you can't pause the execution of your code, you *can* create a loop that does nothing except monitor the application's status. Listing 20-2 shows an example that displays a message box when the application launched by the `Shell` function has ended.

Listing 20-2: Waiting for an application to end

```

Declare Function OpenProcess Lib "kernel32" _
    (ByVal dwDesiredAccess As Long, _
    ByVal bInheritHandle As Long, _
    ByVal dwProcessId As Long) As Long

Declare Function GetExitCodeProcess Lib "kernel32" _
    (ByVal hProcess As Long, _
    lpExitCode As Long) As Long

Sub RunCharMap2()
    Dim TaskID As Long
    Dim hProc As Long
    Dim lExitCode As Long

    ACCESS_TYPE = &H400
    STILL_ACTIVE = &H103

    Program = "Charmap.exe"
    On Error Resume Next

    ' Shell the task
    TaskID = Shell(Program, 1)

    ' Get the process handle
    hProc = OpenProcess(ACCESS_TYPE, False, TaskID)

    If Err <> 0 Then
        MsgBox "Cannot start " & Program, vbCritical, "Error"
        Exit Sub
    End If

    Do 'Loop continuously
    ' Check on the process
    GetExitCodeProcess hProc, lExitCode

```

Continued

Listing 20-2 (continued)

```

'       Allow event processing
        DoEvents
    Loop While lExitCode = STILL_ACTIVE

'       Task is finished, so show message
        MsgBox Program & " is finished"
End Sub

```

While the launched program is running, this procedure continually calls the `GetExitCodeProcess` function from within a Do-Loop structure, testing for its returned value (`lExitCode`). When the program is finished, `lExitCode` returns a different value, the loop ends, and the VBA code resumes executing.



Both of the preceding examples are available on the companion CD-ROM.

Most versions of Windows provide a `Start` command, which can also be used as an argument for the `Shell` function. The `Start` command is not available in Windows NT. The `Start` command is a string literal that starts a Windows application from a DOS window. Using the `Start` command, you need specify only the name of a *document* file—not the executable file. The program associated with that document file's extension is executed, and the file is automatically loaded. For example, the following instructions start up the installed Web browser application—that is, the application associated with the `.htm` extension—and load an HTML document named `homepage.htm`.

```

WebPage = "c:\web\homepage.htm"
Shell "Start " & WebPage

```

Or, you can use an e-mail address to start the default e-mail client:

```

Email = "mailto:bgates@microsoft.com"
Shell "Start " & Email

```

If you would like to use this type of functionality with Windows NT (or another version of Windows that doesn't support the `Start` command), you'll need to use the Windows `ShellExecute` API function. The API declaration follows (this code goes at the top of a VBA module):

```

Private Declare Function ShellExecute Lib "shell32.dll" _
    Alias "ShellExecuteA" (ByVal hWnd As Long, _
    ByVal lpOperation As String, ByVal lpFile As String, _
    ByVal lpParameters As String, ByVal lpDirectory As String, _
    ByVal nShowCmd As Long) As Long

```


The following procedure demonstrates how to call the `ShellExecute` function:

```
Sub OpenFile()
    File = "http://www.microsoft.com"
    Call ShellExecute(0&, vbNullString, File, _
        vbNullString, vbNullString, vbNormalFocus)
End Sub
```

The file can be a URL or any local file. For example, you can use this to open a graphic file (such as a JPG or BMP file) using the default graphic viewer.



Tip

If the application that you want to start is one of several Microsoft applications, you can use the `ActivateMicrosoftApp` method of the `Application` object. For example, the following procedure starts Word:

```
Sub StartWord()
    Application.ActivateMicrosoftApp xlMicrosoftWord
End Sub
```

If Word is already running when the preceding procedure is executed, it is activated. The other constants available for this method are `xlMicrosoftPowerPoint`, `xlMicrosoftMail`, `xlMicrosoftAccess`, `xlMicrosoftFoxPro`, `xlMicrosoftProject`, and `xlMicrosoftSchedulePlus`.

Activating Another Application

Beware of a potential problem: You may find that if an application is already running, using the `Shell` function could start another instance of it. In most cases, you'll want to activate the instance that's running, not start another instance of it.

The following `StartCalculator` uses the `AppActivate` statement to activate an application if it's already running (in this case, the Windows Calculator). The argument for `AppActivate` is the caption of the application's title bar. If the `AppActivate` statement generates an error, it means the Calculator is not running. Therefore, the routine starts the application.

```
Sub StartCalculator()
    AppFile = "Calc.exe"
    On Error Resume Next
    AppActivate "Calculator"
    If Err <> 0 Then
        Err = 0
        CalcTaskID = Shell(AppFile, 1)
        If Err <> 0 Then MsgBox "Can't start Calculator"
    End If
End Sub
```



This example is available on the companion CD-ROM.

Running Control Panel Dialog Boxes and Wizards

Windows provides quite a few system dialog boxes and wizards, most of which are accessible from the Windows Control Panel. You may need to display one or more of these from your Excel application. For example, you may want to display the Windows Date/Time Properties dialog box shown in Figure 20-2.

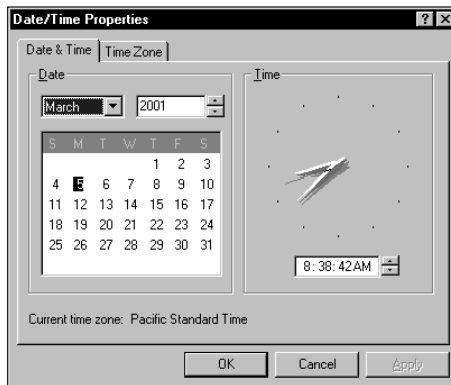


Figure 20-2: Using VBA to display a Control Panel dialog box

The key to running other system dialog boxes is knowing the argument for the Shell function. The following procedure happens to know the argument for the Date/Time dialog box:

```
Sub ShowDateTimeDlg()
    Arg = "rundll32.exe shell32.dll,Control_RunDLL timedate.cpl"
    On Error Resume Next
    TaskID = Shell(Arg)
    If Err <> 0 Then
        MsgBox ("Cannot start the application.")
    End If
End Sub
```



A workbook that demonstrates 50 arguments, depicted in Figure 20-3, is available on the companion CD-ROM.

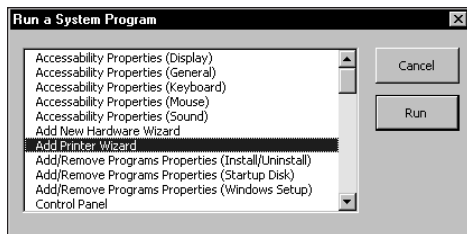


Figure 20-3: This workbook demonstrates how to run system dialog boxes from Excel.

Automation

You can write an Excel macro to control Microsoft Word. More accurately, the Excel macro will control the most important component of Word: its so-called *automation server*. In such circumstances, Excel is called the client application and Word the server application. Or you can write a Visual Basic application to control Excel. The process of one application's controlling another is sometimes known as OLE Automation and other times known as ActiveX Automation (Microsoft has a tendency to change its own terminology quite frequently).

The concept behind Automation is quite appealing. A developer who needs to generate a chart, for example, can just reach into another application's grab bag of objects, fetch a `Chart` object, and then manipulate its properties and use its methods. Automation, in a sense, blurs the boundaries between applications. An end user may be working with an Access object and not even realize it.

Note

Some applications, such as Excel, can function as either a client application or a server application. Other applications can function only as client applications or only as server applications.

In this section, I demonstrate how to use VBA to access and manipulate the objects exposed by other applications. The examples use Microsoft Word, but the concepts apply to any application that exposes its objects for Automation—which accounts for an increasing number of applications.

Working with foreign objects

As you know, you can use Excel's `Insert > Object` command to embed an object such as a Word document in a worksheet. In addition, you can create an object and manipulate it with VBA. (This action is the heart of Automation.) When you do so, you usually have full access to the object. For developers, this technique is generally more beneficial than embedding the object in a worksheet. When an object is embedded, the user must know how to use the Automation object's application. But when you use VBA to work with the object, you can program the object so that the user can manipulate it by an action as simple as a button click.

Early versus late binding

Before you can work with an external object, you must create an instance of the object. This can be done in either of two ways: early binding or late binding. *Binding* refers to matching the function calls written by the programmer to the actual code that implements the function.

Early binding

At design time, you create a reference to the object library using the Tools ⇨ References command in the VBE, which brings up the dialog box shown in Figure 20-4.

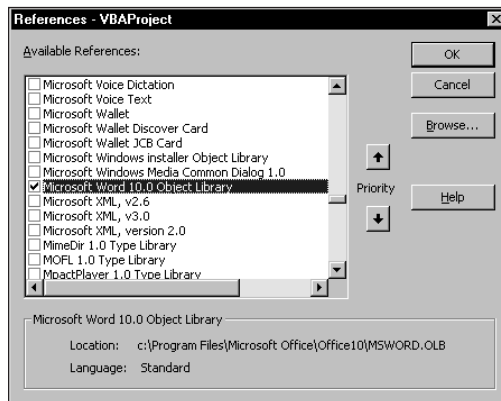


Figure 20-4: Attaching a reference to an object library file



In Excel 2002, the Project Explorer window contains a list of all the references that you've added to your project.

After the reference to the object library is established, you can use the Object Browser shown in Figure 20-5 to view the object names, methods, and properties.

When you use early binding, you must establish a reference to a version-specific object library. For example, you can specify either Microsoft Word 8.0 Object Library, Microsoft Word 9.0 Object Library, or Microsoft Word 10.0 Object Library. Then you use a statement like the following to create the object:

```
Dim WordApp As New Word.Application
```

Using early binding to create the object by setting a reference to the object library usually is more efficient and yields better performance. Early binding is an option only if the object that you are controlling has a separate type library or object library file. You also need to ensure that the user of the application actually has a copy of the specific library installed.

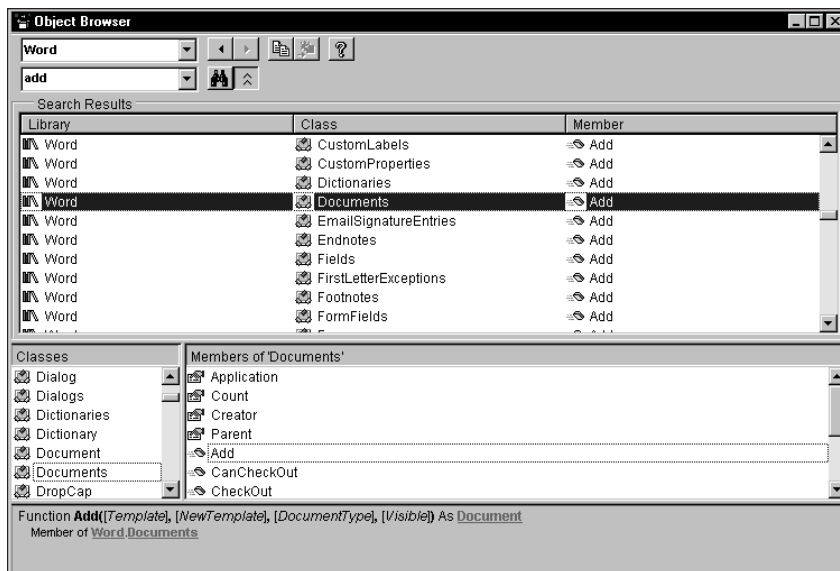


Figure 20-5: Using the Object Browser to learn about the objects in a referenced library

Early binding also enables you to use constants that are defined in the object library. For example, Word (like Excel) contains many predefined constants that you can use in your VBA code. If you use early binding, you can use the constants in your code. If you use late binding, you'll need to use the actual value rather than the constant. Another advantage in using early binding is that you can take advantage of the VBE's Object Browser and Auto List Members option to make it easier to access properties and methods; this feature doesn't work when you use late binding because the type of the object is known only at runtime.

Late binding

At runtime, you use either the `CreateObject` function to create the object or the `GetObject` function to obtain a saved instance of the object. Such an object is declared as a generic `Object` type, and its object reference is resolved at runtime.

It is possible to use late binding even when you don't know which version of the application is installed on the user's system. For example, the following code, which works with Word 97 and later, creates a `Word` object:

```
Dim WordApp As Object
Set WordApp = CreateObject("Word.Application")
```

If multiple versions of Word are installed, you can create an object for a specific version. The following statement, for example, uses Word 2000:

```
Set WordApp = CreateObject("Word.Application.9")
```

The Registry key for Word's Automation object and the reference to the `Application` object in VBA just happen to be the same: `Word.Application`. They do not, however, refer to the same thing. When you declare an object `As Word.Application` or `As New Word.Application`, the term refers to the `Application` object in the Word library. But when you invoke the function `CreateObject("Word.Application")`, the term refers to the moniker by which the latest version of Word is known in the Windows System Registry. This isn't the case for all Automation objects, although it is true for the main Office XP components. If the user replaces Word 2000 with Word 2002, `CreateObject("Word.Application")` will continue to work properly, referring to the new application. If Word 2002 is removed, however, `CreateObject("Word.Application.10")`, which uses the alternate version-specific moniker for Word 2002, will fail to work.

The `CreateObject` function used on an Automation object such as `Word.Application` or `Excel.Application` always creates a new *instance* of that Automation object. That is, it starts up a new and separate copy of the automation part of the program. Even if an instance of the Automation object is already running, a new instance is started, and then an object of the specified type is created.

To use the current instance, or to start the application and have it load a file, use the `GetObject` function.

If you need to automate an Office application, it is recommended that you early bind to the earliest version of the product that you expect could be installed on your client's system. For example, if you need to be able to automate Word 97, Word 2000, and Word 2002, you should use the type library for Word 97 to maintain compatibility with all three versions. This, of course, will mean that you can't make use of features found in the later version of Word.

GetObject vs. CreateObject

VBA's `GetObject` and `CreateObject` functions both return a reference to an object, but they work in different ways.

The `CreateObject` function is used to create an interface to a new instance of an application. Use this function when the application is not running. If an instance of the application is already running, a new instance is started. For example, the following statement starts Excel, and the object returned in `XLApp` is a reference to the `Excel.Application` object it created.

```
Set XLApp = CreateObject("Excel.Application")
```

The `GetObject` function is used with an application that's already running, or to start an application with a file already loaded. The following statement, for example, starts Excel with the file `Myfile.xls` already loaded. The object returned in `XLBook` is a reference to the `Workbook` object (the `Myfile.xls` file).

```
Set XLBook = GetObject("C:\Myfile.xls")
```

A simple example

The following example demonstrates how to create a Word object using late binding. This procedure creates the object, displays the version number, closes the Word application, and then destroys the object (freeing the memory it used).

```
Sub GetWordVersion()
    Dim WordApp As Object
    Set WordApp = CreateObject("Word.Application")
    MsgBox WordApp.Version
    WordApp.Quit
    Set WordApp = Nothing
End Sub
```

Note

The Word object that's created is invisible. If you'd like to see the object while it's being manipulated, set its `Visible` property to `True`, as follows:

```
WordApp.Visible = True
```

This example can also be programmed using early binding. Before doing so, use the Tools ⇄ References command to set a reference to the Word object library. Then you can use the following code:

```
Sub GetWordVersion()
    Dim WordApp As New Word.Application
    MsgBox WordApp.Version
    WordApp.Quit
    Set WordApp = Nothing
End Sub
```

Controlling Word from Excel

The example in this section demonstrates an Automation session using Word. The `MakeMemos` procedure creates three customized memos in Word and then saves each document to a file. The information used to create the memos is stored in a worksheet, shown in Figure 20-6.

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E
1	Region1	145	\$134,555		
2	Region2	122	\$127,883		
3	Region3	203	\$288,323		
4					
5					
6					
7					
8					
9					

A text box in cell E2 contains the text: "Create Word Memos Using Data on This Worksheet".

A message box is displayed in cell E6 with the text: "The monthly sales data for your region is listed below. This information was obtained from the central database. Please call if you have any questions." The word "Message:" is in cell B6.

Figure 20-6: Word automatically generates three memos based on this Excel data.

The `MakeMemos` procedure, presented in Listing 20-3, starts by creating an object called `WordApp`. The routine cycles through the three rows of data in `Sheet1` and uses `Word`'s properties and methods to create each memo and save it to disk. A range named `Message` (in cell E6) contains the text used in the memo.

Listing 20-3: Generating Word documents from an Excel VBA program

```

Sub MakeMemos()
'   Creates memos in word using Automation
'   Dim WordApp As Object

'   Start Word and create an object (late binding)
Set WordApp = CreateObject("Word.Application")

'   Information from worksheet
Set Data = Sheets("Sheet1").Range("A1")
Message = Sheets("Sheet1").Range("Message")

'   Cycle through all records in Sheet1
Records = Application.CountA(Sheets("Sheet1").Range("A:A"))
For i = 1 To Records
'       Update status bar progress message
Application.StatusBar = "Processing Record " & i

'       Assign current data to variables
Region = Data.Cells(i, 1).Value
SalesNum = Data.Cells(i, 2).Value
SalesAmt = Format(Data.Cells(i, 3).Value, "#,000")

'       Determine the file name
SaveAsName = ThisWorkbook.Path & "\" & Region & ".doc"

'       Send commands to Word
With WordApp
    .Documents.Add
    With .Selection
        .Font.Size = 14
        .Font.Bold = True
        .ParagraphFormat.Alignment = 1
        .TypeText Text:="M E M O R A N D U M"
        .TypeParagraph
        .TypeParagraph
        .Font.Size = 12
        .ParagraphFormat.Alignment = 0
        .Font.Bold = False
        .TypeText Text:="Date:" & vbTab & _
            Format(Date, "mmmm d, yyyy")
        .TypeParagraph
    End With
End With

```



```

        .TypeText Text:="To:" & vbTab & Region & _
        " Manager"
        .TypeParagraph
        .TypeText Text:="From:" & vbTab & _
        Application.UserName
        .TypeParagraph
        .TypeParagraph
        .TypeText Message
        .TypeParagraph
        .TypeParagraph
        .TypeText Text:="Units Sold:" & vbTab & _
        SalesNum
        .TypeParagraph
        .TypeText Text:="Amount:" & vbTab & _
        Format(SalesAmt, "$#,##0")
    End With
    .ActiveDocument.SaveAs FileName:=SaveAsName
End With
Next i

' Kill the object
WordApp.Quit
Set WordApp = Nothing

' Reset status bar
Application.StatusBar = ""
MsgBox Records & " memos were created and saved in " & _
    ThisWorkbook.Path
End Sub

```

Figure 20-7 shows a document created by the `MakeMemos` procedure.

Creating this macro involved several steps. I started by recording a macro in Word. I recorded my actions while creating a new document, adding and formatting some text, and saving the file. That Word macro provided the information I needed about the appropriate properties and methods. I then copied the macro to an Excel module. Notice that I used `With-End With`. I added a dot before each instruction between `With` and `End With`. For example, the original Word macro contained (among others) the following instruction:

```
Documents.Add
```

I modified the macro as follows:

```

With WordApp
    .Documents.Add
'    more instructions here
End With

```

The macro I recorded in Word used a few of Word's built-in constants. Because this example uses late binding, I had to substitute actual values for those constants. I was able to learn the values by using the Immediate window in Word's VBE.

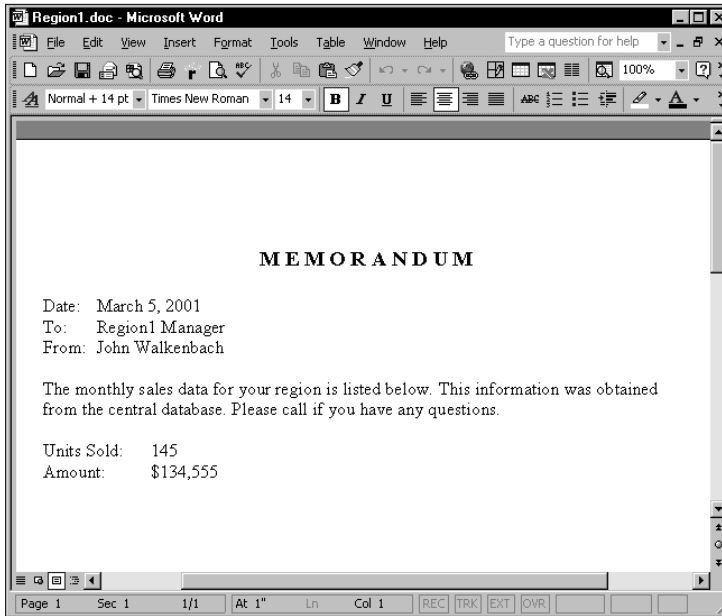


Figure 20-7: An Excel procedure created this document.

Controlling Excel from another application

You can, of course, also control Excel from another application (such as a Visual Basic program or a Word macro). For example, you may want to perform some calculations in Excel and return the result to a Word document.

You can create any of the following Excel objects with the adjacent functions:

Application object	<code>CreateObject("Excel.Application")</code>
Workbook object	<code>CreateObject("Excel.Sheet")</code>
Chart object	<code>CreateObject("Excel.Chart")</code>

Listing 20-4 shows a procedure that is located in a VBA module in a Word 2002 document. This procedure creates an Excel `Worksheet` object — whose moniker is `"Excel.Sheet"` — from an existing workbook.

Listing 20-4: Producing an Excel worksheet on a Word 2000 document

```
Sub MakeExcelChart()  
    Dim XLSheet As Object  
  
    ' Create a new document  
    Documents.Add  
  
    ' Prompt for values  
    StartVal = InputBox("Starting Value?")  
    PctChange = InputBox("Percent Change?")  
  
    ' Create Sheet object  
    Wbook = ThisDocument.Path & "\projections.xls"  
    Set XLSheet = GetObject(Wbook, "Excel.Sheet").ActiveSheet  
  
    ' Put values in sheet  
    XLSheet.Range("StartingValue") = StartVal  
    XLSheet.Range("PctChange") = PctChange  
    XLSheet.Calculate  
  
    ' Insert page heading  
    Selection.Font.Size = 14  
    Selection.Font.Bold = True  
    Selection.TypeText "Monthly Increment: " & _  
        Format(PctChange, "0.0%")  
    Selection.TypeParagraph  
    Selection.TypeParagraph  
  
    ' Copy data from sheet & paste to document  
    XLSheet.Range("data").Copy  
    Selection.Paste  
  
    ' Copy chart and paste to document  
    XLSheet.ChartObjects(1).Copy  
    Selection.PasteSpecial _  
        Link:=False, _  
        DataType:=wdPasteMetafilePicture, _  
        Placement:=wdInLine, DisplayAsIcon:=False  
  
    ' Kill the object  
    Set XLSheet = Nothing  
End Sub
```

The initial workbook is shown in Figure 20-8. The `MakeExcelChart` procedure prompts the user for two values and inserts the values into the worksheet.

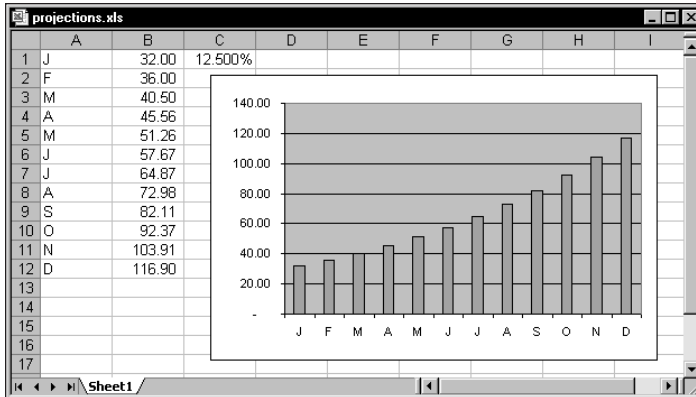


Figure 20-8: A VBA procedure in Word uses this worksheet.

Recalculating the worksheet updates a chart. The data and the chart are then copied from the Excel object and pasted into a new document. The results are shown in Figure 20-9.

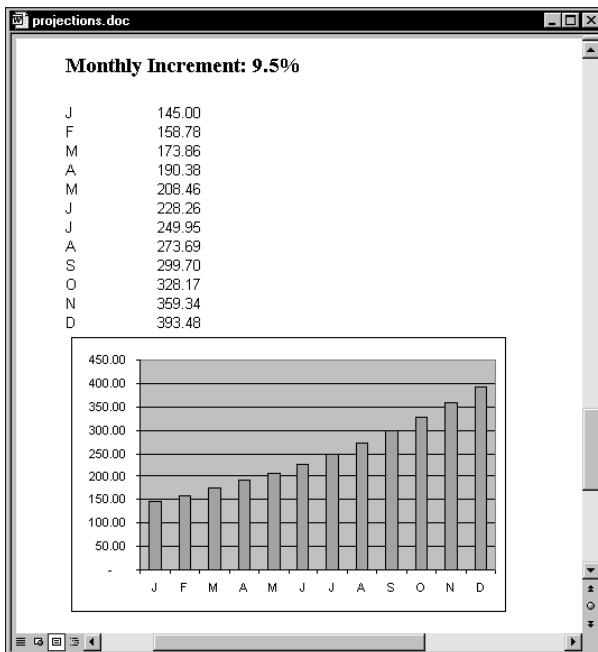


Figure 20-9: The Word VBA procedure uses Excel to create this document.

Working with ADO

ADO (ActiveX Data Objects) is an object model that enables you to access data stored in a variety of database formats. Importantly, this methodology allows you to use a single object model for all your databases. This is currently the preferred data access methodology, and should not be confused with DAO (Data Access Objects).

This section presents a simple example that uses ADO to retrieve data from an Access database.


Note

ADO programming is a very complex topic. If you have a need to access external data in your Excel application, you'll probably want to invest in one or more books that cover this topic in detail.

The following example retrieves data from an Access database named `budget.mdb`. This database contains one table (named `Budget`), and the table has seven fields. This example retrieves the data in which the `Item` field contains the text *Lease* and the `Division` field contains the text *N. America*. The qualifying data is stored in a `Recordset` object, and the data is then transferred to a worksheet (see Figure 20-10).

```
Sub ADO_Demo()
' This demo requires a reference to
' the Microsoft ActiveX Data Objects 2.x Library

Dim DBFullName As String
Dim Cnct As String, Src As String
Dim Connection As ADODB.Connection
Dim Recordset As ADODB.Recordset
Dim Col As Integer

Cells.Clear

' Database information
DBFullName = ThisWorkbook.Path & "\budget.mdb"

' Open the connection
Set Connection = New ADODB.Connection
Cnct = "Provider=Microsoft.Jet.OLEDB.4.0; "
Cnct = Cnct & "Data Source=" & DBFullName & ";"
Connection.Open ConnectionString:=Cnct

' Create RecordSet
Set Recordset = New ADODB.Recordset
With Recordset
' Filter
Src = "SELECT * FROM Budget WHERE Item = 'Lease' "
```

```

Src = Src & "and Division = 'N. America'"
.Open Source:=Src, ActiveConnection:=Connection

'
Write the field names
For Col = 0 To Recordset.Fields.Count - 1
    Range("A1").Offset(0, Col).Value = _
        Recordset.Fields(Col).Name
Next

'
Write the recordset
Range("A1").Offset(1, 0).CopyFromRecordset Recordset
End With
Set Recordset = Nothing
Connection.Close
Set Connection = Nothing
End Sub

```



This example, along with the Access database, is available on the companion CD-ROM.

	A	B	C	D	E	F	G
1	DIVISION	DEPARTMENT	CATEGORY	ITEM	MONTH	BUDGET	ACTUAL
2	N. America	Data Processing	Facility	Lease	Jan	3450	2631
3	N. America	Human Resources	Facility	Lease	Jan	4353	3875
4	N. America	Accounting	Facility	Lease	Jan	3898	2979
5	N. America	Training	Facility	Lease	Jan	3185	3545
6	N. America	Security	Facility	Lease	Jan	3368	4120
7	N. America	R&D	Facility	Lease	Jan	3926	3432
8	N. America	Operations	Facility	Lease	Jan	3329	3715
9	N. America	Shipping	Facility	Lease	Jan	4095	2892
10	N. America	Sales	Facility	Lease	Jan	3242	2687
11	N. America	Advertising	Facility	Lease	Jan	3933	3580
12	N. America	Public Relations	Facility	Lease	Jan	4316	4328
13	N. America	Data Processing	Facility	Lease	Feb	4440	4357
14	N. America	Human Resources	Facility	Lease	Feb	4210	3196
15	N. America	Accounting	Facility	Lease	Feb	2860	3658
16	N. America	Training	Facility	Lease	Feb	4468	3759
17	N. America	Security	Facility	Lease	Feb	3499	3568
18	N. America	R&D	Facility	Lease	Feb	3394	4196
19	N. America	Operations	Facility	Lease	Feb	4187	3074
20	N. America	Shipping	Facility	Lease	Feb	2870	3751
21	N. America	Sales	Facility	Lease	Feb	4046	4013
22	N. America	Advertising	Facility	Lease	Feb	3131	3864
23	N. America	Public Relations	Facility	Lease	Feb	4153	3980

Figure 20-10: This data was retrieved from an Access database.

```

'Create a reference to the Outlook object library

Sub SendMessage(ToWhom As String, About As String, Message As
String)
    Dim oOutl As New Outlook.Application
    Dim oNS As Outlook.NameSpace
    Dim oMail As Outlook.MailItem

```

```
Set oNS = oOutl.GetNamespace("MAPI")
oNS.Logon ' requests user name and password
Set oMail = oOutl.CreateItem(oMailItem)
With oMail
    .Subject = About
    .Recipients.Add ToWhom
    .Body = Message
    .Send
End With
oNS.Logoff
Set oNS = Nothing
End Sub

Sub Demo()
    SendMessage ToWhom:="Susan", About:="Job done", _
        Message:="All the material you have sent has been
processed"
End Sub
```

Using SendKeys

Not all applications support Automation. In some cases, you can still control some aspects of the application even if it doesn't support Automation. You can use Excel's `SendKeys` method to send keystrokes to an application, simulating actions that a user might perform.

Although using the `SendKeys` method may seem like a good solution, you'll find that this can be very tricky. A potential problem is that it relies on a specific user interface. If a later version of the program you're sending keystrokes has a different user interface, your application may no longer work. Consequently, you should use `SendKeys` only as a last resort.

```
Sub TestKeys()
    Shell "calc.Exe", vbNormalFocus
    AppActivate "Calculator"
    For I=1 To 100
        SendKeys I & "*2=", True
    Next
End Sub
```

`SendKeys` is documented in the online help system, which describes how to send nonstandard keystrokes, such as Alt key combinations.

The `CellToDialer` procedure in Listing 20-5 demonstrates the use of `SendKeys`.

Listing 20-5: Having Excel dial the phone, one key at a time

```
Sub CellToDialer()  
' Transfers active cell contents to Dialer  
' And then dials the phone  
  
' Get the phone number  
CellContents = ActiveCell.Value  
If CellContents = "" Then  
    MsgBox "Select a cell that contains a phone number."  
    Exit Sub  
End If  
  
' Activate (or start) Dialer  
Appname = "Dialer"  
AppFile = "Dialer.exe"  
On Error Resume Next  
AppActivate (Appname)  
If Err <> 0 Then  
    Err = 0  
    TaskID = Shell(AppFile, 1)  
    If Err <> 0 Then MsgBox "Can't start " & AppFile  
End If  
  
' Transfer cell contents to Dialer  
Application.SendKeys "%n" & CellContents, True  
  
' Click Dial button  
Application.SendKeys "%d"  
' Application.SendKeys "{TAB}~", True  
End Sub
```

When executed from a worksheet, this procedure starts the Windows Dialer application in Figure 20-11, which dials the phone. If Dialer is not running, it starts Dialer. The macro uses `SendKeys` to transfer the contents of the active cell to the Windows Dialer application, and then “clicks” the Dial button.

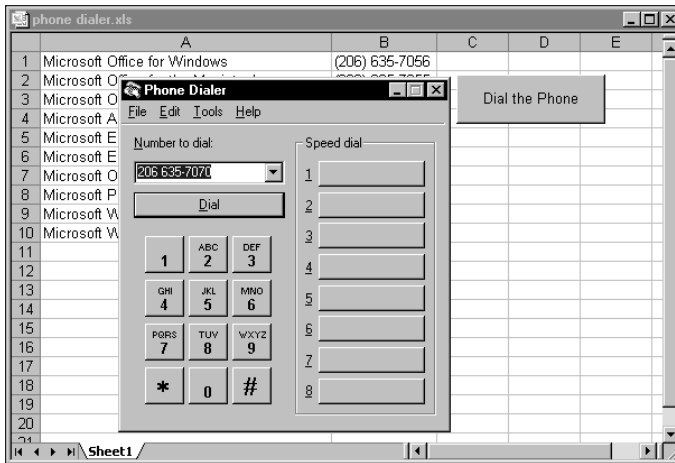


Figure 20-11: SendKeys transfers the phone number in the active cell to Windows Dialer.

Summary

In this chapter, I touched on some of the ways you can automate the process of Excel's working in tandem with other applications. These ways include using Automation to execute and/or activate other applications and using SendKeys.

The next chapter describes how to create an add-in from an Excel workbook.



Creating and Using Add-Ins

One of Excel's most useful features for developers is the capability to create add-ins. In this chapter, I explain the benefits of using add-ins, and I show you how to create your own add-ins by using only the tools built into Excel.

What Is an Add-In?

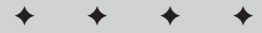
Generally speaking, a spreadsheet add-in is something added to a spreadsheet to give it additional functionality. For example, Excel ships with several add-ins. One of the most popular is the Analysis ToolPak, which adds statistical and analysis capabilities that are not built into Excel.

Some add-ins (such as the Analysis ToolPak) provide new worksheet functions that can be used in formulas. The new features usually blend in well with the original interface, so they appear to be part of the program (this is referred to as *seamless integration*).

Comparing an add-in to a standard workbook

Any knowledgeable Excel user can create an add-in from an XLS workbook; no additional software or programming tools are required. Any XLS file can be converted to an add-in, but not all XLS files are appropriate for add-ins. An Excel add-in is basically a normal XLS workbook with the following differences:

- ◆ The `IsAddin` property of the `ThisWorkbook` object is `True`.



In This Chapter

An overview of add-ins, and why this concept is important for developers

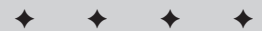
Details about Excel's Add-In Manager

How to create an add-in, including a hands-on example

How XLA files differ from XLS files

Examples of VBA code that manipulates add-ins

How to optimize your add-in for speed and size



- ♦ The workbook window is hidden in such a way that it can't be unhidden using the Window ⇨ Unhide command. This means that you can't display worksheets or chart sheets contained in an add-in (unless you write code to copy the sheet to a standard workbook).
- ♦ An add-in is not a member of the `Workbooks` collection. Rather, it's a member of the `AddIns` collection. However, you can access an add-in by using the `Workbooks` collection (see "Collection membership," later in this chapter).
- ♦ Add-ins can be loaded and unloaded using the Tools ⇨ Add-Ins command.
- ♦ The Macro dialog box does not display the names of the macros contained in an add-in.
- ♦ A custom worksheet function stored within an add-in can be used in formulas without your having to precede its name with the source workbook's filename.

Note

By default, an add-in has an `.xla` file extension. This is not a requirement, however. An add-in file can have any extension that you like.

Why create add-ins?

You might decide to convert your XLS application into an add-in for any of the following reasons:

- ♦ *To restrict access to your code and worksheets.* When you distribute an application as an add-in and you protect it with a password, users can't view or modify the sheets or VBA code in the workbook. Therefore, if you use proprietary techniques in your application, you can prevent anyone from copying the code, or at least make it more difficult to do so.
- ♦ *To avoid confusion.* If a user loads your application as an add-in, the file is not visible and is therefore less likely to confuse novice users or get in the way. Unlike a hidden XLS workbook, an add-in can't be unhidden.
- ♦ *To simplify access to worksheet functions.* Custom worksheet functions stored within an add-in don't require the workbook name qualifier. For example, if you store a custom function named `MOVAVG` in a workbook named `Newfuncs.xls`, you must use a syntax like the following to use this function in a different workbook:

```
=Newfuncs.xls!MOVAVG(A1:A50)
```

But if this function is stored in an add-in file that's open, you can use a much simpler syntax because you don't need to include the file reference:

```
=MOVAVG(A1:A50)
```

- ♦ *To provide easier access for users.* Once you identify the location of your add-in, it appears in the Add-Ins dialog box with a friendly name and a description of what it does.

About COM Add-Ins

Excel 2000 and later versions also support COM (Component Object Model) add-ins. These files have a DLL or EXE file extension. A COM add-in can be written so it works with all Office applications that support add-ins. An additional advantage is that the code is compiled, thereby offering better security. Unlike XLA add-ins, a COM add-in cannot contain Excel sheets or charts. COM add-ins are developed with Visual Basic 5 (or later), or with the Office Developer Edition. Discussion of creating COM add-in procedures is well beyond the scope of this book.

- ♦ *To gain better control over loading.* Add-ins can be opened automatically when Excel starts, regardless of the directory in which they are stored.
- ♦ *To avoid displaying prompts when unloading.* When an add-in is closed, the user never sees the “Save change in xxx?” prompt.

Understanding Excel’s Add-In Manager

The most efficient way to load and unload add-ins is with Excel’s Add-Ins dialog box, which you access by choosing Tools ⇨ Add-Ins. This command displays the Add-Ins dialog box, shown in Figure 21-1. The list box contains the names of all add-ins that Excel knows about, and check marks identify add-ins that are open. You can open and close add-ins from this dialog box by checking or unchecking the check boxes.



The Add-Ins dialog box for Excel 2002 features a new button: Automation. Use this button to install a COM add-in. Although Excel 2000 supports COM add-ins, it didn’t provide a direct way to install them.



You can also open most add-in files by choosing the File ⇨ Open command. Because an add-in is never the active workbook, you can’t close an add-in by choosing File ⇨ Close. You can remove the add-in only by exiting and restarting Excel or by executing VBA code to close the add-in. Opening an add-in with the File ⇨ Open command opens the file, but the add-in is not officially “installed.”

When you open an add-in, you may or may not notice anything different about Excel. In almost every case, however, the user interface changes in some way: Excel displays either a new menu, one or more new menu items on an existing menu, or a toolbar. For example, when you open the Analysis ToolPak add-in, this add-in gives you a new menu item on the Tools menu: Data Analysis. When you open Excel’s Euro Currency Tools add-in, you’ll get a new toolbar named EuroValue. If the add-in contains only custom worksheet functions, the new functions appear in the Insert Function dialog box.

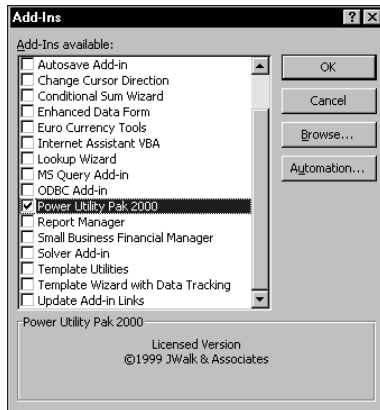


Figure 21-1: The Add-Ins dialog box

Creating an Add-In

As I noted earlier, you can convert any workbook to an add-in, but not all workbooks are appropriate candidates for add-ins. Generally, a workbook that benefits most from being converted to an add-in is one that contains macros — especially general-purpose macro procedures. A workbook that consists only of worksheets would be inaccessible as an add-in because worksheets within add-ins are hidden from the user. You can, however, write code that copies all or part of a sheet from your add-in to a visible workbook.

Creating an add-in from a workbook is simple. The following steps describe how to create an add-in from a normal workbook file:

1. Develop your application, and make sure everything works properly.

Don't forget to include a way to execute the macro or macros in the add-in. You might want to add a new menu or menu item or to create a custom toolbar. See Chapter 23 for details on customizing menus and Chapter 22 for a discussion of custom toolbars.

2. Test the application by executing it when a *different* workbook is active.

This simulates the application's behavior when it's used as an add-in because an add-in is never the active workbook.

3. Activate the VBE, and select the workbook in the Project window. Choose Tools ⇨ xxx Properties, and click the Protection tab. Select the Lock project for viewing check box, and enter a password (twice). Click OK.

This step is necessary only if you want to prevent others from viewing or modifying your macros or custom dialog boxes.

A Few Words About Security

Microsoft has never promoted Excel as a product that creates applications in which the source code is secure. The password feature provided in Excel is sufficient to prevent casual users from accessing parts of your application that you'd like to keep hidden. Excel 2002 includes stronger security than previous versions, but it is possible that your passwords can be cracked. If you must be absolutely sure that no one ever sees your code or formulas, Excel is not your best choice as a development platform.

4. Reactivate Excel and choose File ⇨ Properties, click the Summary tab, and enter a brief descriptive title in the Title field and a longer description in the Comments field.

This step is not required, but it makes the add-in easier to use by displaying descriptive text in the Add-Ins dialog box.

5. Select File ⇨ Save As.
6. In the Save As dialog box, select Microsoft Excel add-in (*.xla) from the Save as type drop-down list.
7. Click Save. A copy of the workbook is saved (with an .xla extension), and the original XLS workbook remains open.



Caution

A workbook being converted to an add-in must have at least one worksheet. For example, if your workbook contains only chart sheets or Excel 5/95 dialog sheets, the Microsoft Excel add-in (*.xla) option does not appear in the Save As dialog box. Also, this option appears only when a worksheet is active when you issue the File ⇨ Save As command.

An Add-In Example

In this section, I discuss the steps involved in creating a useful add-in. The example uses the Text Tools utility that I described in Chapter 16.



On the CD-ROM

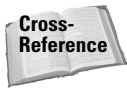
The XLS version of the Text Tools utility is available on the companion CD-ROM. You can use this file to create the described add-in.

Setting up the workbook

In this example, you'll be working with a workbook that has already been developed and debugged. The workbook consists of the following items:

- ♦ A worksheet named `HelpSheet`. This contains the help text that describes the utility.
- ♦ A UserForm named `FormHelp`. This dialog box is used to display help. The code module for this UserForm contains several event-handler procedures.
- ♦ A UserForm named `FormMain`. This dialog box serves as the primary user interface. The code module for this UserForm contains several event-handler procedures.
- ♦ A VBA module named `modMenus`. This contains the code that creates and deletes a menu item (Tools ⇄ Text Tools).
- ♦ A VBA module named `modMain`. This contains several procedures, including a procedure that displays the `FormMain` UserForm.

In addition, the `ThisWorkbook` module contains two event-handler procedures (`Workbook_Open` and `Workbook_BeforeClose`) that call other procedures to create and delete the menu item.



See Chapter 16 for details about how the Text Tools utility works.

Testing the workbook

Before converting this workbook to an add-in, you need to test it. To simulate what happens when the workbook is an add-in, you should test the workbook when a different workbook is active. Remember, an add-in is never the active workbook.

Open a new workbook, and try out the various features in the Text Tools utility. Do everything you can think of to try to make it fail. Better yet, seek the assistance of someone unfamiliar with the application to give it a crash test.

Adding descriptive information

I recommend entering a description of your add-in, but this step is not required. Choose the File ⇄ Properties command, which opens the Properties dialog box. Then click the Summary tab, as shown in Figure 21-2.

Enter a title for the add-in in the Title field. This text appears in the Add-Ins dialog box. In the Comments field, enter a description. This information appears at the bottom of the Add-Ins dialog box when the add-in is selected.

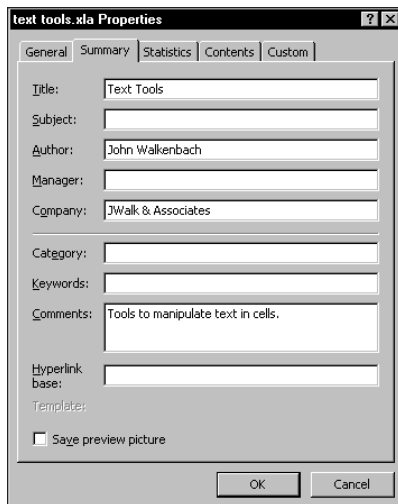


Figure 21-2: Use the Properties dialog box to enter descriptive information about your add-in.

Creating the add-in

To create the add-in, do the following:

1. Activate the VBE, and select the workbook in the Project window.
2. Select Debug ⇄ Compile. This step forces a compilation of the VBA code, and identifies any syntax errors so you can correct them. When you save a file as an add-in, Excel creates the add-in even if it contains syntax errors.
3. Choose Tools ⇄ TextTools Properties, and click the Protection tab. Select the Lock project for viewing check box and enter a password (twice). Click OK. If you don't need to protect the project, you can skip this step.

By default, all VB projects are named VBProject. In this example, the project name was changed to TextTools.

4. Save the workbook.
5. Activate the worksheet, and choose File ⇄ Save As. Excel displays its Save As dialog box.
6. In the Save as type drop-down list, select Microsoft Excel add-in (*.xla).
7. Click Save. A new add-in file is created, and the original XLS version remains open.

About Excel's Add-In Manager

You access Excel's Add-In Manager by selecting the Tools ⇨ Add-Ins command, which displays the Add-Ins dialog box. This dialog box lists the names of all the available add-ins. Those that are checked are open.

In VBA terms, the Add-In dialog box lists the `Title` property of each `AddIn` object in the `AddIns` collection. Each add-in that appears with a check mark has its `Installed` property set to `True`.

You can install an add-in by checking its box, and you can de-install an installed add-in by removing the check mark from its box. To add an add-in to the list, use the `Browse` button to locate its file. By default, the Add-In dialog box lists files of the following types:

- ♦ XLA: An add-in created from an XLS file
- ♦ XLL: A standalone DLL file, written in C and compiled

If you click the `Automation` button (available only in Excel 2002), you'll be able to browse for COM add-ins. Note that the `Automation Servers` dialog box will probably list many files, and the file list is not limited to COM add-ins that work with Excel.

You can enroll an add-in file into the `AddIns` collection with the `Add` method of VBA's `AddIns` collection, but you can't remove one using VBA. You can also open an add-in using VBA by setting the `AddIn` object's `Installed` property to `True`. Setting it to `False` closes the add-in.

The Add-In Manager stores the installed status of the add-ins in the Windows Registry when you exit Excel. Therefore, all add-ins that are installed when you close Excel are automatically opened the next time you start Excel.

Installing the add-in

To avoid confusion, close the XLS workbook before installing the add-in created from that workbook.

To install an add-in, do the following:

1. Choose the Tools ⇨ Add-Ins command. Excel displays the Add-Ins dialog box.
2. Click the `Browse` button, and locate the add-in you just created. After you find your new add-in, the Add-Ins dialog box displays the add-in in its list. As shown in Figure 21-3, the Add-Ins dialog box also displays the descriptive information you provided in the `Properties` dialog box.

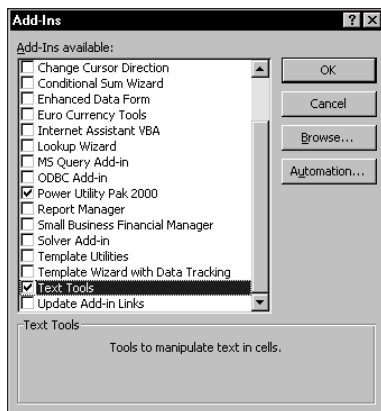


Figure 21-3: The Add-Ins dialog box, with the new add-in selected

3. Click OK to close the dialog box and open the add-in.

When the Text Tools add-in is opened, the Tools menu displays the new menu item that executes the `StartTextTool` procedure in the add-in.

Distributing the add-in

You can distribute this add-in to other Excel users simply by giving them a copy of the XLA file (they don't need the XLS version) along with instructions on how to install it. If you have the Developer's Edition of Office 2002, you can use the Setup Wizard to create a Setup.exe file that your users can easily make sense of. After they install the add-in, the new Text Tools command appears on the Tools menu. If you locked the file with a password, your macro code cannot be viewed or modified by others unless they know the password.

Modifying the add-in

If you want to modify an add-in, first open it and then unlock it. To unlock it, activate the VBE, and double-click its project's name in the Project window. You'll be prompted for the password. Make your changes, and then save the file from the VBE (using the File ⇄ Save command).

If you create an add-in that stores its information in a worksheet, you must set its workbook's `IsAddIn` property to `False` before you can view that workbook in Excel. You do this in the Properties window shown in Figure 21-4 when the `ThisWorkbook` object is selected. After you've made your changes, make sure you set the `IsAddIn` property back to `True` before you save the file. If you leave the `IsAddIn` property set to `False`, the file is saved as a regular workbook, although it still has the .xla extension. At this point, attempting to install this file by using the Add-Ins dialog box results in an error.

Creating an Add-In: A Checklist

Before you release your add-in to the world, take a few minutes to run through this checklist:

- ♦ Did you test your add-in with all supported platforms and Excel versions?
- ♦ Did you give your VB project a new name? By default, every project is named VBProject. It's a good idea to give your project a more meaningful name.
- ♦ Does your add-in make any assumptions about the user's directory structure or directory names?
- ♦ When you use the Add-Ins dialog box to load your add-in, is its name and description correct and appropriate?
- ♦ If your add-in uses VBA functions that aren't designed to be used in a worksheet, have you declared the functions as `Private`? If not, these functions will appear in the Paste Function dialog box.
- ♦ Did you force a recompile of your add-in to ensure that it contains no syntax errors?
- ♦ Did you account for any international issues? For example, if your add-in creates a new item on the Tools menu, will it fail if the Tools menu has a non-English name?
- ♦ Is your add-in file optimized for speed? See "Optimizing the Performance of Add-Ins" later in this chapter.

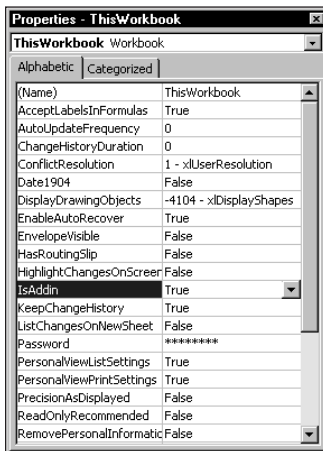


Figure 21-4: Making an add-in not an add-in

Comparing XLA and XLS Files

This section begins by comparing an add-in XLA file to its XLS source file. Later in this chapter, I discuss methods that you can use to optimize the performance of your add-in. I describe a technique that may reduce its file size, which makes it load more quickly and use less disk space and memory.

File size and structure

An add-in based on an XLS source file is exactly the same size as the original. The VBA code in XLA files is not compressed or optimized in any way, so faster performance is not among the benefits of using an add-in.

Collection membership

An add-in is a member of the `AddIns` collection but not an “official” member of the `Workbooks` collection. You can refer to an add-in by referencing the `Workbooks` collection and supplying the add-in’s filename as its index. The following instruction creates an object variable that represents an add-in named `Myaddin.xla`:

```
Set TestAddin = Workbooks("Myaddin.xla")
```

Add-ins cannot be referenced by an index number in the `Workbooks` collection. If you use the following code to loop through the `Workbooks` collection, the `Myaddin.xla` workbook is not displayed:

```
For Each w in Application.Workbooks
    MsgBox w.Name
Next w
```

The following `For-Next` loop, on the other hand, displays `Myaddin.xla`—assuming that Excel “knows” about it—in the `Add-Ins` dialog:

```
For Each a in Application.AddIns
    MsgBox a.Name
Next a
```

Windows

Ordinary XLS workbooks are displayed in one or more windows. For example, the following statement displays the number of windows for the active workbook:

```
MsgBox ActiveWorkbook.Windows.Count
```

You can manipulate the visibility of each window for an XLS workbook by using the `Window ⇨ Hide` command or by changing the `Visible` property. The following code hides all windows for the active workbook:

```
For Each Win In ActiveWorkbook.Windows
    Win.Visible = False
Next Win
```

Add-in files are never visible, and they don't officially have windows, even though they have unseen worksheets. Consequently, they don't appear in the windows list when you select the `Window` command. If `Myaddin.xla` is open, the following statement returns 0:

```
MsgBox Workbooks("Myaddin.xla").Windows.Count
```

Sheets

Add-in XLA files, like XLS files, can have any number of worksheets or chart sheets. But, as I noted earlier in this chapter, an XLS file must have at least one worksheet to convert it to an add-in.

When an add-in is open, your VBA code can access its contained sheets as if it were an ordinary workbook. Because add-in files aren't part of the `Workbooks` collection, though, you must reference an add-in by its name, not by an index number. The following example displays the value in cell A1 of the first worksheet in `Myaddin.xla`, which is assumed to be open:

```
MsgBox Workbooks("Myaddin.xla").Worksheets(1) _
    .Range("A1").Value
```

If your add-in contains a worksheet that you would like the user to see, you can copy it to an open workbook, or create a new workbook from the sheet.

The following code, for example, copies the first worksheet from an add-in and places it in the active workbook (as the last sheet):

```
Sub CopySheetFromAddin()
    Set AddinSheet = Workbooks("Myaddin.xla").Sheets(1)
    NumSheets = ActiveWorkbook.Sheets.Count
    AddinSheet.Copy After:=ActiveWorkbook.Sheets(NumSheets)
End Sub
```

Creating a new workbook from a sheet within an add-in is even simpler:

```
Sub CreateNewWorkbook()
    Workbooks("Myaddin.xla").Sheets(1).Copy
End Sub
```

Note

The preceding examples assume that the code is in a file other than the add-in file. VBA code within an add-in should always use `ThisWorkbook` to qualify references to sheets or ranges within the add-in. For example, the following statement is assumed to be in a VBA module in an add-in file. This statement displays the value in cell A1 on Sheet 1.

```
MsgBox ThisWorkbook.Sheets("Sheet1").Range("A1").Value
```

Accessing VBA procedures in an add-in

Accessing the VBA procedures in an add-in is a bit different from accessing procedures in a normal XLS workbook. First of all, when you issue the Tools ⇨ Macro command, the Macro dialog box does not display macro names belonging to open add-ins. It's almost as if Excel is trying to prevent you from accessing them.

Tip

If you know the name of the procedure, you can enter it directly into the Macro dialog box and click Run to execute it. The `Sub` procedure must be in a general VBA module, not in a code module for an object.

Because procedures contained in an add-in don't appear in the Macro dialog box, you must provide other means to access them. Your choices include direct methods, such as shortcut keys, custom menus, and custom toolbars, as well as indirect methods, such as event-handlers. One such candidate, for example, may be the `OnTime` method, which executes a procedure at a specific time of day.

You can use the `Run` method of the `Application` object to execute a procedure in an add-in. For example,

```
Application.Run "Myaddin.xla!DisplayNames"
```

Another option is to use the Tools ⇨ References command in the VBE to enable a reference to the add-in. Then you can refer directly to one of its procedures in your VBA code without the filename qualifier. In fact, you don't need to use the `Run` method; you can call the procedure directly as long as it's not declared as `Private`. The following statement executes a procedure named `DisplayNames` in an add-in that has been added as a reference:

```
Call DisplayNames
```

Note

Even when a reference to the add-in has been established, its macro names do not appear in the Macro dialog box.

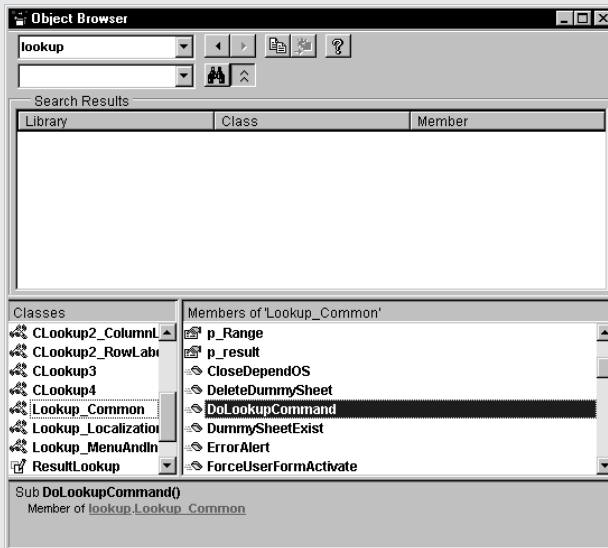
Function procedures defined in an add-in work just like those defined in an XLS workbook. They're easy to access because Excel displays their names in the Insert Function dialog box, under the User Defined category. The only exception is if the

Sleuthing a Protected Add-In

The Macro dialog box does not display the names of procedures contained in add-ins. But what if you'd like to run such a procedure, but the add-in is protected so you can't view the code to determine the name of the procedure? Use the Object Browser!

To illustrate, use the Tools ⇨ Add-Ins command to install the Lookup Wizard add-in. This add-in is distributed with Excel and is protected, so you can't view the code.

1. Activate the VBE, and select the Lookup.xla project in the Project window.
2. Press F2 to activate the Object Browser.
3. In the Libraries drop-down list, select lookup. This displays all the classes in the Lookup.xla add-in, as depicted in the following figure.



4. Select various items in the Classes list to see what class they are and the members they contain.

In the example above, the `Lookup_Common` class is a module, and its members consist of a number of variables, constants, procedures, and functions. One of these procedures, `DoLookupCommand`, sounds like it may be the main procedure that starts the wizard. To test this theory, activate Excel, and choose Tools ⇨ Macro ⇨ Macros. Type **DoLookupCommand** in the Macro Name box, and click Run. Sure enough! You'll see the first dialog box of the Lookup Wizard.

Armed with this information, you can write VBA code to start the Lookup Wizard.

Function procedure was declared with the `Private` keyword; then the function does not appear there. That's why it's a good idea to declare custom functions as `Private` if they will be used only by other VBA procedures and are not designed to be used in worksheet formulas.

**Note**

To see an add-in that does *not* declare its functions as `Private`, install Microsoft's Lookup Wizard add-in. Then click the Insert Function button. You'll find more than three dozen nonworksheet functions listed in the User Defined category of the Insert Function dialog box. These functions are not intended to be used in a worksheet formula.

As I discussed earlier, you can use worksheet functions contained in add-ins without the workbook name qualifier. For example, if you have a custom function named `MOVAVG` stored in the file `Newfuncs.xls`, you would use the following instruction to address the function from a worksheet belonging to a different workbook:

```
=Newfuncs.xls!MOVAVG(A1:A50)
```

But if this function is stored in an add-in file that's open, you can omit the file reference and write the following instead:

```
=MOVAVG(A1:A50)
```

Manipulating Add-Ins with VBA

In this section, I present information that will help you write VBA procedures that manipulate add-ins.

