

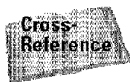
- You can give a name to a value or formula — even when the value or formula doesn't exist on the worksheet. For example, you can create the name `Interest_Rate` for a value of `.075`. Then, you can use this name in your formulas (more about this in the next chapter).

## Valid Names

Although Excel is quite flexible about the names that you can define, it does have some rules:

- Names can't contain any spaces. You might want to use an underscore or a period character to simulate a space (such as `Annual_Total` or `Annual.Total`).
- You can use any combination of letters and numbers, but the name must begin with a letter. A name can't begin with a number (such as `3rdQuarter`) or look like a cell reference (such as `Q3`).
- Symbols, except for underscores and periods, aren't allowed. Although it's not documented, I've found that Excel also allows a backslash (`\`) and question mark (`?`).
- Names are limited to 255 characters. Trust me — using a name anywhere near this length is not a good idea; in fact, it defeats the purpose of naming ranges.
- You can use single letters (except for `R` or `C`), but this is generally not recommended because, again, it defeats the purpose of using meaningful names.

Excel also uses a few names internally for its own use. Although you can create names that override Excel's internal names, you should avoid doing so. To be on the safe side, avoid using the following for names: `Print_Area`, `Print_Titles`, `Consolidate_Area`, and `Sheet_Title`.



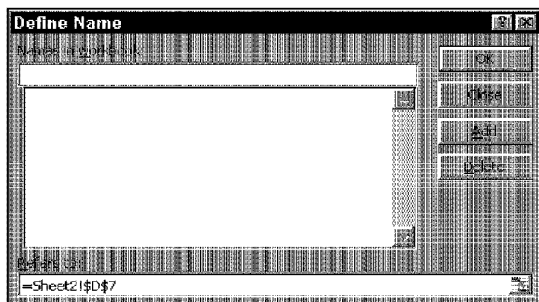
You can use labels that appear as row and column headings as names; when you do, you don't actually have to define the names. This feature is most useful when you use formulas, so it is discussed in detail in Chapter 9.

## Creating Names Manually

Several ways exist to create names. This section discusses two methods to create names manually.

### Using the Define Name dialog box

To create a range name, start by selecting the cell or range that you want to name. Then, select **Insert • Name • Define** (or press `Ctrl+F3`). Excel displays the Define Name dialog box, shown in Figure 8-16.



**Figure 8-16:** Create names for cells or ranges by using the Define Name dialog box.

Type a name in the box labeled Names in workbook (or use the name that Excel proposes, if any). The active or selected cell or range address appears in the Refers to box. Verify that the address listed is correct and then click OK to add the name to your worksheet and close the dialog box. Or, you can click the Add button to continue adding names to your worksheet. If you do this, you must specify the Refers to range either by typing an address (make sure to begin with an equal sign) or by pointing to it in the worksheet. Each name appears in the list box.

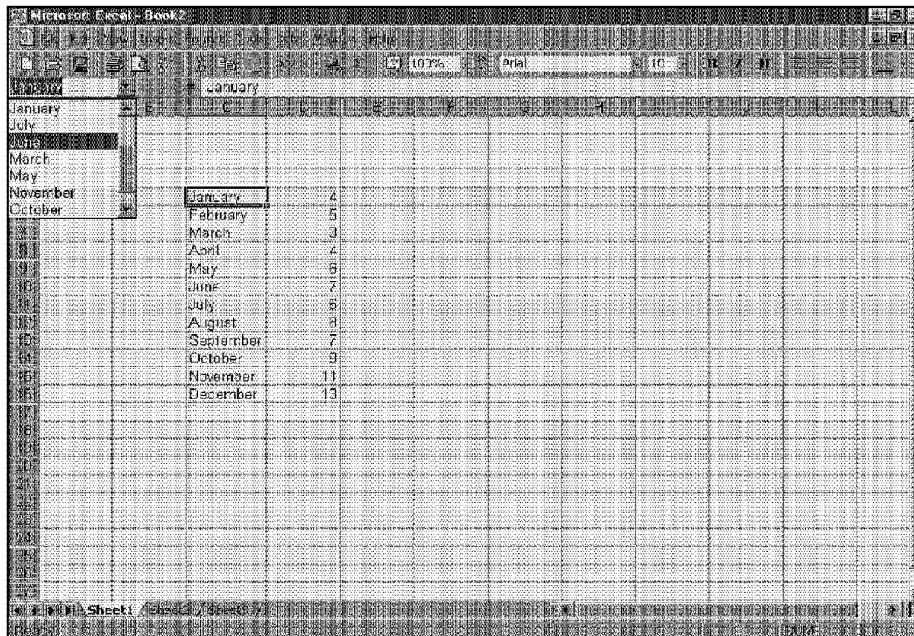
### Using the Name box

A faster way to create a name is to use the Name box. Select the cell or range to name and then click the Name box and type the name. Press Enter to create the name. If a name already exists, you can't use the Name box to change the range to which that name refers. Attempting to do so simply selects the range.



**Note** When you enter a name in the Name box, you *must* press Enter to actually record the name. If you type a name and then click in the worksheet, Excel won't create the name.

The Name box is a drop-down list and shows all names in the workbook (see Figure 8-17). To choose a named cell or range, click the Name box and choose the name. The name appears in the Name box, and Excel selects the named cell or range in the worksheet. Oddly enough, you can't open the Name box by using the keyboard; you must use a mouse. After you click the Name box, however, you can use the direction keys and Enter to choose a name.



**Figure 8-17:** The Name box shows all names defined in the workbook.

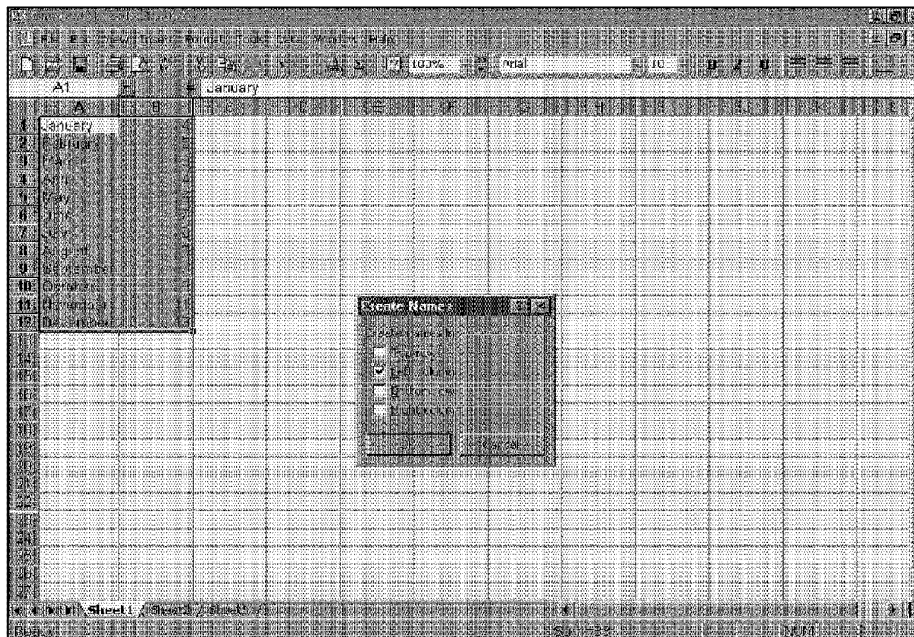
## Creating Names Automatically

You may have a worksheet that contains text that you want to use for names for adjacent cells or ranges. Figure 8-18 shows an example of such a worksheet. In this case, you might want to use the text in column A to create names for the corresponding values in column B. Excel makes this very easy to do.

January	4		
February	5		
March	3		
April	4		
May	6		
June	7		
July	6		
August	8		
September	7		
October	9		
November	11		
December	13		

**Figure 8-18:** Excel makes it easy to create names by using text in adjacent cells.

To create names by using adjacent text, start by selecting the name text and the cells that you want to name (these can be individual cells or ranges of cells). The names must be adjacent to the cells that you're naming (a multiple selection is allowed). Then, choose **Insert • Name • Create** (or **Ctrl+Shift+F3**). Excel displays the **Create Names** dialog box, shown in Figure 8-19. The check marks in this dialog box are based on Excel's analysis of the selected range. For example, if Excel finds text in the first row of the selection, it proposes that you create names based on the top row. If Excel didn't guess correctly, you can change the check boxes. Click **OK** and Excel creates the names.



**Figure 8-19:** The **Create Names** dialog box.



**Note**

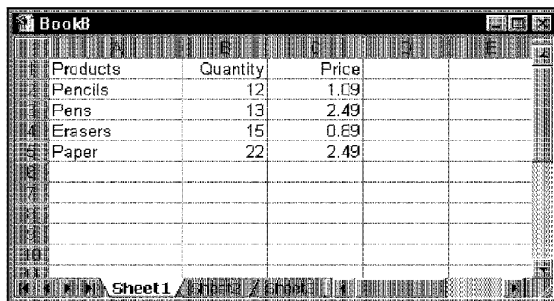
If the text contained in a cell would result in an invalid name, Excel modifies the name to make it valid. For example, if a cell contains the text *Net Income* (which is invalid for a name because it contains a space), Excel converts the space to an underscore character. If Excel encounters a value or a formula where text should be, however, it doesn't convert it to a valid name. It simply doesn't create a name.



**Caution**

You should double-check the names that Excel creates. Sometimes, the **Insert • Name • Create** command works counterintuitively.

Figure 8-20 shows a small table of text and values. If you select the entire table, choose **InsertName • Create**, and accept Excel's suggestions (**Top Row and Left Column** options), you'll find that the name **Products** doesn't refer to A2:A5, as you would expect, but instead refers to B2:C5. If the upper-left cell of the selection contains text and you choose the **Top Row and Left Column** options, Excel uses that text for the name of the entire data — excluding the top row and left column. So, before you accept the names that Excel creates, take a minute to make sure that they refer to the correct ranges.

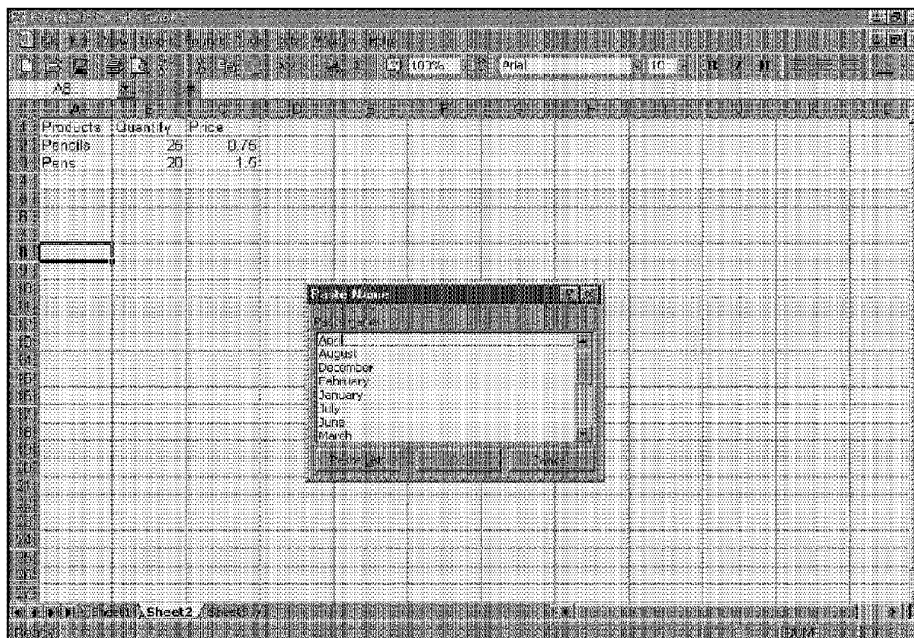


Products	Quantity	Price
Pencils	12	1.09
Pens	13	2.49
Erasers	15	0.09
Paper	22	2.49