The AddIns collection

The `AddIns` collection consists of all add-ins that Excel knows about. These add-ins can either be installed or not. The Tools ⇨ Add-Ins command displays the Add-Ins dialog box, which lists all members of the `AddIns` collection. Those entries accompanied by a check mark are installed.

Adding an item to the AddIns collection

The add-in files that make up the `AddIns` collection can be stored anywhere. Excel maintains a partial list of these files and their locations in the Windows Registry. For Excel 2002, this list is stored at:

```
HKEY_CURRENT_USER\Software\Microsoft\Office\10.0\Excel\Add-in  
Manager
```

You can use the Windows Registry Editor (Regedit.exe) to view this Registry key. Note that the “standard” add-ins that are shipped with Excel do not appear in this Registry key. In addition, add-in files stored in the following directory will also appear in the list (but will not be listed in the Registry):

```
Windows\Application Data\Microsoft\AddIns
```

You can add a new `AddIn` object to the `AddIns` collection either manually or programmatically using VBA. To add a new add-in to the collection manually, select **Tools** ⇨ **Add-Ins**, click the **Browse** button, and locate the add-in.

To enroll a new member of the `AddIns` collection with VBA, use the collection’s `Add` method. Here’s an example:

```
Application.AddIns.Add "c:\files\newaddin.xla"
```

After the preceding instruction is executed, the `AddIns` collection has a new member, and the **Add-Ins** dialog box shows a new item in its list. If the add-in already exists in the collection, nothing happens, and an error is not generated.

If the add-in you’re enrolling is on a removable disk (for example, a floppy disk or CD-ROM), you can also copy the file to Excel’s library directory with the `Add` method. The following example copies `Myaddin.xla` from drive A and adds it to the `AddIns` collection. The second argument (`True`, in this case) specifies whether the add-in should be copied. If the add-in resides on a hard drive, the second argument may be ignored.

```
Application.AddIns.Add "a:\Myaddin.xla", True
```



Enrolling a new workbook into the `AddIns` collection does not install it. To install the add-in, set its `Installed` property to `True`.



The Windows Registry does not actually get updated until Excel closes normally. Therefore, if Excel ends abnormally (that is, if it crashes), the add-in’s name will not get added to the Registry and the add-in will not be part of the `AddIns` collection when Excel restarts.

Removing an item from the AddIns collection

Oddly, there is no direct way to remove an add-in from the `AddIns` collection. The `AddIns` collection does not have a `Delete` or `Remove` method. One way to remove an add-in from the **Add-Ins** dialog box is to edit the Windows Registry database (using Regedit.exe). After you do this, the add-in will not appear in the **Add-Ins** dialog box the next time you start Excel. Note that this method is not guaranteed to work with all add-in files.

Another way to remove an add-in from the `AddIns` collection is to delete, move, or rename its XLA file. You'll get a warning like the one in Figure 21-5 the next time you try to install or uninstall the add-in, along with an opportunity to remove it from the `AddIns` collection.

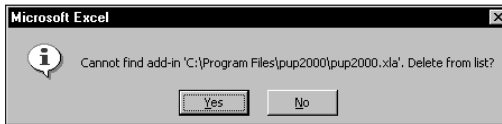


Figure 21-5: One very direct way to remove a member of the `AddIns` collection

AddIn object properties

An `AddIn` object is a single member of the `AddIns` collection. For example, to display the filename of the first member of the `AddIns` collection, use the following:

```
Msgbox AddIns(1).Name
```

An `AddIn` object has 14 properties, which you can read about in the online help. Five of these properties are “hidden” properties. Some of the terminology is a bit confusing, so I'll discuss a few of the more important properties.

Name

This property holds the filename of the add-in. `Name` is a read-only property, so you can't change the name of the file by changing the `Name` property.

Path

This property holds the drive and path where the add-in file is stored. It does not include a final backslash or the filename.

FullName

This property holds the add-in's drive, path, and filename. This property is a bit redundant because this information is also available from the `Name` and `Path` properties. The following instructions produce exactly the same message:

```
MsgBox AddIns(1).Path & "\" & AddIns(1).Name  
MsgBox AddIns(1).FullName
```

Title

This hidden property holds a descriptive name for the add-in. The `Title` property is what appears in the Add-Ins dialog box. This property is read-only, and the only way to add or change the `Title` property of an add-in is to use the File ⇄ Properties command (click the Summary tab, and enter text into the Title field). You must use this menu command with the XLS version of the file before converting it to an add-in.

Typically, a member of a collection is addressed by way of its `Name` property setting. The `AddIns` collection is different; it uses the `Title` property instead. The following example displays the filename for the View Manager add-in (that is, `Views.xls`), whose `Title` property is "View Manager".

```
Sub ShowName()  
    MsgBox AddIns("View Manager").Name  
End Sub
```

You can, of course, also reference a particular add-in with its index number if you happen to know it.

Comments

This hidden property stores text that is displayed in the Add-Ins dialog box when a particular add-in is selected. `Comments` is a read-only property. The only way to change it is to use the Properties dialog box before you convert the workbook to an add-in. Comments can be as long as 255 characters, but the Add-Ins dialog box can display only about 100 characters.

Installed

The `Installed` property is `True` if the add-in is currently installed — that is, if it is checked in the Add-Ins dialog box. Setting the `Installed` property to `True` opens the add-in. Setting it to `False` unloads it. Here's an example of how to install (that is, open) the MS Query add-in with VBA:

```
Sub InstallQuery()  
    AddIns("MS Query Add-In").Installed = True  
End Sub
```

After this procedure is executed, the Add-Ins dialog box displays a check mark next to MS Query Add-In. If the add-in is already installed, setting its `Installed` property to `True` has no effect. To remove this add-in (uninstall it), simply set the `Installed` property to `False`.



If the add-in was opened with the File ⇄ Open command, it is not considered to be officially installed. Consequently, its `Installed` property is `False`.

The following procedure displays the number of add-ins in the `AddIns` collection and the number of those that are installed. You'll find that the count does not include add-ins that were opened with the File ⇨ Open command.

```
Sub CountInstalledAddIns()  
    Dim Count As Integer  
    Dim Item As AddIn  
    Dim Msg As String  
    Count = 0  
    For Each Item In AddIns  
        If Item.Installed Then Count = Count + 1  
    Next Item  
    Msg = "Add-ins: " & AddIns.Count & Chr(13)  
    Msg = Msg & "Installed: " & Count  
    MsgBox Msg  
End Sub
```

The next procedure loops through all add-ins in the `AddIns` collection and uninstalls any add-in that's installed. This procedure does not affect add-ins that were opened with the File ⇨ Open command.

```
Sub UninstallAll()  
    Dim Count As Integer  
    Dim Item As AddIn  
    Count = 0  
    For Each Item In AddIns  
        If Item.Installed Then  
            Item.Installed = False  
            Count = Count + 1  
        End If  
    Next Item  
    MsgBox Count & " Add-Ins Uninstalled."  
End Sub
```

**Note**

You can determine whether a particular workbook is an add-in by accessing its `IsAddIn` property. This is not a read-only property, so you can also convert a workbook to an add-in by setting the `IsAddIn` property to `True`.

Accessing an add-in as a workbook

As I mentioned earlier, there are two ways to open an add-in file: with the File ⇨ Open command and with the Tools ⇨ Add-Ins command. The latter method is the preferred method for the following reason: When you open an add-in with the File ⇨ Open command, its `Installed` property is *not* set to `True`. Therefore, you cannot close the file using the Add-Ins dialog box. In fact, the only way to close such an add-in is with a VBA statement such as the following:

```
Workbooks("Myaddin.xla").Close
```

**Caution**

Using the `Close` method on an installed add-in removes the add-in from memory, but it does *not* set its `Installed` property to `False`. Therefore, the Add-Ins dialog box still lists the add-in as installed, which can be very confusing. The proper way to remove an installed add-in is to set its `Installed` property to `False`.

As you may have surmised, Excel's add-in capability is a bit quirky. Therefore, as a developer, you'll need to pay particular attention to issues involving installing and uninstalling add-ins.

AddIn object events

An `AddIn` object has two events: `AddInInstall` (generated when it is installed) and `AddInUninstall` (generated when it is uninstalled). You can write event-handler procedures for these events in the `ThisWorkbook` object for the add-in.

The following example is displayed as a message when the add-in is installed:

```
Private Sub Workbook_AddinInstall()  
    MsgBox ThisWorkbook.Name & _  
        " add-in in has been installed."  
End Sub
```

**Note**

Don't confuse the `AddInInstall` event with the `Open` event. The `AddInInstall` event occurs only when the add-in is first installed. If you need to execute code every time the add-in is opened, use a `Workbook_Open` procedure.

**Cross-Reference**

For additional information about events, see Chapter 19.

Optimizing the Performance of Add-Ins

It should be obvious that you want your add-in to be as fast and efficient as possible. In this section, I describe some techniques that you may find helpful.

Code speed

If you ask a dozen Excel programmers to automate a particular task, chances are you'll get a dozen different approaches. Most likely, not all these approaches will perform equally well.

Following are a few tips that you can use to ensure that your code runs as quickly as possible:

- ♦ Set the `Application.ScreenUpdating` property to `False` when writing data to a worksheet.

- ♦ Declare the data type for all variables used, and in your finalized code, avoid variants whenever possible. Use an `Option Explicit` statement at the top of each module to force variable declaration.
- ♦ Create object variables to avoid lengthy object references. For example, if you're working with a `Series` object for a chart, create an object variable using code like this:

```
Dim S1 As Series
Set S1 = ActiveWorkbook.Sheets(1).ChartObjects(1). _
    Chart.SeriesCollection(1)
```
- ♦ Declare object variables as a specific object type, not `As Object`.
- ♦ Use the `With-End With` construct, when appropriate, to set multiple properties or call multiple methods for a single object.
- ♦ Remove all extraneous code. This is especially important if you've used the macro recorder to create procedures.
- ♦ If possible, manipulate data with VBA arrays rather than worksheet ranges. Reading and writing to a worksheet takes much longer than manipulating data in memory. This is not a firm rule, however. For best results, test both options.
- ♦ Avoid linking UserForm controls to worksheet cells. Doing so may trigger a recalculation whenever the user changes the UserForm control.
- ♦ Compile your code before creating the add-in. This may increase the file size, but it eliminates the need for Excel to compile the code before executing the procedures.

File size

Excel workbooks (including add-ins) have always suffered from a serious problem: *bloat*. You may have noticed that the size of your files tends to increase over time, even if you don't add any new content. This is especially true if you delete a lot of code and then replace it with other code. Making lots of changes to worksheets also seems to add to file bloat.

If you want to make your add-in—or any workbook, for that matter—as small as possible, you'll need to re-create your workbook. Here's how:

1. Make a backup of your application, and keep it in a safe place.
2. Activate the VBE, and export all the components for your project that contain VBA code (modules, code modules, UserForms, and possibly `ThisWorkbook`, worksheet, and chart modules). Make a note of the filenames and the location.
3. Create a new workbook.
4. Copy the contents of all the worksheets from your original application to worksheets in the new workbook. Be especially careful if you used named ranges in your workbook—they must be re-created.

5. Import the components you exported in Step 2.
6. Compile the code.
7. If applicable, reattach any toolbars that were attached to your original workbook.
8. Save the new workbook.
9. Test the new workbook thoroughly to ensure that nothing was lost in the process.

There's an excellent chance that the newly created file will be much smaller than your original. The size reduction depends on many factors, but I've been able to reduce the size of my XLA files by as much as 55 percent with this process.

Special Problems with Add-Ins

Add-ins are great, but you should realize by now that there's no free lunch. Add-ins present their share of problems—or should I say challenges? In this section, I discuss some issues that you need to know about if you'll be developing add-ins for widespread user distribution.

Ensuring that an add-in is installed

In some cases, you may need to ensure that your add-in is installed properly (that is, opened using the Tools ⇄ Add-Ins command, not the File ⇄ Open command). This section describes a technique that determines just that. If it isn't properly installed, VBA installs it (by attaching it to the `AddIns` collection, if necessary) and uses the message shown in Figure 21-6 to tell the user what was done.



Figure 21-6: When attempting to open the add-in incorrectly, the user sees this message.

Listing 21-1 presents the code module for this example's `ThisWorkbook` object. This technique relies on the fact that the `AddInInstall` event occurs before the `Open` event for the workbook.

Listing 21-1: Ensuring that an accessible add-in is properly installed and workable

```
Dim InstalledProperly As Boolean

Private Sub Workbook_AddinInstall()
    InstalledProperly = True
End Sub

Private Sub Workbook_Open()
    If Not ThisWorkbook.IsAddin Then Exit Sub

    If Not InstalledProperly Then
        ' Add it to the AddIns collection
        If Not InAddInCollection(ThisWorkbook) Then _
            AddIns.Add FileName:=ThisWorkbook.FullName

        ' Install it
        AddInTitle = GetTitle(ThisWorkbook)
        Application.EnableEvents = False
        AddIns(AddInTitle).Installed = True
        Application.EnableEvents = True

        ' Inform user
        Msg = ThisWorkbook.Name & _
            " has been installed as an add-in. "
        Msg = Msg & _
            "Use the Tools Add-Ins command to uninstall it."
        MsgBox Msg, vbInformation, AddInTitle
    End If
End Sub
```

If the add-in is installed properly, the `Workbook_AddinInstall` procedure is executed. This procedure sets the Boolean variable `InstalledProperly` to `True`. If the add-in was opened using the `File ⇨ Open` command, the `Workbook_AddinInstall` procedure is not executed, so the `InstalledProperly` variable has its default value (`False`).

When the `Workbook_Open` procedure is executed, it first checks to make sure the workbook is an add-in. If it isn't, the procedure ends. If the workbook is an add-in, the routine checks the value of `InstalledProperly`. If the add-in was installed properly, the procedure ends. If not, the code executes a custom function to determine whether the add-in is a member of the `AddIns` collection. If it is not in the collection, it is added. The procedure ends by installing the file as an add-in and then informing the user. The net effect is that using `File ⇨ Open` to open the add-in actually installs it properly — and the user receives a brief lesson in the use of add-ins.

The preceding code uses two custom functions, shown in Listing 21-2. The `InAddInCollection` returns `True` if a workbook passed as an argument is a member of the `AddIns` collection. The `GetTitle` function returns the `Title` property for an add-in workbook.

Listing 21-2: Filling in for Excel's missing add-in properties

```
Function InAddInCollection(wb) As Boolean
    Dim Item As AddIn
    For Each Item In AddIns
        If Item.Name = wb.Name Then
            InAddInCollection = True
        End If
    Next Item
End Function

Function GetTitle(wb) As String
    Dim Item As AddIn
    GetTitle = ""
    For Each Item In AddIns
        If Item.Name = wb.Name Then
            GetTitle = Item.Title
        End If
    Next Item
End Function
```

Referencing other files

If your add-in uses other files, you need to be especially careful when distributing the application. You can't assume anything about the storage structure of the system that users will run the application on. The easiest approach is to insist that all files for the application be copied to a single directory. Then you can use the `Path` property of your application's workbook to build path references to all other files.

For example, if your application uses a custom help file, be sure that the help file is copied to the same directory as the application itself. Then you can use a procedure like the following to make sure that the help file can be located:

```
Sub GetHelp()
    Dim Path As String
    Path = ThisWorkbook.Path
    Application.Help Path & "\USER.HLP"
End Sub
```

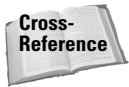
If your application uses API calls to standard Windows DLLs, you can assume that these can be found by Windows. But if you use custom DLLs, the best practice is to make sure that they are installed in the Windows\System directory (which may or may not be named Windows\System). You'll need to use the `GetSystemDirectory` Windows API function to determine the exact path of the System directory.

Specifying the proper Excel version

If your add-in makes use of any features unique to Excel 2002, you'll want to warn users who attempt to open the add-in using an earlier version. The following code does the trick:

```
Sub CheckVersion()  
    If Val(Application.Version) < 10 Then  
        MsgBox "This works only with Excel 2002 or later"  
        ThisWorkbook.Close  
    End If  
End Sub
```

The `Version` property of the `Application` object returns a string. For example, this might return `10.0a`. This procedure uses VBA's `Val` function, which ignores everything after the first alpha character.



See Chapter 26 for additional information about compatibility.

Summary

In this chapter, I covered add-ins and described what they are, how to create them, and how to manipulate them using VBA.

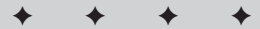
In the next chapter, I demonstrate how to use VBA to interact with other applications.



Developing Applications

The chapters in this part deal with important elements of creating user-oriented applications. Chapters 22 and 23 provide information on creating custom toolbars and menus. Chapter 24 presents several different ways to provide online help for your applications. In Chapter 25, I present some basic information about developing user-oriented applications, and I describe such an application in detail.

VI



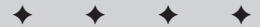
In This Part

Chapter 22
Creating Custom
Toolbars

Chapter 23
Creating Custom
Menus

Chapter 24
Providing Help for
Your Applications

Chapter 25
Developing User-
Oriented
Applications



Creating Custom Toolbars

Toolbars, of course, are a pervasive user interface element found in virtually all software these days. Excel is definitely *not* a toolbar-deficient product. It comes with more than four dozen built-in toolbars, and it's easy to construct new toolbars or customize existing ones either manually or using VBA. In this chapter, I describe how to create and modify toolbars.

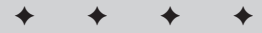
About Command Bars

Beginning with Excel 97, Microsoft introduced a completely new way of handling toolbars. Technically, a toolbar is known as a `CommandBar` object. In fact, what's commonly called a toolbar is actually one of three types of command bars:

Toolbar	A floating bar with one or more clickable controls. This chapter focuses on this type of command bar.
Menu bar	The two built-in menu bars are Worksheet Menu Bar and Chart Menu Bar (see Chapter 23).
Shortcut menu	The menu that pops up when you right-click an object (see Chapter 23).



Because a menu bar is also a command bar, virtually all the information in this chapter also applies to menu bars. In Chapter 23, I discuss the nuances of dealing with custom menus.



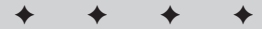
In This Chapter

An overview of command bars, which include toolbars

Understanding how Excel keeps track of toolbars

Customizing toolbars manually

Lots of examples that demonstrate how to use VBA to manipulate toolbars



Toolbar Manipulations

The following list summarizes the ways in which you can customize toolbars in Excel:

- ♦ *Remove controls from built-in toolbars.* You can get rid of controls that you never use and free up a few pixels of screen space.
- ♦ *Add controls to built-in toolbars.* You can add as many controls as you want to any toolbar. These controls can be custom buttons or buttons from other toolbars, or they can come from the stock of controls that Excel provides.
- ♦ *Create new toolbars.* You can create as many new toolbars as you like, with toolbar controls from any source.
- ♦ *Change the functionality of built-in toolbar controls.* You do this by attaching your own macro to a built-in control.
- ♦ *Change the image that appears on any toolbar control.* Excel includes a rudimentary but functional toolbar button editor, although there are several other image-changing techniques.

You can perform these customizations manually by using the Customize dialog box. This dialog box can be displayed using a number of different commands: select View ⇨ Toolbars ⇨ Customize, select the Tools ⇨ Customize command, or right-click any toolbar and choose Customize. In addition, you can customize toolbars by writing VBA code.

**Note**

Don't be afraid to experiment with toolbars. If you mess up a built-in toolbar, you can easily reset it to its default state. Just access the Customize dialog box and click the Toolbars tab. Then select the toolbar in the list, and click the Reset button.

How Excel Handles Toolbars

Before you start working with custom toolbars, it's important to understand how Excel deals with toolbars in general. You may be surprised.

Storing toolbars

Toolbars can be attached to XLS (worksheet) or XLA (add-in) files, which makes it easy to distribute custom toolbars with your applications (see “Distributing toolbars” later in this chapter). You can attach any number of toolbars to a workbook. When the user opens your file, the attached toolbars automatically appear. An exception occurs if a toolbar with the same name already exists. In such a case, the new toolbar does not replace the existing one.

Excel stores toolbar information in an XLB file, which resides in Windows's main directory (\WINDOWS or \WINNT). The exact name (and location) of this file varies.

Why is this XLB file important? Assume that a colleague gives you an Excel workbook that has a custom toolbar stored in it. When you open the workbook, the toolbar appears. You examine the workbook but decide that you're not interested in it. Nonetheless, when you exit Excel, the custom toolbar is added to your XLB file. If you make *any* toolbar changes — from the minor adjustment of a built-in toolbar to the introduction of a custom toolbar — the XLB file is resaved when you exit Excel. Because the entire XLB file is loaded every time you start Excel, the time it takes to start and exit Excel increases significantly as the XLB file grows in size. Plus, all those toolbars eat up memory and system resources. Therefore, it's in your best interest to delete custom toolbars that you never use. Use the View ⇨ Toolbars ⇨ Customize command to do this.

Note

If you upgrade to Excel 2002 from a previous version, the information in your old XLB file will not be migrated to Excel 2002. In other words, you will lose any toolbar customizations that you've made.

When toolbars don't work correctly

Excel's approach to storing toolbars can cause problems. Suppose you've developed an application that uses a custom toolbar, and you've attached that toolbar to the application's workbook. The first time an end user opens the workbook, the toolbar is displayed. When the user closes Excel, your toolbar is saved in the user's XLB file. If the user alters the toolbar in any way — for example, if he or she accidentally removes a button — the next time your application is opened, the correct toolbar does *not* appear. Rather, the user sees the altered toolbar, which now lacks an important button. In other words, a toolbar attached to a workbook is not displayed if the user already has a toolbar with the same name. In many cases, this is *not* what you want to happen.

Fortunately, you can write VBA code to prevent this scenario. The trick is never to allow your custom toolbar to be added to the user's toolbar collection. The best way to do this is to create the toolbar on the fly every time the workbook is opened and then delete it when your application closes. With this process, the toolbar is never stored in the user's XLB file. You might think that creating a toolbar on the fly would be a slow process. As you'll see later in this chapter, creating toolbars with VBA is amazingly fast.

Manipulating Toolbars and Buttons Manually

Excel makes it easy for you to create new toolbars and modify existing toolbars. In fact, you may not even have to use VBA to work with toolbars, because you can do just about all your toolbar customization without it.

**Caution**

It's important to understand that any customizations you make to a toolbar, either built-in or custom, are "permanent." In other words, the changes remain in effect even when you restart Excel. These toolbar changes are not associated with a particular workbook. To restore a toolbar to its original state, you must reset it.

About command bar customization mode

To perform any type of manual toolbar (or menu) customization, Excel needs to be in what I call *command bar customization mode*. You can put Excel into this mode by using any of these techniques:

- ♦ Select View ⇨ Toolbars ⇨ Customize.
- ♦ Select Tools ⇨ Customize.
- ♦ Right-click any toolbar or menu, and select Customize from the shortcut menu.

When Excel is in command bar customization mode, the Customize dialog box is displayed, and you can manipulate toolbars and menus any way you like. You'll find that you can right-click menus and toolbars to get a handy shortcut menu (see Figure 22-1). After you've made your customization, click the Close button in the Customize dialog box.

The Customize dialog box includes three tabs:

Toolbars	Lists all the available toolbars, including custom toolbars you have created. The list box also includes the two menu bars (Worksheet Menu Bar and Chart Menu Bar), plus any other custom menu bars.
Commands	Lists by category all the available built-in commands. Use this tab to add new items to a toolbar or menu bar.
Options	Lets you select various options that relate to toolbars and menus. These include icon size, screen tips, and menu animations.

**Tip**

The Options tab of the Customize dialog box contains an option called Always show full menus. I strongly recommend that you turn this option on. When this option is off, incomplete menus are displayed. Apparently, Microsoft thought this option would lessen confusion for beginners. In fact, it usually has the opposite effect.

In the sections that follow, I briefly describe how to perform some common toolbar modifications manually, using the Customize dialog box.

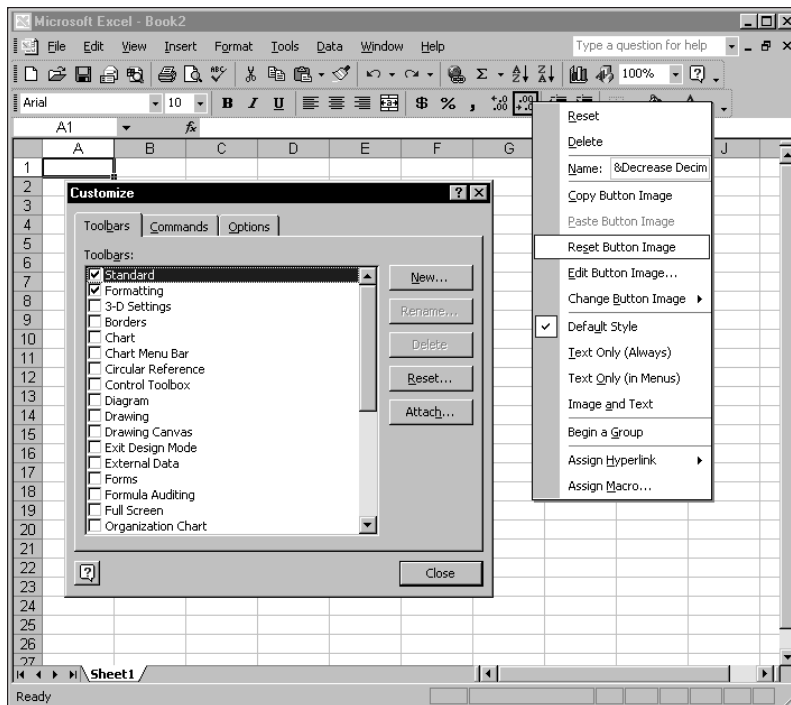


Figure 22-1: In command bar customization mode, you can alter all toolbars and menus.

Hiding or displaying a toolbar

The Toolbars tab in the Customize dialog box displays every toolbar (built-in toolbars and custom toolbars). Add a check mark to display a toolbar; remove the check mark to hide it. The changes take effect immediately.

Creating a new toolbar

Click the New button, and then enter a name in the New Toolbar dialog box. Excel creates and displays an empty toolbar. You can then add buttons (or menu commands) to the new toolbar.

Figure 22-2 shows a custom toolbar that I created manually. This toolbar, called Custom Formatting, contains the formatting tools that I use most frequently. Notice that this toolbar includes drop-down menus as well as standard toolbar buttons.

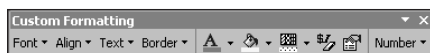


Figure 22-2: A custom toolbar that contains formatting tools

Renaming a custom toolbar

Select a custom toolbar from the list, and click the Rename button. Enter a new name in the Rename Toolbar dialog box. You cannot rename a built-in toolbar.

Deleting a custom toolbar

Select a custom toolbar from the list, and click the Delete button. You cannot delete a built-in toolbar.

Resetting a built-in toolbar

Select a built-in toolbar from the list, and click the Reset button. The toolbar is restored to its default state. If you've added any custom tools to the toolbar, they are removed. If you've removed any of the default tools, they are restored. The Reset button is disabled when a custom toolbar is selected.

Moving and copying controls

When Excel is in command bar customization mode (that is, the Customize dialog box is displayed), you can copy and move toolbar controls freely among any visible toolbars. To move a control, drag it to its new location, either within the current toolbar or on a different toolbar. To copy a control, press Ctrl while you drag that control to another toolbar. You can also copy a control within the same toolbar.

Inserting a new control

To add a new control to a toolbar, use the Commands tab of the Customize dialog box shown in Figure 22-3.



Figure 22-3: The Commands tab contains a list of every available built-in control.

Here, the controls are arranged in 17 categories. When you select a category, the controls in that category appear to the right. To find out what a control does, select it and click the Description button. To add a control to a toolbar, locate it in the Commands list, and then click and drag it to the toolbar.

Adding a toolbar button that executes a macro

To create a new toolbar button to which you will attach a macro, activate the Commands tab of the Customize dialog box, and then choose Macros from the Categories list. Drag the command labeled Custom Button to your toolbar (by default, this button has a smiley face image).

After adding the button, right-click it and select your options from the menu shown in Figure 22-4. You'll want to change the name, assign a macro, and (I hope) change the image.

Note

Selecting Change Button Image from the shortcut menu displays a list of 42 images. This is a tiny subset of all of the available images you can use. See "Adjusting a toolbar button image" later in this chapter.

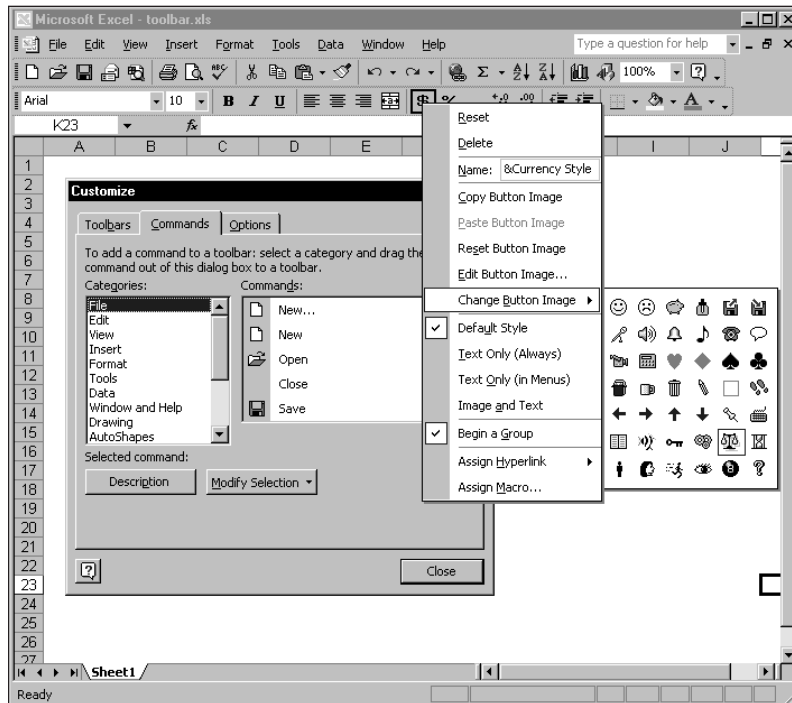


Figure 22-4: Customizing a toolbar button

Distributing toolbars

In this section, I describe how to distribute custom toolbars to others, and I outline what you need to be aware of to prevent problems.

Attaching a toolbar to a workbook

To store a toolbar in a workbook file, select View ⇨ Toolbars ⇨ Customize to display the Customize dialog box. Click the Attach button to bring up the Attach Toolbars dialog box, shown in Figure 22-5. This dialog box lists all the custom toolbars in the Toolbars collection in the list box on the left. Toolbars already stored in the workbook are shown in the list box on the right.

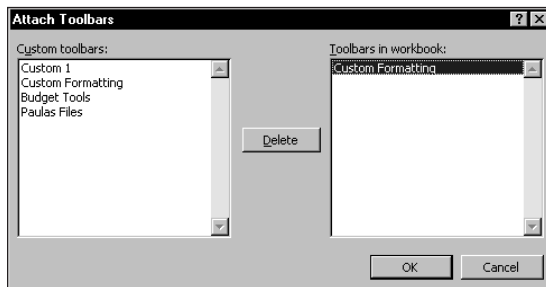


Figure 22-5: The Attach Toolbars dialog box

To attach a toolbar, select it and click the Copy button. When a toolbar in the right list box is selected, the Copy button reads “Delete”; you can click it to remove a selected toolbar from a workbook.

**Note**

Oddly, there is no way to attach or detach toolbars from a workbook with VBA. These operations must be performed manually.

**Caution**

The copy of the toolbar stored in the workbook always reflects its contents at the time you attach it. If you modify the toolbar after attaching it, the changed version is not automatically stored in the workbook. You must manually remove the old toolbar and then attach the edited toolbar.

A toolbar that’s attached to a workbook automatically appears when the workbook is opened, unless the workspace already has a toolbar by the same name. See “How Excel Handles Toolbars” earlier in this chapter.

Distributing a toolbar with an add-in

As I mentioned in Chapter 21, distributing an application as an add-in is often the preferred method for end users. Not surprisingly, an add-in can also include one or more custom toolbars. But you need to be aware of a potential glitch.

Here's a typical scenario: You create an application that uses a custom toolbar. The buttons on that toolbar execute VBA procedures in the application's workbook. You attach the toolbar to the workbook and save the workbook. You create an add-in from the workbook. You close the XLS version of the application. You install the add-in. You click a button on the custom toolbar *and the XLS file opens!*

Your intent, of course, is to have the toolbar buttons execute procedures in the add-in, *not* the XLS file. But when you attach the toolbar to the workbook, the toolbar is saved in its current state. In that state, the workbook includes references to the macros in the XLS file. Consequently, clicking a button opens the XLS file so that the macro can be executed. You could manually (or via VBA) change the `OnAction` property of each toolbar button so it refers to the add-in version (the XLA file). A better approach, however, is to write code to create the toolbar on the fly when the add-in is opened. I discuss this topic in detail later in the chapter.

Manipulating the CommandBars Collection

The `CommandBars` collection, contained in the `Application` object, is a collection of all `CommandBar` objects. Each `CommandBar` object has a collection of `Controls`. All these objects have properties and methods that enable you to control toolbars with VBA procedures.

In this section, I provide some key background information that you should know about before you start writing code to manipulate toolbars. As always, a thorough understanding of the object model will make your task much easier.

You manipulate Excel command bars (including toolbars) by using objects located within the `CommandBars` collection. This collection consists of the following items:

- ♦ All 54 of Excel 2002's built-in toolbars.
- ♦ Any other custom toolbars that you create.
- ♦ A built-in menu bar named Worksheet Menu Bar. This appears when a worksheet is active.
- ♦ A built-in menu bar named Chart Menu Bar. This appears when a chart sheet is active.
- ♦ Any other custom menu bars that you create.
- ♦ All 58 of Excel 2002's built-in shortcut menus.

New Toolbars in Excel 2002

If you're upgrading from a previous version of Excel, you'll notice several new toolbars. Compared to Excel 2000, Excel 2002 has 13 new toolbars:

Borders	Drawing Canvas	Organization Chart
Envelope	Protection	Clipboard
Diagram	PivotTable Field List	Task Pane
Draw Border	Insert Shape	Text to Speech
Online Meeting		

You might be surprised to learn that the Task Pane is actually a toolbar – a very nonstandard toolbar. It contains a single control.

Command bar types

As I mentioned at the beginning of this chapter, there are actually three types of command bars, each of which is distinguished by its `Type` property. Possible settings for the `Type` property of the `CommandBars` collection are shown in the following table. VBA provides built-in constants for the command bar types.

<i>Type</i>	<i>Description</i>	<i>Constant</i>
0	Toolbar	<code>msoBarTypeNormal</code>
1	Menu Bar	<code>msoBarTypeMenuBar</code>
2	Shortcut Menu	<code>msoBarTypePopUp</code>

Listing all CommandBar objects

If you're curious about the objects in the `CommandBars` collection, the following procedure should be enlightening. Executing this procedure generates a list (shown in Figure 22-6) of all `CommandBar` objects in the `CommandBars` collection. For Excel 2002, it lists a total of 114 built-in command bars, plus any custom menu bars or toolbars. For each command bar, the procedure lists its `Index`, `Name`, `Type` property settings (displayed as *Toolbar*, *Menu Bar*, or *Shortcut*), and whether it's a built-in command bar.

	A	B	C	D	E
1	1	Worksheet Menu Bar	Menu Bar	TRUE	
2	2	Chart Menu Bar	Menu Bar	TRUE	
3	3	Standard	Toolbar	TRUE	
4	4	Formatting	Toolbar	TRUE	
5	5	PivotTable	Toolbar	TRUE	
6	6	Chart	Toolbar	TRUE	
7	7	Reviewing	Toolbar	TRUE	
8	8	Forms	Toolbar	TRUE	
9	9	Stop Recording	Toolbar	TRUE	
10	10	External Data	Toolbar	TRUE	
11	11	Formula Auditing	Toolbar	TRUE	
12	12	Full Screen	Toolbar	TRUE	
13	13	Circular Reference	Toolbar	TRUE	
14	14	Visual Basic	Toolbar	TRUE	
15	15	Web	Toolbar	TRUE	
16	16	Control Toolbox	Toolbar	TRUE	
17	17	Exit Design Mode	Toolbar	TRUE	
18	18	Refresh	Toolbar	TRUE	
19	19	Drawing	Toolbar	TRUE	
20	20	Query and Pivot	Shortcut	TRUE	
21	21	PivotChart Menu	Shortcut	TRUE	
22	22	Workbook tabs	Shortcut	TRUE	
23	23	Cell	Shortcut	TRUE	
24	24	Column	Shortcut	TRUE	
25	25	Row	Shortcut	TRUE	
26	26	Cell	Shortcut	TRUE	
27	27	Column	Shortcut	TRUE	
28	28	Row	Shortcut	TRUE	
29	29	Ply	Shortcut	TRUE	
30	30	M Cell	Shortcut	TRUE	

Figure 22-6: VBA code produced this list of all CommandBar objects.

```

Sub ShowCommandBarNames()
    Dim Row As Integer
    Dim cbar As CommandBar
    Cells.Clear
    Row = 1
    For Each cbar In CommandBars
        Cells(Row, 1) = cbar.Index
        Cells(Row, 2) = cbar.Name
        Select Case cbar.Type
            Case msoBarTypeNormal
                Cells(Row, 3) = "Toolbar"
            Case msoBarTypeMenuBar
                Cells(Row, 3) = "Menu Bar"
            Case msoBarTypePopUp
                Cells(Row, 3) = "Shortcut"
        End Select
        Cells(Row, 4) = cbar.BuiltIn
        Row = Row + 1
    Next cbar
End Sub

```

Note

When you work with toolbars, you can turn on the macro recorder to see what's happening in terms of VBA code. Most (but not all) of the steps you take while customizing toolbars generate VBA code. By examining this code, you can discover how the object model for toolbars is put together. The object model actually is fairly simple and straightforward.

Creating a command bar

In VBA, you create a new toolbar using the `Add` method of the `CommandBars` collection. The following instruction creates a new toolbar with a default name, such as `Custom 1`. The created toolbar is initially empty (has no controls) and is not visible (its `Visible` property is `False`).

```
CommandBars.Add
```

More often, you'll want to set some properties when you create a new toolbar. The following example demonstrates one way to do this:

```
Sub CreateAToolbar()  
    Dim TBar As CommandBar  
    Set TBar = CommandBars.Add  
    With TBar  
        .Name = "MyToolbar"  
        .Top = 0  
        .Left = 0  
        .Visible = True  
    End With  
End Sub
```

The `CreateAToolbar` procedure uses the `Add` method of the `CommandBars` collection to add a new toolbar and create an object variable, `Tbar`, that represents this new toolbar. Subsequent instructions provide a name for the toolbar, set its position to the extreme upper-left corner of the screen, and make it visible. The `Top` and `Left` properties specify the position of the toolbar, and these settings represent screen coordinates, not Excel's window coordinates.

Note

When you access the `CommandBars` collection in a code module for a `UserForm`, `ThisWorkbook`, `Sheet`, or `Chart`, you must precede the references with the `Application` object. For example:

```
Application.CommandBars.Add
```

If your code is in a standard VBA module, this is not necessary.

Referring to command bars

You can refer to a particular `CommandBar` object by its `Index` or its `Name` property. For example, the Standard toolbar has an `Index` property setting of 3, so you can refer to this toolbar in either of the following ways:

```
CommandBars(3)
CommandBars("Standard")
```

If you use a name, be aware that it is case-insensitive. In other words, you can use Standard, STANDARD, standard, etc.



Index numbering for command bars is not consistent across versions of Excel! For example, in Excel 2002, the 3-D Settings toolbar has an `Index` of 58. In Excel 2000, the WordArt toolbar has an `Index` of 58. If your application must work in different versions of Excel, you should use the `Name` property instead of the `Index` property.

Deleting a command bar

To delete a custom toolbar, use the `Delete` method of the `CommandBar` object. You can refer to the object by its index number (if you know it) or its name. The following instruction deletes the toolbar named `MyToolbar`:

```
CommandBars("MyToolbar").Delete
```

If the toolbar doesn't exist, the instruction generates an error. To avoid the error message when you attempt to delete a toolbar that may or may not exist, the simplest solution is to ignore the error. The following code deletes `MyToolbar` if it exists. If it doesn't exist, no error message is displayed.

```
On Error Resume Next
CommandBars("MyToolbar").Delete
On Error GoTo 0
```

Another approach is to create a custom function that determines whether a particular toolbar is in the `CommandBars` collection. The following function accepts a single argument (a potential `CommandBar` object name) and returns `True` if the command bar exists. This function loops through the `CommandBars` collection and exits if it finds a command bar with a name that matches the argument.

```
Function CommandBarExists(n) As Boolean
    Dim cb As CommandBar
    For Each cb In CommandBars
        If UCase(cb.Name) = UCase(n) Then
            CommandBarExists = True
        End If
    Next cb
End Function
```

```

        Exit Function
    End If
Next cb
CommandBarExists = False
End Function

```

Properties of command bars

The following are some of the more useful properties of a `CommandBar` object:

<code>BuiltIn</code>	Read-only. True if the object is one of Excel's built-in command bars.
<code>Left</code>	The command bar's left position in pixels.
<code>Name</code>	The command bar's display name.
<code>Position</code>	An integer that specifies the position of the command bar. Possible values are as follows: <code>msoBarLeft</code> — The command bar is docked on the left. <code>msoBarTop</code> — The command bar is docked on the top. <code>msoBarRight</code> — The command bar is docked on the right. <code>msoBarBottom</code> — The command bar is docked on the bottom. <code>msoBarFloating</code> — The command bar isn't docked. <code>msoBarPopup</code> — The command bar is a shortcut menu.
<code>Protection</code>	An integer that specifies the type of protection for the command bar. Possible values are as follows: <code>msoBarNoProtection</code> — (Default) Not protected. The command bar can be customized by the user. <code>msoBarNoCustomize</code> — Cannot be customized. <code>msoBarNoResize</code> — Cannot be resized. <code>msoBarNoMove</code> — Cannot be moved. <code>msoBarNoChangeVisible</code> — Its visibility state cannot be changed by the user. <code>msoBarNoChangeDock</code> — Cannot be docked to a different position. <code>msoBarNoVerticalDock</code> — Cannot be docked along the left or right edge of the window. <code>msoBarNoHorizontalDock</code> — Cannot be docked along the top or bottom edge of the window.

Top	The command bar's top position in pixels.
Type	Returns an integer that represents the type of command bar. Possible values are: msoBarTypeNormal — Toolbar msoBarTypeMenuBar — Menu Bar msoBarTypePopUp — Shortcut Menu
Visible	True if the command bar is visible.

The VBA examples in the following sections demonstrate the use of some of the command bar properties.

Counting custom toolbars

The following function returns the number of custom toolbars. It loops through the `CommandBars` collection and increments a counter if the command bar represented by `cb` is a toolbar and if its `BuiltIn` property is `False`.

```
Function CustomToolbars()
    Dim cb As CommandBar
    Dim Count As Integer
    Count = 0
    For Each cb In CommandBars
        If cb.Type = msoBarTypeNormal Then
            If Not cb.BuiltIn Then
                Count = Count + 1
            End If
        End If
    Next cb
    CustomToolbars = Count
End Function
```

Preventing a toolbar from being modified

The `Protection` property of a `CommandBar` object provides you with many options for protecting a `CommandBar`. The following instruction sets the `Protection` property for a toolbar named `MyToolbar`:

```
CommandBars("MyToolbar").Protection = msoBarNoCustomize
```

After this instruction is executed, the user is unable to customize the toolbar.

The `Protection` constants are *additive*, which means that you can apply different types of protection with a single command. For example, the following instructions adjust the `MyToolbar` toolbar so that it cannot be customized or moved:

```
Set cb = CommandBars("MyToolbar")
cb.Protection = msoBarNoCustomize + msoBarNoMove
```

Creating an “autosense” toolbar

Many of Excel’s built-in toolbars seem to have some intelligence; they appear when you’re working in a specific context and disappear when you stop working in that context. For example, the Chart toolbar normally appears when you are working on a chart, and it disappears when you stop working on the chart. At one time, Microsoft referred to this feature as *toolbar autosensing*, but it stopped using that term in later versions. For lack of a better name, I’ll continue to use *autosensing* to refer to this automatic toolbar behavior.

**Note**

To disable autosensing for a particular toolbar, just close the toolbar while you’re working in the context in which it normally appears. To reenable it, make the toolbar visible again while you’re working in its context.

You may want to program toolbar autosensing for your application. For example, you might want to make a toolbar visible only when a certain worksheet is activated or when a cell in a particular range is activated. Thanks to Excel’s support for events, this sort of programming is relatively easy.

The procedure in Listing 22-1 creates a toolbar when the workbook is opened and uses one of its worksheets’ `SelectionChange` events to determine whether the active cell is contained in a range named `ToolbarRange`. If so, the toolbar is made visible; if not, the toolbar is hidden. In other words, the toolbar is visible only when the active cell is within a specific range of the worksheet.

This procedure, which is called by the `Workbook_Open` procedure, creates a simple toolbar named `AutoSense`. The four toolbar buttons are set up to execute procedures named `Button1`, `Button2`, `Button3`, and `Button4`. Note that, before creating the toolbar, the code deletes the existing toolbar of the same name (if it exists).

Listing 22-1: The toolbar created here is visible only when the cell pointer falls within a given range.

```
Sub CreateToolbar()  
    ' Creates a demo toolbar named "AutoSense"  
    Dim AutoSense As CommandBar  
    Dim Button As CommandBarButton  
  
    ' Delete the existing toolbar if it exists  
    On Error Resume Next  
    CommandBars("AutoSense").Delete  
    On Error GoTo 0  
  
    ' Create the toolbar  
    Set AutoSense = CommandBars.Add
```

```

For i = 1 To 4
    Set Button = AutoSense.Controls.Add(msoControlButton)
    With Button
        .OnAction = "Button" & i
        .FaceId = i + 37
    End With
Next i
AutoSense.Name = "AutoSense"
End Sub

```

The event-handler procedure for the SelectionChange event (which is located in the code module for Sheet1) is as follows:

```

Private Sub Worksheet_SelectionChange(ByVal Target As _
Excel.Range)
    If Union(Target, Range("ToolbarRange")).Address = _
Range("ToolbarRange").Address Then
        CommandBars("AutoSense").Visible = True
    Else
        CommandBars("AutoSense").Visible = False
    End If
End Sub

```

This procedure checks the active cell. If it's contained within a range named `ToolbarRange`, the `AutoSense` toolbar's `Visible` property is set to `True`; otherwise, it is set to `False`.

The workbook also contains a `Workbook_BeforeClose` procedure that deletes the `AutoSense` toolbar when the workbook is closed. This technique, of course, can be adapted to provide other types of autosensing capability for a toolbar.



For a comprehensive discussion of the types of events Excel recognizes, see Chapter 19.

Hiding (and later restoring) all toolbars

Some developers like to “take over” Excel when their application is loaded. For example, they like to hide all toolbars, the status bar, and the formula bar. It's only proper, however, for them to clean up when their application is closed. This includes restoring the toolbars that were originally visible.

The example in this section describes a way to hide all toolbars and then restore them when the application is closed. The `HideAllToolbars` procedure is called from the `Workbook_Open` event-handler, and the `RestoreToolbars` procedure is called by the `Workbook_BeforeClose` event-handler.

The code keeps track of which toolbars were visible by storing their names in a worksheet named `TBSheet`. When the workbook closes, the `RestoreToolbars` subroutine reads these cells and displays the toolbars. Using a worksheet to store the toolbar names is safer than using a VBA array (which can lose its values). Both procedures are shown in Listing 22-2.

Listing 22-2: Removing all toolbars and then restoring them

```

Sub HideAllToolbars()
    Dim TB As CommandBar
    Dim TBNum As Integer
    Dim TBSheet As Worksheet
    Set TBSheet = Sheets("TBSheet")
    Application.ScreenUpdating = False

    ' Clear the sheet
    TBSheet.Cells.Clear

    ' Hide all visible toolbars and store
    ' their names
    TBNum = 0
    For Each TB In CommandBars
        If TB.Type = msoBarTypeNormal Then
            If TB.Visible Then
                TBNum = TBNum + 1
                TB.Visible = False
                TBSheet.Cells(TBNum, 1) = TB.Name
            End If
        End If
    Next TB
    Application.ScreenUpdating = True
End Sub

Sub RestoreToolbars()
    Dim TBSheet As Worksheet
    Dim cell As Range

    Set TBSheet = Sheets("TBSheet")
    Application.ScreenUpdating = False

    ' Unhide the previously displayed the toolbars
    On Error Resume Next
    For Each cell In TBSheet.Range("A:A") _
        .SpecialCells(xlCellTypeConstants)
        CommandBars(cell.Value).Visible = True
    Next cell
    Application.ScreenUpdating = True
End Sub

```

Note

In some cases, you may find that hiding the visible toolbars is insufficient. For example, the autosensing toolbars will still appear in their appropriate context. One solution is to set the `Enabled` property to `False` for all the toolbars that you don't want to appear.

Referring to controls in a command bar

A `CommandBar` object such as a toolbar contains `Control` objects. These objects are mainly toolbar buttons and menu items.

The following `Test` procedure displays the `Caption` property for the first `Control` object contained in the Standard toolbar, which has an index of 3:

```
Sub Test()  
    MsgBox CommandBars(3).Controls(1).Caption  
End Sub
```

When you execute this procedure, you'll see the message box shown in Figure 22-7 (assuming that your Standard toolbar has not been modified).

Using index numbers for command bar controls works regardless of the user's setting of the Always show full menus option (located in the Options tab of the Customize dialog box).



Figure 22-7: Displaying the `Caption` property for a control

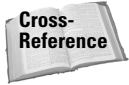
Rather than use an index number to refer to a control, you can use its `Caption` property setting. The following procedure produces the same result as the previous one:

```
Sub Test2()  
    MsgBox CommandBars("Standard").Controls("New").Caption  
End Sub
```

Caution

Referring to a control by using its caption is language dependent. Therefore, the example above will not work in non-English language versions of Excel. The solution is to use the `FindControl` method to locate the control using its `Id` property. This is described in Chapter 23.

If you display the `Caption` property for a control, you'll see that it probably includes an ampersand (&). The letter following the ampersand is the underlined hot key in the displayed text (for example, &New). When you refer to a command bar control by using its `Caption` property, there is no need to include the ampersand.



In some cases, `Control` objects may contain other `Control` objects. For example, the first control on the Drawing toolbar contains other controls (this also demonstrates that you can include menu items on a toolbar). The concept of Controls within Controls will become clearer in Chapter 23, when I discuss menus.

Listing the controls on a command bar

The following procedure displays the `Caption` property for each `Control` object within a `CommandBar` object. This example uses the Standard toolbar.

```
Sub ShowControlCaptions()
    Dim Cbar as CommandBar
    Set CBar = CommandBars("Standard")
    Cells.Clear
    Row = 1
    For Each ctl In CBar.Controls
        Cells(Row, 1) = ctl.Caption
        Row = Row + 1
    Next ctl
End Sub
```

The output of the `ShowControlCaptions` procedure is shown in Figure 22-8.

Listing all controls on all toolbars

The following procedure loops through all command bars in the collection. If the command bar is a toolbar—that is, if its `Type` property is set to 1—another loop displays the `Caption` for each toolbar button.

```
Sub ShowAllToolbarControls()
    Dim row As Integer
    Dim Cbar As CommandBar
    Dim ctl As CommandBarControl

    Cells.Clear
    row = 1
    For Each Cbar In CommandBars
        If Cbar.Type = msoBarTypeNormal Then
            Cells(row, 1) = Cbar.Name
        End If
    Next Cbar
End Sub
```



Figure 22-8: A list of the captions for each control on the Standard toolbar

```

        For Each ctl In Cbar.Controls
            Cells(row, 2) = ctl.Caption
            row = row + 1
        Next ctl
    End If
Next Cbar
End Sub

```

Partial output of the ShowAllToolBarControls procedure is shown in Figure 22-9.

Adding a control to a command bar

To add a new control to a `CommandBar` object, use the `Add` method of the `Controls` collection object. The following instruction adds a new control to a toolbar named `MyToolbar`. Its `Type` property is set to the `msoControlButton` constant, which creates a standard button.

```

CommandBars("MyToolbar").Controls.Add _
    Type:=msoControlButton

```

The toolbar button added in the preceding instruction is just a blank button; clicking it has no effect. Most of the time, you'll want to set some properties when you add a new button to a toolbar. The following code adds a new control, gives it an image through the `FaceId` property, assigns a macro by way of the `OnAction` property, and specifies a caption:

	A	B	C	D
71		Reply with &Changes...		
72		E&nd Review...		
73	Forms	&Label		
74		&Edit Box		
75		&Group Box		
76		&Button		
77		C&heck Box		
78		O&ption Button		
79		L&ist Box		
80		&Combo Box		
81		&Combination List-Edit		
82		&Combination Drop-Down Edit		
83		&Scroll Bar		
84		&Spinner		
85		Control Properties		
86		&Code		
87		Toggle Grid		
88		&Run Dialog		
89	Stop Recording	Stop &Recording		
90		Relative Reference		
91	External Data	&Edit Query...		
92		D&ata Range Properties...		
93		Para&eters...		
94		&Refresh Data		
95		&Cancel Refresh		
96		Refresh &All		
97		&Refresh Status		
98	Formula Auditing	Error Chec&king...		
99		&Trace Precedents		
100		&Remove Precedent Arrows		
101		Trace &Dependents		

Figure 22-9: A list of the captions for each control on all toolbars

```

Sub AddButton()
    Dim NewBtn As CommandBarButton
    Set NewBtn = CommandBars("MyToolbar").Controls.Add _
        (Type:=msoControlButton)
    With NewBtn
        .FaceId = 300
        .OnAction = "MyMacro"
        .Caption = "Tooltip goes here"
    End With
End Sub

```

The `AddButton` procedure creates an object variable (`NewBtn`) that represents the added control. The `With-End With` construct then sets the properties for the object.

Deleting a control from a command bar

To delete a control from a `CommandBar` object, use the `Delete` method of the `Controls` collection. The following instruction deletes the first control on a toolbar named `MyToolbar`:

```
CommandBars("MyToolbar").Controls(1).Delete
```

You can also specify the control by referring to its caption. The following instruction deletes a control that has a caption of `SortButton`:

```
CommandBars("MyToolbar").Controls("SortButton").Delete
```

Properties of command bar controls

As you've seen, command bar controls have a number of properties that determine how the controls look and work. Following is a list of a few of the more useful properties for command bar controls:

<code>BeginGroup</code>	If <code>True</code> , a separator bar appears before the control.
<code>BuiltIn</code>	Read-only. <code>True</code> if the control is one of Excel's built-in controls.
<code>Caption</code>	The text that is displayed for the control. If the control shows only an image, the caption appears when you move the mouse pointer over the control.
<code>Enabled</code>	If <code>True</code> , the control can be clicked.
<code>FaceID</code>	A number that represents a graphic image displayed next to the control's text.
<code>Id</code>	Read-only. A code number for a predefined Excel command.
<code>OnAction</code>	The name of a VBA procedure to be executed when the user clicks the control.
<code>State</code>	Determines whether a control appears "pressed.". This property is available only for a <code>CommandBarButton</code> control.
<code>Style</code>	Determines whether the control appears with a caption and/or image. This property is available only for <code>CommandBarButton</code> and <code>CommandBarComboBox</code> controls.
<code>ToolTipText</code>	Text that appears when the user moves the mouse pointer over the control.
<code>Type</code>	An integer that determines the type of the control.

Setting a control's Style property

The `Style` property of a control determines its appearance (this property applies only to `CommandBarButton` and `CommandBarComboBox` controls). This property is usually specified using a built-in constant. For example, to display a button with an image and text, set the `Style` property to `msoButtonIconAndCaption`. Following are valid style settings for a `CommandBarButton`:

- ♦ `msoButtonAutomatic`
- ♦ `msoButtonCaption`
- ♦ `msoButtonIcon`

- ◆ `msoButtonIconAndCaption`
- ◆ `msoButtonIconAndCaptionBelow`
- ◆ `msoButtonIconAndWrapCaption`
- ◆ `msoButtonIconAndWrapCaptionBelow`
- ◆ `msoButtonWrapCaption`

For a `CommandBarComboBox`, the valid settings are `msoComboLabel` or `msoComboNormal`.

Figure 22-10 shows a toolbar with seven command button controls, each demonstrating a different style.



A workbook that creates this toolbar is available on the companion CD-ROM.

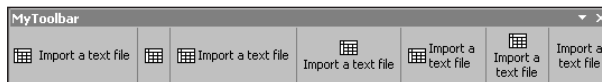


Figure 22-10: The seven values of the `Style` property for a command button control

Note

The text displayed on a control is the control's `Caption` property, and its image is determined by the value of the `FaceID` property.

Adjusting a toolbar button image

When you're in Excel's command bar customization mode, you can right-click any toolbar button and select `Change Button Image`. Doing so displays a list of 42 images from which you can select. Most of the time, none of these images is exactly what you need. Therefore, you must specify the image with VBA.

The image (if any) displayed on a toolbar control is determined by its `FaceID` property. For an image to be displayed, the control's `Style` property can be set to any value *except* `msoButtonCaption`.

The following instruction sets the `FaceID` property of the first button on the `MyToolbar` toolbar image to 45, which is the code number for a mailbox icon:

```
CommandBars("MyToolbar").Controls(1).FaceId = 45
```

How does one determine the code number for a particular image? Well, there's trial and error . . . and there's also a free utility that I developed called `FaceID Identifier`. This add-in makes it easy to determine the `FaceID` value for a particular image. When the add-in is installed, choose `Face ID Identifier` from the `Tools` menu. You'll

see a UserForm that shows all possible command bar images. When you move the mouse pointer over an image, the FaceID value is displayed in a text box (see Figure 22-11).