**Figure 8-20:** Creating names from the data in this table may produce unexpected results.

## Creating a Table of Names

After you create a large number of names, you may need to know the ranges that each name defines, particularly if you're trying to track down errors or document your work. Excel lets you create a list of all names in the workbook and their corresponding addresses. To create a table of names, first move the cell pointer to an empty area of your worksheet—the table is created at the active cell position and will overwrite any information at that location. Use the **Insert • Name • Paste** command (or F3). Excel displays the **Paste Name** dialog box, shown in Figure 8-21, which lists all the defined names. To paste a list of names, click the **Paste List** button.



**Figure 8-21:** The Paste Name dialog box.

## Deleting Names

If you no longer need a defined name, you can delete it. Deleting a range name *does not* delete information in the range; it can, however, make formulas in your workbook invalid.

Choose Insert • Name • Define to display the Define Name dialog box. Choose the name that you want to delete from the list and then click the Delete button.



Be extra careful when deleting names. If the name is used in a formula, deleting the name causes the formula to become invalid (it will display #NAME?). However, deleting a name can be undone, so if you find that formulas return #NAME? after you delete a name, select Edit • Undo to get the name back.

If you delete the rows or columns that contain named cells or ranges, the names contain an invalid reference. For example, if cell A1 on Sheet1 is named Interest and you delete row 1 or column A, Interest then refers to =Sheet1!#REF! (that is, an erroneous reference). If you use Interest in a formula, the formula displays #REF.

## Redefining Names

After you define a name, you may want to change the cell or range to which it refers. Select **Insert • Name • Define** to display the Define Name dialog box. Click the name that you want to change and then edit the cell or range address in the Refers to edit box. If you want to, you can click the edit box and select a new cell or range by pointing in the worksheet.



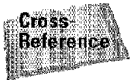
Excel automatically adjusts the cells to which your names refer. For example, assume that cell A10 is named Summary. If you delete a row above row 10, Summary then refers to cell A9. This is just what you would expect to happen, so you don't need to be concerned about it.

## Changing Names

Excel doesn't have a simple way to change a name once you create the name. If you create a name and then realize that it's not the name that you want — or, perhaps, that you spelled it incorrectly — you must create the new name and then delete the old name.

## Learning More About Names

Excel offers some additional features with respect to using names — features unmatched in any of its competitors.



These advanced naming features are most useful when working with formulas and therefore are discussed in Chapter 9.

## Summary

This chapter discusses the basic worksheet operations that involve cells and ranges. These operations include selecting, copying, moving, deleting, and working with ranges that extend across multiple worksheets in a workbook. This chapter also introduces the topic of names, an important concept that can make your worksheets more readable and easier to maintain.

• .....

# Creating and Using Formulas

**F**ormulas are what make a spreadsheet so useful. Without formulas, a spreadsheet would be little more than a word processor with a very powerful table feature. A worksheet without formulas is essentially dead. Using formulas adds life and lets you calculate results from the data stored in the worksheet. This chapter introduces formulas and helps you get up to speed with these important elements.

## Introducing Formulas

To add a formula to a worksheet, you enter it into a cell. You can delete, move, and copy formulas just like any other item of data. Formulas use arithmetic operators to work with values, text, worksheet functions, and other formulas to calculate a value in the cell. Values and text can be located in other cells, which makes changing data easy and gives worksheets their dynamic nature. For example, Excel recalculates formulas if the value in a cell used by the formula changes. In essence, you can see multiple scenarios quickly by changing the data in a worksheet and letting formulas do the work.

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 text
- 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 you select the cell, however.

# 9 CHAPTER

## In This Chapter

Introducing Formulas

Entering Formulas

Referencing Cells Outside the Worksheet

Absolute Versus Relative References

When a Formula Returns an Error

Editing Formulas

Changing When Formulas Are Calculated

Handling Circular References

Indirect Circular References

Intentional Circular References

Advanced Naming Techniques

Tips for Working with Formulas



Here are a few examples of formulas:

=150*.05	Multiplies 150 times .05. This formula uses only values and isn't all that useful.
=A1+A2	Adds the values in cells A1 and A2.
=Income-Expenses	Subtracts the cell named Expenses from the cell named Income.
=SUM(A1:A12)	Adds the values in the range A1:A12.
=A1=C12	Compares cell A1 with cell C12. If they are identical, the formula returns TRUE; otherwise, it returns FALSE.



Notice that formulas always begin with an equal sign so that Excel can distinguish formulas from text.

## Operators Used in Formulas

Excel lets you use a variety of operators in your formulas. Table 9-1 lists the operators that Excel recognizes. In addition to these, Excel has many built-in functions that enable you to perform more operations.

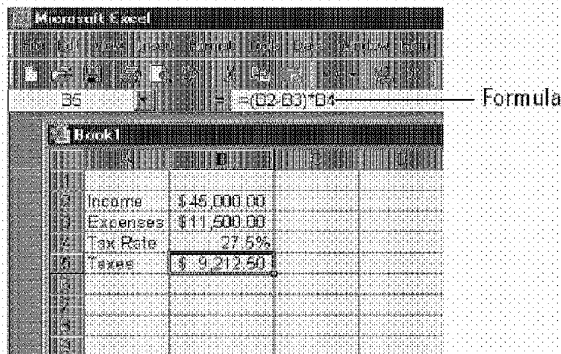


These functions are discussed in detail in Chapter 10.

Table 9-1  
Operators Used in Formulas

Operator	Name
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponentiation
&	Concatenation
=	Logical comparison (equal to)
>	Logical comparison (greater than)
<	Logical comparison (less than)
>=	Logical comparison (greater than or equal to)
<=	Logical comparison (less than or equal to)
<>	Logical comparison (not equal to)

You can, of course, use as many operators as you need (formulas can be quite complex). Figure 9-1 shows a worksheet with a formula in cell B5. The formula is as follows:

$$=(B2 - B3) * B4$$


**Figure 9-1:** A formula that uses two operators.

In this example, the formula subtracts the value in B3 from the value in B2 and then multiplies the result by the value in B4. If the worksheet had names defined for these cells, the formula would be a lot more readable. Here's the same formula after naming the cells:

$$=(Income - Expenses) * TaxRate$$

Now, are you beginning to understand the importance of naming ranges? The following are some additional examples of formulas that use various operators.

- `"Part-" & "23A"` Joins (*concatenates*) the two text strings to produce *Part-23A*.
- `=A1&A2` Concatenates the contents of cell A1 with cell A2. Concatenation works with values as well as text. If cell A1 contains 123 and cell A2 contains 456, this formula would return the value 123456.
- `=6^3` Raises 6 to the third power (216).
- `=216^(1/3)` Returns the cube root of 216 (6).
- `=A1<A2` Returns TRUE if the value in cell A1 is less than the value in cell A2. Otherwise, it returns FALSE. Logical comparison operators also work with text. If A1 contained Bill and A2 contained Julia, the formula would return TRUE, because Bill comes before Julia in alphabetical order.
- `=A1<=A2` Returns TRUE if the value in cell A1 is less than or equal to the value in cell A2. Otherwise, it returns FALSE.

=A1<>A2 Returns TRUE if the value in cell A1 isn't equal to the value in cell A2. Otherwise, it returns FALSE.

## Operator Precedence

In an earlier example, parentheses are used in the formula, to control the order in which the calculations occur. The formula without parentheses looks like this:

```
=Income-Expenses*TaxRate
```

If you enter the formula without the parentheses, Excel computes the wrong answer. To understand why this occurs, you need to understand a concept called *operator precedence*, which basically is the set of rules that Excel uses to perform its calculations. Table 9-2 lists Excel's operator precedence. This table shows that exponentiation has the highest precedence (that is, it's performed first), and logical comparisons have the lowest precedence.

You use parentheses to override Excel's built-in order of precedence. Returning to the previous example, the formula that follows doesn't use parentheses and, therefore, is evaluated using Excel's standard operator precedence. Because multiplication has a higher precedence, the Expense cell is multiplied by the TaxRate cell. Then, this result is subtracted from Income. This isn't what was intended.

The correct formula, which follows, uses parentheses to control the order of operations. Expressions within parentheses are always evaluated first. In this case, Expenses is subtracted from Income and the result is multiplied by TaxRate.

```
=(Income-Expenses)*TaxRate
```

Table 9-2  
Operator Precedence in Excel Formulas

Symbol	Operator	Precedence
^	Exponentiation	1
*	Multiplication	2
/	Division	2
+	Addition	3
-	Subtraction	3
&	Concatenation	4
=	Equal to	5
<	Less than	5
>	Greater than	5

You can also *nest* parentheses in formulas, which means putting parentheses inside of parentheses. If you do so, Excel evaluates the most deeply nested expressions first and works its way out. Figure 9-2 shows an example of a formula that uses nested parentheses.

Item	Quantity	Price
Chairs	6	\$ 125.00
Desks	4	\$ 695.00
Lamps	3	\$ 59.95
Sales Tax	7.5%	
Total Due		\$ 317.49

**Figure 9-2:** A formula with nested parentheses.

$$=((B2*C2)+(B3*C3)+(B4*C4))*B6$$

This formula has four sets of parentheses — three sets are nested inside the fourth set. Excel evaluates each nested set of parentheses and then adds up the three results. This sum is then multiplied by the value in B6.

Using parentheses liberally in your formulas is a good idea. I often use parentheses even when they aren't necessary, to clarify the order of operations and make the formula easier to read. For example, if you want to add 1 to the product of two cells, the following formula will do it:

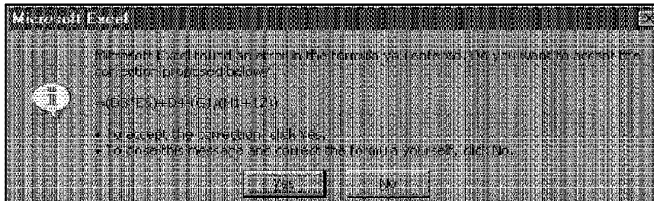
$$=1+A1*A2$$

I find it much clearer, however, to use the following formula (with superfluous parentheses):

$$=1+(A1*A2)$$

Every left parenthesis, of course, must have a matching right parenthesis. If you have many levels of nested parentheses, it can sometimes be difficult to keep them straight. If the parentheses don't match, Excel displays a message explaining the problem and won't let you enter the formula. Fortunately, Excel lends a hand in helping you match parentheses. When you enter or edit a formula that has parentheses, pay attention to the text. When the insertion point moves over a parenthesis, Excel momentarily bolds it and its matching parenthesis. This lasts for less than a second, so be alert.