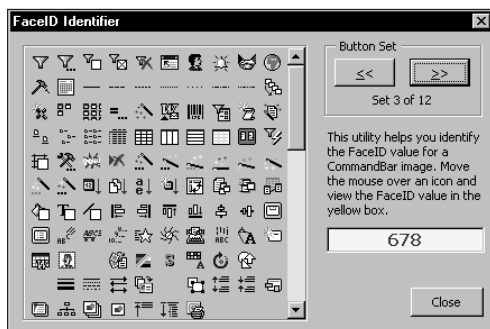


Figure 22-11: The author's FaceID Identifier add-in shows the FaceID values for built-in toolbar images.



The FaceID Identifier add-in is available on the companion CD-ROM.

Adjusting a control's Visible property

The `Visible` property determines if a particular toolbar is hidden or displayed. Setting this property to `False` does not delete the toolbar. The following procedure, which causes lots of on-screen action, simply reverses the `Visible` property of each toolbar. Hidden toolbars are displayed, and visible toolbars are hidden. To return things to normal, execute the procedure a second time.

```
Sub ToggleAllToolbars()
    Dim cb As CommandBar
    On Error Resume Next
    For Each cb In CommandBars
        If cb.Type = msoBarTypeNormal Then
            cb.Visible = Not cb.Visible
        End If
    Next cb
End Sub
```

Note

The `On Error Resume Next` statement is present to prevent the error message that occurs when certain Excel 2002 toolbars are accessed in the incorrect context. Specifically, the toolbars that must be accessed in the correct context are Pivot Table Field List, Online Meeting, and Document Recovery.

Changing a control's caption dynamically

The procedure in Listing 22-3 creates a toolbar that contains a single button. The caption on this button displays the number format string for the active cell (see Figure 22-12). The procedure uses `Worksheet` events to monitor when the selection is changed. When a `SelectionChange` event occurs, a procedure is executed that changes the caption in the button.

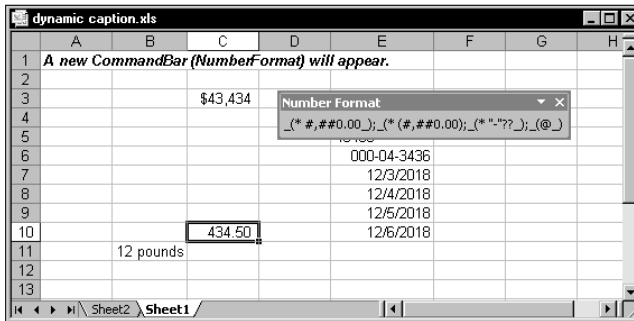


Figure 22-12: This toolbar button displays the number format for the active cell.

Listing 22-3: Showing the user the current cell's number format

```
Sub MakeNumberFormatDisplay()
    Dim TBar As CommandBar
    Dim NewBtn As CommandBarButton

    ' Delete existing toolbar if it exists
    On Error Resume Next
    CommandBars("Number Format").Delete
    On Error GoTo 0

    ' Create a new toolbar
    Set TBar = CommandBars.Add
    With TBar
        .Name = "Number Format"
        .Visible = True
    End With

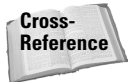
    ' Add a button control
    Set NewBtn = CommandBars("Number Format").Controls.Add _
        (Type:=msoControlButton)
    With NewBtn
        .Caption = ""
    End With
End Sub
```



```

        .OnAction = "ChangeNumFormat"
        .TooltipText = "Click to change the number format"
        .Style = msoButtonCaption
    End With
    Call UpdateToolbar
End Sub

```



For more information about events, see Chapter 19.

The `UpdateToolbar` procedure, which follows, simply copies the `NumberFormat` property of the `ActiveCell` to the `Caption` property of the button control:

```

Sub UpdateToolbar()
    On Error Resume Next
    CommandBars("Number Format"). _
        Controls(1).Caption = ActiveCell.NumberFormat
    If Err <> 0 Then CommandBars("Number Format"). _
        Controls(1).Caption = ""
End Sub

```

The button's `OnAction` property is set to a procedure named `ChangeNumFormat`, which follows. This procedure displays the `Number` tab of Excel's `Format Cells` dialog box (see Figure 22-13).

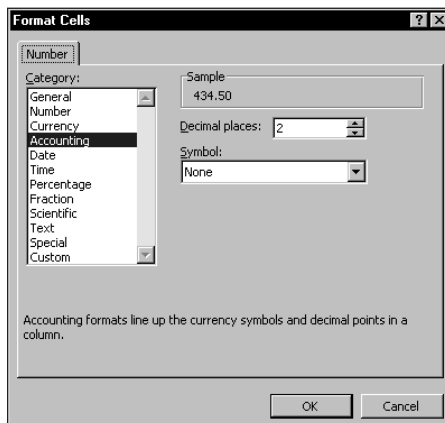


Figure 22-13: Clicking the button enables the user to select a new number format.

```
Sub ChangeNumFormat()
    Application.Dialogs(xlDialogFormatNumber).Show
    Call UpdateToolbar
End Sub
```

The technique described in this section works quite well, but it does have a flaw: If the user changes the number format with a button on the Formatting toolbar, the display in the Number Format is not changed, because changing the number format of a cell does not trigger a trappable event.

Assigning a custom macro to a built-in button

Each of Excel's built-in toolbar buttons executes a specific internal procedure. It's possible to assign your own macro to a built-in button. To do so, just use the `OnAction` property. The following instruction assigns a macro to the Sort Ascending toolbar button.

```
CommandBars("Standard").Controls("Sort Ascending") _
    .OnAction = "ShowMsg"
```

After executing the instruction, clicking the Sort Ascending button will no longer work. Rather, it will execute the `ShowMsg` VBA procedure.

To return the button to its normal functionality, assign an empty string to its `OnAction` property:

```
CommandBars("Standard").Controls("Sort Ascending") _
    .OnAction = ""
```

“Executing” a command bar button

Command bar controls have an `Execute` method. When invoked, this method runs the internal procedure assigned to a built-in control. For example, executing the following instruction is equivalent to clicking the Sort Ascending button on the Standard toolbar:

```
CommandBars("Standard").Controls("Sort Ascending").Execute
```

Using the `Execute` method with a custom command bar button runs the macro assigned to its `OnAction` property.

Using other types of command bar controls

A standard toolbar button is just one type of five control types that you can add to a toolbar. The control type is determined by the `Type` property of the control.

The online help entices you with descriptions and images of 23 control types (see Figure 22-14). Most of these, however, cannot be added to a command bar. You may recognize many of these controls because they are used in Excel's built-in toolbars. I have no idea why they are listed and described, if they cannot be used.

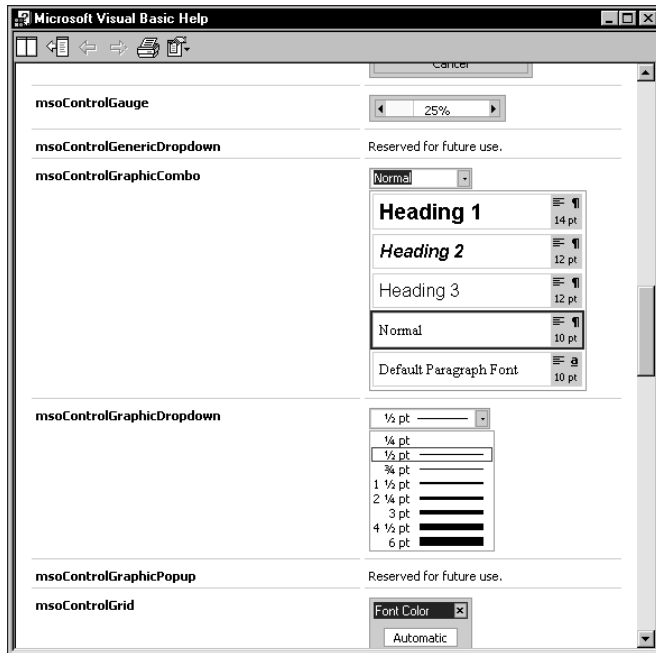


Figure 22-14: The online help describes many controls that aren't available to you.

The built-in constants for the control types that you *can* add to a command bar are as follows:

<code>msoControlButton</code>	A standard button.
<code>msoControlEdit</code>	An edit box.
<code>msoControlComboBox</code>	A combo box.
<code>msoControlDropDown</code>	A drop-down list.
<code>msoControlButtonPopup</code>	A button that, when clicked, displays other controls. Use this control to create a menu with menu items.

Note

The `Type` property for a `Control` object is a read-only property that's set when the control is created. In other words, you can't change a control's type after it has been created.

The `MakeMonthList` procedure in Listing 22-4 creates a new toolbar, adds a drop-down list control, and fills that control with the names of each month. It also sets the `OnAction` property so that clicking the control executes a procedure named `PasteMonth`. The resulting toolbar is shown in Figure 22-15.

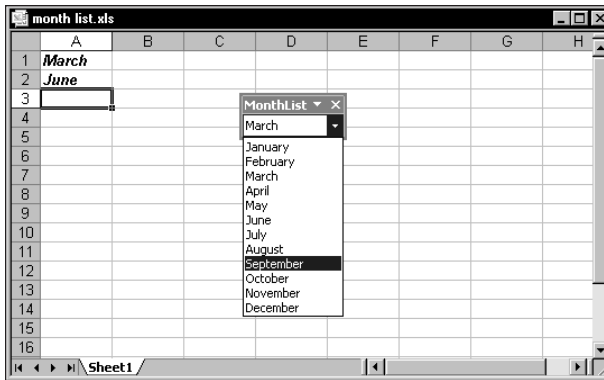


Figure 22-15: This toolbar contains a drop-down list control, with an attached macro.

Listing 22-4: Attaching a drop-down list to a command bar

```

Sub MakeMonthList()
    Dim TBar As CommandBar
    Dim NewDD As CommandBarControl

    ' Delete existing toolbar if it exists
    On Error Resume Next
    CommandBars("MonthList").Delete
    On Error GoTo 0

    ' Create a new toolbar
    Set TBar = CommandBars.Add
    With TBar
        .Name = "MonthList"
        .Visible = True
    End With

    ' Add a DropDown control
    Set NewDD = CommandBars("MonthList").Controls.Add _
        (Type:=msoControlDropDown)
    With NewDD
        .Caption = "DateDD"
        .OnAction = "PasteMonth"
        .Style = msoButtonAutomatic

    ' Fill it with month name
    For i = 1 To 12
        .AddItem Format(DateSerial(1, i, 1), "mmmm")
    Next i
    .ListIndex = 1
    End With
End Sub

```

The PasteMonth procedure follows:

```
Sub PasteMonth()  
    ' Puts the selected month in the active cell  
    On Error Resume Next  
    With CommandBars("MonthList").Controls("DateDD")  
        ActiveCell.Value = .List(.ListIndex)  
    End With  
End Sub
```

The workbook has an additional twist: It uses a `Worksheet_SelectionChange` event-handler. This procedure, which follows, is executed whenever the user makes a new selection on the worksheet. The procedure determines whether the active cell contains a month name. If so, it sets the `ListIndex` property of the drop-down list control in the toolbar.

```
Private Sub Worksheet_SelectionChange(ByVal Target _  
    As Excel.Range)  
    For i = 1 To 12  
        Set ActCell = Target.Range("A1")  
        If ActCell.Value = Format(DateSerial(1, i, 1), _  
            "mmm") Then  
            CommandBars("MonthList").Controls("DateDD") _  
                .ListIndex = i  
            Exit Sub  
        End If  
    Next i  
End Sub
```

Summary

In this chapter, I described how to use Excel's built-in toolbars and how to customize toolbars for your applications.

The next chapter discusses two other types of command bars: menus and shortcut menus.



Creating Custom Menus

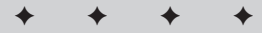
Virtually every Windows program has a menu system, which usually serves as the primary user interface element. The Windows standard places the menu bar directly beneath the application's title bar. In addition, many programs now implement another type of menu: shortcut menus. Typically, right-clicking an item displays a context-sensitive shortcut menu containing relevant commands.

Excel uses both types of menus, and developers have almost complete control over Excel's entire menu system, including shortcut menus. This chapter tells you everything you need to know about working with Excel's menus.

A Few Words about Excel's Menu Bar

If you've read Chapter 22, you already know that a menu bar (like a toolbar) is a `CommandBar` object. In fact, the techniques described in Chapter 22 also apply to menu bars.

So how does a menu bar differ from a toolbar? In general, a menu bar is displayed at the top of the Excel window, directly below the title bar. When clicked, the top-level controls on a menu bar display a drop-down list of menu items. A menu bar may also contain three window control buttons (Minimize, Restore, and Close) that are displayed only when a workbook window is maximized. Toolbars, on the other hand, usually consist of graphic icons and do not display any control buttons. These rules are definitely not hard and fast. You can, if desired, add traditional toolbar buttons to a menu bar or add traditional menu items to a toolbar. You can even move a menu bar from its traditional location and make it free-floating.



In This Chapter

An overview of Excel's menu system

Types of menu modifications you can make

How to manipulate menus with VBA

Various menu programming techniques used with events

A useful (and very easy) technique for creating custom menus

A procedure for replacing standard menu conventions with your own

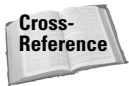
How to customize the shortcut menus

What You Can Do with Excel's Menus

Typical Excel users get by just fine with the standard menus. Because you're reading this book, however, you're probably not the typical Excel user. You may want to modify menus to make your life easier and to make life easier for the folks who use the spreadsheets that you develop.

To modify Excel's menus, you can remove elements, add elements, and change elements. In addition, you can temporarily replace Excel's standard menu bar with one of your own creation. You can change Excel's menus two ways: manually, or with VBA code.

When you close Excel, it saves any changes that you've made to the menu system, and these changes appear the next time you open Excel. The information about menu modifications is stored in an XLB file, usually located in your Windows directory.



See Chapter 22 for more information about the XLB file.



In most cases, *you won't want your menu modifications to be saved between sessions*. Generally, you'll need to write VBA code to change the menus while a particular workbook is open and then change them back when the workbook closes. Therefore, you'll need VBA code to modify the menu when the workbook is opened and more VBA code to return the menus to normal when the workbook is closed.

Menu terminology

Menu terminology is often a bit confusing at first because many of the terms are similar. The following list presents the official Excel menu terminology that I refer to in this chapter:

- ♦ **Command bar.** An object that can function as a menu bar, a shortcut menu, or a toolbar. It is represented by the `CommandBar` object in the Microsoft Office object library.
- ♦ **Menu bar.** The row of words that appears directly below the application's title bar. Excel has two menu bars: One is displayed when a worksheet is active, and the other is displayed when a chart sheet is active or when an embedded chart is activated.
- ♦ **Menu.** A single, top-level element of a menu bar. For example, both of Excel's menu bars have a File menu.
- ♦ **Menu item.** An element that appears in the drop-down list when you select a menu. For example, the first menu item under the File menu is New. Menu items also appear in submenus and shortcut menus.

- ◆ *Separator bar.* A horizontal line that appears between two menu items. The separator bar is used to group similar menu items.
- ◆ *Submenu.* A second-level menu that is under some menus. For example, the Edit menu has a submenu called Clear.
- ◆ *Submenu item.* A menu item that appears in the list when you select a submenu. For example, the Edit ⇨ Clear submenu contains the following submenu items: All, Formats, Contents, and Comments.
- ◆ *Shortcut menu.* The floating list of menu items that appears when you right-click a selection or an object. The shortcut menu that appears depends on the current context.
- ◆ *Enabled.* A menu item that can be used. If a menu item isn't enabled, its text appears grayed, and it can't be used.
- ◆ *Checked.* The status of a menu item that represents an on/off or True/False state. A menu item can display a graphical box that is checked or unchecked. The View ⇨ Status Bar menu item is an example.
- ◆ *Image.* A small graphic icon that appears next to some menu items. In VBA terms, the code associated with each image is known as a *FaceID*.
- ◆ *Shortcut key combination.* A keystroke combination that serves as an alternate method to execute a menu item. The shortcut key combination is displayed at the right side of the menu item. For example, Ctrl+S is the shortcut key combination for File ⇨ Save.

Removing menu elements

You can remove any part of Excel's menu system: menu items, menus, and entire menu bars. For example, if you don't want the end users of your application fiddling with the display, you can remove the View menu from the Worksheet Menu Bar. You can also remove one or more menu items from a menu. If you remove the New menu item from the File menu, for example, users can't use the menu to create a new workbook. Finally, you can eliminate Excel's menu bar and replace it with one that you've created. You might do this if you want your application to be completely under the control of your macros.



It's important to remember that simply removing menu bars, menus, or menu items does not affect the alternate method of accomplishing some actions. Specifically, if there are corresponding shortcut keys, toolbar buttons, or shortcut menus that perform the same action as a menu command, those alternate methods still work. For example, if you remove the New menu item from the File menu, the user can still use the New Workbook toolbar button, the Ctrl+N shortcut key, the Task Pane (in Excel 2002), or the Desktop shortcut menu to create a new workbook.

Moving Up from Excel 5/95?

If you've customized menus using Excel 5 or Excel 95, you can pretty much forget everything you ever learned. Beginning with Excel 97, menu customization has changed significantly in the following respects:

- ♦ *A menu bar is actually a toolbar in disguise.* If you don't believe me, grab the vertical bars at the very left of the menu bar and drag the bar away. You'll end up with a floating toolbar. The official (VBA) term for both menus and toolbars is *command bar*.
- ♦ *The Excel 5/95 Menu Editor is gone.* To edit a menu manually, you use the View ⇨ Toolbars ⇨ Customize command. Understand, however, that Excel 5/95 workbooks that contain menus customized using the old Menu Editor still work in Excel 97 and later. However, to make any changes to these modified menus, you must do so in Excel 5/95.
- ♦ *There is no easy way to assign a VBA macro to a new menu item on the Tools menu.* This was a piece of cake with Excel 5/95. Later in this chapter, however, I provide VBA code that you can use to add a new menu item to the Tools menu.
- ♦ *Excel 2000 and later, by default, displays only the most recently used menu items.* In my opinion, this is one of the worst ideas Microsoft has come up with. I can't imagine why anyone would want the order of his or her menu items to be shifting around. Fortunately, this feature can be disabled in the Options panel of the Customize dialog box.

Adding menu elements

You can add custom menus to built-in menu bars, and you can add custom menu items to a built-in menu. In fact, you can create an entirely new menu bar if you like. For example, you might develop an application that doesn't require any of Excel's built-in menus. A simple solution is to create a new menu bar that consists of custom menus and custom menu items that execute your macros. You can hide Excel's normal menu bar and replace it with your own.

Changing menu elements

If you get bored with Excel's standard menu text, you can change it to something else—for instance, you can change the Tools menu to the Stuff menu. You can also assign your own macros to built-in menu items. You have many other options for changing menu elements, including rearranging the order of the menus on a menu bar (for example, to make the Help menu appear first instead of last).

Referencing the CommandBars Collection

The `CommandBars` collection is a member of the `Application` object. When you reference this collection in a regular VBA module, you can omit the reference to the `Application` object (it is assumed). For example, the following statement (contained in a standard VBA module) displays the name of the first element of the `CommandBars` collection:

```
MsgBox CommandBars(1).Name
```

When you reference the `CommandBars` collection from a code module for a `ThisWorkbook` object, you must precede it with a reference to the `Application` object, like this:

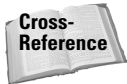
```
MsgBox Application.CommandBars(1).Name
```



Caution

Be careful if you change the captions for Excel's menus. Some Excel developers rely on the standard menu captions when they create new menus -- and their code will fail if you've modified your menu captions. As you'll see later in this chapter, using the `FindControl` method in your code will eliminate these problems.

The remainder of this chapter focuses on writing VBA code to modify menus.



Chapter 22 provides background information about the Customize dialog box.

VBA Examples

In this section, I present some practical examples of VBA code that manipulates Excel's menus.

Listing menu information

The `ListMenuInfo` procedure, which follows, may be instructive. It displays the caption for each item (menu, menu item, and submenu item) on the Worksheet Menu Bar.

```
Sub ListMenuInfo()
    Dim row As Integer
    Dim Menu As CommandBarControl
    Dim MenuItem As CommandBarControl
    Dim SubMenuItem As CommandBarControl
    row = 1
    On Error Resume Next
    For Each Menu In CommandBars(1).Controls
        For Each MenuItem In Menu.Controls
            For Each SubMenuItem In MenuItem.Controls
                Cells(row, 1) = Menu.Caption
            
```

```

        Cells(row, 2) = MenuItem.Caption
        Cells(row, 3) = SubMenuItem.Caption
        row = row + 1
    Next SubMenuItem
Next MenuItem
Next Menu
End Sub

```

Figure 23-1 shows a portion of the `ListMenuInfo` procedure's output.

	A	B	C	D	E	F
105	&View	&Header and Footer...				
106	&View	&Comments				
107	&View	Custom &Views...				
108	&View	F&ull Screen				
109	&View	&Zoom...				
110	&Insert	C&ells...				
111	&Insert	&Rows				
112	&Insert	&Columns				
113	&Insert	&Worksheet				
114	&Insert	C&hart...				
115	&Insert	&Symbol...				
116	&Insert	Page &Break				
117	&Insert	Reset &All Page Breaks				
118	&Insert	&Function...				
119	&Insert	&Name	&Define...			
120	&Insert	&Name	&Paste...			
121	&Insert	&Name	&Create...			
122	&Insert	&Name	&Apply...			
123	&Insert	&Name	&Label...			
124	&Insert	Co&mment				
125	&Insert	&Picture	&Clip Art...			
126	&Insert	&Picture	&From File...			
127	&Insert	&Picture	From &Scanner or Camera...			
128	&Insert	&Picture	&Organization Chart			

Figure 23-1: A portion of the output from the `ListMenuInfo` procedure



A workbook that contains this procedure is available on the companion CD-ROM.



I use `On Error Resume Next` to avoid the error message that appears when the procedure attempts to access a submenu item that doesn't exist.

Adding a new menu to a menu bar

In this section, I describe how to use VBA to add a new menu to the Worksheet Menu Bar. The Worksheet Menu Bar is the first item in the `CommandBars` collection, so you can reference it one of two ways:

```
CommandBars("Worksheet Menu Bar")  
CommandBars(1)
```

In VBA terms, you use the `Add` method to append a new control to the `Controls` collection. The new control is a “pop-up control” of type `msoControlPopup`. You can specify the new control’s position; if you don’t, the new menu is added to the end of the menu bar.

Adding a new menu is a two-step process:

1. Use the `Add` method to create an object variable that refers to the new control. Arguments for the `Add` method enable you to specify the control’s type, its ID (useful only if you’re adding a built-in menu), its position, and whether it’s a temporary control that will be deleted when Excel closes.
2. Adjust the properties of the new control. For example, you’ll probably want to specify a `Caption` property and an `OnAction` property.

Menu-Making Conventions

You may have noticed that menus in Windows programs typically adhere to some established conventions. No one knows where these conventions came from, but you should follow them if you want to give the impression that you know what you’re doing. When you modify menus, keep the following points in mind:

- ♦ Tradition dictates that the File menu is always first and the Help menu is always last.
- ♦ Menu text is always proper case. The first letter of each word is uppercase, except for minor words such as *the*, *a*, and *and*.
- ♦ A top-level menu does not cause any action. In other words, each menu must have at least one menu item.
- ♦ Menu items are usually limited to three or fewer words.
- ♦ Every menu item should have a hot key (underlined letter) that’s unique within the menu.
- ♦ A menu item that displays a dialog box is followed by an ellipsis (...).
- ♦ Menu item lists should be kept relatively short. Sometimes, submenus provide a good alternative to long lists. If you must have a lengthy list of menu items, use separator bars to group items into logical groups.
- ♦ If possible, disable menu items that are not appropriate in the current context. In VBA terminology, to disable a menu item, set its `Enabled` property to `False`.
- ♦ Some menu items serve as toggles. When the option is on, the menu item is preceded by a check mark.

Adding a menu: Take 1

In this example, the objective is to add a new Budgeting menu to the Worksheet Menu Bar and to position this new menu to the left of the Help menu.

```
Sub AddNewMenu()
    Dim HelpIndex As Integer
    Dim NewMenu As CommandBarPopup

    ' Get Index of Help menu
    HelpIndex = CommandBars(1).Controls("Help").Index

    ' Create the menu
    Set NewMenu = CommandBars(1).Controls.Add _
        (Type:=msoControlPopup, _
        Before:=HelpIndex, _
        Temporary:=True)

    ' Add a caption
    NewMenu.Caption = "&Budgeting"
End Sub
```

The preceding code is *not* a good example of how to add a menu, and it may or may not insert the menu at the proper position. It suffers from two problems:

- ♦ It assumes that the Help menu exists. The user may have removed the Help menu.
- ♦ It assumes that the Help menu has *Help* as its caption. Non-English versions of Excel may have a different caption for their menus.

Adding a menu: Take 2

Listing 23-1 presents a better demonstration. It uses the `FindControl` method to attempt to locate the Help menu. If the Help menu is not found, the code adds the new menu item to the end of the Worksheet Menu Bar.

Listing 23-1: Adding the Budgeting menu to Excel's main menu bar

```
Sub AddNewMenu()
    Dim HelpMenu As CommandBarControl
    Dim NewMenu As CommandBarPopup

    ' Find the Help Menu
    Set HelpMenu = CommandBars(1).FindControl(Id:=30010)

    If HelpMenu Is Nothing Then
        ' Add the menu to the end
        Set NewMenu = CommandBars(1).Controls _
            .Add(Type:=msoControlPopup, Temporary:=True)
```

```

Else
    ' Add the menu before Help
    Set NewMenu = CommandBars(1).Controls _
        .Add(Type:=msoControlPopup, Before:=HelpMenu.Index, _
            Temporary:=True)
End If

' Add a caption
NewMenu.Caption = "&Budgeting"
End Sub

```

Note

The preceding procedure creates an essentially useless menu—it has no menu items. See “Adding a menu item to the Tools menu” later in this chapter for an example of how to add a menu item to a menu.

To use the `FindControl` method, you must know the ID property of the control that you’re looking for. Each of Excel’s built-in `CommandBar` controls has a unique ID property. For this example, I determined the ID property of the Help menu by executing the following statement:

```
MsgBox CommandBars(1).Controls("Help").ID
```

The message box displayed 30010, which is the value I used as the ID argument for the `FindControl` method. Table 23-1 shows the ID property settings for the top-level controls in Excel’s menu bars.

Table 23-1
ID Property Settings for Excel’s Top-Level Menus

<i>Menu</i>	<i>ID Setting</i>
File	30002
Edit	30003
View	30004
Insert	30005
Format	30006
Tools	30007
Data	30011
Chart	30022
Window	30009
Help	30010

Deleting a menu from a menu bar

To delete a menu, use the `Delete` method. The following example deletes the menu in the **Worksheet Menu Bar** whose caption is “Budgeting.” Notice that I use `On Error Resume Next` to avoid the error message that appears if the menu does not exist.

```
Sub DeleteMenu()
    On Error Resume Next
    CommandBars(1).Controls("Budgeting").Delete
End Sub
```

Recall that the **Budgeting** menu was given a caption using this instruction:

```
NewMenu.Caption = "&Budgeting"
```

When you delete the menu by using its caption, the ampersand is optional.

Adding menu items to a menu

In the example under “Adding a new menu to a menu bar,” I demonstrated how to add a menu to a menu bar. Listing 23-2 adds to the original procedure and, in so doing, demonstrates how to add menu items to the new menu.

Listing 23-2: Adding selections and submenu items to the Budgeting menu

```
Sub CreateMenu()
    Dim HelpMenu As CommandBarControl
    Dim NewMenu As CommandBarPopup
    Dim MenuItem As CommandBarControl
    Dim SubmenuItem As CommandBarButton

    ' Delete the menu if it already exists
    Call DeleteMenu

    ' Find the Help Menu
    Set HelpMenu = CommandBars(1).FindControl(Id:=30010)

    If HelpMenu Is Nothing Then
        ' Add the menu to the end
        Set NewMenu = CommandBars(1).Controls _
            .Add(Type:=msoControlPopup, temporary:=True)
    Else
        ' Add the menu before Help
        Set NewMenu = CommandBars(1).Controls _
```



```
        .Add(Type:=msoControlPopup, Before:=HelpMenu.Index, _
            temporary:=True)
    End If

' Add a caption for the menu
NewMenu.Caption = "&Budgeting"

' FIRST MENU ITEM
Set MenuItem = NewMenu.Controls.Add _
    (Type:=msoControlButton)
With MenuItem
    .Caption = "&Data Entry..."
    .FaceId = 162
    .OnAction = "Macro1"
End With

' SECOND MENU ITEM
Set MenuItem = NewMenu.Controls.Add _
    (Type:=msoControlButton)
With MenuItem
    .Caption = "&Generate Reports..."
    .FaceId = 590
    .OnAction = "Macro2"
End With

' THIRD MENU ITEM
Set MenuItem = NewMenu.Controls.Add _
    (Type:=msoControlPopup)
With MenuItem
    .Caption = "View &Charts"
    .BeginGroup = True
End With

' FIRST SUBMENU ITEM
Set SubMenuItem = MenuItem.Controls.Add _
    (Type:=msoControlButton)
With SubMenuItem
    .Caption = "Monthly &Variance"
    .FaceId = 420
    .OnAction = "Macro3"
End With

' SECOND SUBMENU ITEM
Set SubMenuItem = MenuItem.Controls.Add _
    (Type:=msoControlButton)
With SubMenuItem
    .Caption = "Year-To-Date &Summary"
    .FaceId = 422
    .OnAction = "Macro4"
End With
End Sub
```

Specifically, the `CreateMenu` procedure builds the menu shown in Figure 23-2. This menu has three menu items, and the last menu item is a submenu with two submenu items.

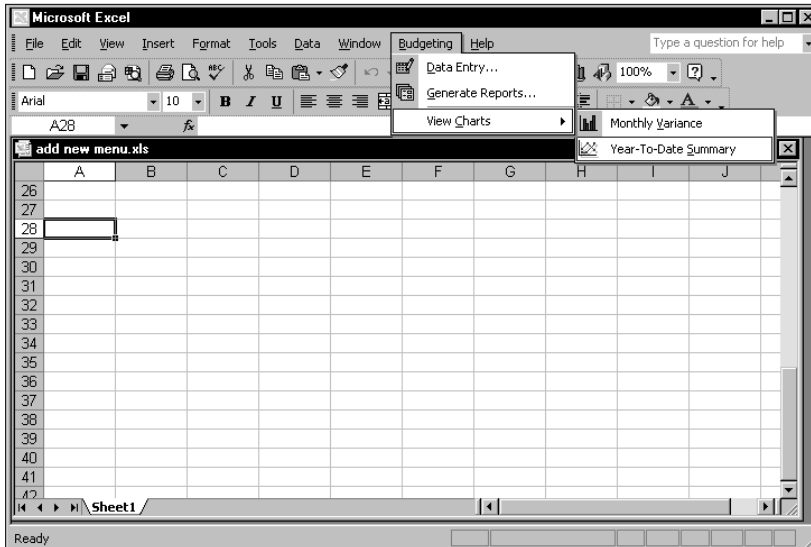


Figure 23-2: A VBA procedure created this menu and its associated menu items.

Note

You might be wondering why the code in the preceding example deletes the menu (if it already exists) and doesn't simply exit the procedure. Rebuilding the menu ensures that the latest version is added to the menu bar. This also makes it much easier on you while you're developing the code because you don't have to delete the menu manually before testing your procedure. As you may have noticed, creating menus is very fast, so the additional time required to rebuild a menu is usually negligible.

When you examine the `CreateMenu` procedure, keep the following points in mind:

- ♦ The control type for the first two menu items is `msoControlButton`. The type of the third menu item, however, is `msoControlPopup` because the third menu item has submenu items. Therefore, the `MenuItem` variable was declared as a generic `CommandBarButton`.
- ♦ The `BeginGroup` property of the third menu item is `True`, which causes a separator bar to appear before the item. The separator bar is purely cosmetic and serves to "group" similar menu items together.

- ♦ The `FaceID` property determines which image (if any) appears next to the menu text. The `FaceID` number represents a built-in image.
- ♦ The text for the `Caption` properties uses an ampersand (&) to indicate the “hot key,” or accelerator key, for the menu item. The hot key is the underlined letter that provides keyboard access to the menu item.

Adding a menu item to the Tools menu

The example in Listing 23-2 adds several menu items to a custom menu on the Worksheet Menu Bar. Often, you'll simply want to add a menu item to one of Excel's built-in menus, such as the Tools menu.

With Excel 5 and Excel 95, assigning a macro to a new menu item on the Tools menu was easy. For some reason, this feature was removed, beginning with Excel 97. This section demonstrates how to write VBA code to add a menu item to Excel's Tools menu.

Listing 23-3 adds the menu item Clear All But Formulas to the Tools menu. Clicking this menu item executes a procedure named `ClearAllButFormulas`.

Listing 23-3: Adding a selection to Excel's Tools menu

```
Sub AddMenuItem()  
    Dim ToolsMenu As CommandBarPopup  
    Dim NewMenuItem As CommandBarButton  
  
    ' Delete the menu if it already exists  
    Call DeleteMenuItem  
  
    ' Find the Tools Menu  
    Set ToolsMenu = CommandBars(1).FindControl(Id:=30007)  
    If ToolsMenu Is Nothing Then  
        MsgBox "Cannot add menu item."  
        Exit Sub  
    Else  
        Set NewMenuItem = ToolsMenu.Controls.Add _  
            (Type:=msoControlButton)  
        With NewMenuItem  
            .Caption = "&Clear All But Formulas"  
            .FaceId = 348  
            .OnAction = "ClearAllButFormulas"  
            .BeginGroup = True  
        End With  
    End If  
End Sub
```

Figure 23-3 shows the Tools menu with the new menu item. Note that the code does not refer to the Tools menu by its caption. Rather, it identifies the menu using its ID property (which is 30007).

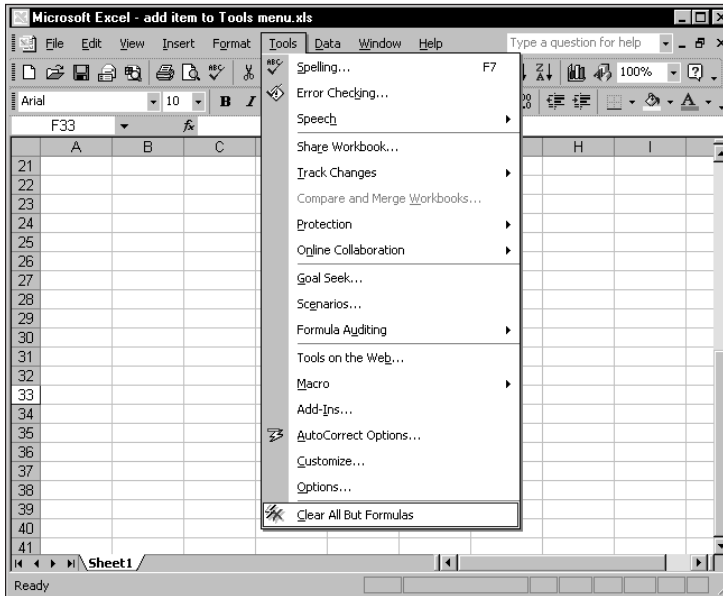


Figure 23-3: A new menu item has been added to the Tools menu.

Deleting a menu item from the Tools menu

To delete a menu item, use the `Delete` method of the `Controls` collection. The following example deletes the `Clear All But Formulas` menu item on the Tools menu. Note that it uses the `FindControl` method to handle the situation when the Tools menu has a different caption.

```
Sub DeleteMenuItem()
    On Error Resume Next
    CommandBars(1).FindControl(Id:=30007). _
        Controls("&Clear All But Formulas").Delete
End Sub
```

Displaying a shortcut key with a menu item

Some of Excel's built-in menu items also display a shortcut key combination that, when pressed, has the same effect as the menu command. For example, Excel's `Edit` menu lists several shortcut keys.

To display a shortcut key combination as part of your menu item, use the `ShortcutText` property. It's important to understand that setting the `ShortcutText` property does not actually assign the shortcut key—it simply affects the display in the menu. You must write additional code to set up the shortcut key.

Listing 23-4 creates a menu item `Clear All But Formulas` on the `Tools` menu. It sets the `ShortcutText` property to the string `Ctrl+Shift+C` and also uses the `MacroOptions` method to set up the shortcut key.

Listing 23-4: Adding a menu selection that features a shortcut key

```
Sub AddMenuItem()  
    Dim ToolsMenu As CommandBarPopup  
    Dim NewMenuItem As CommandBarButton  
  
    ' Delete the menu if it already exists  
    Call DeleteMenuItem  
  
    ' Find the Tools Menu  
    Set ToolsMenu = CommandBars(1).FindControl(Id:=30007)  
    If ToolsMenu Is Nothing Then  
        MsgBox "Cannot add a menu item - use Ctrl+Shift+C."  
        Exit Sub  
    Else  
        Set NewMenuItem = ToolsMenu.Controls.Add _  
            (Type:=msoControlButton)  
        With NewMenuItem  
            .Caption = "&Clear All But Formulas"  
            .FaceId = 348  
            .ShortcutText = "Ctrl+Shift+C"  
            .OnAction = "ClearAllButFormulas"  
            .BeginGroup = True  
        End With  
    End If  
  
    ' Create the shortcut key  
    Application.MacroOptions _  
        Macro:="ClearAllButFormulas", _  
        HasShortcutKey:=True, _  
        ShortcutKey:="C"  
End Sub
```

After this procedure is executed, the menu item is displayed as shown in Figure 23-4.

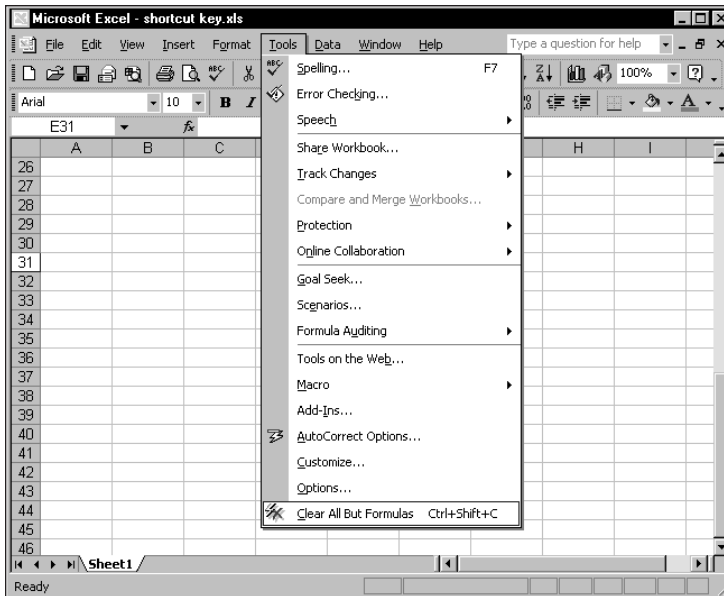


Figure 23-4: The Clear All But Formulas menu item also displays a shortcut key combination.

Fixing a menu that has been reset

Consider this scenario: You write VBA code that creates a new menu when your workbook application is opened. The user opens another workbook containing a macro that resets Excel's menu bar. Or consider this: The user plays around with the Customize dialog box, selects the Workbook Menu Bar from the list on that dialog, and clicks the Reset button. In both cases, your custom menu is zapped.

Your menu-making code is probably triggered by the `Workbook_Open` event, so the only way the user can get your menu back is to close and reopen the workbook. To provide another way, create a key combination that executes the procedure that builds your menu.

Apparently, applications that reset Excel's menu bar are not uncommon. Users of my Power Utility Pak add-in sometimes tell me that the PUP 2000 menu has disappeared for no apparent reason. This is always caused by some other application that feels it must reset the Worksheet Menu Bar. Therefore, I added a key combination (`Ctrl+Shift+U`) that, when pressed, rebuilds the PUP 2000 menu. The following statement, when executed, associates the `CreateMenu` procedure with the `Ctrl+Shift+U` key combination.

```
Application.MacroOptions Macro:="CreateMenu", _
  HasShortcutKey:=True, ShortcutKey:="U"
```

Working with Events

Suppose you want to create a menu when a workbook opens. You'll also want to delete the menu when the workbook closes because menu modifications remain in effect between Excel sessions. Or suppose you want a menu to be available only when a particular workbook or worksheet is active. These sorts of things are relatively easy to program, thanks to Excel's event-handlers.

The examples in this section demonstrate various menu-programming techniques used in conjunction with events.



I discuss event programming in depth in Chapter 19.

Adding and deleting menus automatically

If you need a menu to be created when a workbook is opened, use the `Workbook_Open` event. The following code, stored in the code module for the `ThisWorkbook` object, executes the `CreateMenu` procedure:

```
Private Sub Workbook_Open()  
    Call CreateMenu  
End Sub
```

To delete the menu when the workbook is closed, use a procedure such as the following. This procedure is executed before the workbook closes, and it executes the `DeleteMenu` procedure.

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    Call DeleteMenu  
End Sub
```

A problem may arise, however, if the workbook is not saved when the user closes it. Excel's "save workbook before closing" prompt occurs *after* the `Workbook_BeforeClose` event-handler runs. So if the user clicks `Cancel`, the workbook remains open, but your custom menu has already been deleted!

One solution to this problem is to bypass Excel's prompt and write your own code in the `Workbook_BeforeClose` procedure to ask the user to save the workbook. The following code demonstrates how:

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)  
    If Not Me.Saved Then  
        Msg = "Do you want to save the changes you made to "  
        Msg = Msg & Me.Name & "?"  
        Ans = MsgBox(Msg, vbQuestion + vbYesNoCancel)  
        Select Case Ans  
            Case vbYes  
                Me.Save
```

```
        Case vbNo
            Me.Saved = True
        Case vbCancel
            Cancel = True
            Exit Sub
    End Select
End If
Call DeleteMenu
End Sub
```

This procedure determines whether the workbook has been saved. If it has, no problem; the `DeleteMenu` procedure is executed, and the workbook is closed. But if the workbook has not been saved, the procedure displays a message box that duplicates the one Excel normally shows. If the user clicks Yes, the workbook is saved, the menu is deleted, and the workbook is closed. If the user clicks No, the code sets the `Saved` property of the `Workbook` object to `True` (without actually saving the file) and deletes the menu. If the user clicks Cancel, the `BeforeClose` event is canceled, and the procedure ends without deleting the menu.

Disabling or hiding menus

When a menu or menu item is disabled, its text appears in a faint shade of gray, and clicking it has no effect. Excel disables its menu items when they are out of context. For example, the `Links` menu item on the `Edit` menu is disabled when the active workbook does not contain any links.

You can write VBA code to enable or disable both built-in and custom menus or menu items. Similarly, you can write code to hide menus or menu items. The key, of course, is tapping into the correct event.

The following procedures are stored in the code module for the `ThisWorkbook` object:

```
Private Sub Workbook_Open()
    Call AddMenu
End Sub

Private Sub Workbook_BeforeClose(Cancel As Boolean)
    Call DeleteMenu
End Sub

Private Sub Workbook_Activate()
    Call UnhideMenu
End Sub

Private Sub Workbook_Deactivate()
    Call HideMenu
End Sub
```


When the workbook is opened, the `AddMenu` procedure is called. When the workbook is closed, the `DeleteMenu` procedure is called. Two additional event-handler procedures are executed when the workbook is activated or deactivated. The `UnhideMenu` procedure is called when the workbook is activated, and the `HideMenu` procedure is called when the workbook is deactivated.

The `HideMenu` procedure sets the `Visible` property of the menu item to `False`, which effectively removes it from the menu bar. The `UnhideMenu` procedure does just the opposite. The net effect is that the menu is visible only when the workbook is active. These procedures, which assume that the `Caption` for the menu is "Budgeting", are as follows:

```
Sub UnhideMenu()  
    CommandBars(1).Controls("Budgeting").Visible = True  
End Sub  
  
Sub HideMenu()  
    CommandBars(1).Controls("Budgeting").Visible = False  
End Sub
```

To disable the menu rather than hide it, simply access the `Enabled` property instead of the `Visible` property.



This example is available on the companion CD-ROM.

Working with checked menu items

Several of Excel's menu items appear with or without a check mark. For example, the `View ⇄ Formula Bar` menu item displays a check mark if the formula bar is visible and does not display a check mark if the formula bar is hidden. When you select this menu item, the formula bar's visibility is toggled, and the check mark is either displayed or not.

You can add this type of functionality to your custom menu items. Figure 23-5 shows a menu item that displays a check mark only when the active sheet is displaying grid lines. Selecting this item toggles the grid-line display and also adjusts the check mark. The check mark display is determined by the `State` property of the menu item control.

The trick here is keeping the check mark in sync with the active sheet. To do so, it's necessary to update the menu item whenever a new sheet, a new workbook, or a new window is activated. This is done by setting up application-level events.

Adding the menu item

The `AddMenuItem` procedure shown in Listing 23-5 is executed when the workbook is opened. It creates a new `GridLines` menu item on the `View` menu.

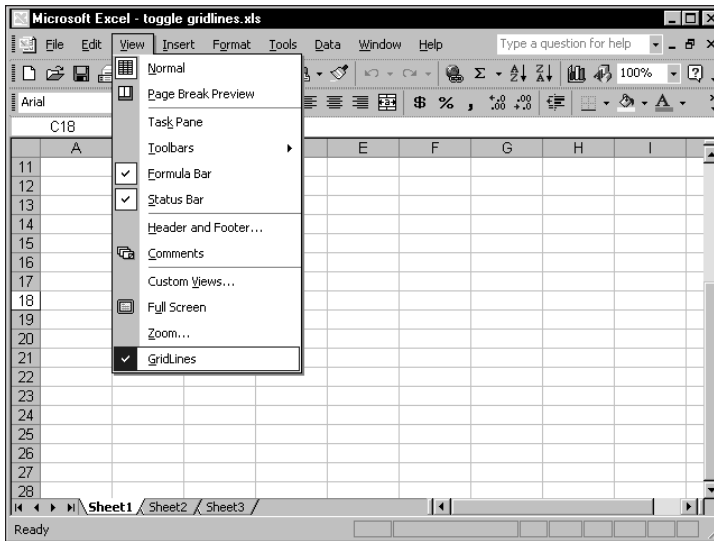


Figure 23-5: The GridLines menu item displays a check mark if the active sheet displays grid lines.

Listing 23-5: Augmenting a built-in Excel menu

```

Dim AppObject As New XLHandler

Sub AddMenuItem()
    Dim ViewMenu As CommandBarPopup
    Dim NewMenuItem As CommandBarButton

    ' Delete the menu if it already exists
    Call DeleteMenuItem

    ' Find the View Menu
    Set ViewMenu = CommandBars(1).FindControl(ID:=30004)
    If ViewMenu Is Nothing Then
        MsgBox "Cannot add menu item."
        Exit Sub
    Else
        Set NewMenuItem = ViewMenu.Controls.Add _
            (Type:=msoControlButton)
        With NewMenuItem
            .Caption = "&GridLines"
            .OnAction = "ToggleGridlines"
        End With
    End If
End Sub

```

```
' Set up application event handler
  Set AppObject.AppEvents = Application
End Sub
```

The `AddMenuItem` procedure adds the new menu item to the Worksheet Menu Bar, not the Chart Menu Bar. Therefore, the new menu item isn't displayed when a chart sheet is active (which is just what we want).

Notice that the final statement in the `AddMenuItem` procedure sets up the application-level events that will be monitored. These event procedures, which are stored in a class module named `XLHandler`, are as follows:

```
Public WithEvents AppEvents As Excel.Application

Private Sub AppEvents_SheetActivate(ByVal Sh As Object)
    Call CheckGridlines
End Sub

Private Sub AppEvents_WorkbookActivate _
    (ByVal Wb As Excel.Workbook)
    Call CheckGridlines
End Sub

Private Sub AppEvents_WindowActivate _
    (ByVal Wb As Workbook, ByVal Wn As Window)
    Call CheckGridlines
End Sub
```


Note

This procedure has one flaw: Changing the gridline setting using the Options dialog box is not detected.

toggling the gridline display

The net effect is that when the user changes worksheets or workbooks, the following `CheckGridlines` procedure is executed. This procedure ensures that the check mark displayed on the `GridLines` menu option is in sync with the sheet.

```
Sub CheckGridlines()
    Dim TG As CommandBarButton
    On Error Resume Next
    Set TG = CommandBars(1).FindControl(Id:=30004). _
        Controls("&GridLines")
    If ActiveWindow.DisplayGridlines Then
        TG.State = msoButtonDown
    Else
        TG.State = msoButtonUp
    End If
End Sub
```

This procedure checks the active window and sets the `State` property of the menu item. If grid lines are displayed, it adds a check mark to the `GridLines` menu item. If grid lines are not displayed, it removes the check mark from the menu item.

Keeping the menu in sync with the sheet

When the menu item is selected, the `OnAction` property of that menu item triggers the `ToggleGridlines` procedure, as follows:

```
Sub ToggleGridlines()
    If TypeName(ActiveSheet) = "Worksheet" Then
        ActiveWindow.DisplayGridlines = _
            Not ActiveWindow.DisplayGridlines
        Call CheckGridlines
    End If
End Sub
```

This procedure simply toggles the gridline display of the active window. I use an `If-Then` construct to ensure that the active sheet is a worksheet

The Easy Way to Create Custom Menus

When Excel 97 was released, I was a bit frustrated with the amount of code required to create a custom menu, so I developed a technique that simplifies the process considerably. My technique uses a worksheet, shown in Figure 23-6, to store information about the new menu. A VBA procedure reads the data in the workbook and creates the menu, menu items, and submenu items.

	A	B	C	D	E	F
1	Level	Caption	Position/Macro	Divider	FaceID	
2	1	&Budget Tools	10			
3	2	&Activate a sheet				
4	3	&Assumptions	GoToAssumptions			
5	3	&Model	GoToModel			
6	3	&Scenarios	GoToScenarios			
7	3	&Notes	GoToNotes			
8	2	&View scenarios...	ViewScenarios			
9	2	&Data entry...	DataEntry	TRUE	387	
10	2	&Printing	Printing	TRUE	4	
11	2	&Charts				
12	3	&Budget vs. Actual	ViewChart1		433	
13	3	&Year-To-Date	ViewChart2		436	
14	3	&Quarterly Summary	ViewChart3		427	
15	2	&Help		TRUE		
16	3	&Help Contents	Help1			
17	3	&Terminology	Help2			
18	3	&About	Help3	TRUE		
19						

Figure 23-6: The information in this worksheet is used to create a custom menu.

The worksheet consists of a table with five columns:

- ♦ *Level*. This is the location of the particular item relative to the hierarchy of the menu system. Valid values are 1, 2, and 3. Level 1 is for a menu, 2 is for a menu item, and 3 is for a submenu item. Normally, you'll have one level 1 item, with level 2 items below it. A level 2 item may or may not have level 3 (submenu) items.
- ♦ *Caption*. This is the text that appears in the menu, menu item, or submenu. To underline a character, place an ampersand (&) before it.
- ♦ *Position/Macro*. For level 1 items, this should be an integer that represents the position in the menu bar. For level 2 or level 3 items, this is the macro that executes when the item is selected. If a level 2 item has one or more level 3 items, the level 2 item may not have a macro associated with it.
- ♦ *Divider*. Enter True if a separator bar should be placed before the menu item or submenu item.
- ♦ *FaceID*. This optional entry is a code number that represents the built-in graphic images displayed next to an item.

Figure 23-7 shows the menu that was created from the worksheet data.

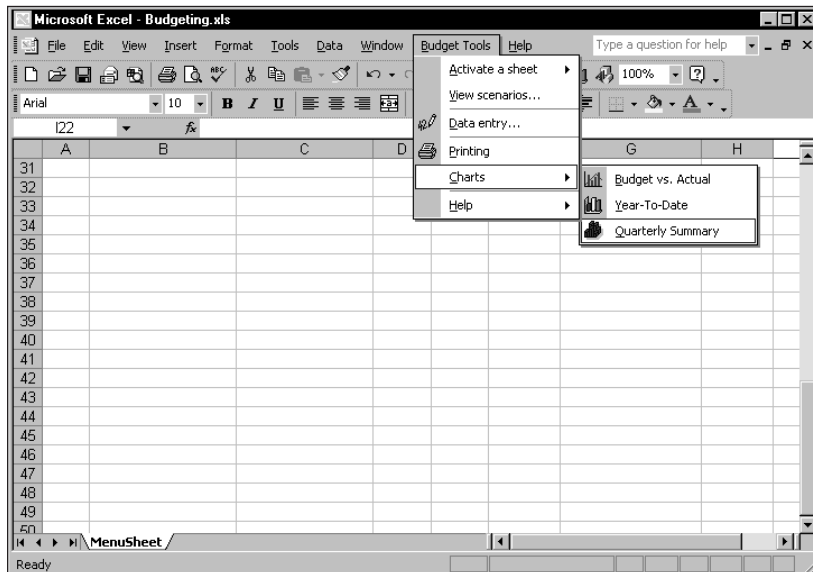


Figure 23-7: This menu was created from the data stored in a worksheet.



A workbook that demonstrates this technique is available on the companion CD-ROM. This workbook contains the VBA procedure that reads the worksheet data and creates the menu. To use this technique in your workbook or add-in, follow the steps described next.

1. Open the example workbook from the CD-ROM.
2. Copy all the code in `Module1` to a module in your project.
3. Add procedures such as the following to the code module for the `ThisWorkbook` object:

```
Private Sub Workbook_Open()
    Call CreateMenu
End Sub
Private Sub Workbook_BeforeClose(Cancel As Boolean)
    Call DeleteMenu
End Sub
```

4. Insert a new worksheet, and name it `MenuSheet`. Better yet, copy the `MenuSheet` from the example file.
5. Customize the `MenuSheet` to correspond to your custom menu.


Note

There is no error handling in the example workbook, so it's up to you to make sure that the menu is created properly.

Creating a Substitute Worksheet Menu Bar

In some cases, you may want to hide Excel's standard Worksheet Menu Bar and replace it with a completely customized menu bar.

The `MakeMenuBar` procedure in Listing 23-6 creates a new menu bar named `MyMenuBar`. This menu bar consists of two menus. The first menu is the standard File menu, copied from the Worksheet Menu Bar. The second menu contains two items: Restore Normal Menu and Help.

Listing 23-6: Replacing Excel's built-in menu with your own

```
Sub MakeMenuBar()
    Dim NewMenuBar As CommandBar
    Dim NewMenu As CommandBarControl
    Dim NewItem As CommandBarControl

    ' Delete menu bar if it exists
    Call DeleteMenuBar

    ' Add a menu bar
    Set NewMenuBar = CommandBars.Add(MenuBar:=True)
```

```

    With NewMenuBar
        .Name = "MyMenuBar"
        .Visible = True
    End With

'   Copy the File menu (ID=30002) from Worksheet Menu Bar
    CommandBars("Worksheet Menu
Bar").FindControl(ID:=30002).Copy _
        Bar:=CommandBars("MyMenuBar")

'   Add a new menu
    Set NewMenu = NewMenuBar.Controls.Add _
        (Type:=msoControlPopup)
    NewMenu.Caption = "&Commands"

'   Add a new menu item
    Set NewItem = NewMenu.Controls.Add(Type:=msoControlButton)
    With NewItem
        .Caption = "&Restore Normal Menu"
        .OnAction = "DeleteMenuBar"
    End With

'   Add a new menu item
    Set NewItem = NewMenu.Controls.Add(Type:=msoControlButton)
    With NewItem
        .Caption = "&Help"
        .OnAction = "ShowHelp"
    End With
End Sub

```

Figure 23-8 shows the new menu bar.

Notice that nothing in this procedure hides the Worksheet Menu Bar. The instruction `Set NewMenuBar = CommandBars.Add(MenuBar:=True)` adds the new command bar. When the `Visible` property of this new command bar is set to `True`, it then takes over as the worksheet menu bar. Only one menu bar can be active at a time.



Note A standard toolbar (as discussed in Chapter 22) has a `Type` property of `msoBarTypeNormal`. A menu bar, as created in the preceding code, has a `Type` property of `msoBarTypeMenuBar`.

Deleting the custom menu bar displays the Worksheet Menu Bar and makes it the active menu bar. The following `DeleteMenuBar` procedure returns things to normal:

```

Sub DeleteMenuBar()
    On Error Resume Next
    CommandBars("MyMenuBar").Delete
    On Error GoTo 0
End Sub

```

The preceding code locates the File menu command bar control by using the FindControl method. This menu is then copied from the Worksheet Menu Bar to the new menu bar by using the Copy method:

```
CommandBars("Worksheet Menu
Bar").FindControl(ID:=30002).Copy _
```

`Bar:=CommandBars("MyMenuBar")` When this instruction is executed, the File menu (along with all of its menu items and submenu items) appears on the new menu bar. Be aware that the menu and submenu items are not true copies of the corresponding items on the Worksheet Menu Bar. For example, change the Caption property for the New menu item on MyMenuBar (change it from *New* to *New Workbook*). That change will also be reflected in the New menu item in the Worksheet Menu Bar. So when you restore the Worksheet Menu Bar, the modified caption will be displayed.

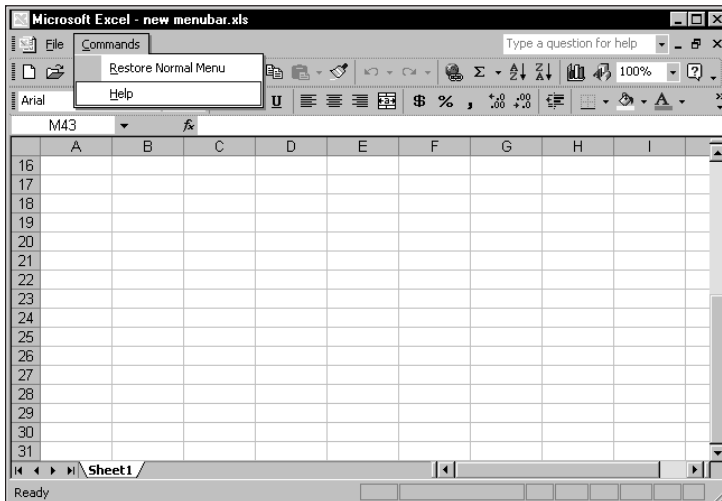


Figure 23-8: A custom menu bar replaces the standard Worksheet Menu Bar.