In some cases, if your formula contains mismatched parentheses, Excel may propose a correction to your formula. Figure 9-3 shows an example of the Formula AutoCorrect feature. You may be tempted simply to accept the proposed correction, but be careful—in many cases, the proposed formula, although syntactically correct, isn't the formula that you want.



**Figure 9-3:** Excel's Formula AutoCorrect feature often suggests a correction to an erroneous formula.

## Excel's Built-in Functions

Excel provides a bewildering number of built-in worksheet functions that you can use in your formulas. These include common functions (such as SUM, AVERAGE, and SQRT) as well as functions designed for special purposes, such as statistics or engineering. Functions can greatly enhance the power of your formulas. They can simplify your formulas and make them easier to read; in many cases, functions enable you to perform calculations that would not be possible otherwise. If you can't find a worksheet function that you need, Excel even lets you create your own custom functions.



Excel's built-in functions are discussed in the next chapter, and Chapter 35 covers the basics of creating custom functions by using VBA.

## Entering Formulas

As mentioned earlier, a formula must begin with an equal sign to inform Excel that the cell contains a formula rather than text. Basically, two ways exist to enter a formula into a cell: enter it manually or enter it by pointing to cell references. Each of these methods is discussed in the following sections.

## Entering Formulas Manually

Entering a formula manually involves, well, entering a formula manually. You simply type an equal sign (=), followed by the formula. As you type, the characters appear in the cell and in the formula bar. You can, of course, use all the normal editing keys when entering a formula.

## Entering Formulas by Pointing

The other method of entering a formula still involves some manual typing, but you can simply point to the cell references instead of entering them manually. For example, to enter the formula =A1+A2 into cell A3, follow these steps:

1. Move the cell pointer to cell A3.
2. Type an equal sign (=) to begin the formula. Notice that Excel displays Enter in the status bar.
3. Press the up arrow twice. As you press this key, notice that Excel displays a faint moving border around the cell and that the cell reference appears in cell A3 and in the formula bar. Also notice that Excel displays Point in the status bar.
4. Type a plus sign (+). The faint border disappears and Enter reappears in the status bar.
5. Press the up arrow one more time. A2 is added to the formula.
6. Press Enter to end the formula.

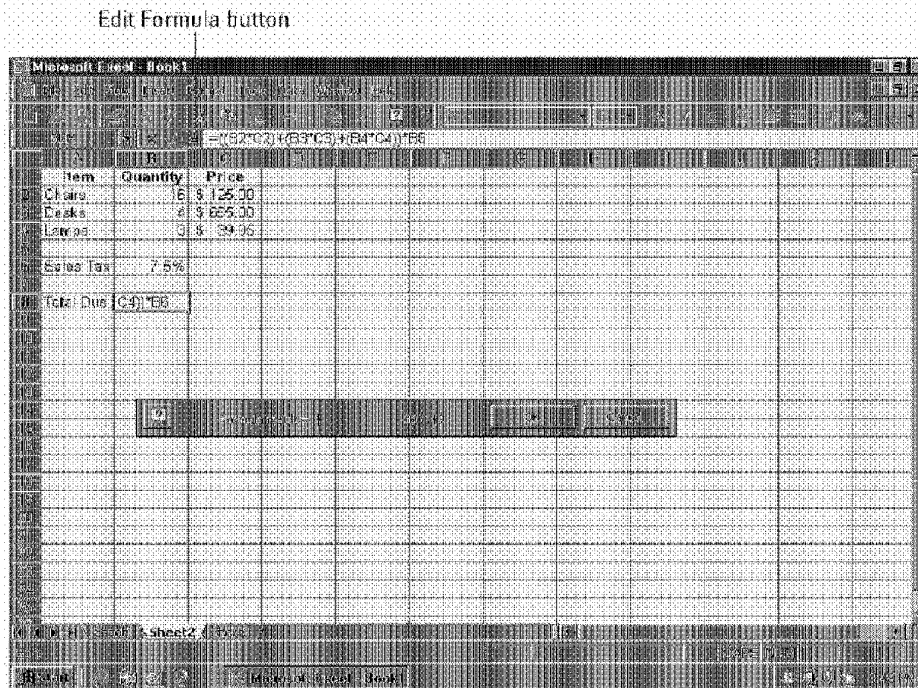
Pointing to cell addresses rather than entering them manually is usually more accurate and less tedious.



Tip

When you create a formula that refers to other cells, the cell that contains the formula has the same number format as the first cell it refers to.

Excel includes the Formula Palette feature that you can use when you enter or edit formulas. To display the Formula Palette, click the Edit Formula button in the Formula bar (the Edit Formula button looks like an equal sign). The Formula Palette lets you enter formulas manually or use the pointing techniques described previously. The Formula Palette, shown in Figure 9-4, displays the result of the formula as it's being entered. The Formula Palette usually appears directly below the edit line, but you can drag it to any convenient location (as you can see in the figure).

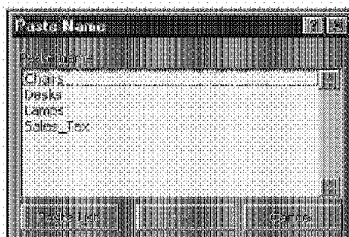


**Figure 9-4:** The Formula Palette displays the result of the formula as it's being entered.

## Pasting Names

If your formula uses named cells or ranges, you can either type the name in place of the address or choose the name from a list and have Excel insert the name for you automatically. You have two ways available to insert a name into a formula:

- **Select Insert • Name • Paste:** Excel displays its Paste Name dialog box with all the names listed (see Figure 9-5). Select the name and click OK. Or, you can double-click the name, which inserts the name and closes the dialog box.
- **Press F3:** This also displays the Paste Name dialog box.