Working with Shortcut Menus

A *shortcut menu* is a pop-up menu that appears when you right-click virtually anything in Excel. You can't use Excel's Customize dialog box to remove or modify shortcut menus. The only way to customize shortcut menus is through VBA.

Excel 2002 has 59 shortcut menus, seven more than Excel 2000. A shortcut menu is a command bar, with a Type setting of `msoBarTypePopup`. To work with a shortcut

menu, you need to know its `Index` or `Name` property setting. You can use the following procedure to generate a list of all shortcut menus. This list displays information about each shortcut menu in one row of a worksheet: the `Index`, `Name`, and a list of all menu items.

```
Sub ListShortCutMenus()
    Row = 1
    For Each cbar In CommandBars
        If cbar.Type = msoBarTypePopup Then
            Cells(Row, 1) = cbar.Index
            Cells(Row, 2) = cbar.Name
            For col = 1 To cbar.Controls.Count
                Cells(Row, col + 2) = _
                    cbar.Controls(col).Caption
            Next col
            Row = Row + 1
        End If
    Next cbar
End Sub
```

Figure 23-9 shows a portion of the output. This procedure will also help you identify the names of various shortcut menus. For example, who would guess that the shortcut menu that appears when you right-click a sheet tab is named *Ply*?

	A	B	C	D	E
6	25	Row	Cu&t	&Copy	&Paste
7	26	Cell	Cu&t	&Copy	&Paste
8	27	Column	Cu&t	&Copy	&Paste
9	28	Row	Cu&t	&Copy	&Paste
10	29	Ply	&Ungroup Sheets	&Insert...	&Delete
11	30	XLM Cell	Cu&t	&Copy	&Paste
12	31	Document	&Save	Save &As...	&Print...
13	32	Desktop	&New...	&Open...	Save &Workspace...
14	33	Nondefault Drag and Drop	&Move Here	&Copy Here	Copy Here as &Values Only
15	34	AutoFill	&Copy Cells	Fill &Series	Fill &Formatting Only
16	35	Button	Cu&t	&Copy	&Paste
17	36	Dialog	&Paste	Ta&b Order...	&Run Dialog
18	37	Series	&Selected Object	Chart T&ype...	&Source Data...
19	38	Plot Area	&Selected Object	Chart T&ype...	&Source Data...
20	39	Floor and Walls	&Selected Object	3-D &View...	Cle&ar
21	40	Trendline	&Selected Object	Cle&ar	
22	41	Chart	&Selected Object	Cle&ar	
23	42	Format Data Series	&Selected Object	Chart T&ype...	&Source Data...
24	43	Format Axis	&Selected Object	Cle&ar	&Hide Detail
25	44	Format Legend Entry	&Selected Object	&Hide Detail	&Show Detail
26	45	Formula Bar	Cu&t	&Copy	&Paste
27	46	PivotTable Context Menu	&Format Cells...	Pivot&Chart	&Wizard...
28	47	Query	Cu&t	&Copy	&Paste
29	48	Query Layout	Cu&t	&Copy	&Paste
30	49	AutoCalculate	&None	&Average	&Count
31	50	Object/Plot	&Format Object...	Chart T&ype...	&Source Data...
32	51	Title Bar (Charting)	&Print...	Page Set&up...	&Spelling...
33	52	Layout	&Format Cells	&Delete	&Wizard

Figure 23-9: A listing of all shortcut menus, plus the menu items in each

**Caution**

Although you can refer to a shortcut menu by its `Index` property, this is not recommended. For some reason, `Index` values have not remained consistent between Excel versions. Rather, you should use the `Name` property to refer to a shortcut menu.

Adding menu items to shortcut menus

Adding a menu item to a shortcut menu works just like adding a menu item to a regular menu. The following example demonstrates how to add a menu item to the Cell shortcut menu that appears when you right-click a cell or a row or column border. This menu item is added to the end of the shortcut menu, with a separator bar above it.

```
Sub AddItemToShortcut()  
    Set NewItem = CommandBars("Cell").Controls.Add  
    With NewItem  
        .Caption = "Toggle Word Wrap"  
        .OnAction = "ToggleWordWrap"  
        .BeginGroup = True  
    End With  
End Sub
```

Selecting the new menu item executes a procedure named `ToggleWordWrap`. Figure 23-10 shows the new shortcut menu in action.

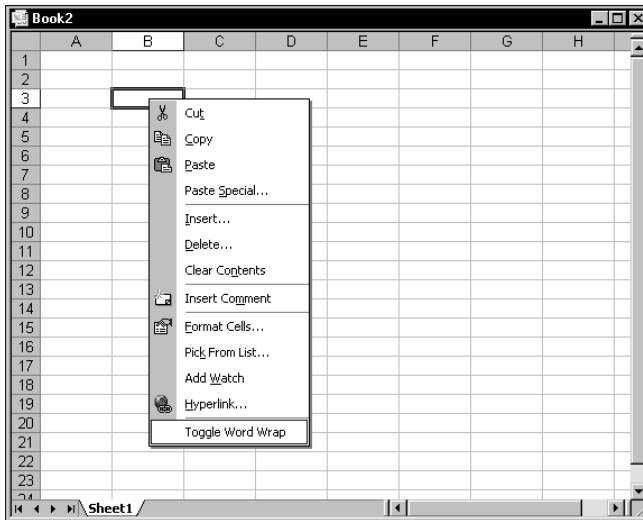


Figure 23-10: This shortcut menu has a new menu item.

The previous example used the `OnAction` property to assign a macro to the shortcut menu item. The following example doesn't use `OnAction`. Rather, it adds a built-in command (`Hide`) to the shortcut menu that appears when you click the title bar of a workbook window.

```
Sub AddItemToShortcut()  
    Set NewItem = CommandBars("Document").Controls.Add(ID:=865)  
    NewItem.Caption = "Hide Window"  
End Sub
```

Selecting this shortcut menu item is equivalent to choosing the `Window ⇨ Hide` command. This command has an ID of 865, which I discovered by executing this instruction:

```
MsgBox CommandBars("Worksheet Menu Bar") _  
    .Controls("Window").Controls("Hide").ID
```

Deleting menu items from shortcut menus

The following procedure uses the `Delete` method to remove the menu item added by the procedure in the previous section:

```
Sub RemoveItemFromShortcut()  
    On Error Resume Next  
    CommandBars("Cell").Controls("Toggle Word Wrap").Delete  
End Sub
```

The `On Error Resume Next` statement avoids the error message that appears if the menu item is not on the shortcut menu.

The following procedure removes the `Hide` menu item from two shortcut menus: the one that appears when you right-click a row header and the one that appears for a column header:

```
Sub RemoveHideMenuItems()  
    CommandBars("Column").Controls("Hide").Delete  
    CommandBars("Row").Controls("Hide").Delete  
End Sub
```

Disabling shortcut menu items

As an alternative to removing menu items, you may want to disable one or more items on certain shortcut menus while your application is running. When an item is disabled, it appears in a light gray color, and clicking it has no effect. The following procedure disables the `Hide` menu item from the `Row` and `Column` shortcut menus:

```
Sub DisableHideMenuItems()
    CommandBars("Column").Controls("Hide").Enabled = False
    CommandBars("Row").Controls("Hide").Enabled = False
End Sub
```

Disabling shortcut menus

You can also disable entire shortcut menus. For example, you may not want the user to access the commands generally made available by right-clicking a cell. The following `DisableCell` procedure disables the Cell shortcut menu. After the procedure is executed, right-clicking a cell has no effect.

```
Sub DisableCell()
    CommandBars("Cell").Enabled = False
End Sub
```

If you want to disable *all* shortcut menus, use the following procedure:

```
Sub DisableAllShortcutMenus()
    Dim cb As CommandBar
    For Each cb In CommandBars
        If cb.Type = msoBarTypePopup Then _
            cb.Enabled = False
    Next cb
End Sub
```


Note

Disabling the shortcut menus “sticks” between sessions. Therefore, you’ll probably want to restore the shortcut menus before closing Excel. To restore the shortcut menus, modify the preceding procedure to set the `Enabled` property to `True`.

Resetting shortcut menus

The `Reset` method restores a shortcut menu to its original, default condition. If your application adds items to a shortcut menu, it’s better to remove the items individually when your application closes. Otherwise, you may delete customizations made by other applications.

The following procedure resets the Cell shortcut menu to its normal state:

```
Sub ResetCellMenu()
    CommandBars("Cell").Reset
End Sub
```

Creating new shortcut menus

It’s possible to create an entirely new shortcut menu. Listing 23-7 creates a shortcut menu named `MyShortcut` and adds six menu items to it. These menu items have

their `OnAction` property set to execute a simple procedure that displays one of the tabs in the Format Cells dialog box. For example, the `ShowNumberFormat` procedure is:

```
Sub ShowFormatNumber()
    Application.Dialogs(xlDialogFormatNumber).Show
End Sub
```

Listing 23-7: Creating an entirely new and separate shortcut menu

```
Sub CreateShortcut()
    Set myBar = CommandBars.Add _
        (Name:="MyShortcut", Position:=msoBarPopup, _
        Temporary:=True)

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Number Format..."
        .OnAction = "ShowFormatNumber"
        .FaceId = 1554
    End With

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Alignment..."
        .OnAction = "ShowFormatAlignment"
        .FaceId = 217
    End With

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Font..."
        .OnAction = "ShowFormatFont"
        .FaceId = 291
    End With

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
    With myItem
        .Caption = "&Borders..."
        .OnAction = "ShowFormatBorder"
        .FaceId = 149
        .BeginGroup = True
    End With

    ' Add a menu item
    Set myItem = myBar.Controls.Add(Type:=msoControlButton)
```

```

With myItem
    .Caption = "&Patterns..."
    .OnAction = "ShowFormatPatterns"
    .FaceId = 1550
End With

' Add a menu item
Set myItem = myBar.Controls.Add(Type:=msoControlButton)
With myItem
    .Caption = "Pr&otection..."
    .OnAction = "ShowFormatProtection"
    .FaceId = 2654
End With
End Sub

```

Figure 23-11 shows how this new shortcut menu looks.

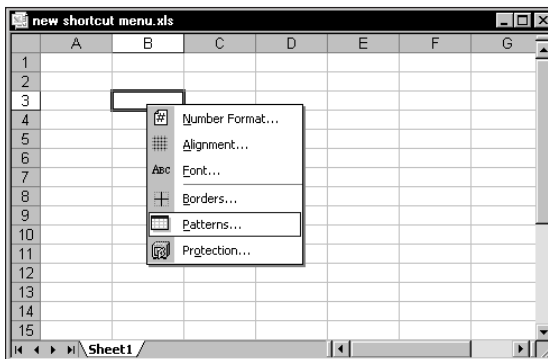


Figure 23-11: This new shortcut menu was created with VBA.

After the shortcut menu is created, you can display it using the `ShowPopup` method. The following procedure, located in the code module for a `Worksheet` object, is executed when the user right-clicks a cell:

```

Private Sub Worksheet_BeforeRightClick _
    (ByVal Target As Excel.Range, Cancel As Boolean)
    If Union(Target.Range("A1"), Range("data")).Address = _
        Range("data").Address Then
        CommandBars("MyShortcut").ShowPopup
        Cancel = True
    End If
End Sub

```

If the cell the user right-clicks is within a range named `data`, the `MyShortcut` menu appears. Setting the `Cancel` argument to `True` ensures that the normal shortcut menu is not displayed.



The companion CD-ROM contains an example that creates a new shortcut menu and displays it in place of the normal Cell shortcut menu.

Summary

In this chapter, I covered the topic of custom menus and presented many examples that demonstrate how to modify and create standard menus and shortcut menus.

The next chapter continues the discussion of application development, covering the topic of user help.



Providing Help for Your Applications

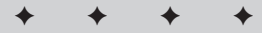
Computer users have become rather spoiled over the years. In the early days of personal computers, software companies rarely provided online help. And the “help” provided often proved less than helpful. Now, just about all commercial software provides online help; and more often than not, online help serves as the primary documentation. Thick software manuals are an endangered species (good riddance!).

In this chapter, I discuss the concept of providing help for your Excel applications. As you’ll see, you have lots of options.

Help for Your Excel Applications?

If you develop a nontrivial application in Excel, you may want to consider building in some sort of help for end users. Doing so makes the users feel more comfortable with the application and may eliminate many of those time-wasting phone calls from users with basic questions. Another advantage is that online help is always available (the instructions can’t be misplaced or buried under a pile of books).

You can add user help to your applications in a number of ways, ranging from simple to complex. The method you choose depends on your application’s scope and complexity and how much effort you’re willing to put into this phase of development. Some applications may require only a brief set of instructions on how to start them. Others may benefit from a full-blown, searchable help system. Most often, applications need something in between.



In This Chapter

Why you might want to provide user help for your applications

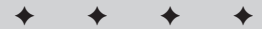
How to provide help by using only the components supplied with Excel

How to create Help files with the Windows Help System or the HTML Help System

How to associate a Help file with your application

How to use the Office Assistant to display help

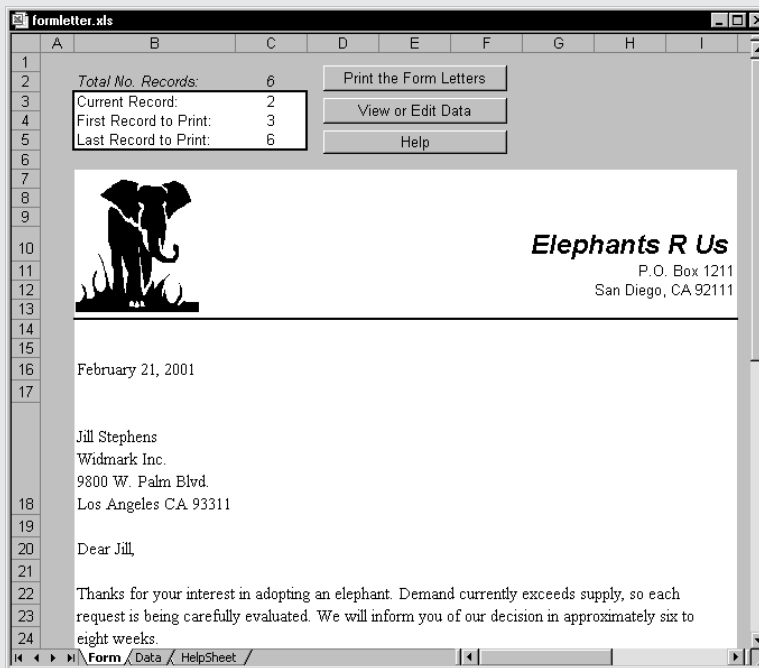
Other ways to display WinHelp or HTML Help



About the Examples in This Chapter

In this chapter, I use a simple workbook application to demonstrate various ways of providing help. The application uses data stored in a worksheet to generate and print form letters.

As you can see in the following figure, cells display the total number of records in the database (C2, calculated by a formula), the current record number (C3), the first record to print (C4), and the last record to print (C5). To display a particular record, the user enters a value into cell C3. To print a series of form letters, the user specifies the first and last record numbers in cells C4 and C5.



The application is simple, but it does consist of several discrete components that demonstrate various ways of displaying context-sensitive help.

The form letter workbook consists of the following components:

- Form A worksheet that contains the text of the form letter.
- Data A worksheet that contains a seven-field database.
- HelpSheet This worksheet is present only in the examples that store help text on a worksheet.

PrintMod	A VBA module that contains macros to print the form letters.
HelpMod	A VBA module that contains macros that control the help display. The content of this module varies, depending on the type of help being demonstrated.
UserForm1	This UserForm is present only if the help technique involves a UserForm.

This chapter classifies online help into two categories:

- ♦ *Unofficial Help System.* This method of displaying help uses standard Excel components (such as a UserForm).
- ♦ *Official Help System.* This help system uses either a compiled HLP file produced by the Windows Help System or a compiled CHM file produced by the HTML Help System.

Creating a compiled Help file is not a trivial task, but it may be worth the effort if your application is complex or if it will be used by a large number of people.



All the examples in this chapter are available on the companion CD-ROM.

Help Systems That Use Excel Components

Perhaps the most straightforward method of providing help to your users is to use the features contained in Excel itself. The primary advantage is that you don't need to learn how to create WinHelp or HTML Help files — which can be a major undertaking and may take longer to develop than your application.

In this section, I provide an overview of some help techniques that use the following built-in Excel components:

- ♦ *Cell comments.* This is about as simple as it gets.
- ♦ *A text box control.* A simple macro is all it takes to toggle the display of a text box that shows help information.
- ♦ *A worksheet.* A simple way to add help is to insert a worksheet, enter your help information, and name its tab "Help." When the user clicks the tab, the worksheet is activated.
- ♦ *A custom UserForm.* A number of techniques involve displaying help text in a UserForm.

Using cell comments for help

Perhaps the simplest way to provide user help is to use cell comments. This technique is most appropriate for describing the type of input that's expected in a cell. When the user moves the mouse pointer over a cell that contains a comment, that comment appears in a small window. Another advantage is that this technique does not require any macros.

Automatic display of cell notes is an option. The following VBA instruction ensures that cell comment indicators are displayed for cells that contain comments:

```
Application.DisplayCommentIndicator = xlCommentIndicatorOnly
```



Tip

Another option is to use Excel's Data Validation command, which displays a dialog box that lets you specify valid validation criteria for a cell or range. The Input Message tab of the Data Validation dialog box lets you specify a message that is displayed when the cell is activated. This text is limited to approximately 250 characters.

Using a Text Box for help

Using a Text Box to display help information is also easy to implement. Simply create a Text Box using the Text Box button on the Drawing toolbar, enter the help text, and format it to your liking. Figure 24-1 shows an example of a Text Box set up to display help information.



Note

Using the Text Box from the Drawing toolbar is preferable to using an ActiveX Text Box from the Control Toolbox toolbar because it allows *rich text* formatting. In other words, the Text Box from the Drawing toolbar enables you to apply formatting to individual characters within the Text Box.

Most of the time, you won't want the Text Box to be visible. Therefore, you might want to add a button to your application to execute a macro that toggles the `Visible` property of the Text Box. An example of such a macro follows. In this case, the Text Box is named `HelpText`.

```
Sub ToggleHelp()  
    ActiveSheet.TextBoxes("HelpText").Visible = _  
        Not ActiveSheet.TextBoxes("HelpText").Visible  
End Sub
```

Using a worksheet to display help text

Another easy way to add help to your application is to create a macro that activates a separate worksheet that holds the help information. Just attach the macro to a button control, toolbar button, or menu item, and voilà! . . . quick-and-dirty help.

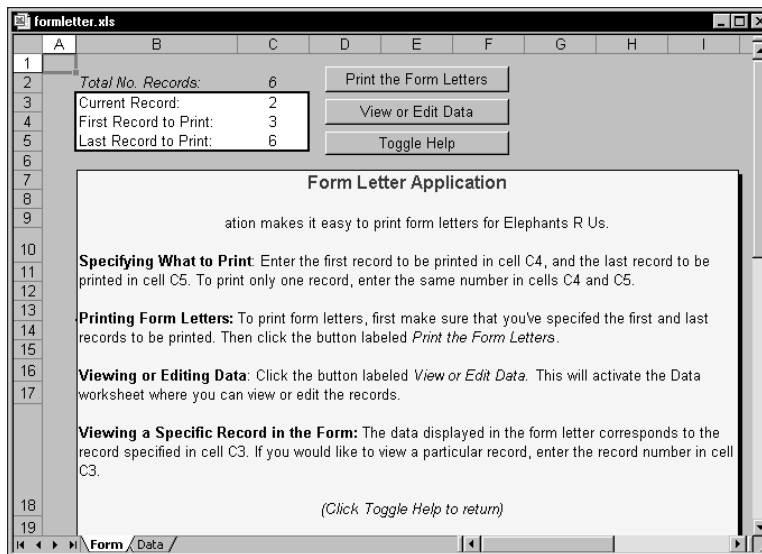


Figure 24-1: Using a Text Box to display help for the user

Figure 24-2 shows a sample help worksheet. I designed the range that contains the help text to simulate a page from a yellow notebook pad—a fancy touch that you may or may not like.

To keep the user from scrolling around the HelpSheet worksheet, the macro sets the `ScrollArea` property of the worksheet. Because this property is not stored with the workbook, it's necessary to set it when the worksheet is activated. I also protected the worksheet to prevent the user from changing the text, and I “froze” the first row so that the Return button is always visible, regardless of how far down the sheet the user scrolls.

The main disadvantage of using this technique is that the help text isn't visible along with the main work area. One possible solution is to write a macro that opens a new window to display the sheet.

Displaying help in a UserForm

Another way to provide help to the user is to display the text in a UserForm. In this section, I describe several techniques that involve UserForms.

Using Label controls to display help text

Figure 24-3 shows a UserForm that contains two Label controls: one for the title, one for the actual text. A SpinButton control enables the user to navigate among the topics. The text itself is stored in a worksheet, with topics in column A and text in column B.

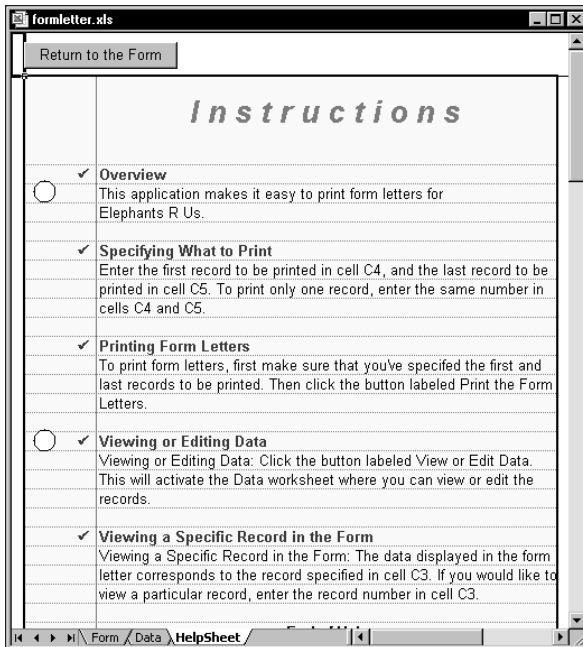


Figure 24-2: Putting user help in a separate worksheet is an easy way to go.

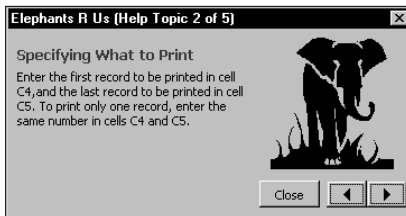


Figure 24-3: Clicking the SpinButton determines the text displayed in the Labels.

Clicking the SpinButton executes the following procedure. This procedure simply sets the `Caption` property of the two Label controls to the text in the appropriate row of the worksheet (named `HelpSheet`).

```
Private Sub SpinButton1_Change()
    HelpTopic = SpinButton1.Value
    LabelTopic.Caption = Sheets("HelpSheet"). _
        Cells(HelpTopic, 1)
    LabelText.Caption = Sheets("HelpSheet").Cells(HelpTopic, 2)
    Me.Caption = APPNAME & ": Topic " & HelpTopic & "/" & _
        & SpinButton1.Max
End Sub
```

Here, APPNAME is a global constant that contains the application's name.

Using a “scrolling” Label to display help text

This technique displays help text in a single Label control. Because a Label control cannot contain a vertical scrollbar, the Label is placed inside a Frame control, which *can* contain a scrollbar. Figure 24-4 shows an example of a UserForm set up in this manner. The user can scroll through the text by using the Frame's scrollbar.

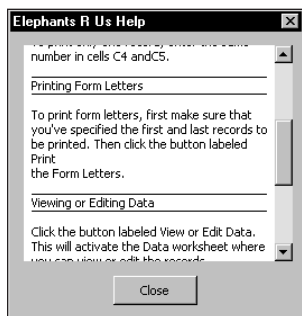


Figure 24-4: Inserting a Label control inside a Frame control adds scrolling to the Label.

The text displayed in the Label is read from a worksheet named HelpSheet when the UserForm is initialized. Listing 24-1 presents the UserForm_Initialize procedure for this worksheet. Notice that the code adjusts the Frame's ScrollHeight property to ensure that the scrolling covers the complete height of the Label. Again, APPNAME is a global constant that contains the application's name.

Listing 24-1: Making the Label control display scrollable text from the worksheet

```
Private Sub UserForm_Initialize()
    Me.Caption = APPNAME & " Help"
    LastRow = Sheets("HelpSheet").Range("A65536") _
        .End(xlUp).Row
    txt = ""
    For r = 1 To LastRow
        txt = txt & Sheets("HelpSheet").Cells(r, 1) _
            .Text & vbCrLf
    Next r
    With Label1
        .Top = 0
        .Caption = txt
        .Width = 160
        .AutoSize = True
    End With
End Sub
```

Continued

Listing 24-1 (continued)

```
With Frame1
    .ScrollHeight = Label1.Height
    .ScrollTop = 0
End With
End Sub
```

Because a Label cannot display formatted text, I used underscore characters in the HelpSheet worksheet to delineate the Help topic titles.

Using a DropDown control to select a Help topic

The example in this section improves upon the previous example. Figure 24-5 shows a UserForm that contains a DropDown control and a Label control. The user can select a topic from the DropDown or view the topics sequentially by clicking the Previous or Next button.

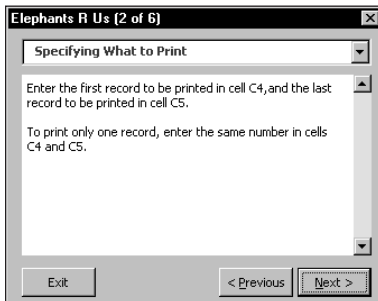


Figure 24-5: Designating the topic of the Label's text with a drop-down list control

This example is a bit more complex than the example in the previous section, but it's also a lot more flexible. It uses the Label-within-a-scrolling-Frame technique (described previously) to support help text of any length.

The help text is stored in a worksheet named HelpSheet in two columns (A and B). The first column contains the topic headings and the second column contains the text. The ComboBox items are added in the UserForm_Initialize procedure, which follows. The CurrentTopic variable is a module-level variable that stores an integer that represents the Help topic.


```
Private Sub UpdateForm()  
    ComboBoxTopics.ListIndex = CurrentTopic - 1  
    Me.Caption = HelpFormCaption & _  
        " (" & CurrentTopic & " of " & TopicCount & ")"  
  
    With LabelText  
        .Caption = HelpSheet.Cells(CurrentTopic, 2)  
        .AutoSize = False  
        .Width = 212  
        .AutoSize = True  
    End With  
    With Frame1  
        .ScrollHeight = LabelText.Height + 5  
        .ScrollTop = 1  
    End With  
  
    If CurrentTopic = 1 Then  
        NextButton.SetFocus  
    ElseIf CurrentTopic = TopicCount Then  
        PreviousButton.SetFocus  
    End If  
    PreviousButton.Enabled = CurrentTopic <> 1  
    NextButton.Enabled = CurrentTopic <> TopicCount  
End Sub
```

Using the Office Assistant to display help

You're probably familiar with the Office Assistant—the cutesy screen character that's always ready to help out. In my experience, most people hate this feature. Apparently, Microsoft got the message. The Office Assistant is turned off, by default, in Office XP.

The Office Assistant is quite programmable, and (if you're so inclined) you can even use it to display help for the user. Figure 24-6 shows the Office Assistant displaying some help text.

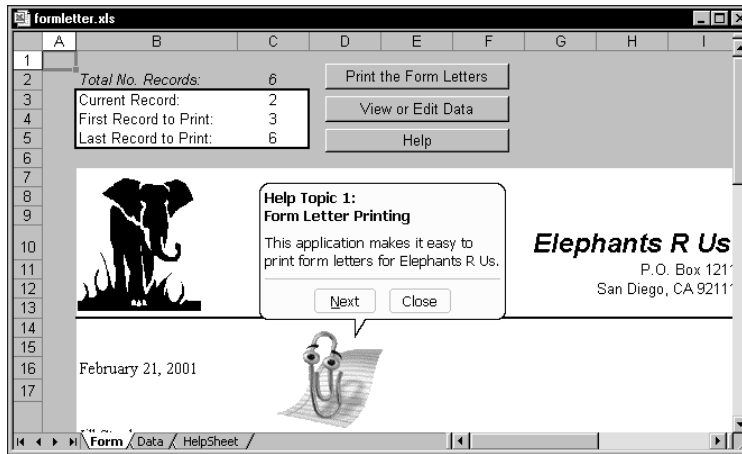


Figure 24-6: Using the Office Assistant to deliver custom help

The main procedure for using the Office Assistant to display help is shown in Listing 24-2. The help text is stored in two columns on a worksheet named HelpSheet. Column A contains the topics, and column B contains the help text.

Listing 24-2: Calling up the Office Assistant to display custom help

```
Public Const APPNAME As String = "Elephants R Us"
Dim Topic As Integer
Dim HelpSheet As Worksheet

Sub ShowHelp()
    Set HelpSheet = ThisWorkbook.Worksheets("HelpSheet")
    Application.Assistant.On = True
    Topic = 1
    With Assistant.NewBalloon
        .Heading = "Help Topic " & Topic & ": " & _
            vbCrLf & HelpSheet.Cells(Topic, 1)
        .Text = HelpSheet.Cells(Topic, 2)
        .Button = msoButtonSetNextClose
        .BalloonType = msoBalloonTypeButtons
        .Mode = msoModeModeless
        .Callback = "ProcessRequest"
        .Show
    End With
End Sub
```

The procedure begins by making sure the Office Assistant is turned on. Then it creates a new `Balloon` object (you'll recall that the Office Assistant's help text is displayed in a balloon) and uses the first `Help` topic in the `HelpSheet` worksheet to set the `Heading` and `Text` properties. It sets the `Button` property so it displays `Next` and `Close` buttons like a wizard. The procedure then sets the `Mode` property to `msoModeModeless` so the user can continue working while the help is displayed. The `Callback` property contains the procedure name that is executed when a button is clicked. Finally, the `Assistant` balloon is displayed using the `Show` method.

The `ProcessRequest` procedure, shown in Listing 24-3, is called when any of the buttons are clicked.

Listing 24-3: Engaging the customized help through the Office Assistant

```
Sub ProcessRequest(bln As Balloon, lbtn As Long, lPriv _
As Long)
    NumTopics = _
        WorksheetFunction.CountA(HelpSheet.Range("A:A"))
    Assistant.Animation = msoAnimationCharacterSuccessMajor
    Select Case lbtn
        Case msoBalloonButtonBack
            If Topic <> 1 Then Topic = Topic - 1
        Case msoBalloonButtonNext
            If Topic <> NumTopics Then Topic = Topic + 1
        Case msoBalloonButtonClose
            bln.Close
            Exit Sub
    End Select
    With bln
        .Close
        Select Case Topic
            Case 1
                .Button = msoButtonSetNextClose
            Case NumTopics
                .Button = msoButtonSetBackClose
            Case Else
                .Button = msoButtonSetBackNextClose
        End Select
        .Heading = "Help Topic " & Topic & ": " & _
            vbCrLf & HelpSheet.Cells(Topic, 1)
        .Text = HelpSheet.Cells(Topic, 2)
        .Show
    End With
End Sub
```

The `ProcessRequest` procedure displays one of several animations and then uses a `Select Case` construct to take action depending on which button was clicked. The button clicked is passed to this procedure through the `lbtn` variable. The procedure also specifies which buttons to display based on the current topic.

If you have an interest in programming the Assistant, I refer you to the online help for the details.



This example is available on the companion CD-ROM.

Using the WinHelp and HTML Help Systems

Currently, the most common help system used in Windows applications is the Windows Help System (WinHelp). This system displays HLP files and supports hypertext *jumps* that let the user display another related topic. However, Microsoft is attempting to phase out WinHelp in favor of HTML Help. Most of the new applications from Microsoft use HTML Help.

Both of these help systems enable the developer to associate a context ID with a particular Help topic. This makes it possible to display a particular Help topic in a context-sensitive manner.

In this section, I briefly describe these two help-authoring systems. Details on creating such help systems are well beyond the scope of this book.

A small icon of a notepad with a pencil, used to denote a note.

Note

If you plan to develop a large-scale help system, I strongly recommend that you purchase a help-authoring software product to make your job easier. Help-authoring software makes it much easier to develop Help files because the software takes care of lots of the tedious details for you. Many products are available, including freeware, shareware, and commercial offerings. Perhaps the most popular help-authoring product is RoboHELP, from eHelp Corporation. RoboHELP creates both WinHelp and HTML help systems. For more information, visit the company's Web site at this address: <http://www.ehelp.com>.

About WinHelp

Figure 24-7 shows a typical Help topic displayed in WinHelp. Some words, called *jump words*, are underlined and displayed in a different color. Clicking a jump word that has a dotted underline makes WinHelp display another window with more explanation, often a definition. Clicking a jump word that has a solid underline makes WinHelp either jump to a new topic or display a secondary help window.

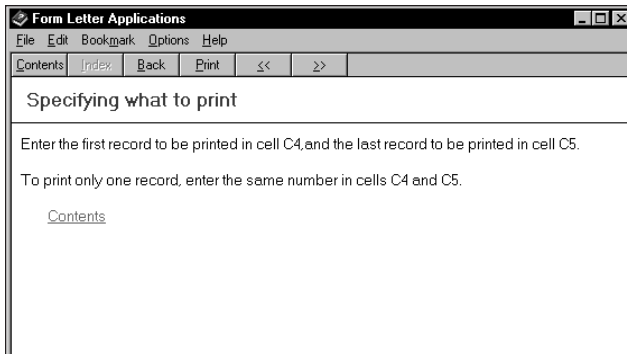


Figure 24-7: An example of WinHelp

WinHelp's main disadvantage is that creating the HLP files takes a great deal of knowledge and effort. An entire Usenet newsgroup is devoted to this topic (`comp.os.ms-windows.programmer.winhelp`), and I'm constantly amazed at the level of discussions in this group. It's clear that creating a good WinHelp file requires lots of experience and some good programming skills to boot.

To create an HLP file, you need a word processing program that can read and write RTF (Rich Text Format) files. Most major word processors can do this, including Microsoft Word. You also need a copy of the Microsoft Help Workshop, which includes the Help compiler. You can download the Help Workshop from Microsoft's FTP site at this address:

`ftp://ftp.microsoft.com/softlib/mslfiles/hcwsetup.exe`



The companion CD-ROM contains a simple compiled HLP file, along with the RTF file and the project file (an HPJ file) that were used to create it.

About HTML Help

As I mentioned, Microsoft has designated HTML Help as the new Windows standard for online help. This system essentially compiles a series of HTML files into a compact help system. HTML Help can also make use of additional tools such as graphics files, ActiveX controls, scripting, and DHTML (Dynamic HTML). Figure 24-8 shows an example of an HTML Help system.

HTML Help is displayed by the HTML Help Viewer, which uses the layout engine of Internet Explorer. The information is displayed in a window, and the table of contents, index, and search tools are displayed in a separate pane. In addition, the help text can contain standard hyperlinks that display another topic or even a document on the Internet. Importantly, HTML Help can also access files stored on a Web site. This is ideal for directing users to a source of up-to-date information that may not have been available when the Help system was created.

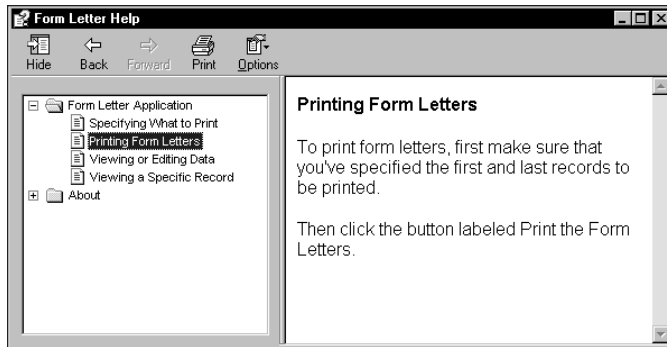


Figure 24-8: An example of HTML Help

Like WinHelp, you need a special compiler to create an HTML Help system. The HTML Help Workshop, along with lots of additional information, is available free from Microsoft's Web site at this address:

<http://msdn.microsoft.com/library/tools/htmlhelp/chm/HH1Start.htm>



Tip

To get a feel for how HTML files are created, display any topic in Excel's online help. Then right-click the document and choose View ⇌ Source. You'll be able to view the original HTML source document.



On the CD-ROM

The companion CD-ROM contains an example of a simple HTML Help system, along with the files used to create it.

Associating a Help File with Your Application

If you use one of the "official" Help file systems (that is, WinHelp or HTML Help), you can associate a particular Help file with your Excel application in one of two ways: by using the Project Properties dialog box or by writing VBA code.

In the VBE, select Tools ⇌ *xxx* Properties (where *xxx* corresponds to your project's name). In the Project Properties dialog box, click the General tab, and specify a Help file for the project (either an HLP file or a CHM file).

It's a good practice to keep your application's Help file in the same directory as the application. The following instruction sets up an association to Myfuncs.hlp, which is assumed to be in the same directory as the workbook:

```
ThisWorkbook.VBProject.HelpFile = _
    ThisWorkbook.Path & "\Myfuncs.hlp"
```

After a Help file is associated with your application, you can call up a particular Help topic in the following situations:

- ♦ When the user presses F1 while a custom worksheet function is selected in the Paste Function dialog box.
- ♦ When the user presses F1 while a UserForm is displayed. The Help topic associated with the control that has the focus is displayed.

Associating a Help topic with a VBA function

If you create custom worksheet functions using VBA, you may want to associate a Help file and context ID with each function. Once these items are assigned to a function, the Help topic can be displayed from the Insert Function dialog box by pressing F1.

To specify a context ID for a custom worksheet function, follow these steps:

1. Create the function as usual.
2. Make sure that your project has an associated Help file (refer to the preceding section).
3. In the VBE, press F2 to activate the Object Browser.
4. Select your project from the Project/Library drop-down list.
5. In the Classes window, select the module that contains your function.
6. In the Members of window, select the function.
7. Right-click the function, and select Properties from the shortcut menu. This displays the Member Options dialog box, as shown in Figure 24-9.

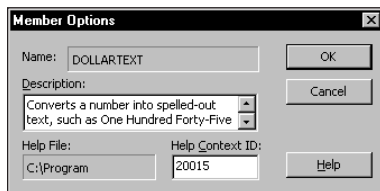


Figure 24-9: Specify a context ID for a custom function in the Member Options dialog box.

8. Enter the context ID of the Help topic for the function. You can also enter a description of the function.

Note

The Member Options dialog box does not let you specify the Help file. It always uses the Help file associated with the project.

You may prefer to write VBA code that sets up the context ID and Help file for your custom functions. You can do this using the `MacroOptions` method. The following procedure uses the `MacroOptions` method to specify a description, Help file, and context ID for two custom functions (`AddTwo` and `Squared`):

```
Sub SetOptions()  
    ' Set options for the AddTwo function  
    Application.MacroOptions Macro="AddTwo", _  
        Description="Returns the sum of two numbers", _  
        HelpFile:=ThisWorkbook.Path & "\Myfuncs.hlp", _  
        HelpContextID=1000  
  
    ' Set options for the Squared function  
    Application.MacroOptions Macro="Squared", _  
        Description="Returns the square of an argument", _  
        HelpFile:=ThisWorkbook.Path & "\Myfuncs.hlp", _  
        HelpContextID=2000  
End Sub
```



A workbook on the companion CD-ROM demonstrates this technique.

Displaying Help from a custom dialog box

Each control on a UserForm — as well as the UserForm itself — can have a Help topic associated with it. The Help file for the topic is the file associated with the project. The type of help provided is determined by the value of the following two UserForm properties:

- ♦ `WhatsThisButton`. If `True`, the UserForm displays a small question mark button in its title bar, like the one in Figure 24-10. The user can click this button and then click a UserForm control to get help regarding the control.
- ♦ `WhatsThisHelp`. If `True`, the help provided for each control is in the form of a small pop-up window that displays the Help topic's title only.

The `WhatsThisHelp` property must be `True` for the `WhatsThisButton` property to be `True`. In other words, only three combinations of values for `WhatsThisHelp` and `WhatsThisButton` are possible. Table 24-1 summarizes the effects of various settings.

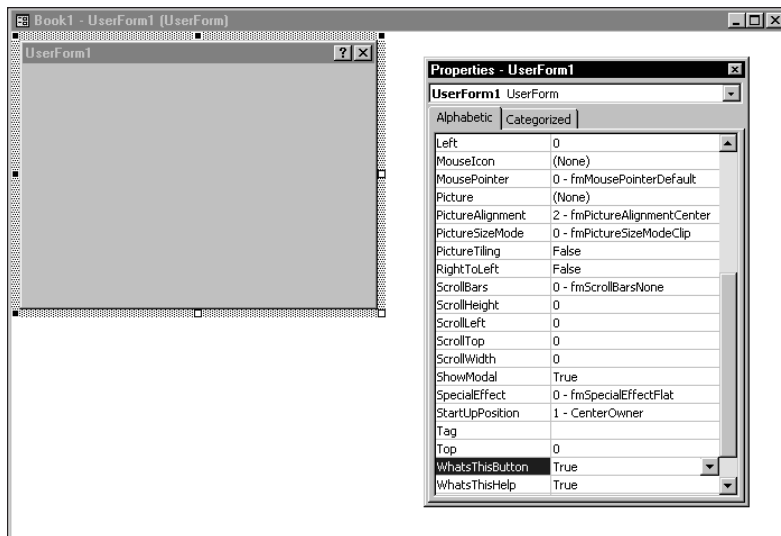


Figure 24-10: A `WhatThisButton` setting of `True` brings up a small question mark button.

Table 24-1
Settings for `WhatThisHelp` and `WhatThisButton` Properties

<i>WhatThisHelp</i>	<i>WhatThisButton</i>	<i>Result</i>
True	True	Question mark button is displayed; F1 gives pop-up help.
True	False	No question mark button is displayed; F1 gives pop-up help.
False	False	No question mark button is displayed; F1 gives full help.



A workbook that demonstrates these settings is available on the companion CD-ROM.

Other Ways of Displaying WinHelp or HTML Help

VBA provides several different ways to display specific Help topics. I describe these in the following sections.

Using the Help method

Use the `Help` method of the `Application` object to display a Help file—either a WinHelp HLP file or an HTML Help CHM file. This method works even if the Help file doesn't have any context IDs defined.

The syntax for the `Help` method is as follows:

```
Application.Help(helpFile, helpContextID)
```

Both arguments are optional. If the name of the Help file is omitted, Excel's Help file is displayed. If the context ID argument is omitted, the specified Help file is displayed with the default topic.

The following example displays the default topic of `Myapp.hlp`, which is assumed to be in the same directory as the workbook that it's called from. Note that the second argument is omitted.

```
Sub ShowHelpContents()  
    Application.Help ThisWorkbook.Path & "\Myapp.hlp"  
End Sub
```

The following instruction displays the Help topic with a context ID of 1002 from an HTML Help file named `Myapp.chm`:

```
Application.Help ThisWorkbook.Path & "\Myapp.chm", 1002
```

Displaying Help from a message box

When you use VBA's `MsgBox` function to display a message box, you include a Help button by adding the `vbMsgBoxHelpButton` constant to the function's second argument. You'll also need to include the Help filename as its fourth argument. The context ID (optional) is its fifth argument. The following code, for example, generates the message box shown in Figure 24-11:

```

Sub MsgBoxHelp()
    Msg = "Do you want to exit now?"
    Buttons = vbQuestion + vbYesNo + vbMsgBoxHelpButton
    HelpFile = ThisWorkbook.Path & "\AppHelp.hlp"
    ContextID = 1002
    Ans = MsgBox(Msg, Buttons, . HelpFile, ContextID)
    If Ans = vbYes Then Call CloseDown
End Sub

```

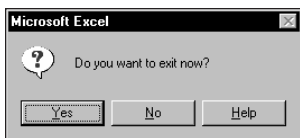


Figure 24-11: A message box with a Help button

Displaying Help from an input box

VBA's `InputBox` function can also display a Help button if its sixth argument contains the Help filename. The following example produces the `InputBox` shown in Figure 24-12:

```

Sub ShowInputBox()
    Msg = "Enter a value"
    DefaultVal = 0
    HFile = ThisWorkbook.Path & "\AppHelp.hlp"
    ContextID = 1002
    x = InputBox( _
        Prompt:=Msg, _
        Default:=DefaultVal, _
        HelpFile:=HFile, _
        Context:=ContextID)
End Sub

```



Figure 24-12: An `InputBox` with a Help button

Summary

In this chapter, I presented several alternative methods of providing online help for end users, including “official” help systems (WinHelp or HTML Help) and “unofficial” help systems that use Excel-specific techniques to display help.

The next chapter wraps up Part VI by providing an example of a user-oriented application.



Developing User-Oriented Applications

In this chapter, I attempt to pull together some of the information presented in the previous chapters. This discussion centers around a user-oriented application called the Loan Amortization Wizard. Useful in its own right, this workbook demonstrates quite a few important application development techniques.

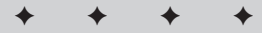
What Is a User-Oriented Application?

I reserve the term *user-oriented application* for an Excel application that can be used by someone with minimal training. These applications produce useful results even for users who know virtually nothing about Excel.

The Loan Amortization Wizard discussed in this chapter qualifies as a user-oriented application because it's designed in such a way that the end user doesn't need to know the intimate details of Excel to use it. Replying to a few simple prompts produces a useful and flexible worksheet complete with formulas.

The Loan Amortization Wizard

The Loan Amortization Wizard generates a worksheet that contains an amortization schedule for a fixed-rate loan. An amortization schedule projects month-by-month details for a loan. The details include the monthly payment amount, the amount of the payment that goes toward interest, the amount that goes toward reducing the principal, and the new loan balance.



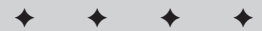
In This Chapter

A description of a user-oriented application

A close look at the Loan Amortization Wizard, which generates a worksheet with an amortization schedule for a fixed-rate loan

A demonstration of application development concepts and techniques by the Loan Amortization Wizard

An application development checklist



An alternative, of course, is to create a template file (*.XLT). As you'll see, this "wizard" approach offers several advantages.

Figure 25-1 shows an amortization schedule generated by the Loan Amortization Wizard.



The Loan Amortization Wizard is available on the CD-ROM that accompanies this book. It's an unprotected add-in.

Using the application

The Loan Amortization Wizard consists of a five-step dialog box sequence that collects information from the user. Typical of a wizard, this enables the user to go forward and backward through the steps. Clicking the Finish button creates the new worksheet.

This application uses a single UserForm with a MultiPage control to display the five steps, shown in Figures 25-2 through 25-6.

Book2							
	A	B	C	D	E	F	G
1	Amortization Schedule						
2	Prepared by Joan Mitchell						
3	Generated Wednesday, February 21, 2001						
4							
5	Purchase Price:		\$279,000.00				
6	Down Pmt Pct:		10.00%				
7	Down Pmt:		\$27,900.00				
8	Loan Amount:		\$251,100.00				
9	Term (Months):		360				
10	Interest Rate:		8.42%				
11	First Payment:		6/1/2001				
12							
13	Pmt No.	Year	Month	Payment	Interest	Principal	Balance
14	1	2001	6	\$1,916.52	\$1,761.89	\$154.64	\$250,945.36
15	2	2001	7	\$1,916.52	\$1,760.80	\$155.72	\$250,789.64
16	3	2001	8	\$1,916.52	\$1,759.71	\$156.82	\$250,632.82
17	4	2001	9	\$1,916.52	\$1,758.61	\$157.92	\$250,474.91
18	5	2001	10	\$1,916.52	\$1,757.50	\$159.02	\$250,315.88
19	6	2001	11	\$1,916.52	\$1,756.38	\$160.14	\$250,155.74
20	7	2001	12	\$1,916.52	\$1,755.26	\$161.26	\$249,994.48
21	2001 Total			\$13,415.66	\$12,310.14	\$1,105.52	\$249,994.48
22	8	2002	1	\$1,916.52	\$1,754.13	\$162.40	\$249,832.08
23	9	2002	2	\$1,916.52	\$1,752.99	\$163.53	\$249,668.55
24	10	2002	3	\$1,916.52	\$1,751.84	\$164.68	\$249,503.87
25	11	2002	4	\$1,916.52	\$1,750.69	\$165.84	\$249,338.03
26	12	2002	5	\$1,916.52	\$1,749.52	\$167.00	\$249,171.03
27	13	2002	6	\$1,916.52	\$1,748.35	\$168.17	\$249,002.85
28	14	2002	7	\$1,916.52	\$1,747.17	\$169.35	\$248,833.50

Figure 25-1: This amortization schedule shows details for a 30-year mortgage loan.



Figure 25-2: Step 1 of the Loan Amortization Wizard

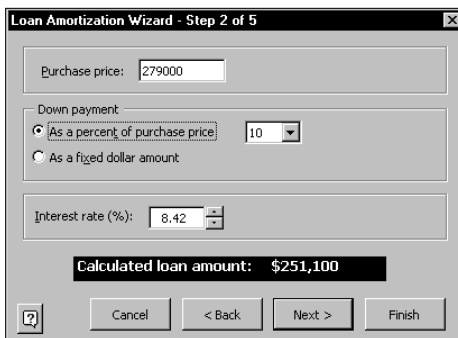


Figure 25-3: Step 2 of the Loan Amortization Wizard



Figure 25-4: Step 3 of the Loan Amortization Wizard



Figure 25-5: Step 4 of the Loan Amortization Wizard



Figure 25-6: Step 5 of the Loan Amortization Wizard

The workbook structure

The Loan Amortization Wizard consists of the following components:

FormMain	A UserForm that serves as the primary user interface.
FormHelp	A UserForm that displays online help.
HelpSheet	A worksheet that contains the text used in the online help.
ModMain	A VBA module that contains a procedure that displays the main UserForm.
ThisWorkbook	The code module for this object contains the event-handler procedures <code>Workbook_Open</code> and <code>Workbook_BeforeClose</code> , which create and delete a menu item, respectively.

Creating the Loan Amortization Wizard

The Loan Amortization Wizard application started out as a simple concept and evolved into a relatively complex project. My primary goal was to demonstrate as many development concepts as possible and still have a useful end product. I would like to say that I clearly envisioned the end result before I began developing the application, but I'd be lying.

My basic idea was much less ambitious. I simply wanted to create an application that gathered user input and created a worksheet. But after I got started, I began thinking of ways to enhance my simple program. I eventually stumbled down several blind alleys. Some folk may consider my wanderings time-wasting, but those false starts became a vital part of the development process.

I completed the entire project in one (long) day, and I spent a few more hours fine-tuning and testing it.

How it works

The Loan Amortization Wizard is an add-in, so it should be installed using the Tools ⇨ Add-Ins command. It works equally well, however, if it's opened with the File ⇨ Open command.

Adding the menu item

When the workbook is opened, the `Workbook_Open` procedure adds a new Loan Amortization Wizard menu item to the Tools menu. Clicking this menu item executes the `StartAmortizationWizard` procedure, which simply displays the `FormMain UserForm`.



Refer to Chapter 23 for information about creating new menu items.

Initializing FormMain

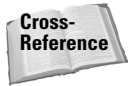
The `UserForm_Initialize` procedure for `FormMain` does quite a bit of work:

- ♦ It sets the `MultiPage` control's `Value` property to 0. This ensures that it displays the first page, regardless of its value when the workbook was last saved.
- ♦ It adds items to three `ComboBox` controls used on the form.
- ♦ It calls the `GetDefaults` procedure, which retrieves the most recently used setting from the Windows Registry (see “Saving and retrieving default settings” later in this section).
- ♦ It checks to see whether a workbook is active. If not, the code disables the `OptionButton` that enables the user to create the new worksheet in the active workbook.

- ♦ If a workbook is active, an additional check determines whether the workbook's structure is protected. If so, the procedure disables the `OptionButton` that enables the user to create the worksheet in the active workbook.

Processing events while the UserForm is displayed

The code module for the `FormMain` `UserForm` contains several event-handler procedures that respond to the `Click` and `Change` events for the controls on the `UserForm`.



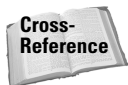
Clicking the `Back` and `Next` buttons determines which page of the `MultiPage` control is displayed. The `MultiPage1_Change` procedure adjusts the `UserForm`'s caption and enables and disables the `Back` and `Next` buttons as appropriate. See Chapter 15 for more information about programming a wizard.

Displaying help

You have several options when it comes to displaying online help. I chose a simple technique that employs the `UserForm` shown in Figure 25-7 to display text stored in a worksheet. You'll notice that this help is context sensitive. When the user clicks the `Help` button, the help topic displayed is relevant to the current page of the `MultiPage` control.



Figure 25-7: User help is presented in a `UserForm` that copies text stored in a worksheet.



For more information about the technique of transferring worksheet text to a `UserForm`, consult Chapter 24.

Creating the new worksheet

Clicking the `Finish` button kicks off all the excitement. The `Click` event-handler procedure for this button performs the following actions:

- ♦ It calls a function named `DataIsValid`, which checks the user's input to ensure that it's valid. If all the entries are valid, the function returns `True`, and the procedure continues. If an invalid entry is encountered, `DataIsValid` sets the focus to the control that needs to be corrected and returns a descriptive error message (see Figure 25-8).



Figure 25-8: If an invalid entry is made, the focus is set back to the control that contains the error.

- ♦ If the user's responses are valid, the procedure creates a new worksheet either in the active workbook or in a new workbook, per the user's request.
- ♦ The loan parameters (purchase price, down payment information, loan amount, term, and interest rate) are written to the worksheet. This requires the use of some `If` statements because the down payment can be expressed as a percentage of the purchase price or as a fixed amount.
- ♦ The column headers are written to the worksheet.
- ♦ The first row of formulas is written below the column headers. The first row is different from the remaining rows because its formulas refer to data in the loan parameters section. The other formulas all refer to the previous row. Notice that I use named ranges in the formulas. These are sheet-level names, so the user can store more than one amortization schedule in the same workbook.
- ♦ For unnamed references, I use `R1C1` notation, which is much easier than trying to determine actual cell addresses!
- ♦ The second row of formulas is written to the worksheet and then copied down one row for each month.
- ♦ If the user requested annual totals as opposed to simply monthly data, the procedure uses the `Subtotal` method to create subtotals. This, by the way, is an example of how using a native feature in Excel can save *lots* of coding!
- ♦ Because subtotaling the Balance column isn't appropriate, the procedure replaces formulas in the balance column with a formula that returns the year-end balance.
- ♦ When Excel adds subtotals, it also creates an outline. If the user didn't request an outline, the procedure uses the `ClearOutline` method to remove it. If an outline was requested, the procedure hides the outline symbols.
- ♦ Next, the procedure applies formatting to the cells: number formatting, plus an `AutoFormat` if the user requested color output.

- ♦ The procedure then adjusts the column widths, freezes the titles just below the header row, and protects the formulas and a few other key cells that can't be changed. The sheet is protected, but not with a password.
- ♦ Finally, the `SaveDefaults` procedure writes the current values of the `UserForm`'s controls to the Windows Registry. These values will be the new default settings the next time the user creates an amortization schedule (see "Saving and retrieving default settings," next).

Saving and retrieving default settings

If you run this application, you'll notice that the `FormMain` `UserForm` always displays the setting that you most recently used. In other words, it "remembers" your last choices and uses them as the new default values. This step makes it very easy to generate multiple "what-if" amortization schedules that vary in only a single parameter. This is accomplished by storing the values in the Windows Registry and then retrieving them when the `UserForm` is initialized. When the application is used for the first time, the Registry doesn't have any values, so it uses the default values stored in the `UserForm` controls.

The following `GetDefaults` procedure loops through each control on the `UserForm`. If the control is a `TextBox`, `ComboBox`, `OptionButton`, `CheckBox`, or `SpinButton`, it calls VBA's `GetSetting` function and reads the value to the Registry. Note that the third argument for `GetSetting` is the value to use if the setting is not found. In this case, it uses the value of the control specified at design time. `APPNAME` is a global constant that contains the name of the application.

```
Sub GetDefaults()  
' Reads default settings from the registry  
Dim ctl As Control  
Dim CtrlType As String  
  
For Each ctl In Me.Controls  
    CtrlType = TypeName(ctl)  
    If CtrlType = "TextBox" Or _  
        CtrlType = "ComboBox" Or _  
        CtrlType = "OptionButton" Or _  
        CtrlType = "CheckBox" Or _  
        CtrlType = "SpinButton" Then  
        ctl.Value = GetSetting _  
            (APPNAME, "Defaults", ctl.Name, ctl.Value)  
    End If  
Next ctl  
End Sub
```

Figure 25-9 shows how these values appear in the Registry, from the perspective of the Windows Registry Editor program.

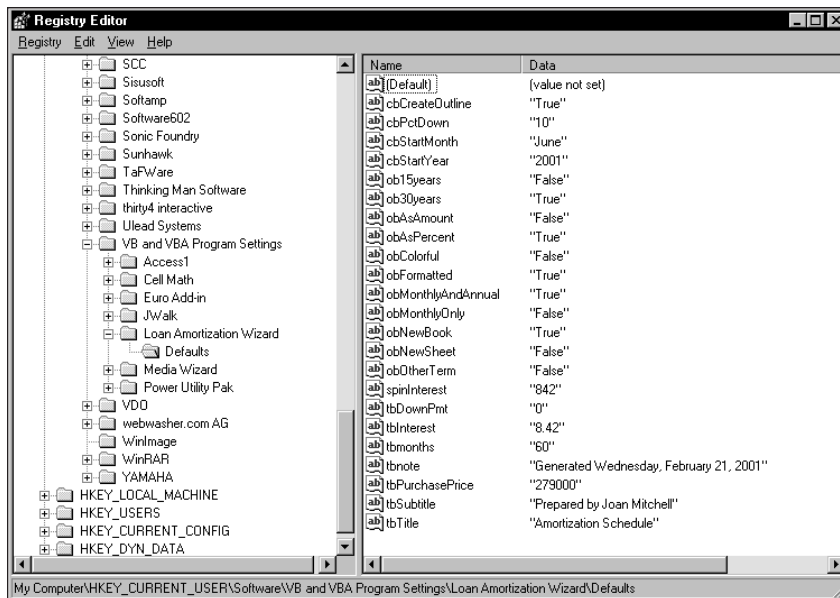


Figure 25-9: The Windows Registry stores the default values for the wizard.