**Figure 9-5:** The Paste Name dialog box lets you insert a name into a formula.

## Referencing Cells Outside the Worksheet

Formulas can refer to cells in other worksheets—and the worksheets don't even have to be in the same workbook. Excel uses a special type of notation to handle these types of references.

### Cells in Other Worksheets

To use a reference to a cell in another worksheet in the same workbook, use the following format:

```
SheetName!CellAddress
```

In other words, precede the cell address with the worksheet name, followed by an exclamation point. Here's an example of a formula that uses a cell on the Sheet2 worksheet:

```
=A1*Sheet2!A1
```

This formula multiplies the value in cell A1 on the current worksheet by the value in cell A1 on Sheet2.



**Note**

If the worksheet name in the reference includes one or more spaces, you must enclose it in single quotation marks. For example, here's a formula that refers to a cell on a sheet named All Depts:

```
=A1*'All Depts'!A1
```

### Cells in Other Workbooks

To refer to a cell in a different workbook, use this format:

```
=[WorkbookName]SheetName!CellAddress
```

In this case, the workbook name (in square brackets), the worksheet name, and an exclamation point precede the cell address. The following is an example of a formula that uses a cell reference in the Sheet1 worksheet in a workbook named Budget:

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

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, here's a formula that refers to a cell on Sheet1 in a workbook named Budget For 1999:

```
=A1*'[Budget For 1999]Sheet1'!A1
```



When a formula refers to cells in a different workbook, the other workbook doesn't need to be open. If the workbook is closed, you must add the complete path to the reference. Here's an example:

```
=A1*'C:\MSOffice\Excel\[Budget For 1999]Sheet1'!A1
```



File linking is covered in detail in Chapter 19.

## Entering References to Cells Outside the Worksheet

To create formulas that refer to cells not in the current worksheet, use the pointing technique described earlier (refer to the section “Entering Formulas by Pointing”). Excel takes care of the details regarding the workbook and worksheet references. The workbook that you're using in your formula must be open to use the pointing method.



If you point to a different worksheet or workbook when creating a formula, you'll notice that Excel always inserts absolute cell references. Therefore, if you plan to copy the formula to other cells, make sure that you change the cell references to relative. This concept of absolute versus relative cell references is discussed in the following section.

## Absolute Versus Relative References

You need to be able to distinguish between *relative* and *absolute cell references*. By default, Excel creates relative cell references in formulas except when the formula includes cells in different worksheets or workbooks. The distinction becomes apparent when you copy a formula to another cell.

### Relative References

Figure 9-5 shows a worksheet with a formula in cell D2. The formula, which uses the default relative references, is as follows:

```
=B2*C2
```

When you copy this formula to the two cells below it, Excel doesn't produce an exact copy of the formula; rather, it generates these formulas:

- Cell D3: =B3\*C3
- Cell D4: =B4\*C4

Excel adjusts the cell references to refer to the cells that are relative to the new formula. Think of it like this: The original formula contained instructions to multiply the value two cells to the left by the value one cell to the left. When you copy the cell, these *instructions* get copied, not the actual contents of the cell. Usually, this is exactly what you want. You certainly don't want to copy the formula verbatim; if you did, the new formulas would produce the same value as the original formula.

Item	Quantity	Price	Total
Chairs	16	\$125.00	\$2,000.00
Desks	4	\$895.00	
Lamps	3	\$39.95	
Sales Tax	7.5%		
Total Due	\$367.49		

**Figure 9-6:** The formula in cell D2 will be copied to the cell below.



When you cut and paste a formula (move it to another location), the cell references in the formula aren't adjusted. Again, this is what you usually want to happen. When you move a formula, you generally want it to continue to refer to the original cells.

## Absolute References

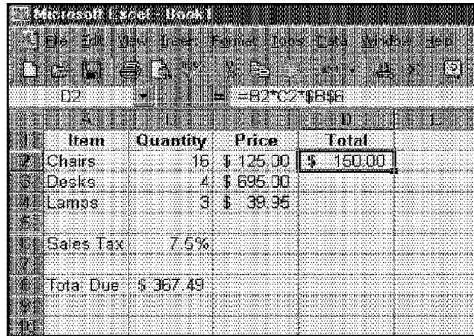
Sometimes, however, you *do* want a cell reference to be copied verbatim. Figure 9-6 shows an example of a formula that contains an absolute reference. In this example, cell B6 contains a sales tax rate. The formula in cell D2 is as follows:

$$=(B2*C2)*\$B\$6$$

Notice that the reference to cell B6 has dollar signs preceding the column letter and the row number. These dollar signs indicate to Excel that you want to use an absolute cell reference. When you copy this formula to the two cells below, Excel generates the following formulas:

- Cell D3:  $=(B3*C3)*\$B\$6$
- Cell D4:  $=(B4*C4)*\$B\$6$

In this case, the relative cell references were changed, but the reference to cell B6 wasn't changed, because it's an absolute reference.



Item	Quantity	Price	Total
Chairs	16	\$ 125.00	\$ 150.00
Desks	4	\$ 695.00	
Lamps	3	\$ 39.95	
Sales Tax	7.5%		
Total Due		\$ 367.49	

**Figure 9-7:** A formula that uses an absolute cell reference.

## Mixed References

An absolute reference uses two dollar signs in its address: one for the column letter and one for the row number. Excel also allows mixed references in which only one of the address parts is absolute. Table 9-3 summarizes all the possible types of cell references.