The following `SaveDefaults` procedure is similar. It uses VBA's `SaveSetting` statement to write the current values to the Registry.

```
Sub SaveDefaults()
' Writes current settings to the registry
Dim ctl As Control
Dim CtrlType As String

For Each ctl In Me.Controls
    CtrlType = TypeName(ctl)
    If CtrlType = "TextBox" Or _
        CtrlType = "ComboBox" Or _
        CtrlType = "OptionButton" Or _
        CtrlType = "CheckBox" Or _
        CtrlType = "SpinButton" Then
        SaveSetting APPNAME, _
            "Defaults", ctl.Name, ctl.Value
    End If
Next ctl
End Sub
```

The `SaveSetting` statement and the `GetSetting` function always use the following Registry key:

```
HKEY_CURRENT_USER\Software\VB and VBA Program Settings\
```

Potential enhancements

It's been said that you never finish writing an application — you just stop working on it. Without even thinking too much about it, I can come up with several enhancements for the Loan Amortization Wizard:

- ♦ Add an option to display cumulative totals for interest and principal.
- ♦ Add an option to work with adjustable rate loans and make projections based on certain interest rate scenarios.
- ♦ Add more formatting options (for example, no decimal places, no dollar signs, and so on).
- ♦ Add options to enable the user to specify page headers or footers.

Application Development Concepts

It's often difficult to follow the logic in an application developed by someone other than yourself. To help you understand my work, I included lots of comments in the code and described the general program flow in the preceding sections. But if you really want to understand this application, I suggest that you use the Debugger to step through the code.

At the very least, the Loan Amortization Wizard demonstrates some useful techniques and concepts that are important for Excel developers:

- ♦ Creating a custom menu item that's displayed only when a particular workbook (or add-in) is open
- ♦ Using a wizardlike UserForm to gather information
- ♦ Setting the `Enabled` property of a control dynamically
- ♦ Linking a `TextBox` and a `SpinButton` control
- ♦ Displaying online help to a user
- ♦ Naming cells with VBA
- ♦ Writing and copying formulas with VBA
- ♦ Reading from and writing to the Windows Registry

Some Final Words

Developing user-oriented applications in Excel is not easy. You must be keenly aware of how people will use (and abuse) the application in real life. Although I tried to make this application completely bulletproof, I did not do extensive real-world testing, so I wouldn't be surprised if it fails under some conditions.

Application Development Checklist

When developing user-oriented applications, you need to keep in mind many things. Let the following checklist serve as a reminder:

- ♦ *Did you clean up after yourself?* Make sure that you restore toolbars and menus to their original state when the application ends.
- ♦ *Do the dialog boxes all work from the keyboard?* Don't forget to add hot keys and check the tab order carefully.
- ♦ *Did you make any assumptions about directories?* If your application reads or writes files, you can't assume that a particular directory exists or that it's the current directory.
- ♦ *Did you make provisions for canceling all dialog boxes?* You can't assume that the user will end a dialog box by clicking the OK button.
- ♦ *Did you assume that no other worksheets are open?* If your application is the only workbook open during testing, you may overlook something that happens when other workbooks are open.
- ♦ *Did you assume that a workbook was visible?* It's possible, of course, to use Excel with no workbooks visible.
- ♦ *Did you attempt to optimize the speed of your application?* For example, you often can speed up your application by declaring variable types and defining object variables.
- ♦ *Are your procedures adequately documented?* Will you understand your code if you revisit it in six months?
- ♦ *Did you include appropriate end-user documentation?* Doing so often eliminates (or at least reduces) the number of follow-up questions.
- ♦ *Did you allow time to revise your application?* Chances are, the application won't be perfect the first time out. Build in some time to fix it.

Summary

In this chapter, I described a relatively complex user-oriented application that creates a worksheet based on user-specified options.

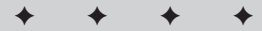
This chapter concludes Part VI. Chapters in the next part cover a variety of topics that you may find helpful, including compatibility issues, manipulating text files with VBA, modifying VBA components, and class modules.



VIII

Other Topics

The five chapters in this part cover additional topics that you may find helpful. Chapter 26 presents information regarding compatibility. In Chapter 27, I discuss various ways to use VBA to work with files. In Chapter 28, I explain how to use VBA to manipulate Visual Basic components such as UserForms and modules. Chapter 29 covers the topic of class modules. I finish the part with a useful chapter that answers many common questions about Excel programming.



In This Part

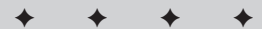
Chapter 26
Compatibility Issues

Chapter 27
Manipulating Files
with VBA

Chapter 28
Manipulating Visual
Basic Components

Chapter 29
Understanding Class
Modules

Chapter 30
Frequently Asked
Questions about
Excel Programming



Compatibility Issues

If the applications that you've developed using Excel 2002 will be used only by others who also use the same version of Excel, you can skip this chapter. But if your application also needs to run on earlier versions of Excel, Excel for Macintosh, or international versions of Excel, you must know about some potential issues. These issues are the topic of this chapter.

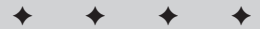
What Is Compatibility?

Compatibility is an often-used term among computer people. In general, it refers to how well software performs under various conditions. These conditions may be defined in terms of hardware, software, or a combination of the two. For example, software that is written specifically for a 32-bit operating system such as Windows XP will not run under the older 16-bit versions of Windows 3.x. In other words, 32-bit applications are not compatible with Windows 3.x. And, as I'm sure you realize, software written for Windows will not run on other operating systems, such as Macintosh or Linux.

In this chapter, I discuss a more specific compatibility issue, involving how your Excel 2002 applications will work with earlier versions of Excel for Windows and Excel for Macintosh. The fact that two versions of Excel may use the same file format isn't always enough to ensure complete compatibility between the contents of their files. For example, Excel 97, Excel 2000, Excel 2002, and Excel 98 for Macintosh all use the same file format — but compatibility issues are rampant. Just because a particular version of Excel can open a worksheet file or an add-in doesn't guarantee that that version of Excel can carry out the VBA macro instructions contained in it.

26

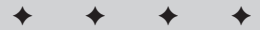
CHAPTER



In This Chapter

How to make sure your Excel 2002 applications will also work with previous versions of Excel

Issues to be aware of if you're developing Excel applications for international use



The compatibility problem is more serious than you may think. You can run into compatibility problems even within the same major version of Excel. For example, Excel 2000 exists in at least three different sub-versions: the original release, the “service release” known as SR-1, plus another service release, SR-1a. The service releases fixed some bugs and also introduced a few subtle changes. Therefore, you can’t be guaranteed that an application developed using the original release of Excel 2000 will perform flawlessly with Excel 2000 SR-1.

The point here is that Excel is a moving target and there is really no way that you can guarantee complete compatibility. Unfortunately, cross-version compatibility doesn’t happen automatically. In most cases, you need to do quite a bit of additional work to achieve compatibility.

Types of Compatibility Problems

You need to be aware of five categories of potential compatibility problems. These are listed here and discussed further in this chapter:

- ♦ *File format issues.* Workbooks can be saved in several different Excel file formats. Excel may not be able to open workbooks that were saved in a later version file format.
- ♦ *New feature issues.* It should be obvious that a feature introduced in a particular version of Excel cannot be used in previous versions of Excel.
- ♦ *32-bit vs. 16-bit issues.* If you use Windows API calls, you need to pay attention to this issue if your application must work with 16-bit versions of Excel (such as Excel 5).
- ♦ *Windows vs. Macintosh issues.* If your application must work on both platforms, plan to spend lots of time ironing out various compatibility problems.
- ♦ *International issues.* If your application will be used by those who speak another language, you must address a number of additional issues.

After reading this chapter, it should be clear that there is only one way to ensure compatibility: You must test your application on every target platform and with every target version of Excel. Often, this is simply not feasible. However, there are measures that you, as a developer, can take to help ensure that your application works with different versions of Excel.

**Note**

If you’re reading this chapter in search of a complete list of specific compatibility issues among the various versions of Excel, you will be disappointed. As far as I know, no such list exists and it would be virtually impossible to compile one. These types of issues are far too numerous and complex.

**Tip**

A good source for information about potential compatibility problems is Microsoft's online Knowledge Base. The URL is:

<http://search.support.microsoft.com>

This will often help you identify bugs that appear in a particular version of Excel.

Excel File Formats Supported

As you probably know, Excel allows you to save a workbook in a format for earlier versions. In addition, you can save a workbook in a “dual-version” format that combines two file formats in a single file. These dual-version formats result in a larger file.

If your application must work with earlier versions of Excel, you will need to make sure your file is saved in the appropriate file format. The various Excel file formats that can be saved by Excel 2002 are:

- ♦ *Microsoft Excel Workbook (*.xls)*. The standard Excel 2002 file format. Can be opened by Excel 97, Excel 2000, and Excel 2002.
- ♦ *Microsoft Excel 5.0/95 Workbook*. A format that can be opened by Excel 5.0 and later versions.
- ♦ *Microsoft Excel 97-2000 & 5.0/95 Workbook*. A dual format that can be opened by Excel 5 and later versions.
- ♦ *Microsoft Excel 4.0 Worksheet (*.xls)*. Can be opened by Excel 4 and later versions. This format saves a single sheet only.
- ♦ *Microsoft Excel 3.0 Worksheet (*.xls)*. Can be opened by Excel 3 and later versions. This format saves a single sheet only.
- ♦ *Microsoft Excel 2.1 Worksheet (*.xls)*. Can be opened by Excel 2.1 and later versions. This format saves a single sheet only.
- ♦ *Microsoft Excel 4.0 Workbook (*.xlw)*. Can be opened by Excel 4.0 and later versions. This format saves multisheet files, but they are not the same format as Excel 5 workbooks.

You can use VBA to access the `FileFormat` property of the `Workbook` object to determine the file format for a particular workbook. The instruction that follows, for example, displays a value that represents the file format for the active workbook:

```
MsgBox ActiveWorkbook.FileFormat
```

Predefined constants are available for the `FileFormat` property. For example, the statement that follows displays `True` if the active workbook is an Excel 5 file:

```
MsgBox ActiveWorkbook.FileFormat = xlExcel5
```

Table 26-1 lists the constants and values for various Excel file formats.

<i>Excel version</i>	<i>Constant</i>	<i>Value</i>
Excel 2.1	<code>xlExcel2</code>	16
Excel 3.0	<code>xlExcel3</code>	29
Excel 4.0	<code>xlExcel4Workbook</code>	35
Excel 5	<code>xlExcel5</code>	39
Excel 95/97	<code>xlExcel9795</code>	43
Excel in HTML format	<code>xlHtml</code>	44
Excel add-in	<code>xlAddIn</code>	18
Excel 97/2000/2002	<code>xlWorkbookNormal</code>	-4143

Avoid Using New Features

If your application must work with Excel 2002 and earlier versions, you will need to avoid any features that were added after the earliest Excel version that you will support. Another alternative is to incorporate the new features selectively. In other words, your code can determine which version of Excel is being used, and either take advantage of the new features or not.

VBA programmers must be careful not to use any objects, properties, or methods that aren't available in earlier versions. In general, the safest approach is to develop your application with the "lowest common denominator." For compatibility with Excel 95, Excel 97, and Excel 2000, you should use Excel 95 for development, and then test thoroughly using the other versions.

If your application must support Excel 95, you can't use any `UserForms`—which were introduced in Excel 97. Rather, you will need to use dialog sheets.

Determining Excel's Version Number

The `Version` property of the `Application` object returns the version of Excel. The returned value is a string, so you may need to convert it to a value. VBA's `Val` function is perfect for this. The following function, for example, returns `True` if the user is running Excel 2002 or later (Excel 2002 is version 10):

```
Function XL100rLater()  
    XL100rLater = Val(Application.Version) >= 10  
End Function
```

Applications That Use Windows API Calls

Excel 95 and later versions are all 32-bit programs. Excel 5, however, is a 16-bit program. This “bitness” determines which operating system Excel can run under. Excel 5 can run on 16-bit Windows 3.x, as well as 32-bit versions of Windows. The 32-bit versions of Excel run only on 32-bit versions of Windows.

This becomes important when your VBA code uses API function calls, since 32-bit Windows API functions are declared differently than 16-bit Windows API functions. Therefore, an Excel 5 application that uses 16-bit Windows API functions will not work with Excel 95 or later. Similarly, an Excel 95 (or later) application that uses 32-bit Windows API functions will not work with Excel 5.

For compatibility with Excel 5 through Excel 2002, you need to declare both the 16-bit and 32-bit version of the API functions in your module. Then your code will need to determine which version of Excel is running and call the appropriate function.

Following is an example of a procedure that utilizes API function calls, and that works with both Excel 5 and later versions. The `Declare` statements for this example appear in the following:

```
' 32-bit API declaration  
Declare Function GetSystemMetrics32 Lib "user32" _  
    Alias "GetSystemMetrics" (ByVal nIndex As Long) As Long  
  
' 16-bit API declaration  
Declare Function GetSystemMetrics16 Lib "user" _  
    Alias "GetSystemMetrics" (ByVal nIndex As Integer) _  
    As Integer
```

I declared the 32-bit version and the 16-bit version of the API function. Note the use of the keyword `Alias`. This precedes the actual name of the function in the Windows API, which are identical here. I declared these functions with different names to distinguish them from one another.

The `DisplayVideoInfo` procedure, which follows, displays the video resolution of the user's system:

```
Sub DisplayVideoInfo()
    Const SM_CXSCREEN = 0
    Const SM_CYSCREEN = 1

    If Val(Application.Version) > 5 Then
        ' 32-bit Excel
        vidWidth = GetSystemMetrics32(SM_CXSCREEN)
        vidHeight = GetSystemMetrics32(SM_CYSCREEN)
    Else
        ' 16-bit Excel
        vidWidth = GetSystemMetrics16(SM_CXSCREEN)
        vidHeight = GetSystemMetrics16(SM_CYSCREEN)
    End If

    Msg = "The current video mode is: "
    Msg = Msg & vidWidth & " X " & vidHeight
    MsgBox Msg
End Sub
```

Here, I used the expression `Val(Application.Version) > 5` to determine whether Excel is 16-bit or 32-bit. If the expression returns `True`, the code calls the 32-bit function; otherwise, it calls the 16-bit function.

But Will It Work on a Mac?

One of the most prevalent problems I hear about concerns Macintosh compatibility. Excel for Macintosh represents a very small proportion of the total Excel market, and many developers choose to simply ignore it. The good news is that Excel files are compatible across both platforms. The bad news is that the features supported are not identical, and VBA macro compatibility is far from perfect.

You can write VBA code to determine which platform your application is running on. The following function accesses the `OperatingSystem` property of the `Application` object and returns `True` if the operating system is any version of Windows (that is, if the returned string contains the text "Win"):

```
Function WindowsOS() As Boolean
    If Application.OperatingSystem like "*Win*" Then
        WindowsOS = True
    Else
        WindowsOS = False
    End If
End Function
```


Many subtle (and not so subtle) differences exist between the Windows versions and the Mac versions of Excel. Many of those differences are cosmetic (for example, different default fonts), but others are much more serious. For example, Excel for Macintosh doesn't include ActiveX controls, and it uses "1904" as the default date system, so workbooks that use dates may be off by four years. Excel for Windows, by default, uses the 1900 date system. On the Macintosh, a date serial number of 1 refers to January 1, 1904; in Excel for Windows, that same serial number represents January 1, 1900.

Another limitation concerns Windows API calls: They won't work with Excel for Macintosh. If your application depends on such functions, you need to develop a workaround.

If your code deals with paths and filenames, you need to construct your path with the appropriate path separator (a colon for the Macintosh, a backslash for Windows). A better approach is to avoid hard-coding the path separator character and use VBA to determine it. The following statement assigns the path separator character to a variable named `PathSep`:

```
PathSep = Application.PathSeparator
```

After this statement is executed, your code can use the `PathSep` variable in place of a hard-coded colon or backslash.

Rather than try to make a single file compatible with both platforms, most developers choose to develop on one platform (typically Excel for Windows) and then modify the application so that it works on the Mac platform. In other words, you'll probably need to maintain two separate versions of your application.

There is only one way to make sure that your application is compatible with the Macintosh version of Excel: You must test it thoroughly on a Macintosh. And be prepared to develop some workarounds for routines that don't work correctly.

Creating an International Application

The final compatibility issue deals with language issues and international settings. Excel is available in many different language versions. The following statement displays the country code for the version of Excel:

```
MsgBox Application.International(xlCountryCode)
```

The United States/English version of Excel has a country code of 1. Other country codes are listed in Table 26-2.

Table 26-2
Excel Country Codes

<i>Language</i>	<i>Country code</i>
English	1
Russian	7
Greek	30
Dutch	31
French	33
Spanish	34
Hungarian	36
Italian	39
Czech	42
Danish	45
Swedish	46
Norwegian	47
Polish	48
German	49
Portuguese (Brazil)	55
Thai	66
Japanese	81
Korean	82
Vietnamese	84
Simplified Chinese	86
Turkish	90
Indian	91
Urdu	92
Portuguese	351
Finnish	358
Traditional Chinese	886
Arabic	966
Hebrew	972
Farsi	982

If your application will be used by those who speak another language, you need to ensure that the proper language is used in your dialog boxes. Also, you need to identify the user's decimal and thousands separator characters. In the United States, these are almost always a period and a comma. But users in other countries may have their systems set up to use other characters. Yet another issue is date and time formats. The United States is one of the few countries that use the month/date/year format.

If you're developing an application that will be used only by people with your company, you probably won't need to be concerned with international compatibility. But if your company has offices throughout the world, or if you plan to distribute your application outside your country, you need to address a number of issues to ensure that your application will work properly. I discuss these issues in this section.

Multilanguage applications

An obvious consideration involves the language that is used in your application. For example, if you use one or more dialog boxes, you may want the text to appear in the language of the user. Fortunately, this is not too difficult (assuming, of course, that you can translate your text or know someone who can).



The companion CD-ROM contains a dialog box wizard that is set up to use any of three languages: English, Spanish, or German. This example is based on a dialog box example presented in Chapter 14.

The first step of the wizard contains three `OptionButtons` that enable the user to select a language. The text for the three languages is stored in a worksheet.

Figures 26-1 through 26-3 show the `UserForm` displaying text in all three languages.

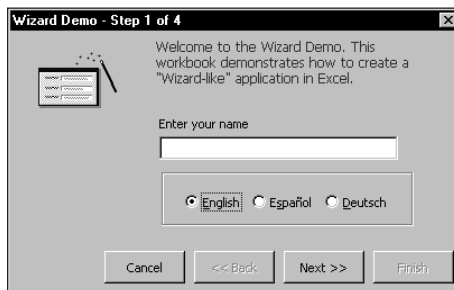


Figure 26-1: The Wizard Demo, in English

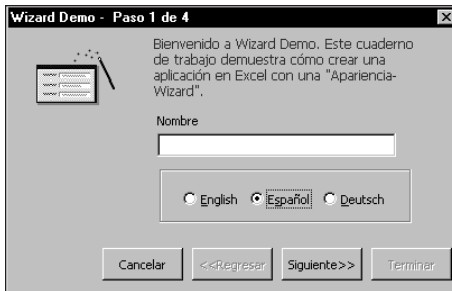


Figure 26-2: The Wizard Demo, in Spanish



Figure 26-3: The Wizard Demo, in German

VBA language considerations

In general, you need not be concerned with the language that you write your VBA code in. Excel uses two object libraries: the Excel object library and the VBA object library. When you install Excel, it registers the English language version of these object libraries as the default libraries (this is true regardless of the language version of Excel).

Using “local” properties

If your code will display worksheet information such as a range address, you probably want to use the local language. For example, the following statement displays the address of the selected range:

```
MsgBox Selection.Address
```

For international applications, a better approach is to use the `AddressLocal` property rather than the `Address` property:

```
MsgBox Selection.AddressLocal
```

An even better approach is to ensure that the reference style (A1 or R1C1) matches the style that the user has selected. This can be accomplished with the following statement:

```
MsgBox Selection.AddressLocal _
    (ReferenceStyle:=Application.ReferenceStyle)
```

Several other properties also have “local” versions. These are shown in Table 26-3 (refer to the online help for details).

Table 26-3
Properties That Have “Local” Versions

<i>Property</i>	<i>“Local” version</i>	<i>Return contents</i>
Address	AddressLocal	An address
Category	CategoryLocal	A function category
Formula	FormulaLocal	A formula
Name	NameLocal	A name
NumberFormat	NumberFormatLocal	A number format
RefersTo	RefersToLocal	A reference

Identifying system settings

Generally, you cannot assume that the end user’s system is set up like the system on which you develop your application. For international applications, you may need to be aware of the following settings:

- Decimal separator The character used to separate the decimal portion of a value.
- Thousands separator The character used to delineate every three digits in a value.
- List separator The character used to separate items in a list.

You can determine the current separator settings by accessing the `International` property of the `Application` object. For example, the following statement displays the decimal separator, which won’t always be a period:

```
MsgBox Application.International(xlDecimalSeparator)
```

There are 45 international settings that you can access with the `International` property. These are listed in Table 26-4.

Table 26-4
Constants for the International Property

Constant	What it returns
<code>xlCountryCode</code>	Country version of Microsoft Excel.
<code>xlCountrySetting</code>	Current country setting in the Windows Control Panel.
<code>xlDecimalSeparator</code>	Decimal separator.
<code>xlThousandsSeparator</code>	Zero or thousands separator.
<code>xlListSeparator</code>	List separator.
<code>xlUpperCaseRowLetter</code>	Uppercase row letter (for R1C1-style references).
<code>xlUpperCaseColumnLetter</code>	Uppercase column letter.
<code>xlLowerCaseRowLetter</code>	Lowercase row letter.
<code>xlLowerCaseColumnLetter</code>	Lowercase column letter.
<code>xlLeftBracket</code>	Character used instead of the left bracket ([]) in R1C1-style relative references.
<code>xlRightBracket</code>	Character used instead of the right bracket (]) in R1C1-style references.
<code>xlLeftBrace</code>	Character used instead of the left brace ({} in array literals.
<code>xlRightBrace</code>	Character used instead of the right brace (}) in array literals.
<code>xlColumnSeparator</code>	Character used to separate columns in array literals.
<code>xlRowSeparator</code>	Character used to separate rows in array literals.
<code>xlAlternateArraySeparator</code>	Alternate array item separator to be used if the current array separator is the same as the decimal separator.
<code>xlDateSeparator</code>	Date separator (/).
<code>xlTimeSeparator</code>	Time separator (:).
<code>xlYearCode</code>	Year symbol in number formats (y).
<code>xlMonthCode</code>	Month symbol (m).
<code>xlDayCode</code>	Day symbol (d).
<code>xlHourCode</code>	Hour symbol (h).
<code>xlMinuteCode</code>	Minute symbol (m).
<code>xlSecondCode</code>	Second symbol (s).
<code>xlCurrencyCode</code>	Currency symbol.

Constant	What it returns
<code>xlGeneralFormatName</code>	Name of the General number format.
<code>xlCurrencyDigits</code>	Number of decimal digits to be used in currency formats.
<code>xlCurrencyNegative</code>	A value that represents the currency format for negative currency values.
<code>xlNoncurrencyDigits</code>	Number of decimal digits to be used in noncurrency formats.
<code>xlMonthNameChars</code>	Always returns three characters for backward compatibility. Abbreviated month names are read from Microsoft Windows and can be any length.
<code>xlWeekdayNameChars</code>	Always returns three characters for backward compatibility. Abbreviated weekday names are read from Microsoft Windows and can be any length.
<code>xlDateOrder</code>	An integer that represents the order of date elements.
<code>xl24HourClock</code>	True if the system is using 24-hour time; False if the system is using 12-hour time.
<code>xlNonEnglishFunctions</code>	True if the system is not displaying functions in English.
<code>xlMetric</code>	True if the system is using the metric system; False if the system is using the English measurement system.
<code>xlCurrencySpaceBefore</code>	True if a space is added before the currency symbol.
<code>xlCurrencyBefore</code>	True if the currency symbol precedes the currency values; False if it follows them.
<code>xlCurrencyMinusSign</code>	True if the system is using a minus sign for negative numbers; False if the system is using parentheses.
<code>xlCurrencyTrailingZeros</code>	True if trailing zeros are displayed for zero currency values.
<code>xlCurrencyLeadingZeros</code>	True if leading zeros are displayed for zero currency values.
<code>xlMonthLeadingZero</code>	True if a leading zero is displayed in months (when months are displayed as numbers).
<code>xlDayLeadingZero</code>	True if a leading zero is displayed in days.
<code>xl4DigitYears</code>	True if the system is using four-digit years; False if the system is using two-digit years.
<code>xlMDY</code>	True if the date order is month-day-year for dates displayed in the long form; False if the date order is day-month-year.
<code>xlTimeLeadingZero</code>	True if a leading zero is displayed in times.

Date and time settings

If your application writes formatted dates and will be used in other countries, you might want to make sure that the date is in a format familiar to the user. The best approach is to specify a date using VBA's `DateSerial` function, and let Excel take care of the formatting details (it will use the user's short date format).

The following procedure uses the `DateSerial` function to assign a date to the `StartDate` variable. This date is then written to cell A1 using the local short date format.

```
Sub WriteDate()  
    Dim StartDate As Date  
    StartDate = DateSerial(2001, 2, 15)  
    Range("A1") = StartDate  
End Sub
```

If you need to do any other formatting for the date, you can write code to do so after the date has been entered into the cell. Excel provides several named date and time formats, plus quite a few named number formats. These are all described in the online help (search for *named date/time formats* or *named numeric formats*).

Summary

In this chapter, I discussed some general issues that you must consider if your Excel application must work with earlier versions of Excel, Excel for Macintosh, and foreign language versions of Excel.

The next chapter describes some techniques that let you read and write text files using VBA.



Manipulating Files with VBA

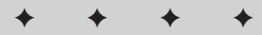
Many applications that you develop for Excel require working with multiple files. For example, you may need to get a listing of files in a directory, delete files, rename files, and so on. Excel, of course, can import and export several types of text files. In many cases, however, Excel's built-in text file handling isn't sufficient. For example, you may need to import a text file that contains more than 256 columns of data. Or, the file may use a nonstandard delimiter such as a backslash. In this chapter, I describe how to use VBA to perform common file operations and work directly with text files.

Performing Common File Operations

Excel provides you with a number of ways to perform common file operations:

- ◆ Use “traditional” VBA statements and functions. This method works for all versions of Excel.
- ◆ Use the `FileSearch` object, which is easier to use, and offers some distinct advantages. This method works for Excel 97 and later.
- ◆ Use the `FileSystemObject`, which makes use of the Microsoft Scripting Library. This method works for Excel 2000 and later.

In the sections that follow, I discuss these three methods and present examples.



In This Chapter

A basic overview of VBA's text file manipulation features

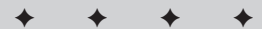
Performing common file operations using both traditional techniques and the `FileSearch` object

Various ways to open a text file

Examples of reading and writing a text file using VBA

Code to import more than 256 columns of data into a workbook

Sample code for exporting a range to HTML format



VBA file-related commands

The VBA commands that you can use to work with files are summarized in Table 27-1.

Command	What it does
ChDir	Changes the current directory
ChDrive	Changes the current drive
Dir	Returns a filename or directory that matches a specified pattern or file attribute
FileCopy	Copies a file
FileDateTime	Returns the date and time a file was last modified
FileLen	Returns the size of a file, in bytes
GetAttr	Returns a value that represents an attribute of a file
Kill	Deletes a file
MkDir	Creates a new directory
Name	Renames a file or directory
Rmdir	Removes an empty directory
SetAttr	Changes an attribute for a file

The remainder of this section consists of examples that demonstrate some of the file manipulation commands.

Determining whether a file exists

The following function returns True if a particular file exists, and False if it does not exist. If the Dir function returns an empty string, the file could not be found, so the function returns False.

```
Function FileExists(fname) As Boolean
    If Dir(fname) <> "" Then _
        FileExists = True _
    Else FileExists = False
End Function
```

The argument for the `FileExists` function consists of a full path and filename. The function can be used in a worksheet, or called from a VBA procedure.

Determining whether a path exists

The following function returns `True` if a specified path exists, and `False` otherwise:

```
Function PathExists(pname) As Boolean
' Returns TRUE if the path exists
  On Error Resume Next
  PathExists = GetAttr(pname) And vbDirectory = vbDirectory
End Function
```

Displaying a list of files in a directory

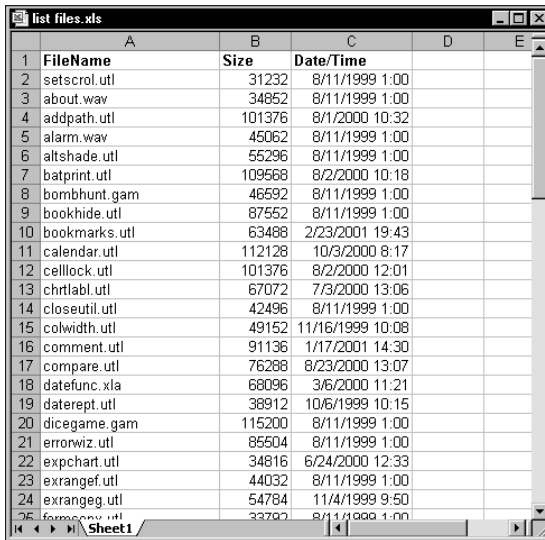
The following procedure displays (in the active worksheet) a list of files contained in a particular directory, along with the file size and date:

```
Sub ListFiles()
  Directory = "c:\windows\desktop\"
  r = 1

  ' Insert headers
  Cells(r, 1) = "FileName"
  Cells(r, 2) = "Size"
  Cells(r, 3) = "Date/Time"
  Range("A1:C1").Font.Bold = True

  ' Get first file
  f = Dir(Directory, 7)
  Do While f <> ""
    r = r + 1
    Cells(r, 1) = f
    Cells(r, 2) = FileLen(Directory & f)
    Cells(r, 3) = FileDateTime(Directory & f)
    ' Get next file
    f = Dir
  Loop
End Sub
```

Figure 27-1 shows an example of the output of the `ListFiles` subroutine.



	A	B	C	D	E
1	FileName	Size	Date/Time		
2	setsctrl.utl	31232	8/11/1999 1:00		
3	about.wav	34852	8/11/1999 1:00		
4	addpath.utl	101376	8/1/2000 10:32		
5	alarm.wav	45062	8/11/1999 1:00		
6	altshade.utl	55296	8/11/1999 1:00		
7	batprint.utl	109568	8/2/2000 10:18		
8	bombhunt.gam	46592	8/11/1999 1:00		
9	bookhide.utl	87552	8/11/1999 1:00		
10	bookmarks.utl	63488	2/23/2001 19:43		
11	calendar.utl	112128	10/3/2000 8:17		
12	celllock.utl	101376	8/2/2000 12:01		
13	chrtlabl.utl	67072	7/3/2000 13:06		
14	closeutil.utl	42496	8/11/1999 1:00		
15	colwidth.utl	49152	11/16/1999 10:08		
16	comment.utl	91136	1/17/2001 14:30		
17	compare.utl	76288	8/23/2000 13:07		
18	datefunc.xla	68096	3/6/2000 11:21		
19	daterept.utl	38912	10/6/1999 10:15		
20	dicegame.gam	115200	8/11/1999 1:00		
21	errorwiz.utl	85504	8/11/1999 1:00		
22	expchart.utl	34816	6/24/2000 12:33		
23	exrangef.utl	44032	8/11/1999 1:00		
24	exrangeg.utl	54784	11/4/1999 9:50		
25	formcopy.utl	33792	8/11/1999 1:00		

Figure 27-1: Output from the ListFiles procedure

Notice that the procedure uses the `Dir` function twice. The first time, it retrieves the first filename found. Subsequent calls retrieve additional filenames. When no more files are found, the function returns an empty string.



The companion CD-ROM contains a more sophisticated version of this procedure that allows you to select a directory from a dialog box.

The `Dir` function also accepts wildcard file specifications in its first argument. To get a list of Excel files, for example, you could use a statement such as:

```
f = Dir(Directory & "*.xl?", 7)
```

This statement retrieves the name of the first `*.xl?` file in the specified directory. The second argument for the `Dir` function lets you specify the attributes of the files. An argument of 7 retrieves filenames that have no attributes, read-only files, hidden files, and system files. Consult the online help for specifics.



If you need to display a list of files to allow a user to select one, this is not the most efficient approach. Rather, you'll want to use the `GetOpenFilename` method, which is discussed in Chapter 12.

Using the FileSearch object

The `FileSearch` object is a member of the Microsoft Office object library. This object essentially gives your VBA code all the functionality of the Windows Find File dialog box. For example, you can use this object to locate files that match a file specification (such as `*.xls`), and even search for files that contain specific text. You can use this object with Excel 97 and later versions.

Table 27-2 summarizes some of the key methods and properties of the `FileSearch` object. For a complete list and details, consult the online help.

Table 27-2
Properties and Methods of the FileSearch Object

<i>Property or method</i>	<i>What it does</i>
<code>FileName</code>	The name of the file to be located (wildcard characters are acceptable)
<code>FoundFiles</code>	Returns an object that contains the names of the files found
<code>LookIn</code>	The directory to be searched
<code>SearchSubfolders</code>	True if subdirectories are to be searched
<code>Execute</code>	Performs the search
<code>NewSearch</code>	Resets the <code>FileSearch</code> object

The remainder of this section consists of examples that demonstrate use of the `FileSearch` object.

Displaying a list of files in a directory

The following procedure displays, in the active worksheet, a list of files contained in a particular directory, along with the file size and date:

```
Sub ListFiles2()
    Directory = "c:\windows\desktop\"

    ' Insert headers
    r = 1
    Cells(r, 1) = "FileName"
    Cells(r, 2) = "Size"
    Cells(r, 3) = "Date/Time"
    Range("A1:C1").Font.Bold = True
    r = r + 1
```

```

With Application.FileSearch
    .NewSearch
    .LookIn = Directory
    .Filename = "*.*"
    .SearchSubFolders = False
    .Execute
    For i = 1 To .FoundFiles.Count
        Cells(r, 1) = .FoundFiles(i)
        Cells(r, 2) = FileLen(.FoundFiles(i))
        Cells(r, 3) = FileDateTime(.FoundFiles(i))
        r = r + 1
    Next i
End With
End Sub

```



The FileSearch object essentially ignores all Windows shortcut files (files with a *.LNK extension).



The companion CD-ROM contains a more sophisticated version of this procedure that allows you to select a directory.

Determining whether a file exists

The following function takes two arguments (the path and the filename), and returns True if the file exists in the specified directory. After the Execute method is run, the Count property of the FoundFiles object will be 1 if the file was found.

```

Function FileExists2(path, fname) As Boolean
    With Application.FileSearch
        .NewSearch
        .Filename = fname
        .LookIn = path
        .Execute
        If .FoundFiles.Count = 1 Then
            FileExists2 = True
        Else
            FileExists2 = False
        End If
    End With
End Function

```



As far as I can tell, it's not possible to use the FileSearch object to determine if a path exists.

Locating files that contain specific text

The following procedure searches the My Documents directory (and its subdirectories) for all *.xls files that contain the text *budget*. The found filenames are then added to a ListBox on a UserForm.

```
Sub FindFiles()  
  With Application.FileSearch  
    .NewSearch  
    .LookIn = "C:\My Documents"  
    .SearchSubFolders = True  
    .TextOrProperty = "budget"  
    .MatchTextExactly = False  
    .Filename = "*.xls"  
    .Execute  
    For i = 1 To .FoundFiles.Count  
      UserForm1.ListBox1.AddItem .FoundFiles(i)  
    Next i  
  End With  
  UserForm1.Show  
End Sub
```

Using the FileSystemObject object

The `FileSystemObject` object is a member of the Windows Scripting Host, and provides access to a computer's file system. This object is often used in script-oriented Web pages (for example, VB Script and JavaScript), and can be used with Excel 2000 and later versions.



The Windows Scripting Host is often used as a way to spread computer viruses. Consequently, the Windows Scripting Host is disabled on many systems. Therefore, use caution if you are designing an application that will be used on many different systems.

Documentation for the `FileSystemObject` object is available online, at:

<http://msdn.microsoft.com/scripting>

Determining whether a file exists

The Function procedure that follows accepts one argument (the path and filename), and returns True if the file exists:

```
Function FileExists3(fname) As Boolean  
  Set FileSys = CreateObject("Scripting.FileSystemObject")  
  FileExists3 = FileSys.FileExists(fname)  
End Function
```

The function creates a new `FileSystemObject` object named `FileSys` and then accesses the `FileExists` property for that object.



The companion CD-ROM contains an example that demonstrates all three methods (VBA commands, `FileSearch`, and `FileSystemObject`) of determining whether a file exists.

Determining whether a path exists

The Function procedure that follows accepts one argument (the path), and returns True if the file exists:

```
Function PathExists3(path) As Boolean
    Set FileSystem = CreateObject("Scripting.FileSystemObject")
    On Error Resume Next
    Set FolderObj = FileSystem.getfolder(path)
    If Err = 0 Then
        PathExists3 = True
    Else
        PathExists3 = False
    End If
End Function
```

The function attempts to create a new `Folder` object named `FolderObj`. If this operation is successful, it means that the directory exists. If an error occurs, the directory does not exist.

Listing information about all available disk drives

The following procedure uses the `FileSystemObject` to retrieve and display various information about all disk drives. The procedure loops through the `Drives` collection, and writes various property values to a worksheet. Figure 27-2 shows the results run on a system with a floppy disk drive, a hard drive, and two CD-ROM drives. The data shown is the drive letter, whether the drive is “ready,” the drive type, the volume name, the total size, and available space.



On some versions of Windows, the `TotalSize` and `AvailableSpace` properties may return incorrect results for drives that exceed two gigabytes in size. Figure 27-2 shows an example of this error. This problem doesn’t occur with Windows NT, or with Windows 2000 or later.



This workbook is available on the companion CD-ROM.

	A	B	C	D	E	F
1	A	TRUE	Removable	BACKUP	1457664	1432576
2	C	TRUE	Fixed	BOOT	2147155968	2147155968
3	D	TRUE	CD-ROM	EXCEL2000P	18939904	0
4	E	TRUE	CD-ROM	CD	690880512	0
5						
6						

Figure 27-2: Output from the `ShowDriveInfo` procedure


```
Sub ShowDriveInfo()  
    Dim FileSys, Drv  
    Dim Row As Integer  
  
    Set FileSys = CreateObject("Scripting.FileSystemObject")  
    Cells.Clear  
    Row = 0  
    On Error Resume Next  
    For Each Drv In FileSys.Drives  
        Row = Row + 1  
        Cells(Row, 1) = Drv.DriveLetter  
        Cells(Row, 2) = Drv.IsReady  
        Select Case Drv.DriveType  
            Case 0: Cells(Row, 3) = "Unknown"  
            Case 1: Cells(Row, 3) = "Removable"  
            Case 2: Cells(Row, 3) = "Fixed"  
            Case 3: Cells(Row, 3) = "Network"  
            Case 4: Cells(Row, 3) = "CD-ROM"  
            Case 5: Cells(Row, 3) = "RAM Disk"  
        End Select  
        Cells(Row, 4) = Drv.VolumeName  
        Cells(Row, 5) = Drv.TotalSize  
        Cells(Row, 6) = Drv.AvailableSpace  
    Next Drv  
End Sub
```

Working with Text Files

VBA contains a number of statements that allow “low-level” manipulation of files. These Input/Output (I/O) statements give you much more control over files than Excel’s normal text file import and export options.

A file can be accessed in any of three ways:

- ♦ *Sequential access.* By far the most common method. This allows reading and writing individual characters or entire lines of data.
- ♦ *Random access.* Used only if you’re programming a database application (which you shouldn’t be doing in VBA because better techniques do exist).
- ♦ *Binary access.* Used to read or write to any byte position in a file, such as storing or displaying a bitmap image. Rarely (if ever) used in VBA.

Because random and binary access files are rarely used with VBA, this chapter focuses on sequential access files. A sequential access file is accessed in a sequential manner. In other words, your code starts reading from the beginning of the file, and reads each line sequentially. For output, your code writes data to the end of the file.

Note

The method of reading and writing text files discussed in this book is the traditional “data channel” approach. Another option is to use the “object” approach. The `FileSystemObject` object contains a `TextStream` object that can be used to read and write text files. The `FileSystemObject` object is part of the Windows Scripting Host. As I mentioned earlier, this scripting service is disabled on many systems due to the strong possibility of transferring a virus.

Opening a text file

VBA's `Open` statement (not to be confused with the `Open` method of the `Application` object) is used to open a file for reading or writing. Before you can read from or write to a file, you must open it.

The `Open` statement is quite versatile, and has a rather complex syntax:

```
Open pathname For mode [Access access] [Lock] _
  As [#]filenumber [Len=reclength]
```

<i>pathname</i>	(Required) The <i>pathname</i> part of the <code>Open</code> statement is quite straightforward. It simply contains the name and path (optional) of the file to be opened.
<i>mode</i>	(Required) The file mode must be one of the following:
Append	A sequential access mode that allows the file to be read, or data to be appended to the end of the file.
Input	A sequential access mode that allows the file to be read, but not written to.
Output	A sequential access mode that allows the file to be read or written to. In this mode, a new file is always created (an existing file with the same name is deleted).
Binary	A random access mode that allows data to be read or written to on a byte-by-byte basis.
Random	A random access mode that allows data to be read or written in units determined by the <code>reclength</code> argument of the <code>Open</code> statement.
<i>access</i>	(Optional) The <code>Access</code> argument determines what can be done with the file. It can be either <code>Read</code> , <code>Write</code> , or <code>Read Write</code> .
<i>lock</i>	(Optional) The <code>Lock</code> argument is useful for multiuser situations. The options are <code>Shared</code> , <code>Lock Read</code> , <code>Lock Write</code> , and <code>Lock Read Write</code> .

<i>filenumber</i>	(Required) A file number ranging from 1 to 511. You can use the <code>FreeFile</code> function to get the next available file number.
<i>reclength</i>	(Optional) The record length (for random access files) or the buffer size (for sequential access files).

Reading a text file

The basic procedure for reading a text file using VBA consists of the following steps:

1. Open the file using the `Open` statement.
2. Specify the position in the file using the `Seek` function (optional).
3. Read data from the file (using the `Input`, `Input #`, or `Line Input #` statements).
4. Close the file using the `Close` statement.

Writing a text file

The basic procedure for writing a text file is:

1. Open or create the file using the `Open` statement.
2. Specify the position in the file using the `Seek` function (optional).
3. Write data to the file using the `Write #` or `Print #` statements.
4. Close the file using the `Close` statement.

Getting a file number

Most VBA programmers simply designate a file number in their `Open` statement. For example:

```
Open "myfile.txt" For Input As #1
```

Then you can refer to the file in subsequent statements as `#1`.

If a second file is opened while the first is still open, you would designate the second file as `#2`:

```
Open "another.txt" For Input As #2
```

Excel's Text File Import and Export Features

Excel supports three types of text files:

- ♦ *CSV (Comma-Separated Value) files.* Columns of data are separated by a comma, and each row of data ends in a carriage return. For some non-English versions of Excel, a semi-colon rather than a comma is used.
- ♦ *PRN.* Columns of data are aligned by character position, and each row of data ends in a carriage return.
- ♦ *TXT (Tab-delimited) files.* Columns of data are separated by tab characters, and each row of data ends in a carriage return.

When you attempt to open a text file with the File ⇨ Open command, the Text Import Wizard may appear to help you delineate the columns. If the text file is tab delimited or comma delimited, Excel usually opens the file without displaying the Text Import Wizard. The Text to Columns Wizard (accessed by Data ⇨ Text to Columns) is identical to the Text Import Wizard, but works with data stored in a single column.

Another approach is to use VBA's `FreeFile` function to get a file handle. Then you can refer to the file using a variable. Here's an example:

```
FileHandle = FreeFile  
Open "myfile.txt" For Input As FileHandle
```

Determining or setting the file position

For sequential file access, it's rarely necessary to know the current location in the file. If for some reason you need to know this, you can use the `Seek` function.

Statements for reading and writing

VBA provides several statements to read and write data to a file.

Three statements are used for reading data from a sequential access file:

- ♦ `Input` Reads a specified number of characters from a file.
- ♦ `Input #` Reads data as a series of variables, with variables separated by a comma.
- ♦ `Line Input #` Reads a complete line of data (delineated by a carriage return and/or line feed character).

Two statements are used for writing data to a sequential access file:

- ♦ `Write #` Writes a series of values, with each value separated by a comma and enclosed in quotes. If you end the statement with a semicolon, a carriage return/linefeed sequence is not inserted after each value. Data written with `Write #` is usually read from a file with an `Input #` statement.
- ♦ `Print #` Writes a series of values, with each value separated by a tab character. If you end the statement with a semicolon, a carriage return/linefeed sequence is not inserted after each value. Data written with `Print #` is usually read from a file with a `Line Input #` or an `Input` statement.

Text File Manipulation Examples

This section contains a number of examples that demonstrate various techniques that manipulate text files.

Importing data in a text file

The following example reads a text file, and places each line of data in a single cell (beginning with the active cell):

```
Sub ImportData()  
    Set ImpRng = ActiveCell  
    Open "c:\windows\desktop\textfile.txt" For Input As #1  
    r = 0  
    Do Until EOF(1)  
        Line Input #1, data  
        ActiveCell.Offset(r, 0) = data  
        r = r + 1  
    Loop  
    Close #1  
End Sub
```

In most cases, this procedure won't be very useful, since each line of data is simply dumped into a single cell. You can, however, use the `Data ⇄ Text to Columns` command to parse the data to columns.

Exporting a range to a text file

The following example is a simple example that writes the data in a selected worksheet range to a CSV text file.

Notice that the procedure uses two `Write #` statements. The first statement ends with a semicolon, so a carriage return/linefeed sequence is not written. For the last cell in a row, however, the second `Write #` statement does not use a semicolon, which causes the next output to appear on a new line.

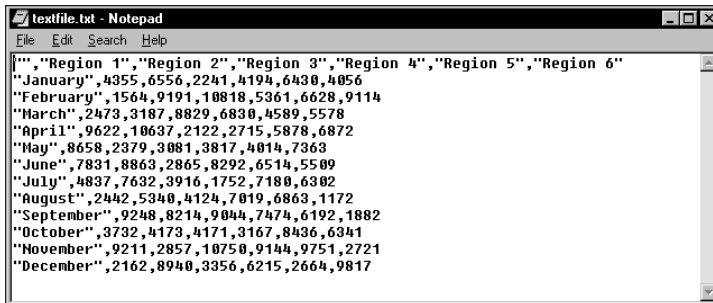
I use a variable named `Data` to store the contents of each cell. If the cell is numeric, the variable is converted to a value. This step ensures that numeric data will not be stored with quotation marks. If a cell is empty, its `Value` property returns 0. Therefore, the code also checks for a blank cell (using the `IsEmpty` function) and substitutes an empty string instead of a zero.

```
Sub ExportRange()  
    Dim Filename As String  
    Dim NumRows As Long, NumCols As Integer  
    Dim r As Long, c As Integer  
    Dim Data  
    Dim ExpRng As Range  
    Set ExpRng = Selection  
    NumCols = ExpRng.Columns.Count  
    NumRows = ExpRng.Rows.Count  
    Filename = "c:\windows\desktop\textfile.txt"  
    Open Filename For Output As #1  
        For r = 1 To NumRows  
            For c = 1 To NumCols  
                Data = ExpRng.Cells(r, c).Value  
                If IsNumeric(Data) Then Data = Val(Data)  
                If IsEmpty(ExpRng.Cells(r, c)) Then Data = ""  
                If c <> NumCols Then  
                    Write #1, Data;  
                Else  
                    Write #1, Data  
                End If  
            Next c  
        Next r  
    Close #1  
End Sub
```



This example is available on the companion CD-ROM.

Figure 27-3 shows the contents of the resulting file.



```

"","Region 1","Region 2","Region 3","Region 4","Region 5","Region 6"
"January",4355,6556,2241,4194,6430,4056
"February",1564,9191,10818,5361,6628,9114
"March",2473,3187,8829,6830,4589,5578
"April",9622,10637,2122,2715,5878,6872
"May",8658,2379,3081,3817,4014,7363
"June",7831,8863,2865,8292,6514,5509
"July",4837,7632,3916,1752,7180,6302
"August",2442,5340,4124,7019,6863,1172
"September",9248,8214,9044,7474,6192,1882
"October",3732,4173,4171,3167,8436,6341
"November",9211,2857,10750,9144,9751,2721
"December",2162,8940,3356,6215,2664,9817

```

Figure 27-3: This text file was generated by VBA.

Importing a text file to a range

The following subroutine reads the text file created in the previous example, and stores the values beginning at the active cell. The code reads each character and essentially parses the line of data, ignoring quote characters and looking for commas to delineate the columns.

```

Sub ImportRange()
    Dim ImpRng As Range
    Dim Filename As String
    Dim r As Long, c As Integer
    Dim txt As String, Char As String * 1
    Dim Data
    Dim i As Integer

    Set ImpRng = ActiveCell
    On Error Resume Next
    Filename = "c:\windows\desktop\textfile.txt"
    Open Filename For Input As #1
    If Err <> 0 Then
        MsgBox "Not found: " & Filename, vbCritical, "ERROR"
        Exit Sub
    End If
    r = 0
    c = 0
    txt = ""
    Application.ScreenUpdating = False
    Do Until EOF(1)
        Line Input #1, Data
        For i = 1 To Len(Data)
            Char = Mid(Data, i, 1)
            If Char = "," Then 'comma
                ActiveCell.Offset(r, c) = txt
                c = c + 1
            End If
        Next i
        r = r + 1
        txt = ""
    Loop
End Sub

```

```

        txt = ""
    ElseIf i = Len(Data) Then 'end of line
        If Char <> Chr(34) Then txt = txt & Char
        ActiveCell.Offset(r, c) = txt
        txt = ""
    ElseIf Char <> Chr(34) Then
        txt = txt & Char
    End If
Next i
c = 0
r = r + 1
Loop
Close #1
Application.ScreenUpdating = True
End Sub

```



The procedure above has a flaw: It doesn't handle data that contains a comma or a quote character. In addition, an imported date will be surrounded by number signs. For example: #2001-05-12#.



This example is available on the companion CD-ROM.

Logging Excel usage

The example in this section writes data to a text file every time Excel is opened and closed. In order for this to work reliably, the procedure must be located in a workbook that is opened every time you start Excel. The Personal Macro Workbook is an excellent choice.

The following procedure, stored in the code module for the `ThisWorkbook` object, is executed when the file is opened:

```

Private Sub Workbook_Open()
    Open Application.Path & "\excelusage.txt" _
        For Append As #1
    Print #1, "Started " & Now
    Close #1
End Sub

```

The procedure appends a new line to a file named `excelusage.txt`. The new line contains the current date and time, and might look something like this:

```
Started 03/09/00 9:27:43 PM
```


The following subroutine is executed when the workbook is closed. It appends a new line that contains the word “Stopped,” along with the current date and time.

```
Private Sub Workbook_BeforeClose(Cancel As Boolean)
    Open Application.Path & "\excelusage.txt" _
        For Append As #1
    Print #1, "Stopped " & Now
    Close #1
End Sub
```

Filtering a text file

The example in this section demonstrates how to work with two text files at once. The `FilterFile` procedure that follows reads a text file (`infile.txt`) and copies only the rows that contain a specific text string to a second text file (`output.txt`).

```
Sub FilterFile()
    Open "infile.txt" For Input As #1
    Open "output.txt" For Output As #2
    TextToFind = "January"
    Do Until EOF(1)
        Line Input #1, data
        If InStr(1, data, TextToFind) Then
            Print #2, data
        End If
    Loop
    Close
End Sub
```



This example is available on the companion CD-ROM.

Importing more than 256 columns of data

It's not uncommon to need to import a text file that exceeds Excel's 256-column capacity. If you attempt to open such a file with the File ⇨ Open command, Excel simply ignores any data past column 256 (and doesn't even warn you about it!).

The following procedure is a variation of the `ImportRange` procedure presented earlier in this chapter. It reads a text file, and imports the data into a new workbook. If the data contains more than 256 column of data, additional sheets are added to the workbook.

```
Sub ImportLongLines()
    ' Imports a text file with >256 columns of data

    Dim ImpRange As Range
    Dim r As Long, c As Integer
    Dim CurrLine As Long
```

```

Dim Data As String, Char As String, Txt As String
Dim i As Integer
Dim CurrSheet As Worksheet

' Create a new workbook with one sheet
Workbooks.Add xlWorksheet

Open ThisWorkbook.Path & "\longfile.txt" For Input As #1
r = 0
c = 0
Set ImpRange = ActiveWorkbook.Sheets(1).Range("A1")
Application.ScreenUpdating = False

' Read the first line, and insert new sheets if necessary
CurrLine = CurrLine + 1
Line Input #1, Data
For i = 1 To Len(Data)
    Char = Mid(Data, i, 1)
    ' Are we out of columns?
    If c <> 0 And c Mod 256 = 0 Then
        With ActiveWorkbook.Sheets
            Set CurrSheet = .Add(after:=.Sheets(.Count))
        End With
        Set ImpRange = CurrSheet.Range("A1")
        c = 0
    End If
    ' End of the field?
    If Char = "," Then
        ImpRange.Offset(r, c) = Txt
        c = c + 1
        Txt = ""
    Else
        ' Skip quote characters
        If Char <> Chr(34) Then _
            Txt = Txt & Mid(Data, i, 1)
    End If
    ' End of the line?
    If i = Len(Data) Then
        ImpRange.Offset(r, c) = Txt
        c = c + 1
        Txt = ""
    End If
End If
Next i

.....

' Read the remaining data
c = 0
CurrLine = 1
Set ImpRange = ActiveWorkbook.Sheets(1).Range("A1")
r = r + 1

```

```

Do Until EOF(1)
    Set ImpRange = ActiveWorkbook.Sheets(1).Range("A1")
    CurrLine = CurrLine + 1
    Line Input #1, Data
    Application.StatusBar = "Processing line " & CurrLine
    For i = 1 To Len(Data)
        Char = Mid(Data, i, 1)
        ' Are we out of columns?
        If c <> 0 And c Mod 256 = 0 Then
            c = 0
            Set ImpRange = ImpRange.Parent.Next.Range("A1")
        End If

        ' End of the field
        If Char = "," Then
            ImpRange.Offset(r, c) = Txt
            c = c + 1
            Txt = ""
        Else
            ' Skip quote characters
            If Char <> Chr(34) Then _
                Txt = Txt & Mid(Data, i, 1)

            ' End of the line?
            If i = Len(Data) Then
                ImpRange.Offset(r, c) = Txt
                c = c + 1
                Txt = ""
            End If
        End If
    Next i
    c = 0
    Set ImpRange = ActiveWorkbook.Sheets(1).Range("A1")
    r = r + 1
Loop

' Tidy up
Close #1
Application.ScreenUpdating = True
Application.StatusBar = False
End Sub

```

This procedure consists of two parts. The first part reads the first row of data and adds new sheets, if necessary. The second part reads the remaining data in the text file. The code assumes that the first row is typical of the remaining data and that it has the maximum number of columns.



This example is available on the companion CD-ROM, along with a text file that contains 100 rows, each with 600 columns of data.

Exporting a range to HTML format

The final example in this chapter demonstrates how to export a range of cells to an HTML file. An HTML file, as you may know, is simply a text file that contains special formatting tags that describe how the information will be presented in a browser.

The `ExportToHTML` procedure follows:

```
Sub ExportToHTML()
'   Dim ws As Worksheet
'   Dim Filename As Variant
'   Dim TDOpenTag As String, TDCloseTag As String
'   Dim CellContents As String
'   Dim Rng As Range
'   Dim r As Long, c As Integer

'   Use the selected range of cells
  Set Rng = Application.Intersect(ActiveSheet.UsedRange,
Selection)

'   Get a file name
  Filename = Application.GetSaveAsFilename( _
    InitialFileName:="myrange.htm", _
    fileFilter:="HTML Files (*.htm), *.htm")
  If Filename = False Then Exit Sub

'   Open the text file
  Open Filename For Output As #1

'   Write the <TABLE> tag
  Print #1, "<TABLE BORDER=1 CELLPADDING=3>"

'   Loop through the cells
  For r = 1 To Rng.Rows.Count
    Print #1, "<TR>"
    For c = 1 To Rng.Columns.Count
      TDOpenTag = "<TD ALIGN=RIGHT>"
      TDCloseTag = "</TD>"
      If Rng.Cells(r, c).Font.Bold Then
        TDOpenTag = TDOpenTag & "<B>"
        TDCloseTag = "</B>" & TDCloseTag
      End If
      If Rng.Cells(r, c).Font.Italic Then
        TDOpenTag = TDOpenTag & "<I>"
        TDCloseTag = "</I>" & TDCloseTag
      End If
    Next c
  Next r
End Sub
```

```

        End If
        CellContents = Rng.Cells(r, c).Text
        Print #1, TDOpenTag & CellContents & TDCloseTag
    Next c
    Print #1, "</TR>"
Next r
' Close the table
Print #1, "</TABLE>"

' Close the file
Close #1

' Tell the user
MsgBox Rng.Count & " cells exported to " & Filename
End Sub

```



This example is available on the companion CD-ROM.

The procedure starts by determining the range to export. This is based on the intersection of the selected range and the used area of the worksheet. This ensures that entire rows or columns are not processed. Next, the user is prompted for a filename and the text file is opened. The bulk of the work is done within two For-Next loops. The code generates the appropriate HTML tags and writes the information to the text file. Finally, the file is closed and the user sees a summary message.

Figure 27-4 shows a range in a worksheet, and Figure 27-5 shows how it looks in a browser after being converted to HTML.

	A	B	C	D	E	F	G
1							
2			New York	Los Angeles	Chicago	Total	
3		<i>January</i>	\$3,813.00	\$8,874.00	\$15,174.00	\$27,861.00	
4		<i>February</i>	\$21,161.00	\$611.00	\$7,786.00	\$29,558.00	
5		<i>March</i>	\$21,097.00	\$963.00	\$10,357.00	\$32,417.00	
6		<i>April</i>	\$15,392.00	\$19,794.00	\$9,850.00	\$45,036.00	
7		<i>May</i>	\$12,858.00	\$22,693.00	\$8,698.00	\$44,249.00	
8		<i>June</i>	\$14,336.00	\$1,819.00	\$111.00	\$16,266.00	
9		<i>July</i>	\$19,842.00	\$354.00	\$11,558.00	\$31,754.00	
10		<i>August</i>	\$15,716.00	\$2,003.00	\$20,739.00	\$38,458.00	
11		<i>September</i>	\$4,219.00	\$2,976.00	\$8,080.00	\$15,275.00	
12		<i>October</i>	\$12,338.00	\$20,490.00	\$15,769.00	\$48,597.00	
13		<i>November</i>	\$18,693.00	\$5,389.00	\$14,664.00	\$38,746.00	
14		<i>December</i>	\$17,141.00	\$13,602.00	\$12,920.00	\$43,663.00	
15		Total	\$176,606.00	\$99,568.00	\$135,706.00	\$411,880.00	
16							

Figure 27-4: A worksheet range, ready to be converted to HTML

	New York	Los Angeles	Chicago	Total
<i>January</i>	\$3,813.00	\$8,874.00	\$15,174.00	\$27,861.00
<i>February</i>	\$21,161.00	\$611.00	\$7,786.00	\$29,558.00
<i>March</i>	\$21,097.00	\$963.00	\$10,357.00	\$32,417.00
<i>April</i>	\$15,392.00	\$19,794.00	\$9,850.00	\$45,036.00
<i>May</i>	\$12,858.00	\$22,693.00	\$8,698.00	\$44,249.00
<i>June</i>	\$14,336.00	\$1,819.00	\$111.00	\$16,266.00
<i>July</i>	\$19,842.00	\$354.00	\$11,558.00	\$31,754.00
<i>August</i>	\$15,716.00	\$2,003.00	\$20,739.00	\$38,458.00
<i>September</i>	\$4,219.00	\$2,976.00	\$8,080.00	\$15,275.00
<i>October</i>	\$12,338.00	\$20,490.00	\$15,769.00	\$48,597.00
<i>November</i>	\$18,693.00	\$5,389.00	\$14,664.00	\$38,746.00
<i>December</i>	\$17,141.00	\$13,602.00	\$12,920.00	\$43,663.00
<i>Total</i>	\$176,606.00	\$99,568.00	\$135,706.00	\$411,880.00

Figure 27-5: The worksheet data, after being converted to HTML

Why not use Excel's File ⇨ Save as Web Page command? The procedure listed here has a distinct advantage: It does not produce bloated HTML code. For example, I used the `ExportToHTML` procedure to export a range of 70 cells. The file size was 2.6K. Then I used Excel's File ⇨ Save as Web Page command to export the sheet. The result was 15.8K — more than six times larger. But, on the other hand, the `ExportToHTML` procedure does not maintain all of the cell formatting. In fact, the only formatting information it produces is bold and italic. You'll find that this procedure has another serious limitation: It cannot handle merged cells.

You may want to use the `ExportToHTML` procedure as the basis for additional customizations.

Summary

This chapter discussed three ways to work with files on disk: VBA's standard commands, the `FileSearch` object, and the `FileSystemObject` object. It also presented several examples of reading and writing text files using VBA.

The next chapter demonstrates how you can make a VBA application generate another VBA application on the fly.



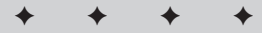
Manipulating Visual Basic Components

This chapter discusses a topic that some readers may find extremely useful: writing VBA code that manipulates components in a VBA project. The VBA Integrated Development Environment (IDE) contains an object model that exposes key elements of your VBA projects, including the Editor itself. You can write VBA code that adds or removes modules, generates other VBA code, or even creates a UserForm on the fly.

Introducing the IDE

The IDE is essentially an OLE Automation interface for the Visual Basic Editor. Once you establish a reference to the Visual Basic Extensibility Library (using the VBE's Tools ⇄ References command), you have access to all the VBE's objects, properties, and methods, and you can declare objects from the IDE's member classes.

In the References dialog box, you may add a reference to Microsoft Visual Basic for Applications Extensibility. This gives you access to an object called `VBIDE`. Creating a reference to `VBIDE` enables you to declare object variables contained in the `VBIDE`, and gives you access to a number of predefined constants that relate to the IDE. Actually, you can access the objects in the IDE *without* creating a reference, but you won't be able to use the constants in your code nor will you be able to declare specific objects that refer to IDE components.



In This Chapter

An overview of the VBA Integrated Development Environment and its object model

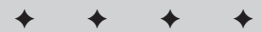
Important information for Excel 2002 users

How to use VBA to add and remove modules from a project

How to write VBA code that creates more VBA code

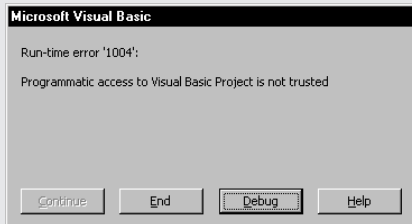
How to use VBA to help create UserForms

A useful function that creates a UserForm on the fly



Important Note for Excel 2002 Users

If you're using Excel 2002 to develop applications for others to use, be aware that things have changed in Excel 2002. To reduce the possibility of macro viruses, Microsoft made it much more difficult for a VBA macro to modify components in a VBA project. If you attempt to execute any of the procedures in this chapter, you will probably see an error message like the one that follows:

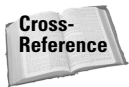


Whether you see this error message depends on a setting in Excel's Security dialog box (accessed using Tools ⇨ Macro ⇨ Security). This setting, called Trust access to Visual Basic Project, is turned off by default. Even if the user chooses to trust the macros contained in the workbook, the macros cannot modify the VBA project if this setting is turned off. Note that this setting applies to all workbooks, and cannot be changed only for a particular workbook.

You can't access the value of this particular setting directly. The only way to detect this setting is to attempt to access the `VBProject` object, and then check for an error. The following code demonstrates:

```
On Error Resume Next
Set x = ActiveWorkbook.VBProject
If Err <> 0 Then
    MsgBox "Your security settings do not allow this macro to run."
    Exit Sub
End If
```

Not all the examples in this chapter are intended to be used by end users. Many of them are designed to assist developers create projects. For these projects, you'll want to turn off the Trust access to Visual Basic Project setting.



Refer to Chapter 20 for background information about OLE Automation.

After you understand how the IDE object model works, you can write code to perform a variety of operations, including:

- ♦ Adding and removing VBA modules
- ♦ Inserting VBA code

- ♦ Creating UserForms
- ♦ Adding controls to a UserForm

The IDE Object Model

Programming the IDE requires an understanding of its object model. The top object in the object hierarchy is the VBE (Visual Basic Environment). As with Excel's object model, the VBE contains other objects. A simplified version of the IDE object hierarchy is as follows:

```
VBE
  VBProject
    VBComponent
      CodeModule
      Designer
      Property
      Reference
      Window
      CommandBar
```



This chapter ignores the Extensibility Library's `Windows` collection and `CommandBars` collection, which aren't all that useful for Excel developers. Rather, the chapter focuses on the `VBProject` object, which can be very useful for developers—as long as you don't develop for Excel 2002 (see the sidebar, “Important Note for Excel 2002 Users”).

The VBProjects collection

Every open workbook or add-in is represented by a `VBProject` object. To access the `VBProject` object for a workbook, use the `VBProject` property of the `Workbook` object. The following instructions, for example, create an object variable that represents the `VBProject` object for the active workbook:

```
Dim VBP As VBProject
Set VBP = ActiveWorkbook.VBProject
```

If you get an error message when VBA encounters the `Dim` statement, make sure that you've added a reference to Microsoft Visual Basic for Applications Extensibility.

Each `VBProject` object contains a collection of the VBA component objects in the project (UserForms, modules, class modules, or document modules). Not surprisingly, this collection is called `VBComponents`. A `VBProject` object also contains a `References` collection for the project, representing the libraries being referenced currently by the project.

Note

It's not possible to add a new member to the `VBProjects` collection directly. Rather, you do so indirectly by opening or creating a new workbook in Excel. Doing so automatically adds a new member to the `VBProjects` collection. Similarly, you can't remove a `VBProject` object directly; closing a workbook removes the `VBProject` object from the collection.

The VBComponents collection

To access a member of the `VBComponents` collection, use the `VBComponents` property with an index number or name. The following instructions demonstrate the two ways to access a VBA component and create an object variable:

```
Set VBC = ThisWorkbook.VBProject.VBComponents(1)
Set VBC = ThisWorkbook.VBProject.VBComponents("Module1")
```

The References collection

Every VBA project in Excel contains a number of references. You can view, add, or delete the references for a project using the `Tools ⇨ References` command (see Figure 28-1). Every project contains some references (such as VBA itself, Excel, OLE Automation, and the Office Object Library), and you can add additional references to a project as needed.

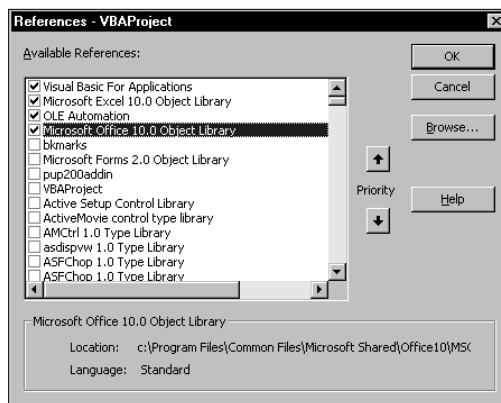


Figure 28-1: The References dialog box shows the references for each project.

You can also manipulate the references for a project using VBA. The `References` collection contains `Reference` objects, and the `Reference` class for these objects has properties and methods. The following procedure, for example, displays a message box that lists the `Name`, `Description`, and `FullPath` property for each `Reference` object in the active workbook's project:

```
Sub ListReferences()
    Dim Ref As Reference
    Msg = ""
    For Each Ref In ActiveWorkbook.VBProject.References
        Msg = Msg & Ref.Name & vbCrLf
        Msg = Msg & Ref.Description & vbCrLf
        Msg = Msg & Ref.FullPath & vbCrLf & vbCrLf
    Next Ref
    MsgBox Msg
End Sub
```

Figure 28-2 shows the result of running this procedure when a workbook that contains five references is active.

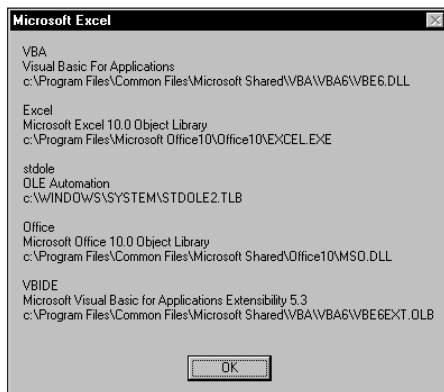


Figure 28-2: This message box displays information about the references for a project.

Note

Because it declares an object variable of type `Reference`, the `ListReferences` procedure requires a reference to the VBA Extensibility Library. If you declare `Ref` as a generic `Object`, the VBA Extensibility Library reference is not needed.

You can also add a reference programmatically using either of two methods of the `Reference` class. `AddFromFile` adds a reference if you know its filename and storage path. `AddFromGuid` adds a reference if you know the reference's *globally unique identifier*, or GUID. Refer to the online help for complete details.

An Introductory Example

The `ShowComponents` procedure shown in Listing 28-1 loops through each VBA component in the active workbook and writes the following information to a worksheet:

- ♦ The component's name
- ♦ The component's type
- ♦ The number of lines of code in the code module for the component

Listing 28-1: Displaying each active VBA component in a worksheet

```
Sub ShowComponents()  
    Dim VBP As VBProject  
    Set VBP = ActiveWorkbook.VBProject  
    NumComponents = VBP.VBComponents.Count  
    Cells.ClearContents  
    For i = 1 To NumComponents  
        ' Name  
        Cells(i, 1) = VBP.VBComponents(i).Name  
  
        ' Type  
        Select Case VBP.VBComponents(i).Type  
            Case 1  
                Cells(i, 2) = "Module"  
            Case 2  
                Cells(i, 2) = "Class Module"  
            Case 3  
                Cells(i, 2) = "UserForm"  
            Case 100  
                Cells(i, 2) = "Document Module"  
        End Select  
        ' Lines of code  
        Cells(i, 3) = _  
            VBP.VBComponents(i).CodeModule.CountOfLines  
    Next i  
End Sub
```

Figure 28-3 shows the result of running the `ShowComponents` procedure. In this case, the VBA project contained five components, and only one of them had a nonempty code module.

	A	B	C	D	E
1	ThisWorkbook	Document Module	0		
2	Sheet1	Document Module	0		
3	Module1	Module	35		
4	Class1	Class Module	0		
5	UserForm1	UserForm	0		
6					
7					
8					

Figure 28-3: The result of executing the `ShowComponents` procedure



This workbook is available on the companion CD-ROM. Notice that it contains a reference to the VBA Extensibility Library.

Replacing a Module with an Updated Version

The example in this section demonstrates how to replace a VBA module with a different VBA module. Besides demonstrating three `VbComponent` methods (`Export`, `Remove`, and `Import`), the procedure also has a practical use. For example, you may distribute a workbook to a group of users, and later discover that a macro contains an error or needs to be updated. Because the users may have added data to the workbook, it would not be practical to replace the entire workbook. The solution, then, is to distribute another workbook that contains a macro that replaces the VBA module with an updated version stored in a file.

This example consists of two workbooks:

- UserBook.xls Contains a module (Module1) that needs to be replaced
- UpdateUserBook.xls Contains VBA procedures to replace Module1 in UserBook.xls with a later version of Module1 stored in UpdateUserBook.xls

The `BeginUpdate` procedure shown in Listing 28-2 is contained in the `UpdateUserBook` workbook, which would be distributed to users of `UserBook.xls`. This procedure ensures that `UserBook.xls` is open. It then informs the user of what is about to happen with the message shown in Figure 28-4.

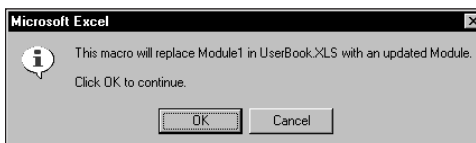


Figure 28-4: This message box informs the user that a module will be replaced.

Listing 28-2: Preparing the user for some changes that are afoot

```

Sub BeginUpdate()
    Filename = "UserBook.xls"

    ' Activate workbook
    On Error Resume Next
    Workbooks(Filename).Activate
    If Err <> 0 Then
        MsgBox Filename & " must be open!", vbCritical
        Exit Sub
    End If

    Msg = "This macro will replace Module1 in UserBook.XLS "
    Msg = Msg & "with an updated Module." & vbCrLf & vbCrLf
    Msg = Msg & "Click OK to continue."
    If MsgBox(Msg, vbInformation + vbOKCancel) = vbOK Then
        Call ReplaceModule
    Else
        MsgBox "Module not replaced!", vbCritical
    End If
End Sub

```

When the user clicks OK, the `ReplaceModule` procedure is called. This procedure, shown in Listing 28-3, replaces the existing `Module1` in `UserBook.xls` with an updated version stored in the `UpdateUserBook` workbook.

Listing 28-3: Updating the existing code module with a revised one

```

Sub ReplaceModule()
    ' Export Module1 from this workbook
    Filename = ThisWorkbook.Path & "\tempmodxxx.bas"
    ThisWorkbook.VBProject.VBComponents("Module1") _
        .Export Filename

    ' Replace Module1 in UserBook
    Set VBP = ActiveWorkbook.VBProject
    On Error GoTo ErrHandle
    With VBP.VBComponents
        .Remove VBP.VBComponents("Module1")
        .Import Filename
    End With

```

```
' Delete the temporary module file
Kill Filename
MsgBox "The module has been replaced.", vbInformation
Exit Sub

ErrHandle:
' Did an error occur?
MsgBox "ERROR. The module may not have been replaced.", _
    vbCritical
End Sub
```

The procedure in Listing 28-3 performs the following steps:

1. It exports `Module1` (the updated module) to a file. The file has an unusual name to reduce the likelihood of overwriting an existing file.
2. It removes `Module1` (the old module) from `UserBook.xls`, using the `Remove` method of the `VBComponents` collection.
3. It imports the module (saved in Step 1) to `UserBook.xls`.
4. It deletes the file saved in Step 1.
5. It reports the action to the user. General error handling is used to inform the user that an error occurred.



This example (which uses two files) is available on the companion CD-ROM. Because the macro writes to the active directory, make sure you copy the files to your hard drive before running the example.

Using VBA to Write VBA Code

The example in this section demonstrates how you can write VBA code that writes more VBA code. The `AddSheetAndButton` procedure does the following:

1. It inserts a new worksheet.
2. It adds a `CommandButton` to the worksheet.
3. It adjusts the position, size, and caption of the `CommandButton`.
4. It inserts an event-handler procedure for the `CommandButton` named `CommandButton1_Click` in the sheet's code module. This procedure simply activates `Sheet1`.

Listing 28-4 provides the `AddSheetAndButton` procedure.

Listing 28-4: Generating a new worksheet, built-in button, and event-handler

```
Sub AddSheetAndButton()  
    Dim NewSheet As Worksheet  
    Dim NewButton As OLEObject  
  
    ' Add the sheet  
    Set NewSheet = Sheets.Add  
  
    ' Add a CommandButton  
    Set NewButton = NewSheet.OLEObjects.Add _  
        ("Forms.CommandButton.1")  
    With NewButton  
        .Left = 4  
        .Top = 4  
        .Width = 100  
        .Height = 24  
        .Object.Caption = "Return to Sheet1"  
    End With  
  
    ' Add the event handler code  
    Code = "Sub CommandButton1_Click()" & vbCrLf  
    Code = Code & "    On Error Resume Next" & vbCrLf  
    Code = Code & "    Sheets(""Sheet1").Activate" & vbCrLf  
    Code = Code & "    If Err <> 0 Then" & vbCrLf  
    Code = Code & "        MsgBox ""Cannot activate Sheet1."" _  
        & vbCrLf  
    Code = Code & "    End If" & vbCrLf  
    Code = Code & "End Sub"  
  
    With ActiveWorkbook.VBProject._  
        VBComponents(NewSheet.Name).CodeModule  
            NextLine = .CountOfLines + 1  
            .InsertLines NextLine, Code  
    End With  
End Sub
```

Figure 28-5 shows a worksheet and CommandButton that were added by the AddSheetAndButton procedure.

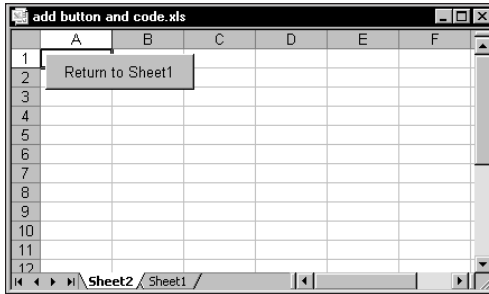


Figure 28-5: This sheet, the CommandButton, and its event-handler were added using VBA.

The tricky part of this procedure is inserting the VBA code into the code module for the new worksheet. The code is stored in a variable named `Code`, with each instruction separated by a carriage return and line feed sequence. The `InsertLines` method adds the code to the code module for the inserted worksheet.

The `NextLine` variable stores the number of existing lines in the module incremented by one. This ensures that the procedure is added to the end of the module. If you simply insert the code beginning at line 1, it causes an error if the user's system is set up to add an `Option Explicit` statement to each module automatically.

Figure 28-6 shows the procedure that is created by the `AddSheetAndButton` procedure in its new home in the code window.

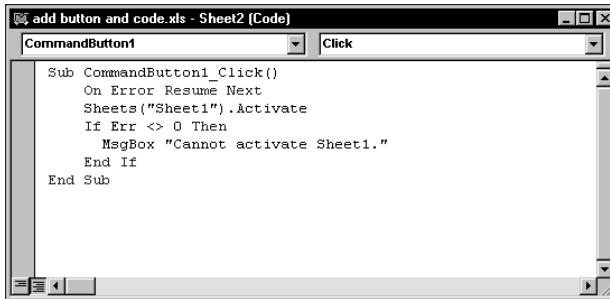


Figure 28-6: VBA generated this event-handler procedure.

Adding Controls to a UserForm at Design Time

If you've spent any time developing UserForms, you probably know that it can be quite tedious to add and adjust the controls so they are aligned and sized consistently. Even if you take full advantage of the VBE's formatting commands, it can still take a considerable amount of time to get the controls to look just right.

The UserForm shown in Figure 28-7 contains 100 CommandButtons, all of which are identical in size and positioned precisely on the form. Furthermore, each CommandButton has its own event-handler procedure. Adding these buttons manually and creating their event-handlers would take some time—lots of time. Adding them automatically at design time using a VBA procedure takes about three seconds.

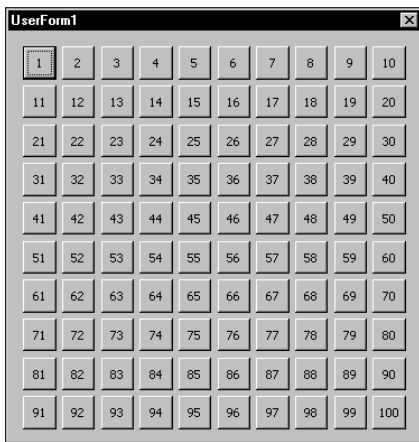


Figure 28-7: A VBA procedure added the CommandButtons on this UserForm.

Design-time versus runtime UserForm manipulations

It's important to understand the distinction between manipulating UserForms or controls at design time and manipulating these objects at runtime. Runtime manipulations are apparent when the UserForm is shown, but the changes made are not permanent. For example, you might write code that changes the `Caption` property of the UserForm before the form is displayed. The new caption appears when the UserForm is shown, but when you return to the VBE, the UserForm displays its original caption. Part IV of this book contains many examples of code that perform runtime manipulation of UserForms and controls.

Design-time manipulations, on the other hand, are permanent—just as if you made the changes manually using the tools in the VBE. Normally, you perform design-time manipulations as a way to automate some of the tedious chores in designing a UserForm. To make design-time manipulations, you access the `Designer` object for the UserForm.

To demonstrate the difference between design-time and runtime manipulations, I developed two simple procedures that add a `CommandButton` to a UserForm. One procedure adds the button at runtime; the other adds it at design time.

The following `RunTimeButton` procedure is very straightforward. Attached to a general (nonform) module, it simply adds a `CommandButton`, changes a few of its properties, and then displays the UserForm. The `CommandButton` appears on the form when the form is shown, but when you view the form in the VBE, the `CommandButton` is not there.

```
Sub RunTimeButton()  
    ' Adds a button at runtime  
    Dim Butn As CommandButton  
    Set Butn = UserForm1.Controls.Add("Forms.CommandButton.1")  
    With Butn  
        .Caption = "Added at runtime"  
        .Width = 100  
        .Top = 10  
    End With  
    UserForm1.Show  
End Sub
```

Following is the `DesignTimeButton` procedure. What's different here is that this procedure uses the `Designer` object, which is contained in the `VBComponent` object. Specifically, it uses the `Add` method to add the `CommandButton`. Because the `Designer` object was addressed, the `CommandButton` is added to the UserForm just as if you did it manually in the VBE.

```
Sub DesignTimeButton()  
    ' Adds a button at design time  
    Dim Butn As CommandButton  
    Set Butn = ThisWorkbook.VBProject. _  
        VBComponents("UserForm1") _  
        .Designer.Controls.Add("Forms.CommandButton.1")  
    With Butn  
        .Caption = "Added at design time"  
        .Width = 120  
        .Top = 40  
    End With  
End Sub
```

Adding 100 CommandButtons at design time

The example in this section demonstrates how to take advantage of the Designer object to help you design a UserForm. In this case, the code adds 100 CommandButtons (perfectly spaced and aligned), sets the Caption property for each CommandButton, and also creates 100 event-handler procedures (one for each CommandButton).

Listing 28-5 shows the complete code for the Add100Buttons procedure.

Listing 28-5: Generating an instant 100-button UserForm

```
Sub Add100Buttons()
    Dim UFvbc As Object 'VbComponent
    Dim CMod As Object 'CodeModule
    Dim ctl As Control
    Dim cb As CommandButton
    Dim n As Integer, c As Integer, r As Integer
    Dim code As String

    Set UFvbc = ThisWorkbook.VBProject.VBComponents("UserForm1")

    ' Delete all controls, if any
    For Each ctl In UFvbc.Designer.Controls
        UFvbc.Designer.Controls.Remove ctl.Name
    Next ctl

    ' Delete all VBA code
    UFvbc.CodeModule.DeleteLines 1, UFvbc.CodeModule.CountOfLines

    ' Add 100 CommandButtons
    n = 1
    For r = 1 To 10
        For c = 1 To 10
            Set cb = _
                UFvbc.Designer.Controls.Add("Forms.CommandButton.1")
            With cb
                .Width = 22
                .Height = 22
                .Left = (c * 26) - 16
                .Top = (r * 26) - 16
                .Caption = n
            End With

            ' Add the event handler code
            With UFvbc.CodeModule
                code = ""
                code = code & "Private Sub CommandButton" & n & _
```

```

        "_Click" & vbCr
        code = code & "Msgbox ""This is CommandButton" & n & _
            """" & vbCr
        code = code & "End Sub"
        .InsertLines .CountOfLines + 1, code
    End With
    n = n + 1
Next c
Next r
End Sub

```

The `Add100Buttons` procedure requires a `UserForm` named `UserForm1`. The procedure starts by deleting all controls on the form using the `Remove` method of the `Controls` collection, and then deleting all of the code in the code module using the `DeleteLines` method of the `CodeModule` object. Next, the `CommandButtons` are added and the event-handler procedures are created within two `For-Next` loops. These event-handlers are very simple. Here's an example of such a procedure for `CommandButton1`:

```

Private Sub CommandButton1_Click()
    MsgBox "This is CommandButton1"
End Sub

```

If you remember to clear the form and its attached code each time before you have the `Add100Buttons` procedure generate the controls, it'll be easier for you to test various parameters such as button width and spacing. Just change a few values, rerun the procedure, and see how it looks. There's no need to delete the old controls manually before rerunning the procedure.

If you would like to show the form after adding the controls at design time, you need to add the following instruction right before the `End Sub` statement:

```
VBA.UserForms.Add("UserForm1").Show
```

It took me quite a while to figure out how to actually display the `UserForm`. When the VBA interpreter generates the 100-button `UserForm`, it indeed exists in VBA's memory, but it isn't officially part of the project yet. So you need the `Add` method to formally enroll `UserForm1` into the collection of `UserForms`. The return value of this method (yes, it has one) is a reference to the form itself, which is why the `Show` method can be appended to the end of the `Add` method. So as a rule, the `UserForm` must be added to the `UserForms` collection before it can be used.

Creating UserForms Programmatically

The final topic in this chapter demonstrates how to use VBA code to create UserForms at runtime. I present two examples: One is relatively simple and the other is quite a bit more complex.

A simple example

The example in this section isn't all that useful—in fact, it's completely useless. But it does demonstrate some useful concepts. The `MakeForm` procedure performs several tasks:

1. It creates a temporary UserForm in the active workbook using the `Add` method of the `VBComponents` collection.
2. It adds a `CommandButton` control to the UserForm using the `Designer` object.
3. It adds an event-handler procedure to the UserForm's code module (`CommandButton1_Click`). This procedure, when executed, simply displays a message box and then unloads the form.
4. It displays the UserForm.
5. It deletes the UserForm.

The net result is a UserForm that's created on the fly, put to use, and then deleted. This example and the one in the next section both blur the distinction between modifying forms at design time and modifying forms at runtime. The form is created using design-time techniques, but it all happens at runtime.

**Note**

The online documentation for topics dealing with creating UserForms is quite poor. Consequently, I relied heavily on trial and error when I developed this procedure.

Following is the complete listing for the `MakeForm` procedure:

Listing 28-6: Generating a UserForm on the fly

```
Sub MakeForm()  
    Dim TempForm As Object  
    Dim NewButton As Msforms.CommandButton  
    Dim Line As Integer  
  
    Application.VBE.MainWindow.Visible = False
```

```

' Create the UserForm
Set TempForm = ThisWorkbook.VBProject. _
  VBComponents.Add(3) 'vbext_ct_MSForm
With TempForm
  .Properties("Caption") = "Temporary Form"
  .Properties("Width") = 200
  .Properties("Height") = 100
End With

' Add a CommandButton
Set NewButton = TempForm.Designer.Controls _
  .Add("forms.CommandButton.1")
With NewButton
  .Caption = "Click Me"
  .Left = 60
  .Top = 40
End With

' Add an event-handler sub for the CommandButton
With TempForm.CodeModule
  Line = .CountOfLines
  .InsertLines Line + 1, "Sub CommandButton1_Click()"
  .InsertLines Line + 2, "  MsgBox ""Hello!""""
  .InsertLines Line + 3, "  Unload Me"
  .InsertLines Line + 4, "End Sub"
End With

' Show the form
VBA.UserForms.Add(TempForm.Name).Show

' Delete the form
ThisWorkbook.VBProject.VBComponents.Remove TempForm
End Sub

```

This procedure creates and shows the simple UserForm shown in Figure 28-8.

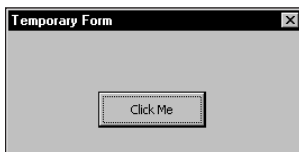


Figure 28-8: This UserForm and its underlying code were generated on the fly.



Note

The workbook that contains the `MakeForm` procedure does not need a reference to the VBA Extensibility Library because it declares `TempForm` as a generic `Object` (not specifically as a `VbComponent` object). Moreover, it doesn't use any built-in constants.

Notice that one of the first instructions hides the VBE window by setting its `Visible` property to `False`. This eliminates the flashing that may occur while the form and code are being generated.

A useful (but not so simple) example

The example in this section is both instructive and useful. It consists of a function named `GetOption` that displays a `UserForm`. Within this `UserForm` are a number of `OptionButtons`, whose captions are specified as arguments to the function. The function returns a value that corresponds to the `OptionButton` selected by the user. Listing 28-7 shows the complete function.

Listing 28-7: A dynamically generated option button form

```
Function GetOption(OpArray, Default, Title)
    Dim TempForm As Object
    Dim NewOptionButton As Msforms.OptionButton
    Dim NewCommandButton1 As Msforms.CommandButton
    Dim NewCommandButton2 As Msforms.CommandButton
    Dim i As Integer, TopPos As Integer
    Dim MaxWidth As Long
    Dim Code As String

    ' Hide VBE window to prevent screen flashing
    Application.VBE.MainWindow.Visible = False

    ' Create the UserForm
    Set TempForm = _
        ThisWorkbook.VBProject.VBComponents.Add(3)
    TempForm.Properties("Width") = 800

    ' Add the OptionButtons
    TopPos = 4
    MaxWidth = 0 'Stores width of widest OptionButton
    For i = LBound(OpArray) To UBound(OpArray)
        Set NewOptionButton = TempForm.Designer.Controls. _
            Add("forms.OptionButton.1")
        With NewOptionButton
            .Width = 800
            .Caption = OpArray(i)
            .Height = 15
            .Left = 8
            .Top = TopPos
            .Tag = i
            .AutoSize = True
            If Default = i Then .Value = True
            If .Width > MaxWidth Then MaxWidth = .Width
        End With
    Next i
End Function
```



```

        End With
        TopPos = TopPos + 15
    Next i

' Add the Cancel button
Set NewCommandButton1 = TempForm.Designer.Controls. _
    Add("forms.CommandButton.1")
With NewCommandButton1
    .Caption = "Cancel"
    .Height = 18
    .Width = 44
    .Left = MaxWidth + 12
    .Top = 6
End With

' Add the OK button
Set NewCommandButton2 = TempForm.Designer.Controls. _
    Add("forms.CommandButton.1")
With NewCommandButton2
    .Caption = "OK"
    .Height = 18
    .Width = 44
    .Left = MaxWidth + 12
    .Top = 28
End With

' Add event-handler subs for the CommandButtons
Code = ""
Code = Code & "Sub CommandButton1_Click()" & vbCrLf
Code = Code & "    GETOPTION_RET_VAL=False" & vbCrLf
Code = Code & "    Unload Me" & vbCrLf
Code = Code & "End Sub" & vbCrLf
Code = Code & "Sub CommandButton2_Click()" & vbCrLf
Code = Code & "    Dim ctl" & vbCrLf
Code = Code & "    GETOPTION_RET_VAL = False" & vbCrLf
Code = Code & "    For Each ctl In Me.Controls" & vbCrLf
Code = Code & "        If TypeName(ctl) = ""OptionButton"" _
    Then" & vbCrLf
Code = Code & "            If ctl Then GETOPTION_RET_VAL = _
    ctl.Tag" & vbCrLf
Code = Code & "        End If" & vbCrLf
Code = Code & "    Next ctl" & vbCrLf
Code = Code & "    Unload Me" & vbCrLf
Code = Code & "End Sub"

With TempForm.CodeModule
    .InsertLines .CountOfLines + 1, Code
End With

' Adjust the form
With TempForm
    .Properties("Caption") = Title
    .Properties("Width") = NewCommandButton1.Left + _

```

Continued

Listing 28-7 (continued)

```

        NewCommandButton1.Width + 10
    If .Properties("Width") < 160 Then
        .Properties("Width") = 160
        NewCommandButton1.Left = 106
        NewCommandButton2.Left = 106
    End If
    .Properties("Height") = TopPos + 24
End With

' Show the form
VBA.UserForms.Add(TempForm.Name).Show

' Delete the form
ThisWorkbook.VBProject.VBComponents.Remove
VBComponent:=TempForm

' Pass the selected option back to the calling procedure
GetOption = GETOPTION_RET_VAL
End Function

```

The `GetOption` function is remarkably fast, considering all that's going on behind the scenes. On my system, the form appears almost instantaneously. The `UserForm` is deleted after it has served its purpose.

Using the `GetOption` function

The `GetOption` function takes three arguments:

- OpArray* A string array that holds the items to be displayed in the form as `OptionButtons`.
- Default* An integer that specifies the default `OptionButton` that is selected when the `UserForm` is displayed. If 0, none of the `OptionButtons` are selected.
- Title* The text to display in the title bar of the `UserForm`.

How `GetOption` works

The `GetOption` function performs the following operations:

1. It hides the VBE window to prevent any flashing that may occur when the `UserForm` is created or the code is added.
2. It creates a `UserForm` and assigns it to an object variable named `TempForm`.
3. It adds the `OptionButton` controls, using the array passed to the function via the `OpArray` argument. It uses the `Tag` property of the control to store the

index number. The `Tag` setting of the chosen option is the value that's eventually returned by the function.

4. It adds two `CommandButtons`: the OK button and the Cancel button.
5. It creates an event-handler procedure for each of the `CommandButtons`.
6. It does some final cleanup work. It adjusts the position of the `CommandButtons`, as well as the overall size of the `UserForm`.
7. It displays the `UserForm`. When the user clicks OK, the `CommandButton1_Click` procedure is executed. This procedure determines which `OptionButton` is selected, and assigns a number to the `GETOPTION_RET_VAL` variable (a `Public` variable).
8. It deletes the `UserForm` after it's dismissed.
9. It returns the value of `GETOPTION_RET_VAL` as the function's result.

Note

A significant advantage of creating the `UserForm` on the fly is that the function is self-contained in a single module, and doesn't even require a reference to the VBA Extensibility Library. Therefore, you can simply export this module (which is named `modOptionsForm`) and then import it into any of your workbooks, giving you access to the `GetOption` function.

The following procedure demonstrates how to use the `GetOption` function. In this case, the `UserForm` presents five options (contained in the `Ops` array).

```
Sub TestGetOption()
    Dim Ops(1 To 5)
    Dim UserOption
    Ops(1) = "North"
    Ops(2) = "South"
    Ops(3) = "West"
    Ops(4) = "East"
    Ops(5) = "All Regions"
    UserOption = GetOption(Ops, 5, "Select a region")
    Debug.Print UserOption
    MsgBox Ops(UserOption)
End Sub
```

The `UserOption` variable contains the index number of the option selected by the user. If the user clicks Cancel, the `UserOption` variable is set to `False`.

Figure 28-9 shows the `UserForm` this function generated.

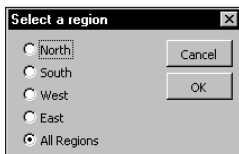


Figure 28-9: The `GetOption` function generated this `UserForm`.

Note

The UserForm adjusts its size to accommodate the number of elements in the array passed to it. Theoretically, the `UserOption` function can accept an array of any size. Practically speaking, however, you'll want to limit the number of options to keep the UserForm at a reasonable size.

What GetOption makes

Following are the event-handler procedures for the two CommandButtons. This is the code generated within the `GetOption` function and placed in the code module for the temporary UserForm.

```
Sub CommandButton1_Click()
    GETOPTION_RET_VAL = False
    Unload Me
End Sub

Sub CommandButton2_Click()
    Dim ctl
    GETOPTION_RET_VAL = False
    For Each ctl In Me.Controls
        If TypeName(ctl) = "OptionButton" Then
            If ctl Then GETOPTION_RET_VAL = ctl.Tag
        End If
    Next ctl
    Unload Me
End Sub
```

Note

Because the UserForm is deleted after it's used, you can't see what it looks like in the VBE. So if you'd like to view the UserForm, convert the following instruction to a comment by typing an apostrophe (') in front of it:

```
ThisWorkbook.VBProject.VBComponents.Remove _
    VBComponent:=TempForm
```

Summary

In this chapter, I provided an introduction to the VBA Integrated Development Environment. I presented examples that demonstrate how to use VBA to add and remove modules, insert VBA code, and create UserForms.

The next chapter introduces another advanced topic: class modules.



Understanding Class Modules

For many VBA programmers, the concept of a class module is a mystery. This feature has been available in Visual Basic for several years, and was added to Excel beginning with Excel 97. This chapter presents an introduction to class modules and includes several examples that may help you better understand this feature and give you ideas for using class modules in your own projects.

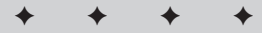
What Is a Class Module?

A *class module* is a special type of VBA module that you can insert into a VBA project. Basically, a class module enables the programmer (you) to create a new object class. As you should know by now, programming Excel really boils down to manipulating objects. A class module allows you to create new objects, along with corresponding properties, methods, and events.



Examples in previous chapters in this book have used class modules. See Chapters 15, 18, 19, and 23.

At this point, you may be asking, “Do I really need to create new objects?” The answer is no. You don’t *need* to, but you may want to once you understand some of the benefits of doing so. In many cases, a class module simply serves as a substitute for functions or procedures, but it may be a more convenient and manageable alternative. In other cases, however, you’ll find that a class module is the only way to accomplish a particular task.

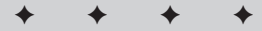


In This Chapter

An introduction to class modules

A list of some typical uses for class modules

Examples that demonstrate some key concepts related to class modules



Following is a list of some typical uses for class modules:

- ♦ *To handle events associated with embedded charts.* (See Chapter 18 for an example.)
- ♦ *To monitor application-level events*, such as activating any worksheet. (See Chapters 19 and 23 for examples.)
- ♦ *To encapsulate a Windows API function to make it easier to use in your code.* For example, you can create a class that makes it easy to detect or set the state of the Num Lock or Caps Lock key. Or you can create a class that simplifies access to the Windows Registry.
- ♦ *To enable multiple objects in a UserForm to execute a single procedure.* Normally, each object has its own event-handler. The example in Chapter 15 demonstrates how to use a class module so that multiple CommandButtons have a single Click event-handler procedure.
- ♦ *To create reusable components that can be imported into other projects.* Once you create a general-purpose class module, you can import it into other projects to reduce your development time.

Example: Creating a NumLock Class

In this section, I provide step-by-step instructions for creating a useful, albeit simple, class module. This class module creates a NumLock class that has one property: `Value`. Detecting or changing the state of the Num Lock key requires several Windows API functions. The purpose of this class module is to simplify things. All the API declarations and code are contained in a class module (not in your normal VBA modules). The benefits? Your code will be much easier to work with, and you can use this class module in your other projects.

After the class is created, your VBA code can determine the current state of the Num Lock key by using an instruction such as the following, which displays the `Value` property:

```
MsgBox NumLock.Value
```

Or, your code can change the state of the Num Lock key. The following instruction, for example, turns the Num Lock key on:

```
NumLock.Value = True
```

It's important to understand that a class module contains the code that *defines* the object, including its properties and methods. You can then create an instance of this object in your VBA general code modules and manipulate its properties and methods.

To better understand the process of creating a class module, you may want to follow the instructions in the sections that follow. Start with an empty workbook.

Inserting a class module

Activate the VBE, and select **Insert** ⇨ **Class Module**. This adds an empty class module named `Class1`. If the Properties window isn't displayed, press F4 to display it. Then change the name of the class module to `NumLockClass` (see Figure 29-1).

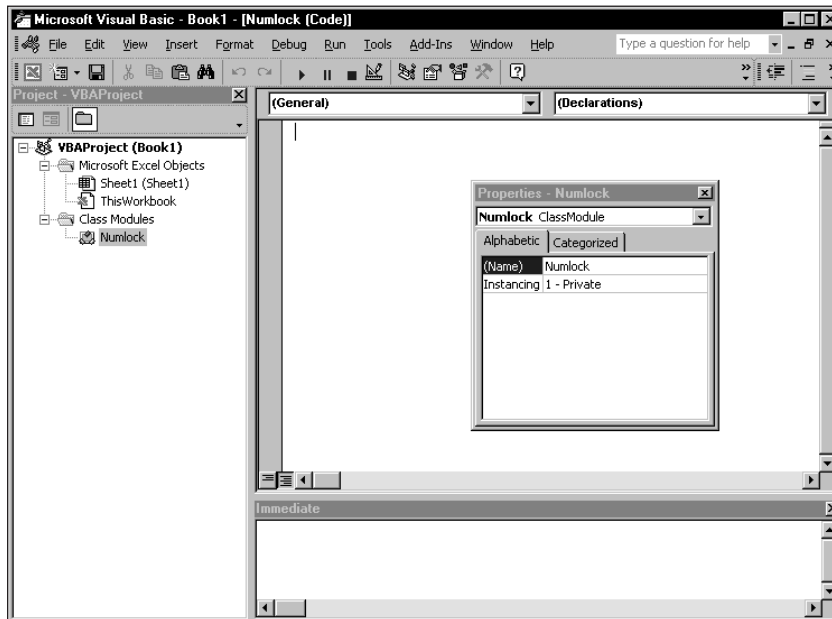


Figure 29-1: An empty class module named `NumLockClass`

Adding the VBA code

In this step, you create the code for the `Value` property. To detect or change the state of the Num Lock key, the class module needs the required Windows API declarations that are used to detect and set the Num Lock key. That code follows:

```
Private Type KeyboardBytes
    kbByte(0 To 255) As Byte
End Type

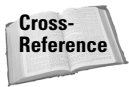
Dim kbArray As KeyboardBytes
```

```
Private Declare Function GetKeyState _
    Lib "user32" (ByVal nVirtKey As Long) As Long
Private Declare Function GetKeyboardState _
    Lib "user32" (kbArray As KeyboardBytes) As Long
Private Declare Function SetKeyboardState _
    Lib "user32" (kbArray As KeyboardBytes) As Long

Const VK_NUMLOCK = &H90
```

Next, you need a procedure that retrieves the current state of the Num Lock key. I'll call this the `Value` property of the object. You can use any name for the property; `Value` seems like a good choice. To retrieve the state, insert the following Property Get procedure:

```
Property Get Value() As Boolean
    Value = GetKeyState(VK_NUMLOCK) And 1 = 1
End Property
```



The details of Property procedures are described later in this chapter. See “Programming properties.”

This procedure, which uses the `GetKeyState` Windows API function to determine the current state of the Num Lock key, is called whenever VBA code reads the `Value` property of the object. For example, a VBA statement such as this executes the Property Get procedure:

```
MsgBox NumLock.Value
```

You now need a procedure that sets the Num Lock key to a particular state: either on or off. You can do this with the following Property Let procedure:

```
Property Let Value(boolVal As Boolean)
    GetKeyboardState kbArray
    kbArray.kbByte(VK_NUMLOCK) = Abs(boolVal)
    SetKeyboardState kbArray
End Property
```

The Property Let procedure takes one argument, which is either `True` or `False`. A VBA statement such as the following sets the `Value` property of the `NumLock` object to `True` by executing the Property Let procedure:

```
NumLock.Value = True
```

Using the NumLock class

Before you can use the `NumLockClass` class module, you must create an instance of the object. The following statement, which resides in a regular VBA module (not the class module), does just that:

```
Dim NumLock As New NumLockClass
```


Notice that the object type is `NumLockClass` (that is, the name of the class module). The object variable itself can have any name, but `NumLock` certainly seems like a logical name for this.

The following procedure sets the `Value` property of the `NumLock` object to `True`, which results in the Num Lock key's being turned on:

```
Sub NumLockOn()  
    Dim NumLock As New NumLockClass  
    NumLock.Value = True  
End Sub
```

The next procedure displays a message box that indicates the current state of the Num Lock key (`True` is on; `False` is off):

```
Sub GetNumLockState()  
    Dim NumLock As New NumLockClass  
    MsgBox NumLock.Value  
End Sub
```

Finally, the following procedure toggles the Num Lock key:

```
Sub ToggleNumLock()  
    Dim NumLock As New NumLockClass  
    NumLock.Value = Not NumLock.Value  
End Sub
```



The completed class module for this example is available on the companion CD-ROM. The workbook also contains a class module to detect and set the state of the Caps Lock key.

More about Class Modules

The example in the preceding section demonstrates how to create a new object class with a single property named `Value`. An object class can contain any number of properties; it can also contain methods and events.

Naming the object class

The name you use for the class module in which you define the object class is also the name of the object class. By default, class modules are named `Class1`, `Class2`, and so on. Usually, you'll want to provide a more meaningful name for your object class.

Programming properties

Most objects have at least one property, and you can give them as many as you need. After a property is defined, you can use it in your code, using the standard “dot” syntax:

```
object.property
```

The VBE’s Auto List Members option works with objects defined in a class module. This makes it easier to select properties or methods when writing code.

Properties for the object that you define can be read-only, write-only, or read/write. You define a read-only property with a single procedure, using the `Property Get` keyword. Here’s an example of a `Property Get` procedure:

```
Property Get FileNameOnly() As String
    FileNameOnly = ""
    For i = Len(FullName) To 1 Step -1
        Char = Mid(FullName, i, 1)
        If Char = "\" Then
            Exit Function
        Else
            FileNameOnly = Char & FileNameOnly
        End If
    Next i
End Property
```

You may have noticed that a `Property Get` procedure works like a `Function` procedure. The code performs calculations and then returns a property value that corresponds to the procedure’s name. In this example, the procedure’s name is `FileNameOnly`. The property value returned is the filename part of a path string (contained in a `Public` variable named `FullName`). For example, if `FullName` is `c:\windows\myfile.txt`, the procedure returns a property value of `myfile.txt`. The `FileNameOnly` procedure is called when VBA code references the object and property.

For read/write properties, you create two procedures: a `Property Get` procedure, which reads a property value, and a `Property Let` procedure, which writes a property value. The value being assigned to the property is treated as the final argument (or the only argument) of a `Property Get` procedure.

Two example procedures follow:

```
Property Get SaveAsExcelFile() As Boolean
    SaveAsExcelFile = XLFile
End Property

Property Let SaveAsExcelFile(boolVal As Boolean)
    XLFile = boolVal
End Property
```

Note

Use Property Set in place of Property Let when the property is an object data type.

A Public variable in a Class Module can also be used as a property of the object. In the preceding example, the Property Get and Property Let procedures could be eliminated and replaced with this module level declaration:

```
Public SaveAsExcelFile As Boolean
```

In the unlikely event that you need to create a write-only property, you create a single Property Let procedure with no corresponding Property Get procedure.

The preceding examples assume a Boolean module-level variable named `XLFile`. The Property Get procedure simply returns the value of this variable as the property value. If the object were named `FileSys`, for example, the following statement would display the current value of the `SaveAsExcelFile` property:

```
MsgBox FileSys.SaveAsExcelFile
```

The Property Let statement, on the other hand, accepts an argument and uses the argument to change the value of a property. For example, you could write a statement such as the following to set the `SaveAsExcelFile` property to True:

```
FileSys.SaveAsExcelFile = True
```

In this case, the value True is passed to the Property Let statement, changing the property's value.

The preceding examples use a module-level variable named `XLFile` that actually stores the property value. You'll need to create a variable that represents the value for each property that you define within your class module.

Note

Normal procedure-naming rules apply to property procedures, and you'll find that VBA won't let you use some names if they are reserved words. So if you get a syntax error when creating a property procedure, try changing the name of the procedure.

Programming methods

A method for an object class is programmed using a standard Sub or Function procedure placed in the class module. An object may or may not use methods. Your code executes a method using standard notation:

```
object.method
```

Like any other VBA method, a method that you write for an object class will perform some type of action. The following procedure is an example of a method that saves a workbook in one of two file formats, depending on the value of the `XLFile` variable. As you can see, there is nothing special about this procedure.

```
Sub SaveFile()  
    If XLFile Then  
        ActiveWorkbook.SaveAs FileName:=FName, _  
            FileFormat:=xlWorkbookNormal  
    Else  
        ActiveWorkbook.SaveAs FileName:=FName, _  
            FileFormat:=xlCSV  
    End If  
End Sub
```

The example in the next section should clarify the concepts of properties and methods for object classes defined in a class module.

Class module events

Every class module has two events: `Initialize` and `Terminate`. The `Initialize` event is triggered when a new instance of the object is created; the `Terminate` event is triggered when the object is destroyed. You might want to use the `Initialize` event to set default property values.

The frameworks for these event-handler procedures are as follows:

```
Private Sub Class_Initialize()  
    ' Initialization code goes here  
End Sub  
  
Private Sub Class_Terminate()  
    ' Termination code goes here  
End Sub
```

An object is *destroyed* (and its memory is freed) when the procedure or module in which it is declared finishes executing. You can destroy an object at any time by setting it to `Nothing`. The following statement, for example, destroys the object named `MyObject`:

```
Set MyObject = Nothing
```

Example: A CSV File Class

The example presented in this section defines an object class called `CSVFileClass`. This class has two properties and two methods:

Properties

- `ExportRange` (Read/write) A worksheet range to be exported as a CSV file
- `ImportRange` (Read/write) The range into which a CSV file will be imported

Methods

- `Import` Imports the CSV file represented by the `CSVFileName` argument into the range represented by the `ImportRange` property
- `Export` Exports the range represented by the `ExportRange` property to a CSV file represented by the `CSVFileName` argument

Class module-level variables

A class module must maintain its own private variables that mirror the property settings for the class. The `CSVFileClass` class module uses two variables to keep track of the two property settings. These variables are declared at the top of the class module:

```
Private RangeToExport As Range
Private ImportToCell As Range
```

`RangeToExport` is a `Range` object that represents the range to be exported. `ImportToCell` is a `Range` object that represents the upper-left cell of the range into which the file will be imported. These variables are assigned values by the `Property Get` and `Property Let` procedures listed in the next section.

Property procedures

The property procedures for the `CSVFileClass` class module are shown in Listing 29-1. The `Property Get` procedures return the value of a variable, and the `Property Let` procedures set the value of a variable.

Listing 29-1: Property procedures for the `CSVFileClass` module

```
Property Get ExportRange() As Range
    Set ExportRange = RangeToExport
End Property

Property Let ExportRange(rng As Range)
    Set RangeToExport = rng
End Property
```

Continued

Listing 29-1 (continued)

```
Property Get ImportRange() As Range
    Set ImportRange = ImportToCell
End Property

Property Let ImportRange(rng As Range)
    Set ImportToCell = rng
End Property
```

Method procedures

The `CSVFileClass` class module contains two procedures that represent the two methods. These are listed and discussed in the sections that follow.

The Export procedure

The `Export` procedure in Listing 29-2 is called when the `Export` method is executed. It takes one argument: the full name of the file receiving the exported range. The procedure provides some basic error handling. For example, it ensures that the `ExportRange` property has been set by checking the `RangeToExport` variable. The procedure sets up an error handler to trap other errors.

Listing 29-2: Exporting a worksheet range with a class module method

```
Sub Export(CSVFileName)
    ' Exports a range to CSV file
    If RangeToExport Is Nothing Then
        MsgBox "ExportRange not specified"
        Exit Sub
    End If

    On Error GoTo ErrHandle
    Application.ScreenUpdating = False
    Set ExpBook = Workbooks.Add(xlWorksheet)
    RangeToExport.Copy
    Application.DisplayAlerts = False

    With ExpBook
        .Sheets(1).Paste
        .SaveAs FileName:=CSVFileName, FileFormat:=xlCSV
    End With
End Sub
```

```

        .Close SaveChanges:=False
    End With
    Application.CutCopyMode = False
    Application.ScreenUpdating = True
    Application.DisplayAlerts = True
    Exit Sub
ErrHandle:
    ExpBook.Close SaveChanges:=False
    Application.CutCopyMode = False
    Application.ScreenUpdating = True
    Application.DisplayAlerts = True
    MsgBox "Error " & Err & vbCrLf & vbCrLf & Error(Err), _
        vbCritical, "Export Method Error"
End Sub

```

The `Export` procedure works by copying the range specified by the `RangeToExport` variable to a new temporary workbook, saving the workbook as a CSV text file, and closing the file. Because screen updating is turned off, the user does not see this happening. If an error occurs—for example, an invalid filename is specified—the procedure jumps to the `ErrHandle` section and displays a message box that contains the error number and description.

The Import procedure

The `Import` procedure in Listing 29-3 imports a CSV file specified by the `CSVFileName` argument and copies its contents to a range specified by the `ImportToCell` variable, which maintains the `ImportRange` property. The file is then closed. Again, screen updating is turned off, so the user does not see the file being opened. Like the `Export` procedure, the `Import` procedure incorporates some basic error handling.

Listing 29-3: Importing text file contents into a range with a class module method

```

Sub Import(CSVFileName)
' Imports a CSV file to a range
If ImportToCell Is Nothing Then
    MsgBox "ImportRange not specified"
    Exit Sub
End If

If CSVFileName = "" Then
    MsgBox "Import FileName not specified"
    Exit Sub
End If

```

Continued

Listing 29-3 (continued)

```
On Error GoTo ErrHandle
Application.ScreenUpdating = False
Application.DisplayAlerts = False
Workbooks.Open CSVFileName
Set CSVFile = ActiveWorkbook
ActiveSheet.UsedRange.Copy Destination:=ImportToCell
CSVFile.Close SaveChanges:=False
Application.ScreenUpdating = True
Application.DisplayAlerts = True
Exit Sub
ErrHandle:
CSVFile.Close SaveChanges:=False
Application.ScreenUpdating = True
Application.DisplayAlerts = True
MsgBox "Error " & Err & vbCrLf & vbCrLf & Error(Err), _
    vbCritical, "Import Method Error"
End Sub
```

Using the CSVFileClass object

To create an instance of a CSVFileClass object in your code, start by declaring a variable as type CSVFileClass. Here's an example:

```
Dim CSVFile As New CSVFileClass
```

You may prefer to declare the object variable first and then create the object when needed. This requires a Dim statement and a Set statement:

```
Dim CSVFile As CSVFileClass
' other code may go here
Set CSVFile = New CSVFile
```

The advantage of using both a Dim and a Set statement is that the object isn't actually created until the Set statement is executed. You may want to use this technique to save memory by not creating an object if it's not needed. For example, your code might contain logic that determines whether the object is actually created. In addition, using the Set command enables you to create multiple instances of an object.

After creating an instance of the object, you can write other instructions to access the properties and methods defined in the class module.

As you can see in Figure 29-2, the VBE's Auto List Members feature works just like any other object. After you type the variable name, followed by a dot, you'll see a list of properties and methods for the object.

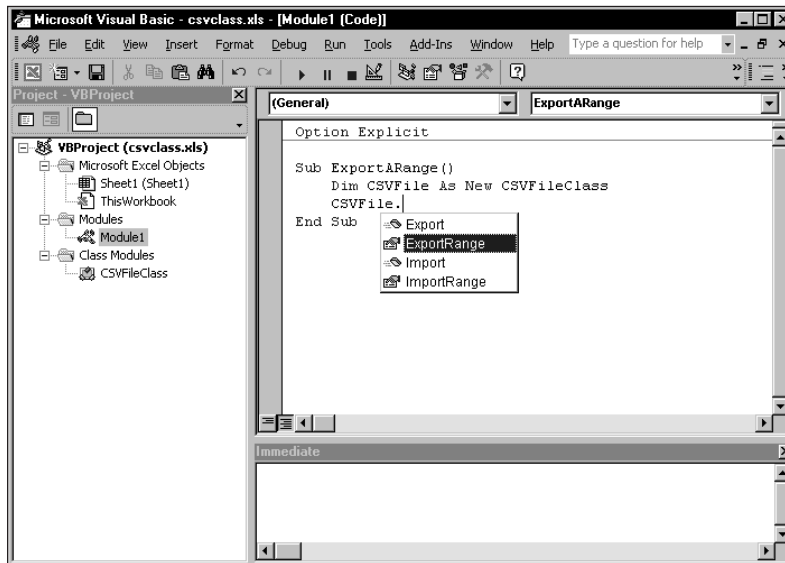


Figure 29-2: The Auto List Members feature displays the available properties and methods.