When would you use a mixed reference? Figure 9-7 shows an example of a situation in which a mixed reference is appropriate. This worksheet will contain a table of values in which each cell consists of the value in column A multiplied by the value in row 1. The formula in cell B2 is as follows:

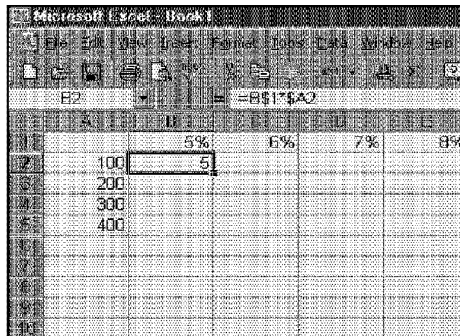
```
=B$1*$A2
```

**Table 9-3**  
**Types of Cell References**

Example	Type
A1	Relative reference
\$A\$1	Absolute reference
\$A1	Mixed reference (column letter is absolute)
A\$1	Mixed reference (row number is absolute)

This formula contains two mixed cell references. In the B\$1 reference, the row number is absolute, but the column letter is relative. In the \$A2 reference, the row number is relative, but the column letter is absolute. You can copy this formula to the range B2:E5 and each cell will contain the correct formula. For example, the formula in cell E5 would be as follows:

```
=E$1*$A5
```



**Figure 9-8:** This formula uses a mixed reference.

## Entering Nonrelative References

You can enter nonrelative references (absolute or mixed) manually by inserting dollar signs in the appropriate positions. Or, you can use a handy shortcut: the F4 key. When you're entering a cell reference—either manually or by pointing—you can press F4 repeatedly to have Excel cycle through all four reference types.

For example, if you enter `=A1` to start a formula, pressing F4 converts the cell reference to `=$A$1`. Pressing F4 again converts it to `=A$1`. Pressing it again displays `=$A1`. Pressing it one more time returns to the original `=A1`. Keep pressing F4 until Excel displays the type of reference that you want.



When you name a cell or range, Excel (by default) uses an absolute reference for the name. For example, if you give the name `SalesForecast` to `A1:A12`, the `Refers to` box in the `Define Name` dialog box lists the reference as `$A$1:$A$12`. This is almost always what you want. If you copy a cell that has a named reference in its formula, the copied formula contains a reference to the original name.

## When a Formula Returns an Error

Sometimes when you enter a formula, Excel displays a value that begins with a pound sign (`#`). This is a signal that the formula is returning an error value. You'll have to correct the formula (or correct a cell that the formula references) to get rid of the error display.

As noted previously in this chapter, Excel often suggests a correction for an erroneous formula.



If the entire cell is filled with pound characters, this means that the column isn't wide enough to display the value. You can either widen the column or change the number format of the cell.

Table 9-4 lists the types of error values that may appear in a cell that has a formula. Formulas may return an error value if a cell to which they refer has an error value. This is known as the ripple effect—a single error value can make its way into lots of other cells that contain formulas that depend on the cell.

**Table 9-4**  
**Excel Error Values**

<b>Error Value</b>	<b>Explanation</b>
#DIV/0!	The formula is trying to divide by zero (an operation that's not allowed on this planet). This also occurs when the formula attempts to divide by a cell that is empty.
#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.
#N/A	The formula is referring (directly or indirectly) to a cell that uses the NA function to signal that data is not available.
#NULL!	The formula uses an intersection of two ranges that don't intersect (this concept is described later in the chapter).
#NUM!	A problem with a value exists; 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 <i>operand</i> is a value or cell reference that a formula uses to calculate a result.

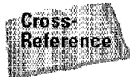
## Editing Formulas

You can edit your formulas just like you can edit any other cell. You might need to edit a formula if you make some changes to your worksheet and need to adjust the formula to accommodate the changes. Or, the formula may return one of the error values described in the previous section, and you need to edit the formula to correct the error.

The following are the four ways to get into cell-edit mode:

- Double-click the cell, which enables you to edit the cell contents directly in the cell.
- Press F2, which enables you to edit the cell contents directly in the cell.

- Select the cell that you want to edit, and then click in the formula bar. This enables you to edit the cell contents in the formula bar.
- Click the Edit Formula button in the Formula bar to access the Formula Palette.



Chapter 6 also discusses these methods.

While you're editing a formula, you can select multiple characters either by dragging the mouse over them or by holding down Shift while you use the direction keys.

You might have a lengthy formula that you can't seem to edit correctly—and Excel won't let you enter it because of the error. In this case, you can convert the formula to text and tackle it again later. To convert a formula to text, just remove the initial equal sign (=). When you're ready to try again, insert the initial equal sign to convert the cell contents back to a formula.

## Changing When Formulas Are Calculated

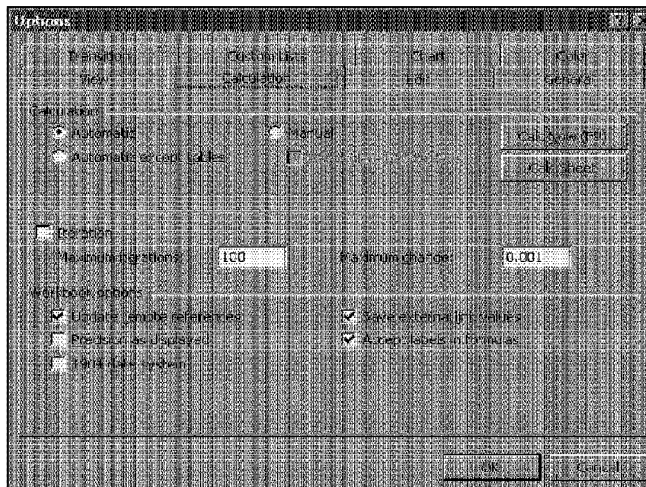
You've probably noticed that Excel calculates the formulas in your worksheet immediately. If you change any cells that the formula uses, Excel displays the formula's new result, with no effort on your part. All this happens when Excel's Calculation mode is set to Automatic. In Automatic Calculation mode (which is the default mode), Excel follows these rules when calculating your worksheet:

- When you make a change—enter or edit data or formulas, for example—Excel calculates immediately those formulas that depend on new or edited data.
- If Excel is in the middle of a lengthy calculation, it temporarily suspends the 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, Excel calculates cell D11 before calculating 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 things can slow to a snail's pace while Excel does its thing. In such a case, set Excel's calculation mode to Manual, which you can do in the Calculation tab of the Options dialog box (see Figure 9-9).