The following procedure demonstrates how to save the current range selection to a CSV file named temp.csv, which is stored in the same directory as the current workbook:

```
Sub ExportARange()
    Dim CSVFile As New CSVFileClass
    With CSVFile
        .ExportRange = ActiveWindow.RangeSelection
        .Export CSVFileName:=ThisWorkbook.Path & "\temp.csv"
    End With
End Sub
```

Using the With-End With structure isn't mandatory. For example, the procedure could be written as follows:

```
Sub ExportARange()
    Dim CSVFile As New CSVFileClass
    CSVFile.ExportRange = ActiveWindow.RangeSelection
    CSVFile.Export CSVFileName:=ThisWorkbook.Path & "\temp.csv"
End Sub
```

The following procedure demonstrates how to import a CSV file, beginning at the active cell:

```
Sub ImportAFile()  
    Dim CSVFile As New CSVFileClass  
    With CSVFile  
        On Error Resume Next  
        .ImportRange = ActiveCell  
        .Import CSVFileName:=ThisWorkbook.Path & "\temp.csv"  
    End With  
    If Err <> 0 Then _  
        MsgBox "Cannot import " & ThisWorkbook.Path & "\temp.csv"  
End Sub
```

Your code can work with more than one instance of an object. The following code, for example, creates an array of three CSVFileClass objects:

```
Sub Export3Files()  
    Dim CSVFile(1 To 3) As New CSVFileClass  
    CSVFile(1).ExportRange = Range("A1:A20")  
    CSVFile(2).ExportRange = Range("B1:B20")  
    CSVFile(3).ExportRange = Range("C1:C20")  
  
    For i = 1 To 3  
        CSVFile(i).Export CSVFileName:="File" & i & ".csv"  
    Next i  
End Sub
```

Summary

In this chapter, I presented an introduction to class modules and included examples that demonstrate how to create new object classes containing properties and methods. Previous chapters in this book contain other examples of class modules.

The next chapter wraps up Part VII with a handy list of frequently asked questions.

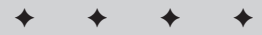


Frequently Asked Questions about Excel Programming

If you like to cruise the Internet, you're undoubtedly familiar with *FAQs*—lists of *frequently asked questions* (and their answers) about a particular topic. FAQs are prevalent in the Usenet discussion groups and are posted in an attempt to reduce the number of messages that ask the same questions over and over again. But they rarely serve their intended purpose because the same questions keep appearing despite the FAQs.

I've found that people tend to ask the same questions about Excel programming, so I put together a list of FAQs that cover programming topics for Excel 97 and later versions. Although this FAQ list certainly won't answer *all* of your questions, it covers many common questions and may set you straight about a thing or two. The questions (and many of the answers) came from the following sources:

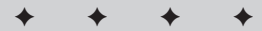
- ◆ `microsoft.public.excel.*` newsgroups
- ◆ The `comp.apps.spreadsheets` newsgroup
- ◆ Microsoft's Knowledge Base
- ◆ E-mail sent to me in an attempt to get some free consulting



In This Chapter

Lists of frequently asked questions about Excel programming

Where to go if your question isn't answered here



What If My Question Isn't Answered Here?

If this chapter doesn't provide an answer to your question, start by checking the index of this book. This book includes lots of information that doesn't qualify as a frequently asked question. If you come up empty-handed, check out the resources listed in Appendix A.

I organized this list of questions by assigning each question to one of eight categories:

- ♦ General Excel
- ♦ The Visual Basic Editor
- ♦ Sub procedures and Function procedures
- ♦ Objects, properties, methods, and events
- ♦ VBA instructions
- ♦ UserForms
- ♦ Add-ins
- ♦ CommandBars

In some cases, my classifications are rather arbitrary; a question could justifiably be assigned to other categories. Moreover, questions within each category are listed in no particular order.

By the way, most of the information in this chapter is discussed in greater detail in other chapters in this book.

General Excel Questions

Why does Excel have two macro languages?

Early versions of Excel used a macro language called XLM. The VBA language was introduced in Excel 5 and is vastly superior in every way. XLM has been phased out, so you should use VBA for new macro development.

I need to distribute a workbook to someone who still uses Excel 4. Is there a way to record my actions to an XLM macro?

No. Beginning with Excel 97, the macro recorder can generate only VBA macro code. Generally speaking, it's not a good idea to develop a workbook using a version of Excel that's newer than the Excel version it will be used with.

Do XLM macros written for previous versions of Excel work in Excel 97 and later versions?

In most cases, they will work perfectly.

I'm looking for a third-party utility that will convert my Excel 4 macros to VBA. Am I out of luck?

Yes, you are. No such utility exists, and it is extremely unlikely that one will be written. Such conversions must be done manually. Because all versions of Excel can execute XLM macros, however, there is really no reason to convert these macros unless you'd like to update them to incorporate new features found in later versions of Excel.

Is it possible to call a VBA procedure from an Excel 4.0 XLM macro?

Yes, you can do so by using XLM's RUN function. For example, the following macro runs the Test procedure contained in Module1 in workbook Book1.xls:

```
=RUN(Book1.xls!Module1.Test)
```

Is there a way to automatically convert 1-2-3 or Quattro Pro macros to VBA macros?

No. You must rewrite the macros for Excel.

Where can I find examples of VBA code?

The Internet has thousands of VBA examples. A good starting point is my Web site:

```
http://www.j-walk.com/ss/
```

Is there a utility that will convert my Excel application into a standalone EXE file?

No.

How can I add a drop-down list to a cell so the user can choose a value from the list?

Type the list of valid entries in a single column. You can hide this column from the user if you wish. Select the cell or cells that will display the list of entries, choose Data ⇨ Validation, and select the Settings tab. From the Allow drop-down list, select List. In the Source box, enter a range address or a reference to the items in your sheet. Make sure the In-cell dropdown check box is selected. If the list is short, you can simply type the items, each separated by a comma. This technique does not require any macros.

Can I use this drop-down list method if my list is stored on a different worksheet in the workbook?

Yes. You need to create a name for the list (for example, `ListEntries`). Then, in the Data Validation dialog box, enter `=ListEntries` in the Source box. Make sure that you include the initial equal sign, otherwise it won't work.

I use `Application.Calculation` to set the calculation mode to manual. However, this seems to affect all workbooks, not just the active workbook.

The `Calculation` property is a member of the `Application` object. Therefore, the calculation mode affects all workbooks. It is not possible to set the calculation mode for only one workbook. Excel 2000 provides a new `Worksheet` object property: `EnableCalculation`. When this property is `False`, the worksheet will not be calculated, even if the user requests a calculation. Setting the property to `True` will cause the sheet to be calculated.

How can I increase the number of columns in a worksheet?

You can't. This number is fixed and cannot be changed. Microsoft continues to ignore what must amount to thousands of requests for more worksheet columns.

How can I increase the number of rows in a worksheet?

See the answer to the previous question.

Is it possible to change the color of the sheet tabs?

If you use Excel 2002, right-click the sheet tab and select `Tab Color`. Previous versions of Excel do not allow you to change the tab color.

Is it possible to change the font of the sheet tabs?

Yes, but you must go outside of Excel to do so. In the Windows Control Panel, select `Display`. In the `Display Properties` dialog box, click the `Appearance` tab. In the `Item` list, select `Scrollbar`. Use the spinner to increase or decrease the size. This setting will affect other programs.

Is it possible to change the default font and color of cell comments?

Yes. In the Windows Control Panel, select `Display`. In the `Display Properties` dialog box, click the `Appearance` tab. In the `Item` list, select `ToolTip`. Use the controls to change the settings. This setting will affect other programs.

What happened to the mapping feature in Excel 2002?

Microsoft's license for that software expired, and it was not renewed. Consequently, all traces of this feature have been expunged (including any references in the online help). Therefore, users and developers who relied on that feature will have to seek another solution if they upgraded to Excel 2002.

Is it possible to play sounds in Excel?

Yes, you can play WAV and MIDI files, but it requires Windows API functions (see Chapter 11). If you're using Excel 2002, you can take advantage of the new `Speech` object. The following statement, when executed, greets the user by name (assuming the user has a sound card):

```
Application.Speech.Speak ("Hello" & Application.UserName)
```

When I open a workbook, Excel asks if I want to update the links. I've searched all of my formulas, and I cannot find any links in this workbook. Is this a bug?

Probably not. Links can occur in places other than formulas. If you have a chart in your workbook, click each data series in the chart and examine the `SERIES` formula in the formula bar. If the formula refers to another workbook, you've identified the link. To eliminate it, move the chart's data into the current workbook and re-create your chart.

If your workbook contains any Excel 5/95 dialog sheets, select each object in each dialog box and examine the formula bar. If any object contains a reference to another workbook, edit or delete that reference.

Select `Insert` ⇨ `Name` ⇨ `Define`. Scroll down the list in the `Define Name` dialog box and examine the `Refers to` box. Delete names that refer to another workbook or that contain an erroneous reference (such as `#REF!`). This is the most common cause of "phantom links."

How can I print the workbook's full path and filename in a page header?

If you use Excel 2002, you can take advantage of a new feature in the `Page Setup` dialog box. When this dialog is displayed, click the `Header/Footer` tab and click `Custom Header`. You'll find a new icon that inserts the code to print the full path and filename of the workbook. Note, however, that if the workbook has not been saved, the path name may be incorrect (it uses the default workbook path).

For older versions of Excel, you need to use a VBA macro and take advantage of the `WorkbookBeforePrint` event. For example, place the following procedure in the code module for the `ThisWorkbook` object to print the workbook's full path and filename in the left header of each sheet:

```
Private Sub Workbook_BeforePrint(Cancel As Boolean)
    For Each sht In ThisWorkbook.Sheets
        sht.PageSetup.LeftHeader = ThisWorkbook.FullName
    Next sht
End Sub
```

I've heard that some programs have "secret" commands that display a list of the program's developers. Is there such a command in Excel?

These hidden messages are sometimes known as *Easter Eggs*. Each version of Excel has its own Easter Egg. To view Excel 2000's Easter Egg, follow these steps:

1. Open a new Excel workbook.
2. Press F5.
3. Type **X2000:L2000** and press Enter.
4. You should now be on row 2000.
5. Press Tab once, to move to column M.
6. Hold Control and Shift, then right-click the Chart Wizard icon on the Standard toolbar. Some people have reported that it works only if you left-click the Chart Wizard icon.

Watch the list of developers for Excel scroll by.

What about the Easter Egg for Excel 2002?

As this book was going to press, the Excel 2002 Easter Egg (if any) had not yet been discovered. Check my Web site (<http://www.j-walk.com/ss/excel/eastereg.htm>) for the latest Excel Easter Egg news. Microsoft has received many complaints about Easter Eggs, so it's possible that this practice has been discontinued.

The Visual Basic Editor

In Excel 95, my VBA modules were located in my workbook. I can't see them when I open the file using Excel 97 or later.

The modules are still there, but you view and edit them in the Visual Basic Editor. Press Alt+F11 to toggle between the VBE and Excel.

Can I use the VBA macro recorder to record all of my macros?

No. Recording is useful for very simple macros only. Macros that use variables, looping, or any other type of program flow changes cannot be recorded. You can, however, often take advantage of the macro recorder to write some parts of your code or to discover the relevant properties or methods.

Excel 95 had a “record at mark” feature that enabled you to record a macro beginning at a particular location within an existing macro. Is that feature still available?

No, it was removed beginning with Excel 97. To add new recorded code to an existing macro, you need to record it and then cut and paste the code to your existing macro.

I have some macros that are general in nature. I would like to have these available all the time. What’s the best way to do this?

Consider storing those general-purpose macros in your Personal Macro Workbook. This is a (normally) hidden workbook that is loaded automatically by Excel. When you record a macro, you have the option of recording it to your Personal Macro Workbook. The file, `Personal.xls`, is stored in your `\XLStart` directory.

I can’t find my Personal Macro Workbook. Where is it?

The `Personal.xls` file doesn’t exist until you record a macro to it.

Every time my Excel 97 macro copies a worksheet, the new sheet name appears in the Project window of VBE as something like Sheet1111111111(Sheet 1(9)). What’s the deal with this?

These strange names are the “code names” for `Worksheet` objects, and they can get very unwieldy if you do a lot of sheet copying. In fact, when the sheet name reaches 32 characters, it will cause Excel to crash. You can change the code name by using the Properties window in the VBE. This problem was fixed in Excel 2000.

I locked my VBA project with a password, and I forget what it was. Is there any way to unlock it?

Several third-party password-cracking products exist. Use a Web search engine, and search for *Excel password*. The existence of these products should tell you that Excel passwords are not very secure.

How can I write a macro to change the password of my project?

You can’t. The protection elements of a VBA project are not exposed in the object model. Most likely, this was done to make it more difficult for password-cracking software.

When I insert a new module, it always starts with an Option Explicit line. What does this mean?

If `Option Explicit` is included at the top of a module, it means that you must declare every variable before you use it (which is a good idea). If you don't want this line to appear in new modules, activate the VBE and select the Tools ⇨ Options command, click the Editor tab, and uncheck the Require Variable Declaration check box. Then you can either declare your variables or let VBA handle the data typing automatically.

Why does my VBA code appear in different colors? Can I change these colors?

VBA uses color to differentiate various types of text: comments, keywords, identifiers, statements with a syntax error, and so on. You can adjust these colors and the font used by selecting the Tools ⇨ Options command (Editor Format tab) in the VBE.

I want to delete a VBA module by using VBA code. Can I do this?

Yes. The following code deletes `Module1` from the active workbook:

```
With ActiveWorkbook.VBProject
    .VBComponents.Remove .VBComponents("Module1")
End With
```

This may not work with Excel 2002. See the next question.

I wrote a macro in Excel 2000 that adds VBA code to the VB project. When I run it in Excel 2002, I get an error message. What's wrong?

Excel 2002 has a new setting: Trust access to Visual Basic Project. By default, this setting is turned off. To change it, select Tools ⇨ Macro ⇨ Security and click the Trusted Sources tab in the Security dialog box.

How can I change the user's macro security setting? I want to avoid the "this workbook contains macros" message when my application is opened.

The ability to change the security level using VBA would pretty much render the entire macro security system worthless. Think about it.

When I open a workbook, I get the standard macro warning message. However, I deleted all the macros in this workbook! Is there a virus?

Probably not. In addition to deleting your macros, make sure that you also delete the VBA module in which they were stored.

I don't understand how the `UserInterfaceOnly` option works when protecting a worksheet.

When protecting a worksheet, you can use a statement such as:

```
ActiveSheet.Protect UserInterfaceOnly:=True
```

This causes the sheet to be protected, but your macros can still make changes to the sheet. It's important to understand that this setting is not saved with the workbook. When the workbook is re-opened, you'll need to re-execute the statement in order to reapply the `UserInterfaceOnly` protection.

How can I tell if a workbook has a macro virus?

In the VBE, activate the project that corresponds to the workbook. Examine all of the code modules and look for VBA code that is not familiar to you. Usually, virus code will not be formatted well, and will contain lots of unusual variable names. Another option is to use a commercial virus scanning program.

I'm having trouble with the concatenation operator (&) in VBA. When I try to concatenate two strings, I get an error message.

VBA is probably interpreting the ampersand as a type-declaration character. Make sure that you insert a space before and after the concatenation operator.

I can't seem to get the VBA line continuation character (underscore) to work.

The line continuation sequence is actually two characters: a space followed by an underscore.

In Excel 95, I set my VBA module to be "very hidden" to prevent users from seeing it. When the workbook is opened in Excel 97, the module can be viewed in the VBE. Is this right?

I don't know if it's right, but that's the way it is. Excel 97 and later does not support the `xlVeryHidden` property setting for modules.

After deleting a major amount of VBA code, I've noticed that the XLS file size is not reduced accordingly. Why is this?

Excel doesn't always do a good job of cleaning up after itself. This sometimes causes some subtle problems with variables that you no longer use. One way to fix it is to export your module to a file, delete the module, and then import it again.

I distributed an XLS application to many users. On some machines, my VBA error-handling procedures don't work. Why not?

The error-handling procedures won't work if the user has the Break on All Errors option set. This option is available in the Options dialog box (General tab) in the VBE. Unfortunately, you can't change this setting with VBA. To avoid this problem, you can distribute your application as an XLA add-in.

Procedures

What's the difference between a VBA procedure and a macro?

Nothing, really. The term *macro* is a carry-over from the old days of spreadsheets. These terms are now used interchangeably.

What's a procedure?

A procedure is a grouping of VBA instructions that can be called by name. If these instructions are to give an explicit result, such as a value, back to the instruction that called them, they most likely belong to a Function procedure. Otherwise, they probably belong to a Sub procedure.

What is a variant data type?

Variables that aren't specifically declared are assigned the variant type by default, and VBA automatically converts the data to the proper type when it's used. This is particularly useful for retrieving values from a worksheet cell when you don't know in advance what the cell contains. Generally, it's a good idea to specifically declare your variables with the `Dim`, `Public`, or `Private` statement because using variants is a bit slower and is not the most efficient use of memory.

What's the difference between a variant array and an array of variants?

A variant is a unit of memory with a special data type that can contain any kind of data: a single value or an array of values (that is, a *variant array*). The following code creates a variant that contains an array:

```
Dim X As Variant
X = Array(30, 40, 50)
```

A normal array can contain items of a specified data type, including nontyped variants. The following statement creates an array that consists of 12 variants:

```
Dim X (0 To 2) As Variant
```

Although a variant containing an array is conceptually different from an array whose elements are of type variant, the array elements are accessed in the same way.

What's a type-definition character?

VBA lets you append a character to a variable's name to indicate the data type. For example, you can declare the `MyVar` variable as an integer by tacking `%` onto the name, as follows:

```
Dim MyVar%
```

Here's a list of the type-declaration characters supported by VBA:

Integer	%
Long	&
Single	!
Double	#
Currency	@
String	\$

I wrote a VBA function that works perfectly when I call it from another procedure. But it doesn't work when I use it in a worksheet formula. What's wrong?

VBA functions called from a worksheet formula have some limitations. In general, they must be strictly "passive"—they can't change the active cell, apply formatting, open workbooks, or change the active sheet. If the function attempts to do any of these things, the formula will return an error.

Functions can only perform calculations and return a value. An exception to this rule is the VBA `MsgBox` function. A custom function can display a message box whenever it is recalculated. This is very handy for debugging a custom function.

I would like to create a procedure that automatically changes the formatting of a cell based on the data I enter. For example, if I enter a value greater than 0, the cell's background color should be red. Is this possible?

It's certainly possible, and you don't need any programming. Use Excel's Conditional Formatting feature, accessed with the `Format` ⇄ `Conditional Formatting` command.

The Conditional Formatting feature is useful, but I'd like to perform other types of operations when data is entered into a cell.

In that case, you can take advantage of the `Change` event for a worksheet object. Whenever a cell is changed, the `Change` event is triggered. If the code module for the `Sheet` object contains a procedure named `Worksheet_Change`, this procedure will be executed automatically.

What other types of events can be monitored?

Lots! Search the online help for *events* to get a complete listing.

I tried entering an event procedure (Sub Workbook_Open), but the procedure isn't executed when the workbook is opened. What's wrong?

You probably put the procedure in the wrong place. Workbook event procedures must be in the code module for the `ThisWorkbook` object. Worksheet event procedures must be in the code module for the appropriate `Sheet` object, as shown in the VBE's Project window.

I can write an event procedure for a particular workbook. Is it possible to write an event procedure that will work for any workbook that's open?

Yes, but you need to use a class module. Details are in Chapter 19.

I'm very familiar with creating formulas in Excel. Does VBA use the same mathematical and logical operators?

Yes. And it includes some additional operators that aren't valid in worksheet formulas. These additional VBA operators are listed in the following table:

<i>Operator</i>	<i>Function</i>
<code>\</code>	Division with an integer result
<code>Eqv</code>	Returns True if both expressions are True or both are False
<code>Imp</code>	Logical implication on two expressions
<code>Is</code>	Compares two object variables
<code>Like</code>	Compares two strings, using wildcard characters
<code>Xor</code>	Returns True if only one expression is True

How can I execute a procedure that's in a different workbook?

Use the `Run` method of the `Application` object. The following instruction executes a procedure named `Macro1` located in the `Personal.xls` workbook:

```
Run "Personal.xls!Macro1"
```

I've used VBA to create several custom functions. I like to use these functions in my worksheet formulas, but I find it inconvenient to precede the function name with the workbook name. Is there any way around this?

Yes. Convert the workbook that holds the function definitions to an XLA add-in. When the add-in is open, you can use the functions in any other worksheet without referencing the function's filename.

In addition, if you set up a reference to the workbook that contains the custom functions, you can use the function without preceding it with the workbook name. To create a reference, use the `Tools` ⇨ `References` command in the VBE.

I would like a particular workbook to be loaded every time I start Excel. I would also like a macro in this workbook to execute automatically. Am I asking too much?

Not at all. To open the workbook automatically, just store it in your `\XLStart` directory. To have the macro execute automatically, create a `Workbook_Open` macro in the code module for the workbook's `ThisWorkbook` object.

I have a workbook that uses a `Workbook_Open` procedure. Is there a way to prevent this from executing when I open the workbook?

Yes. Hold down `Shift` when you issue the `File` ⇨ `Open` command. To prevent a `Workbook_BeforeClose` procedure from executing, press `Shift` when you close the workbook. Using the `Shift` key will not prevent these procedures from executing when you're opening an add-in.

Can a VBA procedure access a cell's value in a workbook that is not open?

VBA can't do it, but Excel's old XLM language can. Fortunately, you can execute XLM from VBA. Here's a simple example that retrieves the value from cell `A1` on `Sheet1` in a workbook named `myfile.xls` in the `c:\files` directory:

```
MsgBox ExecuteExcel4Macro("'c:\files\[myfile.xls]Sheet1'!R1C1")
```

Note that the cell address must be in RC notation.

How can I prevent the “save file” prompt from being displayed when I close a workbook from VBA?

You can use this statement:

```
ActiveWorkbook.Close SaveChanges:=False
```

Or, you can set the workbook's `Saved` property to `True` by using a statement like this:

```
ActiveWorkbook.Saved = True
```

This statement, when executed, does not actually save the file, so any unsaved changes will be lost when the workbook is closed.

A more general solution to avoid Excel prompts is to insert the following instruction:

```
Application.DisplayAlerts = False
```

How can I set things up so my macro runs once every hour?

You need to use the `OnTime` method of the `Application` object. This enables you to specify a procedure to execute at a particular time of day. When the procedure ends, use the `OnTime` method again to schedule another event in one hour.

How do I prevent a macro from showing in the macro list?

Declare the procedure using the `Private` keyword:

```
Private Sub MyMacro()
```

Or you can add a dummy optional argument, declared as a specific data type:

```
Sub MyMacro (Optional FakeArg as Integer)
```

Is it possible to save a chart as a GIF file?

Yes. The following code saves the first embedded chart on `Sheet1` as a GIF file named `Mychart.gif`:

```
Set CurrentChart = Sheets("Sheet1").ChartObjects(1).Chart  
Fname = ThisWorkbook.Path & "\Mychart.gif"  
CurrentChart.Export Filename:=Fname, FilterName:="GIF"
```


Are variables in a VBA procedure available to other VBA procedures? What if the procedure is in a different module? Or in a different workbook?

You're talking about a variable's *scope*. There are three levels of scope: local, module, and public. Local variables have the narrowest scope and are declared within a procedure. A local variable is visible only to the procedure in which it was declared. Module-level variables are declared at the top of a module, prior to the first procedure. Module-level variables are visible to all procedures in the module. Public variables have the broadest scope, and they are declared using the `Public` keyword.

Functions

I created a custom worksheet function. When I access this function with the Insert Function dialog, it says, "No help available." How can I get the Insert Function dialog box to display a description of my function?

To add a description for your custom function, activate the workbook that contains the Function procedure. Then select `Tools` ⇨ `Macro` ⇨ `Macros` to display the Macro dialog box. Your function won't be listed, so you must type it into the Macro name box. After typing the function's name, click `Options` to display the Macro Options dialog box. Enter the descriptive text in the Description box.

Can I also display help for the arguments for my custom function in the Paste Function dialog box?

Unfortunately, no.

My custom worksheet function appears in the User Defined category in the Insert Function dialog box. How can I make my function appear in a different function category?

You need to use VBA to do this. The following instruction assigns the function named `MyFunc` to Category 1 (Financial):

```
Application.MacroOptions Macro:="MyFunc", Category:=1
```

The following table lists the valid function category numbers.

<i>Number</i>	<i>Category</i>
0	No category (appears only in All)
1	Financial
2	Date & Time
3	Math & Trig
4	Statistical
5	Lookup & Reference
6	Database
7	Text
8	Logical
9	Information
10	Commands (this category is normally hidden)
11	Customizing (this category is normally hidden)
12	Macro Control (this category is normally hidden)
13	DDE/External (this category is normally hidden)
14	User Defined (default)
15	Engineering (this category is valid only if the Analysis ToolPak add-in is installed)

How can I create a new function category?

You can create a new function category by using an XLM macro. However, this method is not reliable, and is not recommended.

I have a custom function that will be used in a worksheet formula. If the user enters arguments that are not appropriate, how can I make the function return a true error value (#VALUE)?

If your function is named `MyFunction`, you can use the following instruction to return an error value to the cell that contains the function:

```
MyFunction = CVErr(xlErrValue)
```

In this example, `xlErrValue` is a predefined constant. Constants for the other error values are listed in the online help.

How can I force a recalculation of formulas that use my custom worksheet function?

Press Ctrl+Alt+F9.

Can I use Excel's built-in worksheet functions in my VBA code?

In most cases, yes. Excel's worksheet functions are accessed via the `WorksheetFunction` method of the `Application` object. For example, you could access the `POWER` worksheet functions with a statement such as the following:

```
Ans = Application.WorksheetFunction.Power(5, 3)
```

This example raises 5 to the third power, and returns 125.

Generally, if VBA includes an equivalent function, you cannot use Excel's worksheet version. For example, because VBA has a function to compute square roots (`Sqr`) you cannot use the `SQRT` worksheet function in your VBA code.

Excel 95 doesn't support the `WorksheetFunction` method. Does that mean I can't make my Excel 2002 application compatible with Excel 95?

No. Actually, using the `WorksheetFunction` method is superfluous. The following statements have exactly the same result:

```
Ans = Application.WorksheetFunction.Power(5, 3)
Ans = Application.Power(5, 3)
```

Can I use Analysis ToolPak functions in my VBA code?

Yes, but it takes a few extra steps. In Excel, choose `Tools` ⇨ `Add-Ins`, and place a check mark next to the add-in named `Analysis ToolPak - VBA`. Then activate your VB project and choose `Tools` ⇨ `References`. Place a check mark next to `atpvbaen.xls` to create a reference. Then you can use any of the Analysis ToolPak functions in your code. For example, the following statement uses the Analysis ToolPak's `CONVERT` function, and converts 5,000 meters to miles:

```
MsgBox CONVERT(5000, "m", "mi")
```

Is there any way to force a line break in the text of a message box?

Use a carriage return or a line feed character to force a new line. The following statement displays the message box text on two lines. `vbCr` is a built-in constant that represents a carriage return.

```
MsgBox "Hello" & vbCr & Application.UserName
```

Objects, Properties, Methods, and Events

I don't understand the concept of objects. Is there a listing of the Excel objects I can use?

Yes. The online help includes the information in a graphical format.

I'm overwhelmed with all the properties and methods available. How can I find out which methods and properties are available for a particular object?

There are several ways. You can use the Object Browser available in the VBE. Press F2 to access the Object Browser and then choose Excel from the Libraries/Workbooks drop-down list. The Classes list (on the left) shows all the Excel objects. When you select an object, its corresponding properties and methods appear in the Member of list on the right.

You can also get a list of properties and methods as you type. For example, enter the following:

```
Range("A1").
```

When you type the dot, you'll see a list of all properties and methods for a Range object. If this doesn't work, choose Tools ⇨ Options, click the Editor tab, and place a check mark next to Auto List Members.

And, of course, the online help system for VBA is very extensive; it lists the properties and methods available for most objects of importance. The easiest way to access these lists is to type the object name into the Immediate window at the bottom of the VBE and move the cursor anywhere within the object name. Press F1, and you'll get the help topic appropriate for the object.

What's the story with collections? Is a collection an object? What are collections?

A *collection* is an object that contains a group of related objects. A collection is designated by a plural noun. For example, the `Worksheets` collection is an object that contains all the `Worksheet` objects in a workbook. You can think of this as an array: `Worksheets(1)` refers to the first `Worksheet` object in the `Workbook`. Rather than use index numbers, you can also use the actual worksheet name, such as `Worksheets("Sheet1")`. The concept of a collection makes it easy to work with all related objects at once and to loop through all objects in a collection by using the `For Each-Next` construct.

When I refer to a worksheet in my VBA code, I get a “subscript out of range” error. I’m not using any subscripts. What gives?

This error occurs when you attempt to access an element in a collection that doesn’t exist. For example, the following instruction generates the error if the active workbook does not contain a worksheet named `MySheet`:

```
Set X = ActiveWorkbook.Worksheets("MySheet")
```

How can I prevent the user from scrolling around the worksheet?

You can either hide the unused rows and columns or use a VBA instruction to set the scroll area for the worksheet. The following instruction, for example, sets the scroll area on `Sheet1` so the user cannot activate any cells outside of `B2:D50`:

```
Worksheets("Sheet1").ScrollArea = "B2:D50"
```

To set scrolling back to normal, use a statement like this:

```
Worksheets("Sheet1").ScrollArea = ""
```

Be aware that the `ScrollArea` setting is not saved with the workbook. Therefore, you’ll need to execute the `ScrollArea` assignment instruction whenever the workbook is opened. This instruction can go in the `Workbook_Open` event-handler procedure.

What’s the difference between using `Select` and `Application.Goto`?

The `Select` method of the `Range` object selects a range on the *active* worksheet only. Use `Application.Goto` to select a range on any worksheet in a workbook. `Application.Goto` may or may not make another sheet the active sheet. The `Goto` method also lets you scroll the sheet so that the range is in the upper-left corner.

What’s the difference between activating a range and selecting a range?

In some cases, the `Activate` method and the `Select` method have exactly the same effect. But in other cases, they produce quite different results. Assume that range `A1:C3` is selected. The following statement activates cell `C3`. The original range remains selected, but `C3` becomes the active cell—that is, the cell that contains the cell pointer.

```
Range("C3").Activate
```

Again, assuming that range `A1:C3` is selected, the following statement selects a single cell, which also becomes the active cell.

```
Range("C3").Select
```

Is there a quick way to delete all values from a worksheet, but keep the formulas intact?

Yes. The following code works on the active sheet, and deletes all nonformula cells (the cell formatting is not affected):

```
On Error Resume Next  
Cells.SpecialCells(xlCellTypeConstants, 23).ClearContents
```

Using `On Error Resume Next` prevents the error message that occurs if no cells qualify.

I know how to write a VBA instruction to select a range by using a cell address, but how can I write one to select a range if I know only its row and column number?

Use the `Cells` method. The following instruction, for example, selects the cell in the 5th row and the 12th column (that is, cell L5):

```
Cells(5, 12).Select
```

Is there a VBA command to quit Excel? When I try to record the File ⇨ Exit command, Excel closes down before I can see what code it generates!

Use the following instruction to end Excel:

```
Application.Quit
```

How can I turn off the screen updating while a macro is running?

The following instruction turns off screen updating and speeds up macros that modify the display:

```
Application.ScreenUpdating = False
```

What's the easiest way to create a range name using VBA?

If you turn on the macro recorder while you name a range, you'll get code something like this:

```
Range("D14:G20").Select  
ActiveWorkbook.Names.Add Name:="InputArea", _  
    RefersToR1C1:="=Sheet1!R14C4:R20C7"
```

A much simpler method is to use a statement like this:

```
Sheets("Sheet1").Range("D14:G20").Name = "InputArea"
```

How can I determine if a particular cell or range has a name?

You need to check the `Name` property of the `Name` object contained in the `Range` object. The following function accepts a range as an argument, and returns the name of the range (if it has one). If the range has no name, the function returns `False`.

```
Function RangeName(rng) As Variant
    On Error Resume Next
    RangeName = rng.Name.Name
    If Err <> 0 Then RangeName = False
End Function
```

Is there a way to disable the Setup and Margins buttons that are displayed in Excel's Print Preview window?

Yes, use a statement like this:

```
ActiveSheet.PrintPreview EnableChanges:=False
```

The `EnableChanges` argument for the `PrintPreview` method is not documented in the online help, but this argument does appear in the Object Browser.

Is it possible to display messages in the status bar while a macro is running? I have a lengthy macro, and it would be nice to display its progress in the status bar.

Yes. Assign the text to the `StatusBar` property of the `Application` object. Here's an example:

```
Application.StatusBar = "Now processing File " & FileNum
```

When your routine finishes, return the status bar back to normal with the following instruction:

```
Application.StatusBar = False
```

I recorded a VBA macro that copies a range and pastes it to another area. The macro uses the `Select` method. Is there a more efficient way to copy and paste?

Yes. Although the macro recorder generally selects cells before doing anything with them, selecting is not necessary and may actually slow down your macro. Recording a very simple copy-and-paste operation generates four lines of VBA code, two of which use the `Select` method. Here's an example:

```
Range("A1").Select
Selection.Copy
Range("B1").Select
ActiveSheet.Paste
```

These four lines can be replaced with a single instruction, such as the following:

```
Range("A1").Copy Range("B1")
```

Notice that this instruction does not use the `Select` method.

I have not been able to find a method to sort a VBA array. Does this mean that I have to copy the values to a worksheet and then use the `Range.Sort` method?

There is no built-in way to sort an array in VBA. Copying the array to a worksheet is one method, but you'll probably be better off if you write your own sorting procedure. Many sorting algorithms are available, and some are quite easy to code in VBA. This book contains VBA code for several sorting techniques.

My macro works with the selected cells, but it fails if something else (like a chart) is selected. How can I make sure that a range is selected?

You can use VBA's `TypeName` function to check the `Selection` object. Here's an example:

```
If TypeName(Selection) <> "Range" Then
    MsgBox "Select a range!"
    Exit Sub
End If
```

Another approach is to use the `RangeSelection` property, which returns a `Range` object that represents the selected cells on the worksheet in the specified window, even if a graphic object is active or selected. This property applies to a `Window` object, not a `Workbook` object. The following instruction, for example, displays the address of the selected range:

```
MsgBox ActiveWindow.RangeSelection.Address
```

My VBA macro needs to count the number of rows selected by the user. Using `Selection.Rows.Count` doesn't work when nonadjacent rows are selected. Is this a bug?

Actually, this is the way it's supposed to work. The `Count` method returns the number of elements in only the *first* area of the selection (a noncontiguous selection has multiple areas). To get an accurate row count, your VBA code must first determine

the number of areas in the selection and then count the number of rows in each area. Use `Selection.Areas.Count` to count the number of areas. Here's an example that stores the total number of selected rows in the `NumRows` variable:

```
NumRows = 0
For Each areaCounter In Selection.Areas
    NumRows = NumRows + areaCounter.Rows.Count
Next areaCounter
```

By the way, this process is also relevant to counting columns and cells.

I use Excel to create invoices. Is there a way to generate a unique invoice number?

One way to do this is to use the Windows Registry. The following code demonstrates:

```
Counter = GetSetting("XYZ Corp", "InvoiceNum", "Count", 0)
Counter = Counter + 1
SaveSetting "XYZ Corp", "InvoiceNum", "Count", Counter
```

When these statements are executed, the current value is retrieved from the Registry, incremented by one, and assigned to the `Counter` variable. Then this updated value is stored back to the Registry. You can use the value of `Counter` as your unique invoice number.

Is there a workbook property that forces an Excel workbook always to remain visible so it won't be hidden by another application's window?

No.

Is there a way to stop Excel from displaying messages while my macro is running? For example, I'd like to eliminate the message that appears when my macro deletes a worksheet.

The following statement turns off most of Excel's warning messages:

```
Application.DisplayAlerts = False
```

Is there a VBA instruction to select the last entry in a column or row? Normally, I can use Ctrl+Shift+down arrow or Ctrl+Shift+right arrow to do this, but how can I do it with a macro?

The VBA equivalent for Ctrl+Shift+down arrow is the following:

```
Selection.End(xlDown).Select
```

The constants used for the other directions are `xlToLeft`, `xlToRight`, and `xlUp`.

How can I determine the last nonempty cell in a particular column?

The following instruction displays the address of the last nonempty cell in column A:

```
MsgBox ActiveSheet.Range("A65536").End(xlUp).Address
```

The following instruction will work if Excel worksheets ever have more than 65,536 rows:

```
MsgBox ActiveSheet.Cells(Rows.Count, 1).End(xlUp).Address
```

But that instruction won't work if cell A65536 is not empty!

To handle that unlikely occurrence, use this code:

```
With ActiveSheet.Cells(Rows.Count, 1)
    If IsEmpty(.Value) Then
        MsgBox .End(xlUp).Address
    Else
        MsgBox .Address
    End If
End With
```

VBA references can become very lengthy, especially when you need to fully qualify an object by referencing its sheet and workbook. Is there a way to reduce the length of these references?

Yes. Use the Set statement to create an object variable. Here's an example:

```
Dim MyRange as Range
Set MyRange = ThisWorkbook.Worksheets("Sheet1").Range("A1")
```

After the Set statement is executed, you can refer to this single-cell Range object simply as MyRange. For example, you can assign a value to the cell with the following:

```
MyRange.Value = 10
```

Besides making it easier to refer to objects, using object variables can also help your code execute more quickly.

Is there a way to declare an array if you don't know how many elements it will have?

Yes. You may declare a dynamic array with the Dim statement, using empty parentheses, and then allocate storage for that array later with the ReDim statement when you know how many elements the array should have. Use ReDim Preserve if you don't want to lose the current array contents when reallocating it.

How can I write a macro to select some, but not all, of the sheets in a workbook?

Use `False` as the argument for the `Select` method. For example, the following procedure selects all chart sheets in the active workbook:

```
Sub SelectChartSheets()  
    Dim cht As Chart  
    If Charts.Count = 0 Then Exit Sub  
    Charts(1).Select  
    For Each cht In Charts  
        cht.Select False  
    Next cht  
End Sub
```

Can I let the user undo my macro?

Yes, but it's not something that can be done automatically. To enable the user to undo the effects of your macro, your VBA code module must keep track of what was changed by the macro and then be capable of restoring the original state if the user selects `Edit ⇨ Undo`.

To enable the `Edit ⇨ Undo` command, use the `OnUndo` method as the last action in your macro. This method enables you to specify text that will appear on the `Undo` menu item and also to specify a procedure to run if the user selects `Edit ⇨ Undo`. Here's an example:

```
Application.OnUndo "The Last Macro", "MyUndoMacro"
```

I have a 1-2-3 macro that pauses so the user can enter data into a certain cell. How can I get the same effect in a VBA macro?

Excel can't duplicate that type of behavior, but you can use Excel's `InputBox` statement to get a value from a user and place it in a particular cell. The first instruction that follows, for example, displays an input box. When the user enters a value, that value is placed in cell `A1`.

```
UserVal = Application.InputBox(prompt:="Value?", Type:=1)  
If UserVal <> False Then Range("A1") = UserVal
```

VBA has an `InputBox` function, but there's also an `InputBox` method for the `Application` object. Are these the same?

No. Excel's `InputBox` method is more versatile because it allows validation of the user's entry. The preceding example uses `1` (which represents a numeric value) for the `Type` argument of the `InputBox` method. This ensures that the user enters a value into the input box.

When I use the RGB function to assign a color, the color sometimes isn't correct. What am I doing wrong?

Probably nothing. An Excel workbook can use only 56 different colors (the color palette). If a specified RGB color isn't in the palette, Excel uses the closest match it can find.

I'm trying to write a VBA instruction that creates a formula. To do so, I need to insert a quote character (") within quoted text. How can I do that?

Assume you want to enter the following formula into cell B1 with VBA:

```
=IF(A1="Yes",TRUE,FALSE)
```

The following instruction generates a syntax error:

```
Range("B1").Formula = "=IF(A1="Yes",TRUE,FALSE)" 'erroneous
```

The solution is to use two double quotes side by side. The following instruction produces the desired result:

```
Range("B1").Formula = "=IF(A1=""Yes"",TRUE,FALSE)"
```

Another approach is to use VBA's Chr function with an argument of 34, which returns a quotation mark. The following example demonstrates:

```
Range("B1").Formula = _  
    "=IF(A1=" & Chr(34) & "Yes" & Chr(34) & ",TRUE,FALSE)"
```

I created an array, but the first element in that array is being treated as the second element. What's wrong?

Unless you tell it otherwise, VBA uses 0 as the first index number for an array. If you want all your arrays to always start with 1, insert the following statement at the top of your VBA module:

```
Option Base 1
```

Or you can specify the upper and lower bounds of an array when you declare it. Here's an example:

```
Dim Months(1 To 12) As String
```

I would like my VBA code to run as quickly as possible.**Any suggestions?**

Here are a few general tips: Make sure that you declare all your variables. Use `Option Explicit` at the top of your modules to force yourself to do this. If you reference an Excel object more than once, create an object variable for it. Use the `With-End With` construct whenever possible. If your macro writes information to a worksheet, turn off screen updating by using `Application.ScreenUpdating = False`. If your application enters data into cells that are referenced by one or more formulas, set the calculation mode to manual to avoid unnecessary calculations.

I'm working with Windows API functions. Is there a way to get the Windows "handle" of the Excel window?

Yes, but you'll need Excel 2002. Access the `Hwnd` property of the `Application` object.

UserForms

I need to get just a few pieces of information, and a UserForm seems like overkill. Are there any alternatives?

Yes, check out VBA's `MsgBox` function and its `InputBox` function. Alternatively, you might want to use Excel's `InputBox` method.

I have 12 CommandButtons on a UserForm. How can I assign a single macro to be executed when any of the buttons is clicked?

There is no easy way to do this because each `CommandButton` has its own `Click` event procedure. One solution is to call another procedure from each of the `CommandButton_Click` procedures. Another solution is to use a class module to create a new class. This procedure is described in Chapter 15.

Is there any way to display a chart in a UserForm?

There is no direct way to do this. One solution is to write a macro that saves the chart to a GIF file and then loads the GIF file into an `Image` control.

How can I remove the "X" from the title bar of my UserForm? I don't want the user to click that button to close the form.

Removing the Close button on a UserForm's title bar requires some complex API functions. A simpler approach is to intercept all attempts to close the UserForm by

using a `UserForm_QueryClose` event procedure in the code module for the `UserForm`. The following example does not allow the user to close the form by clicking the Close button:

```
Private Sub UserForm_QueryClose _  
    (Cancel As Integer, CloseMode As Integer)  
    If CloseMode = vbFormControlMenu Then  
        MsgBox "You can't close the form like that."  
        Cancel = True  
    End If  
End Sub
```

I've created a UserForm whose controls are linked to cells on the worksheet with the ControlSource property. Is this the best way to do this?

In general, you should avoid using links to worksheet cells unless you absolutely must. Doing so can slow your application down because the worksheet is recalculated every time a control changes the cell.

Is there any way to create a control array for a UserForm? It's possible with Visual Basic 6.0, but I can't figure out how to do it with Excel VBA.

You can't create a control array, but you can create an array of `Control` objects. The following code creates an array consisting of all `CommandButton` controls:

```
Private Sub UserForm_Initialize()  
    Dim Buttons() As CommandButton  
    Cnt = 0  
    For Each Ctl In UserForm1.Controls  
        If TypeName(Ctl) = "CommandButton" Then  
            Cnt = Cnt + 1  
            ReDim Preserve Buttons(1 To Cnt)  
            Set Buttons(Cnt) = Ctl  
        End If  
    Next Ctl  
End Sub
```

Is there any difference between hiding a UserForm and unloading a UserForm?

Yes, the `Hide` method keeps the `UserForm` in memory but makes it invisible. The `Unload` statement unloads the `UserForm`, beginning the "termination" process (invoking the `Terminate` event for the `UserForm`) and removing the `UserForm` from memory.

How can I make my UserForm stay open while I do other things?

By default, each UserForm is *modal*, which means that it must be dismissed before you can do anything else. Beginning with Excel 2000, however, you can make a UserForm modeless by writing `vbModeless` as the argument for the `Show` method. Here's an example:

```
UserForm1.Show vbModeless
```

Excel 97 gives me a compile error when I write `UserForm1.Show vbModeless`. How can I make the form modeless in Excel 2002, while allowing it to remain modal in Excel 97?

Test for the version of Excel that the user is running and then execute a separate procedure if the version is Excel 2000 or later. The following code demonstrates how:

```
Sub ShowUserForm()  
    If Val(Application.Version) >= 9 Then  
        ShowModelessForm  
    Else  
        UserForm1.Show  
    End If  
End Sub  
  
Sub ShowModelessForm()  
    Dim frm As Object  
    Set frm = UserForm1  
    frm.Show 0 ' vbModeless  
End Sub
```

Because the `ShowModelessForm` procedure is not executed in Excel 97, it will not cause a compile error.

I need to display a progress indicator like those you see when you're installing software while a lengthy process is being executed. How can I do this?

You can do this with a UserForm. Chapter 15 describes several different techniques, including one where I gradually stretch a shape inside a frame while the lengthy process is running.

How can I use Excel's drawing tools to create simple drawings on my UserForm?

You can't use the drawing tools directly with a UserForm, but you can do so indirectly. Start by creating the drawing on a worksheet. Then select the drawing and choose Edit ⇨ Copy. Activate your UserForm and insert an Image object. Press F4 to display the Properties window. Select the Picture property and press Ctrl+V to paste the clipboard contents to the Image control. You may also need to set the AutoSize property to True.

How can I generate a list of files and directories into my UserForm so the user can select a file from the list?

There's no need to do that. Use VBA's GetOpenFilename method. This displays a "file open" dialog box in which the user can select a drive, directory, and file.

I have several 1-2-3 for Windows files and Quattro Pro for Windows files that contain custom dialog boxes. Is there a utility to convert these to Excel dialog boxes?

No.

I need to concatenate strings and display them in a ListBox control. But when I do so, they aren't aligned properly. How can I get them to display equal spacing between strings?

You can use a monospaced font such as Courier New for the ListBox. A better approach, however, is to set up your ListBox to use two columns (see Chapter 14 for details).

Is it possible to display a built-in Excel dialog box from VBA?

Most, but not all, of Excel's dialog boxes can be displayed by using the Application.Dialogs method. For example, the following instruction displays the dialog box that enables you to format numbers in cells:

```
Application.Dialogs(xlDialogFormatNumber).Show
```

Use the Object Browser to display a list of the constants for the built-in dialog boxes. Press F2 from the VBE, select the Excel library, and search for xlDialog. You'll probably need to use some trial and error to locate the constant that corresponds to the dialog you want to display.

I tried the technique described in the preceding question and received an error message. Why is that?

The `Dialogs` method will fail if the context isn't appropriate. For example, if you attempt to display the Chart Type dialog box (`xlDialogChartType`) when a chart is not activated, you'll get an error message.

Every time I create a UserForm, I go through the steps of adding an OK button and a Cancel button. Is there a way to get these controls to appear automatically?

Yes. Set up a UserForm with the controls you use most often. Then select File ⇨ Export File to save the UserForm. When you want to add a new form to another project, select File ⇨ Import File.

Is it possible to create a UserForm without a title bar?

No. The closest you can get is to make the dialog box's caption blank by setting the `Caption` property to an empty string.

I recorded a VBA macro that prints to a file. However, there seems to be no way to supply the filename in my code. No matter what I try, I keep getting the prompt to supply a filename.

This common problem was corrected in Excel 2000. In Excel 2000 and later, you can provide a `PrToFileName` argument for the `PrintOut` method. Here's an example:

```
ActiveSheet.PrintOut PrintToFile:=True, _  
    PrToFileName:="test.prn"
```

When I click a button on my UserForm, nothing happens. What am I doing wrong?

Controls added to a UserForm do nothing unless you write event-handler procedures for them. These procedures must be located in the code module for the UserForm and they must have the correct name.

Can I create a custom dialog box whose size is always the same, regardless of the video display resolution?

You can, but it's probably not worth the effort. You can write code to determine the video resolution and then make use of the `Zoom` property of a UserForm to change its size. The normal way to deal with this matter is simply to design your UserForm for a 640 × 480 display.

Is it possible to create a UserForm box that lets the user select a range in a worksheet by pointing?

Yes. Use the RefEdit control for this. See Chapter 14 for an example.

Is there a way to change the start-up position of a UserForm?

Yes, you can set the UserForm's `Left` and `Top` properties. But for these to be effective, you need to set the UserForm's `StartPosition` property to 0.

Can I add an Excel 5/95 dialog sheet to my workbook?

Yes. Right-click any sheet tab in a workbook, and select `Insert` from the shortcut menu. In the `Insert` dialog box, select `MS Excel 5.0 Dialog`. Be aware that none of the information in this book applies to Excel 5/95 dialog sheets.

Add-Ins

Where can I get Excel add-ins?

You can get Excel add-ins from a number of places:

- ♦ Excel includes several add-ins you can use whenever you need them.
- ♦ You can download more add-ins from Microsoft's Office Update Web site.
- ♦ Third-party developers distribute and sell add-ins for special purposes.
- ♦ Many developers create free add-ins and distribute them via their Internet sites.
- ♦ You can create your own add-ins.

How do I install an add-in?

You can load an add-in by selecting either the `Tools` ⇨ `Add-Ins` command or the `File` ⇨ `Open` command. Using `Tools` ⇨ `Add-Ins` is the preferred method. An add-in opened with `File` ⇨ `Open` cannot be closed without using VBA.

When I install my add-in using Excel's Add-Ins dialog box, it shows up without a name or description. How can I give my add-in a description?

Before creating the add-in, use the `File` ⇨ `Properties` command to bring up the `Properties` dialog box. Click the `Summary` tab. In the `Title` box, enter the text that you want to appear in the `Add-Ins` dialog box. In the `Comments` field, enter the description for the add-in. Then create the add-in as usual.

I have several add-ins that I no longer use, yet I can't figure out how to remove them from the Add-Ins Available list in the Add-Ins dialog box. What's the story?

Oddly, there is no way to remove unwanted add-ins from the list directly from Excel. You must edit the Windows Registry and remove the references to the add-in files you don't want listed. Another way to do this is to move or delete the add-in files. Then when you attempt to open the add-in from the Add-Ins dialog box, Excel will ask if you want to remove the add-in from the list.

How do I create an add-in?

Activate any worksheet, and select File ⇨ Save As. Then select Microsoft Excel Add-in (*.xla) from the Save as type drop-down list.

I try to create an add-in, but the Save as type drop-down box doesn't provide Add-in as an option.

The most likely reason is that the active sheet is not a worksheet.

Should I convert all my essential workbooks to add-ins?

No! Although you can create an add-in from any workbook, not all workbooks are suitable. When a workbook is converted to an add-in, it is essentially invisible. For most workbooks, being invisible isn't a good thing.

Is it necessary to keep two copies of my workbook, the XLS version and the XLA version?

With versions prior to Excel 97, maintaining an XLS and an XLA version was necessary. Beginning with Excel 97, however, this is no longer necessary. An add-in can be converted back to a normal workbook.

How do I modify an add-in after it's been created?

Activate the VBE (Alt+F11), and set the `IsAddIn` property of the `ThisWorkbook` object to `False`. Make your changes, set the `IsAddIn` property to `True`, and resave the file.

What's the difference between an XLS file and an XLA file created from an XLS file? Is the XLA version compiled? Does it run faster?

There isn't a great deal of difference between the files, and you generally won't notice any speed differences. VBA code is always "compiled" before it is executed. This is true whether it's in an XLS file or an XLA file. However, XLA files contain the actual VBA code, not compiled code.

How do I protect the code in my add-in from being viewed by others?

Activate the VBE and select Tools ⇨ xxxx Properties (where xxxx is the name of your project). Click the Protection tab, select Lock project for viewing, and enter a password.

Are my XLA add-ins safe? In other words, if I distribute an XLA file, can I be assured that no one else will be able to view my code?

Protect your add-in by locking it with a password. This prevents most users from being able to access your code. Recent versions of Excel have improved the security features, but the password still may be broken by using any of a number of utilities. Bottom line? Don't think of an XLA as being a secure file.

CommandBars

I have a macro attached to a toolbar button. Is it possible to have the macro perform a different action if the user presses Shift while the button is clicked?

Yes, but you have to use a Windows API call to do it. Refer to Chapter 11 for details.

Excel 95 had a handy menu editor, but it's missing in Excel 97 and later versions. What gives?

Beginning with Excel 97, the toolbars and menus in Excel are entirely different. Both are called CommandBars. The menu editor is gone, but users can edit CommandBars by using the Customize dialog box (select Tools ⇨ Customize).

Can I edit menus created by Excel 95's menu editor?

Yes, but you'll need to do so in Excel 95.

When I change a menu with the Customize dialog box, the menu is changed permanently. How can I make the menu change apply to only one workbook?

You'll need to perform your menu changes with VBA code when the workbook is opened, and restore the menu to normal when the workbook is closed.

I know you can use the FaceId property to add an image to a toolbar control. But how do I figure out which FaceId value goes with a particular image?

Microsoft didn't provide any way to do this, but several utilities exist that make it easy to identify the FaceId values. See Chapter 22 for an add-in that you might find helpful.

I attached a new version of my toolbar to a workbook, but Excel continues to use the older version. How do I get it to use the new version of my toolbar?

When Excel opens a workbook that has an attached toolbar, it displays the toolbar only if one with the same name does not already exist on the user's system. The best solution is to write VBA code to create the toolbar on the fly when the workbook is opened and to delete it when the workbook is closed. Alternatively, you can attach the toolbar to the workbook and then write code to delete the toolbar when the workbook is closed.

I've made lots of changes to Excel's toolbars. How can I restore all of these toolbars to their original state?

You can use the Customize dialog box and reset each one manually. Or run the following procedure:

```
Sub ResetAllToolbars()  
    For Each tb In CommandBars  
        If tb.Type = msoBarTypeNormal Then  
            If tb.BuiltIn Then tb.Reset  
        End If  
    Next tb  
End Sub
```

Be aware that this procedure will also remove any toolbar customizations performed by add-ins.

How can I set things up so my custom menu is displayed only when a particular workbook is active?

You need to make use of the `WorkbookActivate` and `WorkbookDeactivate` events. In other words, write procedures in the code module for the `ThisWorkbook` object that hide the custom menu when the workbook is deactivated and unhide the custom menu when the workbook is activated.

How can I add a "spacer" between two buttons on a toolbar?

Set the `BeginGroup` property of the control after the spacer to `True`.

How do you display a check mark next to a menu item?

A check mark on a menu item is controlled by the menu item's `State` property. The following instruction, for example, displays a check mark next to the menu item called `My Item`:

```
CommandBars(1).Commands("MyMenu")._ _  
    Commands("My Item").State = msoButtonDown
```

To uncheck the menu item, set the `State` property to `msoButtonUp`.

I accidentally deleted some items from the Worksheet menu and can't get them back. Restarting Excel doesn't fix it.

Select Tools ⇨ Customize, and select the Toolbars tab in the Customize dialog box. Select the Worksheet Menu Bar item, and click the Reset button.

How can I disable all the right-click shortcut menus?

The following procedure will do the job:

```
Sub DisableAllShortcutMenus()  
    Dim cb As CommandBar  
    For Each cb In CommandBars  
        If cb.Type = msoBarTypePopup Then _  
            cb.Enabled = False  
    Next cb  
End Sub
```

Is there a way to disable the shortcut menus that appear when the user clicks the right mouse button?

Yes, the following instruction will do the job:

```
CommandBars("Toolbar List").Enabled = False
```

I just entered CommandBars("Toolbar List").Enabled = False, and it doesn't work on my system!

The original version of Excel 97 had a problem with this instruction. It was corrected in the SR-1 service release for Excel 97.



Excel Resources Online

If I've done my job, the information provided in this book will be useful to you. It is, however, by no means comprehensive. In addition, new issues tend to crop up, so you'll want to make sure that you're up to date. Therefore, I've compiled a list of additional resources that may help you become more proficient in Excel application development. I've classified these resources into three categories:

- ◆ Microsoft technical support
- ◆ Internet newsgroups
- ◆ Internet Web sites

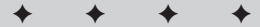
Microsoft Technical Support

Technical support is the common term for assistance provided by a software vendor. In this case, I'm talking about assistance that comes directly from Microsoft. Microsoft's technical support is available in several different forms.

Support options

To find out your support options, choose the Help ⇄ About Microsoft Excel command. Then click the Tech Support button. This opens a help file that lists all the support options offered by Microsoft, including both free and fee-based support.

My experience is that you should use vendor *standard telephone* support only as a last resort. Chances are, you'll run up a big phone bill (assuming that you can even get through) and spend lots of time on hold, but you may or may not find an answer to your question.



About the URLs Listed Here

As you know, the Internet is a dynamic entity that tends to change rapidly. Web sites are often reorganized (especially those at the microsoft.com domain). Therefore, a particular URL listed in this appendix may not be available when you try to access it. Each URL was accurate at the time of this writing, but it's possible that a URL may have changed by the time you read this.

The truth is, the people who answer the phone are equipped to answer only the most basic questions. And the answers to these basic questions are usually readily available elsewhere.

Microsoft Knowledge Base

Your best bet for solving a problem may be the Microsoft Knowledge Base. This is the primary Microsoft product information source—an extensive, searchable database that consists of tens of thousands of detailed articles containing technical information, bug lists, fix lists, and more.

You have free and unlimited access to the Knowledge Base via the Internet. The URL is:

<http://support.microsoft.com>

Microsoft Excel home page

The official home page of Excel is at:

<http://www.microsoft.com/office/excel/>

Microsoft Office update

For product updates, add-ins, downloads, and other information about Office 2000 (including Excel), try this site:

<http://officeupdate.microsoft.com>

Internet Newsgroups

Usenet is an Internet service that provides access to several thousand special interest groups that enable you to communicate with people who share common interests. There are thousands of newsgroups covering virtually every topic you can think of (and many that you haven't). Typically, questions posed on a newsgroup

are answered within 24 hours — assuming, of course, that the questions are asked in a manner that makes others want to reply.


Note

Besides an Internet connection, you need special newsreader software to access newsgroups. Microsoft Outlook Express (free) is a good choice. This product is available on your Office 2002 CD-ROM. If you don't have access to newsreader software (or if your Internet connection doesn't allow access to the newsgroups), you can also access the microsoft.public.* newsgroups from this URL:

<http://communities.microsoft.com/newsgroups>

Spreadsheet newsgroups

The primary Usenet newsgroup for general spreadsheet users is:

`comp.apps.spreadsheets`

This newsgroup is intended for users of any spreadsheet brand, but about 90 percent of the postings deal with Excel. My advice? Skip this one and head directly for the Microsoft newsgroups.

Microsoft newsgroups

Microsoft has an extensive list of newsgroups, including quite a few devoted to Excel. If your Internet service provider doesn't carry the Microsoft newsgroups, you can access them directly from Microsoft's news server. You'll need to configure your newsreader software or Web browser to access Microsoft's news server, which is at this address:

`msnews.microsoft.com`

Table A-1 lists the key newsgroups you'll find on Microsoft's news server.

Table A-1
Microsoft.com's Excel-Related Newsgroups

<i>Newsgroup</i>	<i>Topic</i>
microsoft.public. excel.programming	Programming Excel with VBA or XLM macros
microsoft.public. excel.123quattro	Converting 1-2-3 or Quattro Pro sheets into Excel sheets
microsoft.public. excel.worksheet.functions	Worksheet functions

Continued

Table A-1 (continued)

Newsgroup	Topic
microsoft.public. excel.charting	Building charts with Excel
microsoft.public. excel.printing	Printing with Excel
microsoft.public. excel.queryDAO	Using Microsoft Query and Data Access Objects (DAO) in Excel
microsoft.public. excel.datamap	Using the Data Map feature in Excel
microsoft.public. excel.crashesGPFs	Help with General Protection Faults or system failures
microsoft.public. excel.misc	General topics that do not fit one of the other categories
microsoft.public. excel.links	Using links in Excel
microsoft.public. excel.macintosh	Excel issues on the Macintosh operating system
microsoft.public. excel.interopoledde	OLE, DDE, and other cross-application issues
microsoft.public. excel.setup	Setting up and installing Excel
microsoft.public. excel.templates	Spreadsheet Solutions templates and other XLT files
microsoft.public. excel.sdk	Issues regarding the Excel Software Development Kit

Searching newsgroups

Many people don't realize that you can perform a keyword search on past newsgroup postings. Often, this is an excellent alternative to posting a question to the newsgroup because you can get the answer immediately. You can search the newsgroups at the following Web address:

<http://groups.google.com/>



Formerly, newsgroup searches were performed at the Deja.com Web site. That site has closed down, and the newsgroup archives were purchased by Google.

Tips for Posting to a Newsgroup

1. Make sure that your question has not already been answered. Check the FAQ (if one exists) and also perform a Google search (see “Searching newsgroups” in this appendix).
2. Make the subject line descriptive. Postings with a subject line such as “Help me!” and “Excel Question” are less likely to be answered than postings with a subject such as “VBA Code to Resize a Chart in Excel 2002.”
3. Specify the spreadsheet product and version that you are using. In many cases, the answer to your question depends on your version of Excel.
4. Make your question as specific as possible.
5. Keep your question brief and to the point, but provide enough information so it can be adequately answered.
6. Indicate what you’ve done to try to answer your own question.
7. Post in the appropriate newsgroup, and don’t cross-post to other groups unless the question applies to multiple groups.
8. Don’t type in all uppercase or all lowercase, and check your grammar and spelling.
9. Don’t include a file attachment.
10. Do not post in HTML format.
11. If you would like an e-mail reply, don’t use an “anti-spam” e-mail address that requires the responder to modify your address. Why cause extra work for someone who’s doing *you* a favor?

How does searching work? Assume you’re having a problem with the `ListBox` control on a `UserForm`. You can perform a search using the following keywords: `Excel`, `ListBox`, and `UserForm`. The Google search engine will probably find dozens of newsgroup postings that deal with these topics. It may take a while to sift through the messages, but there’s an excellent chance that you’ll find an answer to your question.

Internet Web Sites

The Web has hundreds of sites that deal with Excel. I list a few of my favorites here.

The Spreadsheet Page

This is my own Web site. All humility aside, this is one of the best sites on the Web for developer information. It contains files to download, developer tips, instructions for accessing Excel Easter Eggs, an extensive list of links to other spreadsheet sites, information about my books, and even spreadsheet jokes. The URL is:

<http://j-walk.com/ss>



This site also contains a list of errors that I've found in each of my books, including the book you're reading now. (Yes, a few errors have been known to creep into these pages.)

Chip Pearson's Excel pages

Chip is principal of Pearson Software Consulting, and his Web site contains dozens of useful examples of VBA and clever formula techniques. The URL is:

<http://www.cpearson.com>

Stephen Bullen's Excel page

Stephen is an Excel developer based in the United Kingdom, and head of Business Modeling Solutions Ltd. His Web site contains some fascinating examples of Excel code, including a section titled "They Said It Couldn't Be Done." The URL is:

<http://www.bmsltd.co.uk/excel>

Spreadsheet FAQ

Many newsgroups have a *FAQ*—a list of frequently asked questions. The purpose of FAQs is to prevent the same questions from being asked over and over. The FAQ for the `comp.apps.spreadsheets` newsgroup is available at:

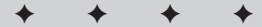
<http://www.faqs.org/faqs/spreadsheets/faq>

CompuServe Forums

CompuServe offers several Excel forums, including a useful forum named *Excel Macros and VBA*. You must be a CompuServe member to post to these forums, but anyone can read them. The URL is as follows:

<http://go.compuServe.com/MSOfficeForum>





VBA Statements and Functions Reference

This appendix contains a complete listing of all VBA statements and built-in functions. For details, consult Excel's online help.



Note

There are no new VBA statements in Excel 2002.

**Table B-1
Summary of VBA Statements**

<i>Statement</i>	<i>Action</i>
AppActivate	Activates an application window
Beep	Sounds a tone using the computer's speaker
Call	Transfers control to another procedure
ChDir	Changes the current directory
ChDrive	Changes the current drive
Close	Closes a text file
Const	Declares a constant value
Date	Sets the current system date
Declare	Declares a reference to an external procedure in a DLL
DefBool	Sets the default data type to Boolean for variables that begin with specified letters
DefByte	Sets the default data type to byte for variables that begin with a specified letter

Continued

Table B-1 (continued)

Statement	Action
DefDate	Sets the default data type to date for variables that begin with a specified letter
DefDec	Sets the default data type to decimal for variables that begin with a specified letter
DefDouble	Sets the default data type to double for variables that begin with a specified letter
DefInt	Sets the default data type to integer for variables that begin with a specified letter
DefLng	Sets the default data type to long for variables that begin with a specified letter
DefObj	Sets the default data type to object for variables that begin with a specified letter
DefSng	Sets the default data type to single for variables that begin with a specified letter
DefStr	Sets the default data type to string for variables that begin with a specified letter
DefVar	Sets the default data type to variant for variables that begin with a specified letter
DeleteSetting	Deletes a section or key setting from an application's entry in the Windows Registry
Dim	Declares an array
Do-Loop	Loops
End	Used by itself, exits the program; End is also used to end a block of statements that begin with If, With, Sub, Function, Property, Type, and Select
Enum*	Declares a type for enumeration
Erase	Reinitializes an array
Error	Simulates a specific error condition
Event*	Declares a user-defined event
Exit Do	Exits a block of Do-Loop code
Exit For	Exits a block of Do-For code
Exit Function	Exits a Function procedure
Exit Property	Exits a property procedure
Exit Sub	Exits a subroutine procedure
FileCopy	Copies a file

Statement	Action
For Each-Next	Loops
For-Next	Loops
Function	Declares the name and arguments for a Function procedure
Get	Reads data from a text file
GoSub...Return	Branches
GoTo	Branches
If-Then-Else	Processes statements conditionally
Implements*	Specifies an interface or class that will be implemented in a class module
Input #	Reads data from a sequential text file
Kill	Deletes a file from a disk
Let	Assigns the value of an expression to a variable or property
Line Input #	Reads a line of data from a sequential text file
Load	Loads an object but doesn't show it
Lock...Unlock	Controls access to a text file
Lset	Left-aligns a string within a string variable
Mid	Replaces characters in a string with other characters
MkDir	Creates a new directory
Name	Renames a file or directory
On Error	Branches on an error
On...GoSub	Branches on a condition
On...GoTo	Branches on a condition
Open	Opens a text file
Option Base	Changes default lower limit
Option Compare	Declares the default comparison mode when comparing strings
Option Explicit	Forces declaration of all variables in a module
Option Private	Indicates that an entire module is Private
Print #	Writes data to a sequential file
Private	Declares a local array or variable
Property Get	Declares the name and arguments of a Property Get procedure
Property Let	Declares the name and arguments of a Property Let procedure

Continued

Table B-1 (continued)

Statement	Action
Property Set	Declares the name and arguments of a Property Set procedure
Public	Declares a public array or variable
Put	Writes a variable to a text file
RaiseEvent	Fires a user-defined event
Randomize	Initializes the random number generator
ReDim	Changes the dimensions of an array
Rem	Specifies a line of comments (same as an apostrophe [''])
Reset	Closes all open text files
Resume	Resumes execution when an error-handling routine finishes
Rmdir	Removes an empty directory
RSet	Right-aligns a string within a string variable
SaveSetting	Saves or creates an application entry in the Windows Registry
Seek	Sets the position for the next access in a text file
Select Case	Processes statements conditionally
SendKeys	Sends keystrokes to the active window
Set	Assigns an object reference to a variable or property
SetAttr	Changes attribute information for a file
Static	Changes the dimensions of an array, keeping the data intact
Stop	Pauses the program
Sub	Declares the name and arguments of a Sub procedure
Time	Sets the system time
Type	Defines a custom data type
Unload	Removes an object from memory
While...Wend	Loops
Width #	Sets the output line width of a text file
With	Sets a series of properties for an object
Write #	Writes data to a sequential text file

* Not available in Excel 97 and earlier editions

Invoking Excel Functions in VBA Instructions

If a VBA function that's equivalent to one you use in Excel is not available, you can use Excel's worksheet functions directly in your VBA code. Just precede the function with a reference to the `WorksheetFunction` object. For example, VBA does not have a function to convert radians to degrees. Because Excel has a worksheet function for this procedure, you can use a VBA instruction such as the following:

```
Deg = Application.WorksheetFunction.Degrees(3.14)
```

The `WorksheetFunction` object was introduced in Excel 97. For compatibility with earlier versions of Excel, you can omit the reference to the `WorksheetFunction` object and write an instruction such as the following:

```
Deg = Application.Degrees(3.14)
```



Note

There are no new VBA functions in Excel 2002.

Table B-2
Summary of VBA Functions

<i>Function</i>	<i>Action</i>
Abs	Returns the absolute value of a number
Array	Returns a variant containing an array
Asc	Converts the first character of string to its ASCII value
Atn	Returns the arctangent of a number
CallByName*	Executes a method, or sets or returns a property of an object
Cbool	Converts an expression to a Boolean data type
Cbyte	Converts an expression to a byte data type
Ccur	Converts an expression to a currency data type
Cdate	Converts an expression to a date data type
Cdbl	Converts an expression to a double data type
Cdec	Converts an expression to a decimal data type
Choose	Selects and returns a value from a list of arguments
Chr	Converts a character code to a string
Cint	Converts an expression to an integer data type
CLng	Converts an expression to a long data type

Continued

Table B-2 (continued)

Function	Action
Cos	Returns the cosine of a number
CreateObject	Creates an OLE Automation object
CSng	Converts an expression to a single data type
CStr	Converts an expression to a string data type
CurDir	Returns the current path
Cvar	Converts an expression to a variant data type
CVDate	Converts an expression to a date data type (for compatibility, not recommended)
CVErr	Returns a user-defined error value that corresponds to an error number
Date	Returns the current system date
DateAdd	Adds a time interval to a date
DateDiff	Returns the time interval between two dates
DatePart	Returns a specified part of a date
DateSerial	Converts a date to a serial number
DateValue	Converts a string to a date
Day	Returns the day of the month of a date
DDB	Returns the depreciation of an asset
Dir	Returns the name of a file or directory that matches a pattern
DoEvents	Yields execution so the operating system can process other events
Environ	Returns an operating environment string
EOF	Returns True if the end of a text file has been reached
Err	Returns the error message that corresponds to an error number
Error	Returns the error message that corresponds to an error number
Exp	Returns the base of the natural logarithms (e) raised to a power
FileAttr	Returns the file mode for a text file
FileDateTime	Returns the date and time when a file was last modified
FileLen	Returns the number of bytes in a file
Filter	Returns a subset of a string array, filtered
Fix	Returns the integer portion of a number
Format	Displays an expression in a particular format

Function	Action
FormatCurrency*	Returns an expression formatted with the system currency symbol
FormatDateTime*	Returns an expression formatted as a date or time
FormatNumber*	Returns an expression formatted as a number
FormatPercent*	Returns an expression formatted as a percentage
FreeFile	Returns the next available file number when working with text files
FV	Returns the future value of an annuity
GetAllSettings	Returns a list of settings and values from the Windows Registry
GetAttr	Returns a code representing a file attribute
GetObject	Retrieves an OLE Automation object from a file
GetSetting	Returns a specific setting from the application's entry in the Windows Registry
Hex	Converts from decimal to hexadecimal
Hour	Returns the hour of a time
IIF	Evaluates an expression and returns one of two parts
Input	Returns characters from a sequential text file
InputBox	Displays a box to prompt a user for input
InStr	Returns the position of a string within another string
InStrRev*	Returns the position of a string within another string, from the end of the string
Int	Returns the integer portion of a number
Ipmt	Returns the interest payment for a given period of an annuity
IRR	Returns the internal rate of return for a series of cash flows
IsArray	Returns True if a variable is an array
IsDate	Returns True if a variable is a date
IsEmpty	Returns True if a variable has not been initialized
IsError	Returns True if an expression is an error value
IsMissing	Returns True if an optional argument was not passed to a procedure
IsNull	Returns True if an expression contains a Null value
IsNumeric	Returns True if an expression can be evaluated as a number
IsObject	Returns True if an expression references an OLE Automation object
Join*	Combines strings contained in an array
LBound	Returns the smallest subscript for a dimension of an array

Continued

Table B-2 (continued)

Function	Action
LCase	Returns a string converted to lowercase
Left	Returns a specified number of characters from the left of a string
Len	Returns the number of characters in a string
Loc	Returns the current read or write position of a text file
LOF	Returns the number of bytes in an open text file
Log	Returns the natural logarithm of a number
LTrim	Returns a copy of a string with no leading spaces
Mid	Returns a specified number of characters from a string
Minute	Returns the minute of a time
MIRR	Returns the modified internal rate of return for a series of periodic cash flows
Month	Returns the month of a date
MonthName	Returns the month, as a string
MsgBox	Displays a modal message box
Now	Returns the current system date and time
NPer	Returns the number of periods for an annuity
NPV	Returns the net present value of an investment
Oct	Converts from decimal to octal
Partition	Returns a string representing a range in which a value falls
Pmt	Returns a payment amount for an annuity
Ppmt	Returns the principal payment amount for an annuity
PV	Returns the present value of an annuity
QBColor	Returns an RGB color code
Rate	Returns the interest rate per period for an annuity
Replace*	Returns a string in which a substring is replaced with another string
RGB	Returns a number representing an RGB color value
Right	Returns a specified number of characters from the right of a string
Rnd	Returns a random number between 0 and 1
Round	Returns a rounded number
RTrim	Returns a copy of a string with no trailing spaces

Function	Action
Second	Returns the seconds portion of a specified time
Seek	Returns the current position in a text file
Sgn	Returns an integer that indicates the sign of a number
Shell	Runs an executable program
Sin	Returns the sine of a number
SLN	Returns the straight-line depreciation for an asset for a period
Space	Returns a string with a specified number of spaces
Spc	Positions output when printing to a file
Split*	Returns a one-dimensional array containing a number of substrings
Sqr	Returns the square root of a number
Str	Returns a string representation of a number
StrComp	Returns a value indicating the result of a string comparison
StrConv	Returns a converted string
String	Returns a repeating character or string
StrReverse*	Returns a string, reversed
Switch	Evaluates a list of Boolean expressions and returns a value associated with the first True expression
SYD	Returns the sum-of-years' digits depreciation of an asset for a period
Tab	Positions output when printing to a file
Tan	Returns the tangent of a number
Time	Returns the current system time
Timer	Returns the number of seconds since midnight
TimeSerial	Returns the time for a specified hour, minute, and second
TimeValue	Converts a string to a time serial number
Trim	Returns a string without leading spaces and/or trailing spaces
TypeName	Returns a string that describes the data type of a variable
UBound	Returns the largest available subscript for a dimension of an array
UCase	Converts a string to uppercase
Val	Returns the number formed from any initial numeric characters of a string
VarType	Returns a value indicating the subtype of a variable

Continued

Table B-2 (continued)

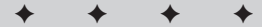
Function	Action
Weekday	Returns a number indicating a day of the week
WeekdayName*	Returns a string indicating a day of the week
Weekday	Returns a number representing a day of the week
Year	Returns the year of a date

* Not available in Excel 97 and earlier editions



VBA Error Codes

This appendix contains a complete listing of the error codes for all trappable errors. This information is useful for error trapping. For complete details, consult Excel's online help.



<i>Error code</i>	<i>Message</i>
3	Return without GoSub.
5	Invalid procedure call or argument.
6	Overflow (for example, value too large for an integer).
7	Out of memory. This error rarely refers to the amount of physical memory installed on your system. Rather, it usually refers to a fixed-size area of memory used by Excel or Windows (for example, the area used for graphics or custom formats).
9	Subscript out of range. You will also get this error message if a named item is not found in a collection of objects; for example, if your code refers to <code>Sheets("Sheet2")</code> and Sheet2 does not exist.
10	This array is fixed or temporarily locked.
11	Division by zero.
13	Type mismatch.
14	Out of string space.
16	Expression too complex.
17	Can't perform requested operation.
18	User interrupt occurred. This error occurs if the user interrupts a macro by pressing the Cancel key.
20	Resume without error. This error probably indicates that you forgot the <code>Exit Sub</code> statement before your error handler code.
28	Out of stack space.
35	Sub or Function not defined.

Continued

Error code	Message
47	Too many DLL application clients.
48	Error in loading DLL.
49	Bad DLL calling convention.
51	Internal error.
52	Bad filename or number.
53	File not found.
54	Bad file mode.
55	File already open.
57	Device I/O error.
58	File already exists.
59	Bad record length.
61	Disk full.
62	Input past end of file.
63	Bad record number.
67	Too many files.
68	Device unavailable.
70	Permission denied.
71	Disk not ready.
74	Can't rename with different drive.
75	Path/File access error.
76	Path not found.
91	Object variable or With block variable not set. This error occurs if you don't use Set at the beginning of a statement that creates an object variable. Or, it occurs if you refer to a worksheet object (such as <code>ActiveCell</code>) when a chart sheet is active.
92	For loop not initialized.
93	Invalid pattern string.
94	Invalid use of Null.
96	Unable to sink events of object because the object is already firing events to the maximum number of event receivers that it supports.
97	Cannot call friend function on object which is not an instance of defining class.

Error code	Message
98	A property or method call cannot include a reference to a private object, either as an argument or as a return value.
321	Invalid file format.
322	Can't create necessary temporary file.
325	Invalid format in resource file.
380	Invalid property value.
381	Invalid property array index.
382	Set not supported at runtime.
383	Set not supported (read-only property).
385	Need property array index.
387	Set not permitted.
393	Get not supported at runtime.
394	Get not supported (write-only property).
422	Property not found.
423	Property or method not found.
424	Object required. This error occurs if text following a dot is not recognized as an object.
429	ActiveX component can't create object (may be a registration problem with a library you have referenced).
430	Class does not support Automation or does not support expected interface.
432	Filename or class name not found during Automation operation.
438	Object doesn't support this property or method.
440	Automation error.
442	Connection to type library or object library for remote process has been lost. Press OK for dialog to remove reference.
443	Automation object does not have a default value.
445	Object doesn't support this action.
446	Object doesn't support named arguments.
447	Object doesn't support current locale setting.
448	Named argument not found.
449	Argument not optional.

Continued

Error code	Message
450	Wrong number of arguments or invalid property assignment.
451	Property Let procedure not defined and Property Get procedure did not return an object.
452	Invalid ordinal.
453	Specified DLL function not found.
454	Code resource not found.
455	Code resource lock error.
457	This key is already associated with an element of this collection.
458	Variable uses an Automation type not supported in Visual Basic.
459	Object or class does not support the set of events.
460	Invalid clipboard format.
461	Method or data member not found.
462	The remote server machine does not exist or is unavailable.
463	Class not registered on local machine.
481	Invalid picture.
482	Printer error.
735	Can't save file to TEMP.
744	Search text not found.
746	Replacements too long.
1004	Application-defined or object-defined error. This is a very common "catch-all" error message. This error occurs when an error does not correspond to an error defined by VBA. In other words, the error is defined by Excel (or some other object) and is propagated back to VBA. This error also occurs if you generate an error (using the <code>Raise</code> method of the <code>Err</code> object) and the error is not defined by VBA.



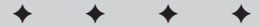
ANSI Code Reference

This appendix contains the ANSI codes, the character (if any) they produce, their hex value, binary value, and the keystroke (if any) that generates the code.



Note

The actual character displayed may depend on the font in use.



<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
1	<None>	&H01	0000 0001	<None>
2	<None>	&H02	0000 0010	<None>
3	<None>	&H03	0000 0011	<None>
4	<None>	&H04	0000 0100	<None>
5	<None>	&H05	0000 0101	<None>
6	<None>	&H06	0000 0110	<None>
7	<None>	&H07	0000 0111	<None>
8	<Backspace>	&H08	0000 1000	Backspace
9	<Tab>	&H09	0000 1001	Tab
10	<Line feed>	&H0A	0000 1010	<None>
11	<None>	&H0B	0000 1011	<None>
12	<None>	&H0C	0000 1100	<None>
13	<Carriage return>	&H0D	0000 1101	Return
14	<None>	&H0E	0000 1110	<None>
15	<None>	&H0F	0000 1111	<None>
16	<None>	&H10	0001 0000	<None>
17	<None>	&H11	0001 0001	<None>
18	<None>	&H12	0001 0010	<None>
19	<None>	&H13	0001 0011	<None>
20	<None>	&H14	0001 0100	<None>
21	<None>	&H15	0001 0101	<None>
22	<None>	&H16	0001 0110	<None>
23	<None>	&H17	0001 0111	<None>
24	<None>	&H18	0001 1000	<None>
25	<None>	&H19	0001 1001	<None>
26	<None>	&H1A	0001 1010	<None>
27	<None>	&H1B	0001 1011	<None>
28	<None>	&H1C	0001 1100	<None>
29	<None>	&H1D	0001 1101	<None>
30	<None>	&H1E	0001 1110	<None>

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
31	<None>	&H1F	0001 1111	<None>
32	<Space>	&H20	0010 0000	Space
33	!	&H21	0010 0001	!
34	"	&H22	0010 0010	"
35	#	&H23	0010 0011	#
36	\$	&H24	0010 0100	\$
37	%	&H25	0010 0101	%
38	&	&H26	0010 0110	&
39	'	&H27	0010 0111	'
40	(&H28	0010 1000	(
41)	&H29	0010 1001)
42	*	&H2A	0010 1010	*
43	+	&H2B	0010 1011	+
44	,	&H2C	0010 1100	,
45	-	&H2D	0010 1101	-
46	.	&H2E	0010 1110	.
47	/	&H2F	0010 1111	/
48	0	&H30	0011 0000	0
49	1	&H31	0011 0001	1
50	2	&H32	0011 0010	2
51	3	&H33	0011 0011	3
52	4	&H34	0011 0100	4
53	5	&H35	0011 0101	5
54	6	&H36	0011 0110	6
55	7	&H37	0011 0111	7
56	8	&H38	0011 1000	8
57	9	&H39	0011 1001	9
58	:	&H3A	0011 1010	:
59	;	&H3B	0011 1011	;
60	<	&H3C	0011 1100	<
61	=	&H3D	0011 1101	=

Continued

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
62	>	&H3E	0011 1110	>
63	?	&H3F	0011 1111	?
64	@	&H40	0100 0000	@
65	A	&H41	0100 0001	A
66	B	&H42	0100 0010	B
67	C	&H43	0100 0011	C
68	D	&H44	0100 0100	D
69	E	&H45	0100 0101	E
70	F	&H46	0100 0110	F
71	G	&H47	0100 0111	G
72	H	&H48	0100 1000	H
73	I	&H49	0100 1001	I
74	J	&H4A	0100 1010	J
75	K	&H4B	0100 1011	K
76	L	&H4C	0100 1100	L
77	M	&H4D	0100 1101	M
78	N	&H4E	0100 1110	N
79	O	&H4F	0100 1111	O
80	P	&H50	0101 0000	P
81	Q	&H51	0101 0001	Q
82	R	&H52	0101 0010	R
83	S	&H53	0101 0011	S
84	T	&H54	0101 0100	T
85	U	&H55	0101 0101	U
86	V	&H56	0101 0110	V
87	W	&H57	0101 0111	W
88	X	&H58	0101 1000	X
89	Y	&H59	0101 1001	Y
90	Z	&H5A	0101 1010	Z
91	[&H5B	0101 1011	[

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
92	\	&H5C	0101 1100	\
93]	&H5D	0101 1101]
94	^	&H5E	0101 1110	^
95	_	&H5F	0101 1111	_
96	`	&H60	0110 0000	`
97	a	&H61	0110 0001	a
98	b	&H62	0110 0010	b
99	c	&H63	0110 0011	c
100	d	&H64	0110 0100	d
101	e	&H65	0110 0101	e
102	f	&H66	0110 0110	f
103	g	&H67	0110 0111	g
104	h	&H68	0110 1000	h
105	i	&H69	0110 1001	i
106	j	&H6A	0110 1010	j
107	k	&H6B	0110 1011	k
108	l	&H6C	0110 1100	l
109	m	&H6D	0110 1101	m
110	n	&H6E	0110 1110	n
111	o	&H6F	0110 1111	o
112	p	&H70	0111 0000	p
113	q	&H71	0111 0001	q
114	r	&H72	0111 0010	r
115	s	&H73	0111 0011	s
116	t	&H74	0111 0100	t
117	u	&H75	0111 0101	u
118	v	&H76	0111 0110	v
119	w	&H77	0111 0111	w
120	x	&H78	0111 1000	x
121	y	&H79	0111 1001	y
122	z	&H7A	0111 1010	z

Continued

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
123	{	&H7B	0111 1011	{
124		&H7C	0111 1100	
125	}	&H7D	0111 1101	}
126	~	&H7E	0111 1110	~
127	_	&H7F	0111 1111	Del
128		&H80	1000 0000	Alt+0128
129	_	&H81	1000 0001	Alt+0129
130	,	&H82	1000 0010	Alt+0130
131	f	&H83	1000 0011	Alt+0131
132	"	&H84	1000 0100	Alt+0132
133	...	&H85	1000 0101	Alt+0133
134	†	&H86	1000 0110	Alt+0134
135	‡	&H87	1000 0111	Alt+0135
136	^	&H88	1000 1000	Alt+0136
137	‰	&H89	1000 1001	Alt+0137
138	_	&H8A	1000 1010	Alt+0138
139	‹	&H8B	1000 1011	Alt+0139
140	Œ	&H8C	1000 1100	Alt+0140
141	_	&H8D	1000 1101	Alt+0141
142	_	&H8E	1000 1110	Alt+0142
143	_	&H8F	1000 1111	Alt+0143
144	_	&H90	1001 0000	Alt+0144
145	'	&H91	1001 0001	Alt+0145
146	'	&H92	1001 0010	Alt+0146
147	"	&H93	1001 0011	Alt+0147
148	"	&H94	1001 0100	Alt+0148
149	•	&H95	1001 0101	Alt+0149
150	_	&H96	1001 0110	Alt+0150
151	_	&H97	1001 0111	Alt+0151
152	~	&H98	1001 1000	Alt+0152

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
153	(tm)	&H99	1001 1001	Alt+0153
154	_	&H9A	1001 1010	Alt+0154
155	›	&H9B	1001 1011	Alt+0155
156	œ	&H9C	1001 1100	Alt+0156
157	_	&H9D	1001 1101	Alt+0157
158	_	&H9E	1001 1110	Alt+0158
159	ÿ	&H9F	1001 1111	Alt+0159
160	<None>	&HA0	1010 0000	Alt+0160
161	ı	&HA1	1010 0001	Alt+0161
162	ç	&HA2	1010 0010	Alt+0162
163	£	&HA3	1010 0011	Alt+0163
164		&HA4	1010 0100	Alt+0164
165	¥	&HA5	1010 0101	Alt+0165
166	_	&HA6	1010 0110	Alt+0166
167	§	&HA7	1010 0111	Alt+0167
168	¨	&HA8	1010 1000	Alt+0168
169	(c)	&HA9	1010 1001	Alt+0169
170	ª	&HAA	1010 1010	Alt+0170
171	«	&HAB	1010 1011	Alt+0171
172	¬	&HAC	1010 1100	Alt+0172
173	_	&HAD	1010 1101	Alt+0173
174	(r)	&HAE	1010 1110	Alt+0174
175	ˆ	&HAF	1010 1111	Alt+0175
176	°	&HB0	1011 0000	Alt+0176
177	±	&HB1	1011 0001	Alt+0177
178	_	&HB2	1011 0010	Alt+0178
179	_	&HB3	1011 0011	Alt+0179
180	´	&HB4	1011 0100	Alt+0180
181	>	&HB5	1011 0101	Alt+0181
182	¶	&HB6	1011 0110	Alt+0182
183	·	&HB7	1011 0111	Alt+0183

Continued

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
184	.	&HB8	1011 1000	Alt+0184
185	_	&HB9	1011 1001	Alt+0185
186	°	&HBA	1011 1010	Alt+0186
187	»	&HBB	1011 1011	Alt+0187
188	1/4	&HBC	1011 1100	Alt+0188
189	1/2	&HBD	1011 1101	Alt+0189
190	3/4	&HBE	1011 1110	Alt+0190
191	ı	&HBF	1011 1111	Alt+0191
192	À	&HC0	1100 0000	Alt+0192
193	Á	&HC1	1100 0001	Alt+0193
194	Â	&HC2	1100 0010	Alt+0194
195	Ã	&HC3	1100 0011	Alt+0195
196	Ä	&HC4	1100 0100	Alt+0196
197	Å	&HC5	1100 0101	Alt+0197
198	Æ	&HC6	1100 0110	Alt+0198
199	Ç	&HC7	1100 0111	Alt+0199
200	È	&HC8	1100 1000	Alt+0200
201	É	&HC9	1100 1001	Alt+0201
202	Ê	&HCA	1100 1010	Alt+0202
203	Ë	&HCB	1100 1011	Alt+0203
204	Ì	&HCC	1100 1100	Alt+0204
205	Í	&HCD	1100 1101	Alt+0205
206	Î	&HCE	1100 1110	Alt+0206
207	Ï	&HCF	1100 1111	Alt+0207
208	–	&HD0	1101 0000	Alt+0208
209	Ñ	&HD1	1101 0001	Alt+0209
210	Ò	&HD2	1101 0010	Alt+0210
211	Ó	&HD3	1101 0011	Alt+0211
212	Ô	&HD4	1101 0100	Alt+0212
213	Õ	&HD5	1101 0101	Alt+0213

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
214	Ö	&HD6	1101 0110	Alt+0214
215	–	&HD7	1101 0111	Alt+0215
216	Ø	&HD8	1101 1000	Alt+0216
217	Ù	&HD9	1101 1001	Alt+0217
218	Ú	&HDA	1101 1010	Alt+0218
219	Û	&HDB	1101 1011	Alt+0219
220	Ü	&HDC	1101 1100	Alt+0220
221	–	&HDD	1101 1101	Alt+0221
222	–	&HDE	1101 1110	Alt+0222
223	ß	&HDF	1101 1111	Alt+0223
224	à	&HE0	1110 0000	Alt+0224
225	á	&HE1	1110 0001	Alt+0225
226	â	&HE2	1110 0010	Alt+0226
227	ã	&HE3	1110 0011	Alt+0227
228	ä	&HE4	1110 0100	Alt+0228
229	å	&HE5	1110 0101	Alt+0229
230	æ	&HE6	1110 0110	Alt+0230
231	ç	&HE7	1110 0111	Alt+0231
232	è	&HE8	1110 1000	Alt+0232
233	é	&HE9	1110 1001	Alt+0233
234	ê	&HEA	1110 1010	Alt+0234
235	ë	&HEB	1110 1011	Alt+0235
236	ì	&HEC	1110 1100	Alt+0236
237	í	&HED	1110 1101	Alt+0237
238	î	&HEE	1110 1110	Alt+0238
239	ï	&HEF	1110 1111	Alt+0239
240	–	&HF0	1111 0000	Alt+0240
241	ñ	&HF1	1111 0001	Alt+0241
242	ò	&HF2	1111 0010	Alt+0242
243	ó	&HF3	1111 0011	Alt+0243
244	ô	&HF4	1111 0100	Alt+0244

Continued

<i>ANSI code</i>	<i>Character</i>	<i>Hex code</i>	<i>Binary code</i>	<i>Keystroke*</i>
245	õ	&HF5	1111 0101	Alt+0245
246	ö	&HF6	1111 0110	Alt+0246
247	÷	&HF7	1111 0111	Alt+0247
248	ø	&HF8	1111 1000	Alt+0248
249	ù	&HF9	1111 1001	Alt+0249
250	ú	&HFA	1111 1010	Alt+0250
251	û	&HFB	1111 1011	Alt+0251
252	ü	&HFC	1111 1100	Alt+0252
253	–	&HFD	1111 1101	Alt+0253
254	—	&HFE	1111 1110	Alt+0254
255	ÿ	&HFF	1111 1111	Alt+0255

*For keystrokes that use the Alt key, use the numeric keypad with Num Lock on.



What's on the CD-ROM

This appendix describes the contents of the companion CD-ROM.

CD-ROM Overview

The CD-ROM consists of five components:

- ◆ Chapter Examples. Excel workbooks that I discuss in this book.
- ◆ Power Utility Pak. The trial version of my popular Excel add-in. Use the coupon in this book to order the full version free. The complete VBA source code is also available for a small fee.
- ◆ Sound-Proof 2000. The demo version of my audio proof-reader add-in.
- ◆ Complete, searchable version of the book in PDF format (use Acrobat Reader to access these files).
- ◆ The latest version of Acrobat Reader from Adobe.

Chapter Examples

Each chapter of this book that contains example workbooks has its own subdirectory on the CD-ROM. For example, the example files for Chapter 3 are found in the following directory:

```
chapters\chap03\
```

Following is a list of the chapter examples, with a brief description of each.

Chapter 3

array examples.xls	Examples of array formulas.
megaformula-1.xls	The “remove middle name” formula example that uses intermediate formulas.
megaformula-2.xls	The “remove middle name” formula example that uses a megaformula.
megaformula-3.xls	The “remove middle name” formula example that uses a custom VBA function.
named formula.xls	Examples that use named formulas.

Chapter 7

comment objects.xls	Examples of VBA code that manipulates <code>Comment</code> objects.
---------------------	---

Chapter 9

sheet sorter.xls	The sheet-sorting application.
sheet sorter-2.xls	The sheet-sorting application, improved so that it better handles sheet names that end in numbers.

Chapter 10

commission.xls	Contains various versions of the <code>Commission</code> function used to calculate a sales commission.
draw.xls	Contains the <code>Draw</code> function, which randomly chooses one cell from a range.
key press.xls	Demonstrates how to use an API function to determine whether the <code>Shift</code> , <code>Ctrl</code> , or <code>Alt</code> key is pressed.
month names.xls	Demonstrates the <code>MonthNames</code> function, which returns an array.
mysum.xls	Demonstrates the <code>MySum</code> function, which emulates Excel’s <code>SUM</code> function.
reverse.xls	Demonstrates the <code>Reverse</code> function, which returns an error value if its argument is not a string.
uppercase.xls	Contains the <code>UpCase</code> function that emulates Excel’s <code>UPPER</code> function.

winapi.txt	Contains Windows API declarations and constants.
windows directory.xls	Demonstrates the <code>ShowWindowsDir</code> function, which uses an API function to display the Windows directory name.

Chapter 11

about selection.xls	Contains a procedure that describes the current range selection.
auto average.xls	Demonstrates how to insert an <code>AVERAGE</code> function in a manner similar to Excel's AutoSum feature. When this workbook is open, you have access to a new menu command: Tools ⇨ Enter Average Formula.
batch processing.xls	Demonstrates how to process a series of files. The example uses three additional files: <code>text01.txt</code> , <code>text02.txt</code> , and <code>text03.txt</code> .
data type.xls	Uses the <code>CellType</code> function to determine the type of data in a cell.
date and time.xls	Contains a procedure that displays the current date and time.
delete empty rows.xls	Contains a procedure that deletes all empty rows in a worksheet.
disk info.xls	Demonstrates various API functions that return information about disk drives.
extract element.xls	Demonstrates the <code>ExtractElement</code> function.
file association.xls	Demonstrates an API function that returns the full path to the application associated with a particular file.
fill range.xls	Contains two procedures that demonstrate how to fill a range with data from an array.
in range.xls	Contains a function that returns <code>True</code> if a range is contained inside another range.
input.xls	Contains examples of using VBA's <code>InputBox</code> function to prompt for a value.
last saved and printed.xls	Contains the <code>LastSaved</code> and <code>LastPrinted</code> functions, which access a workbook's built-in document properties.
list fonts.xls	Creates a list of all installed fonts.
max all sheets.xls	Contains the function, which returns the maximum value across all worksheets <code>MaxAllSheets</code> in a workbook.

next empty row.xls	Demonstrates how to insert data into the next empty row of a worksheet.
page count.xls	Contains a procedure that counts the number of pages to be printed.
play sound.xls	Contains the <code>Alarm</code> function, which plays a sound when a cell meets a certain condition. Uses the <code>sound.wav</code> file.
printer info.xls	Demonstrates an API function that returns information about the default printer.
random functions.xls	Contains the <code>RandomIntegers</code> function (which returns an array of nonduplicated random integers) and the <code>RangeRandomize</code> function (which randomizes a range).
range selections.xls	Demonstrates several common types of range selections relative to the active cell. After opening this file, use the <code>Selection Demo</code> menu.
registry.xls	Demonstrates API functions that enable you to read from and write to the Windows Registry.
select max.xls	Contains a procedure that selects the cell that contains the maximum value.
selective color.xls	Contains a procedure that colors cells based on their contents.
sheet offset.xls	Demonstrates two versions of the <code>SheetOffset</code> function.
sorting demo.xls	Demonstrates three VBA array-sorting procedures.
sound.xls	Demonstrates API functions that play sound files.
stat functions.xls	Demonstrates the <code>StatFunction</code> function.
toggles.xls	Contains procedures that toggle various settings.
utility functions.xls	Contains the following functions: <code>FileExists</code> , <code>FileNameOnly</code> , <code>PathExists</code> , <code>RangeNameExists</code> , <code>SheetExists</code> , and <code>WorkbookIsOpen</code> .
variant transfer.xls	Demonstrates how to transfer a range of cells to a variant array and transfer a variant array to a range of cells.
video mode.xls	Demonstrates an API function that returns the current video resolution.

worksheet functions.xls	Contains the following worksheet functions: SheetName, WorkbookName, AppName, CountBetween, LastInColumn, LastInRow, and IsLike.
write and read range.xls	Contains procedures that write data to a range and read data from a range.

Chapter 12

get a filename.xls	Demonstrates how to use the GetOpenFilename method.
get directory.xls	Demonstrates API functions that display a dialog box that enables the user to select a directory.

Chapter 13

controls on sheet.xls	An example of using controls (from the Control Toolbox toolbar) on a worksheet.
controls on sheet2.xls	Another example that demonstrates using controls on worksheets.
get name and sex.xls	The end result of the hands-on example described in Chapter 13.
newcontrols.pag	Contains customized controls for your Toolbox. To import this file as a new page, right-click a Toolbox tab and select Import Page.
spinbutton events.xls	Demonstrates the sequence of events pertaining to SpinButton controls.
spinbutton textbox.xls	Demonstrates how to pair a SpinButton control with a TextBox control.
userform events.xls	Demonstrates the sequence of events pertaining to UserForms.

Chapter 14

activate sheet.xls	Demonstrates how to display a list of sheet names in a ListBox control.
change size.xls	Demonstrates a UserForm that changes sizes.
fill listbox.xls	Demonstrates two ways to add items to a ListBox control.

item transfer.xls	Demonstrates how to let the user transfer items between two ListBox controls.
move items.xls	Demonstrates how to enable the user to move items up and down within a ListBox control.
multicolumn listbox.xls	Demonstrates how to create a multicolumn ListBox control using data stored in a worksheet.
multicolumn listbox2.xls	Demonstrates how to create a multicolumn ListBox control using data stored in an array.
multiple lists.xls	Demonstrates how to display multiple lists in a single ListBox control.
queryclose.xls	Demonstrates a technique that ensures that the user can't close a UserForm by clicking its Close button.
refedit.xls	Demonstrates the RefEdit control.
select rows.xls	Demonstrates how to use a multicolumn ListBox control to enable the user to select rows in a worksheet.
selected items.xls	Demonstrates how to identify selected items in a ListBox control.
splash.xls	Demonstrates a splash screen that is displayed when the workbook is opened.
unique.xls	Demonstrates how to fill a ListBox control with unique items.
userform menus.xls	Demonstrates two simple menu systems using CommandButton controls and a ListBox control.
zoom and scroll sheets.xls	Demonstrates how to use dialog box controls to zoom and scroll a worksheet.
zoom.xls	Demonstrates the use of the Zoom property to zoom a dialog box.

Chapter 15

chart in userform.xls	Demonstrates how to display a chart on a UserForm.
color picker.xls	Demonstrates a function that enables the user to select a color from a dialog box.
dataform.xla	An add-in that serves as a replacement for Excel's Data Form. This add-in is protected.
modeless userform.xls	Demonstrates a modeless UserForm that displays information about the active cell.
modeless user form2.xls	Demonstrates a more sophisticated modeless UserForm that displays information about the active cell.

multiple buttons.xls	Demonstrates how to use a single event-handler procedure for multiple controls.
my msgbox.xls	Contains the MyMsgBox function, which emulates VBA's MsgBox function.
owc chart - simple.xls	Creates a chart in a Userform, using the Office Web Components.
owc chart 2000.xls	Creates a chart in a Userform, using the Office Web Components. This version is for Excel 2000.
owc chart 2002.xls	Creates a chart in a Userform, using the Office Web Components. This version is for Excel 2002.
owc spreadsheet.xls	Demonstrates the Office Web Components Spreadsheet control.
progress-1.xls	Demonstrates how to display a progress indicator while a macro is running. (The progress indicator is not initiated by a UserForm.)
progress-2.xls	Demonstrates another way to display a progress indicator while a macro is running. (The progress indicator is initiated by a UserForm.)
wizard.xls	Demonstrates how to create a multistep “wizard.”

Chapter 16

text tools.xls	The text manipulation utility described in Chapter 15 (workbook version).
undo.xls	Demonstrates one way to undo the effects of a VBA procedure.

Chapter 17

budget.xls	Demonstrates how to create a pivot table from a worksheet database with VBA.
external db.xls	Demonstrates how to create a pivot table from an external database table with VBA. This workbook uses the budget.mdb database file.
modify pivot.xls	Demonstrates how to write VBA code to modify a pivot table.
simple db.xls	A very simple worksheet database, used to demonstrate how to create a pivot table. Contains a recorded macro, plus a “cleaned up” version of the macro.
survey data.xls	Demonstrates how to create multiple pivot tables to analyze survey data.

Chapter 18

animated chart.xls	Animated chart example.
autofilter chart.xls	Demonstrates the use of AutoFiltering with a chart.
chart active cell.xls	Demonstrates how to change a chart's data series based on the active cell.
chart image map.xls	Demonstrates how to create a chart that serves as a type of image map.
chart in userform.xls	Demonstrates how to create a chart on the fly and display it in a UserForm.
chartseriesclass-1.xls	An example of using the <code>ChartSeriesClass</code> class module.
chartseriesclass-2.xls	More examples of using the <code>ChartSeriesClass</code> class module.
clock chart.xls	An example of a chart formatted to look like an analog clock.
combobox chart.xls	Demonstrates how to use a <code>ComboBox</code> control to change a chart's data series.
create chart.xls	Contains a recorded macro to create a chart, plus a "cleaned up" version of the macro.
data labels.xls	Demonstrates how to use a range for data labels in a chart.
events - chart sheet.xls	Demonstrates chart events, with a chart sheet.
events - embedded.xls	Demonstrates chart events, with an embedded chart.
get chart range.xls	Contains a custom function that returns a <code>Range</code> object that represents the data used in a chart.
hypocycloid.xls	Contains a chart that plots hypocycloid curves.
linked pictures.xls	Demonstrates how to use a linked picture of a range in a chart.
multiple charts.xls	Demonstrates how to display multiple charts on a single chart sheet.
printed embedded charts.xls	Demonstrates how to print embedded charts on a full sheet of paper.
xy sketch.xls	A chart that doubles as a primitive sketching tool.

Chapter 19

application events 2k.xls	Demonstrates how to monitor Application-level events. Uses a modeless UserForm, so it requires Excel 2000 or later version.
application events 97.xls	Demonstrates how to monitor Application-level events. Works in Excel 97 or later version.
log workbook open.xls	Demonstrates how to keep track of every workbook that is opened by storing information in a text file.
onkey demo.xls	Demonstrates the use of the <code>OnKey</code> method to remap keyboard keys.
selection change.xls	Demonstrates monitoring the worksheet selection change event to highlight the active row and column.
track changes in comment.xls	Demonstrates a procedure that uses comments to track changes made to cells.
validate entry1.xls	Demonstrates how to validate data entered into a cell; uses the <code>EnableEvents</code> property.
validate entry2.xls	Demonstrates how to validate data entered into a cell; does not use the <code>EnableEvents</code> property.

Chapter 20

automate Excel.doc	A Microsoft Word file that contains a procedure to automate Excel. It uses the <code>projections.xls</code> workbook file.
make memos.xls	Demonstrates Automation of Microsoft Word to generate memos using data stored in a worksheet.
phone dialer.xls	Demonstrates how to use <code>SendKeys</code> to control the Windows Phone Dialer application.
simple ado example.xls	Demonstrates how to retrieve data from a Microsoft Access file (uses <code>budget.mdb</code>).
start calculator.xls	Demonstrates how to execute (or activate) the Windows Calculator program.
start charmap.xls	Demonstrates two ways to execute the Windows Character Map program.
system dialogs.xls	Demonstrates how to display any of 50 system dialog boxes.

Chapter 21

is addin installed.xls	Contains code that determines whether an add-in is properly installed.
text tools.xla	The text manipulation utility described in Chapter 16.

Chapter 22

autosense.xls	Contains a procedure that creates an “autosense” toolbar that is displayed only when the active cell is in a particular range.
commandbarbuttons.xls	Shows the various ways that a <code>CommandBarButton</code> can be displayed.
dynamic caption.xls	Creates a toolbar button that displays the number format string for the active cell.
faceids.xla	Is an add-in that makes it very easy to determine the <code>FaceId</code> property setting for a particular image. This add-in uses additional files and is contained in a separate <code>\faceids</code> subdirectory.
hide and restore.xls	Contains procedures that hide and then later restore toolbars.
list all controls.xls	Contains a procedure that displays the <code>Caption</code> property for each control on every toolbar.
list commandbars.xls	Contains a procedure that lists each <code>CommandBar</code> ’s name, index number, and type.
month list.xls	Demonstrates the use of a drop-down list control on a <code>CommandBar</code> .
toggle toolbars.xls	Contains a procedure that toggles the <code>Visible</code> property of each <code>CommandBar</code> .

Chapter 23

add new menu.xls	Contains a procedure that adds a new menu with menu items.
add to Tools menu.xls	Contains a procedure that adds a new menu item to the Tools menu on the Worksheet Menu Bar.
hide menu.xls	Demonstrates how to display a menu only when a particular workbook is active.
list menu info.xls	Contains a procedure that displays the caption for each item (menu, menu item, and submenu item) on the Worksheet Menu Bar.

list shortcut menus.xls	Contains a procedure that lists all shortcut menus.
menu maker1.xls	Demonstrates an easy way to create a menu with information contained in a worksheet.
menu maker2.xls	Demonstrates an easy way to create a menu with information contained in a worksheet (another example).
new menubar.xls	Demonstrates how to replace Excel's menu bar with one of your own.
new shortcut menu.xls	Contains a procedure that creates a new shortcut menu.
shortcut key.xls	Contains a procedure that adds new menu items with a shortcut key.
toggle gridlines.xls	Demonstrates how to display a "toggle" menu with a check mark.

Chapter 24

\assistant\ formletter.xls	Demonstrates how to display help by using the Office Assistant.
\comments\ formletter.xls	Demonstrates how to display help by using cell comments.
\function\myfuncs.xls	Demonstrates how to display help for custom functions.
\htmlhelp\ formletter.xls	Demonstrates a simple HTML Help system (includes the source files).
\other\myapp.xls	Demonstrates other ways to display help: with the Help method, from a message box, and from an input box.
\textbox\formletter.xls	Demonstrates how to display help by using a TextBox control on a worksheet.
\userform1\ formletter.xls	Demonstrates how to display help by using Label controls in a UserForm.
\userform2\ formletter.xls	Demonstrates how to display help by using a "scrolling" Label control in a UserForm.
\userform3\ formletter.xls	Demonstrates how to display help by using a DropDown control and a Label control in a UserForm.
\winhelp\ formletter.xls	Demonstrates a simple WinHelp Help system (includes the source files).
\worksheet\ formletter.xls	Demonstrates how to display help by activating a worksheet.

Some of the examples in Chapter 24 use multiple files, and many use the same file-name. Therefore, each example is contained in a separate subdirectory.

Chapter 25

loan amortization wizard.xla An add-in “wizard” that creates an amortization schedule for a fixed-rate loan. This add-in is not protected. When the add-in is installed, access the wizard from the Tools menu.

Chapter 26

multilingual wizard.xls A simple wizard that lets the user choose from three languages.

video mode.xls Demonstrates how to use an API function that works with both 16-bit and 32-bit versions of Excel.

Chapter 27

does file exist.xls Contains code to check for the existence of a file, using three different techniques.

export import.xls Contains procedures to export a range to a CSV file and to import a CSV file at the active cell position.

export to HTML.xls Contains to code to export a range of cells to an HTML file.

filter text file.xls Contains a procedure that reads a text file (infile.txt) and copies only the rows that contain a specific text string to a second text file (output.txt).

import more than 256.xls Contains a procedure that reads a text file and stores the data in Sheet1. If the line contains more than 256 columns of data, the additional data is stored in additional sheets. Uses long-file.txt, which has 600 columns of data.

list files1.xls Contains a procedure that displays a list of files contained in a particular directory, along with the file size and date.

list files2.xls	Contains a procedure that displays a list of files contained in a particular directory, along with the file size and date; uses the <code>FileSearch</code> object.
show drive info.xls	Contains a procedure that uses the <code>FileSystemObject</code> to retrieve and display various information about all disk drives.

Chapter 28

add 100 buttons.xls	Contains a procedure that adds 100 <code>CommandButtons</code> and that creates an event-handler procedure for each.
add button and code.xls	Contains a procedure that adds a <code>CommandButton</code> and a VBA procedure.
add controls.xls	Demonstrates how to add controls to a <code>UserForm</code> at design time and at runtime.
add userform.xls	Contains a procedure that creates a <code>UserForm</code> on the fly.
options form.xls	Contains a function that creates a <code>UserForm</code> (with <code>OptionButtons</code>) on the fly and that returns an integer corresponding to the user's choice.
replace module.xls	Contains a procedure that replaces a module with another module. This example uses the <code>UserBook.xls</code> file.
show components.xls	Contains a procedure that displays information about each VB component in the active workbook.

Chapter 29

csvclass.xls	Contains a class module that makes it easy to import and export a CSV file.
keyboard.xls	Contains a class module that defines a <code>NumLock</code> and a <code>CapsLock</code> class.

Power Utility Pak

Power Utility Pak is a collection of Excel add-ins that I developed. The companion CD-ROM contains a copy of the trial version of this product. The trial version can be used for 30 days.

Registering Power Utility Pak

The normal registration fee for Power Utility Pak is \$39.95. You can use the coupon in this book, however, to get a free copy of the latest version of Power Utility Pak (you pay shipping and handling only). In addition, you can purchase the complete VBA source code for only \$20.00.

Installing the trial version

To install the trial version of Power Utility Pak, follow these steps:

1. Make sure that Excel is not running.
2. Locate the PUP2000T.EXE file on the CD-ROM. This file is located in the PUP\ directory.
3. Double-click PUP2000T.EXE. This expands the files to a directory that you specify on your hard drive.
4. Start Excel.
5. Select Tools ⇨ Add-Ins and click the Browse button. Locate the PUP2000.XLA file in the directory you specified in Step 3.
6. Make sure that Power Utility Pak 2000 is checked in the add-ins list.
7. Click OK to close the Add-Ins dialog box.

After you install Power Utility Pak, it will be available whenever you start Excel, and Excel will have a new menu: PUP 2000. Access the Power Utility Pak features from the PUP 2000 menu or select the Create a PUP toolbar command to generate a toolbar.

Power Utility Pak includes extensive online help. Select PUP 2000 ⇨ Help to view the Help file.

Uninstalling Power Utility Pak

If you decide that you don't want Power Utility Pak, follow these instructions to remove it from Excel's list of add-ins:

1. In Excel, select Tools ⇨ Add-Ins.

2. In the Add-Ins dialog box, remove the check mark from Power Utility Pak 2000.
3. Click OK to close the Add-Ins dialog box.

To remove Power Utility Pak from your system after you've followed the preceding steps to uninstall it from Excel, delete the directory into which you originally installed it.

Sound-Proof 2000

Sound-Proof 2000 is an Excel add-in that I developed. It uses Microsoft Agent to read the contents of selected cells. It's the perfect proofreading tool for anyone who does data entry in Excel.



Excel 2002 includes a new text-to-speech feature. However, you'll find that Sound-Proof 2000 is more customizable and has many additional options.

Cells are read back using natural language format. For example, 154.78 is read as "one hundred fifty-four point seven eight." Date values are read as actual dates (for example, "June fourteen, nineteen ninety-eight") and time values are read as actual times (for example, "six forty-five a.m.>").

The companion CD-ROM contains a demo version of Sound-Proof 2000. The demo version's only limitation is that it reads no more than 12 cells at a time. The full version is available for \$24.95. Ordering instructions are provided in the online Help file.

Installing the demo version

To install the demo version of Sound-Proof, follow these steps:

1. Make sure that Excel is not running.
2. Locate the SP2000D.EXE file on the CD-ROM. This file is located in the SP\ directory.
3. Double-click SP2000D.EXE. This expands the files to a directory you specify on your hard drive.
4. Start Excel.
5. Select Tools ⇨ Add-Ins and click the Browse button. Locate the SP2000.XLA file in the directory you specified in Step 3.
6. Make sure that Sound-Proof 2000 is checked in the add-ins list.
7. Click OK to close the Add-Ins dialog box.

After you install Sound-Proof 2000, it will be available whenever you start Excel, and Excel will have a new menu command: Tools ⇨ Sound-Proof 2000.

Uninstalling Sound-Proof

If you decide that you don't want Sound-Proof 2000, follow these instructions to remove it from Excel's list of add-ins:

1. In Excel, select Tools ⇨ Add-Ins.
2. In the Add-Ins dialog box, remove the check mark from Sound-Proof 2000.
3. Click OK to close the Add-Ins dialog box.

After performing these steps, you can reinstall Sound-Proof at any time by placing a check mark next to the Sound-Proof 2000 item in the Add-Ins dialog box.

To remove Sound-Proof from your system after you have performed the preceding steps to uninstall the add-in from Excel, delete the directory into which you originally installed it.

Electronic Version of *Excel 2002 Power Programming with VBA*

The complete (and searchable) text of this book is on the CD-ROM in Adobe's Portable Document Format (PDF), readable with the Adobe Acrobat Reader (also included). For more information on Adobe Acrobat Reader, go to www.adobe.com.

Adobe Acrobat Reader

The Adobe Acrobat Reader is a helpful program that enables you to view the searchable version of this book, which is in .pdf format on the CD-ROM. To install and run Adobe Acrobat Reader, follow these steps:

1. Start Windows Explorer or Windows NT Explorer and then open the Acrobat folder on the CD-ROM.
2. In the Reader folder, double-click the .exe file and follow the instructions presented on-screen for installing Adobe Acrobat Reader.



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*PUP 2000 is compatible with Excel 97, Excel 2000, and Excel 2002.

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The CD-ROM that you find in the back of this book contains software for both Macintosh and Windows 95/98/NT/ME/2000/XP users. You will need a copy of Excel 2002 to use the examples and software on the CD-ROM. Read the What's on the CD-ROM appendix for complete information about the stuff on the CD-ROM.

Note: You do not need to install all the items on the CD-ROM. Just install the programs that appeal to you.

To start the CD-ROM using Windows, follow these steps:

1. Insert the CD-ROM into your computer's CD-ROM drive.
2. Launch Windows Explorer.
3. Click Browse to browse the CD. This enables you to access the author-created files. (Note that you must save files to your hard drive if you make changes.)

For detailed information about installing the demonstration programs from the CD, please see the What's on the CD-ROM appendix.