To select Manual calculation mode, click the Manual option button. When you switch to Manual calculation mode, Excel automatically places a check in the Recalculate before save check box. You can remove the check if you want to speed up file saving operations.

If your worksheet uses any data tables (described in Chapter 26), you may want to select the Automatic except tables option. Large data tables calculate notoriously slowly.



**Figure 9-9:** The Options dialog box lets you control when Excel calculates formulas.

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 aren't calculated.
- **Ctrl+Alt+F9:** This keyboard shortcut combination isn't documented. It forces a complete recalculation. This shortcut became popular when several recalculation bugs in Excel 97 surfaced.



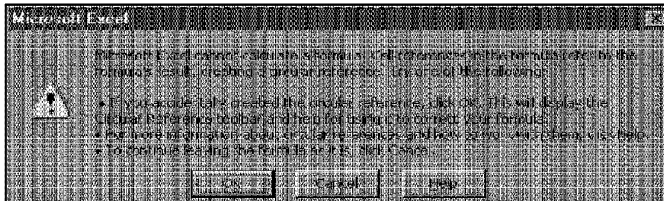
**Note**

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.

## Handling Circular References

When you're entering formulas, you may occasionally see a message from Excel like the one shown in Figure 9-9, indicating that the formula you just entered will result in a *circular reference*. A circular reference occurs when a formula refers to its own

value — either directly or indirectly. For example, you create a circular reference if you enter `=A1+A2+A3` into cell A3, because the formula in cell A3 refers to cell A3. Every time the formula in A3 is calculated, it must be calculated again because A3 has changed. The calculation would go on forever — in other words, the answer will never be resolved.



**Figure 9-10:** Excel's way of telling you that your formula contains a circular reference.

When you get the circular reference message after entering a formula, Excel gives you two options:

- Click OK to attempt to locate the circular reference
- Click Cancel to enter the formula as-is

Usually, you want to correct any circular references, so you should choose OK. When you do so, Excel displays the Help topic on circular references and the Circular Reference toolbar (see Figure 9-11). On the Circular Reference toolbar, click the first cell in the Navigate Circular Reference drop-down list box, and then examine the cell's formula. If you cannot determine whether the cell is the cause of the circular reference, click the next cell in the Navigate Circular Reference box. Continue to review the formulas until the status bar no longer displays Circular.

If you ignore the circular reference message (by clicking Cancel), Excel lets you enter the formula, and displays a message in the status bar to remind you that a circular reference exists. In this case, the message reads Circular: A3. If you activate a different workbook, the message simply displays Circular (without the cell reference).



**Note**

Excel won't tell you about a circular reference if the Iteration setting is on. You can check this in the Options dialog box (in the Calculation tab). If Iteration is on, Excel performs the circular calculation the number of times specified in the Maximum iterations field (or until the value changes by less than .001 — or whatever value is in the Maximum change field). In a few situations, you may use a circular reference intentionally (explained in a following section). In these cases, the Iteration setting must be on. However, keeping the Iteration setting turned off is best, so that you are warned of circular references. Most of the time, a circular reference indicates an error that you must correct.



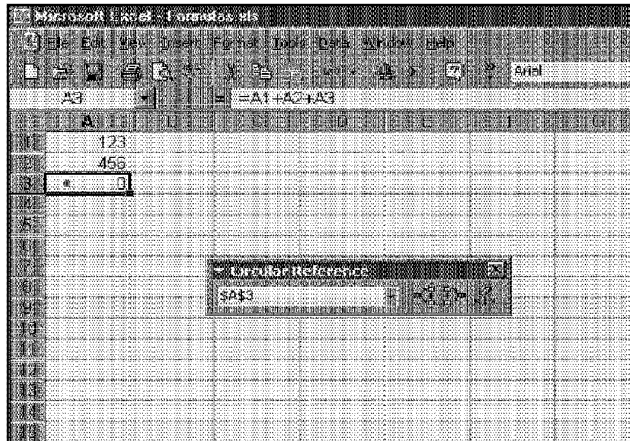
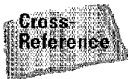


Figure 9-11: The Circular Reference toolbar.

## Indirect Circular References

Usually, a circular reference is quite obvious and, therefore, easy to identify and correct. Sometimes, however, circular references are indirect. In other words, a formula may refer to a formula that refers to a formula that refers back to the original formula. In some cases, it may require a bit of detective work to get to the problem.



You may be able to get some assistance identifying a formula's dependents and precedents by using the tools on the Circular Reference toolbar, which are discussed in Chapter 31.

## Intentional Circular References

As mentioned previously, you can use a circular reference to your advantage in some situations. Figure 9-12 shows a simple example.

In this example, a company has a policy of contributing five percent of its net profit to charity. The contribution itself, however, is considered an expense and is therefore subtracted from the net profit figure. This produces a circular reference—but this circular reference can be resolved if the Excel's Iteration setting is turned on.



This workbook is available on the companion CD-ROM.

## Using AutoFill Rather Than Formulas

Chapter 8 discusses AutoFill as a quick way to copy a cell to adjacent cells. AutoFill also has some other uses, which may even substitute for formulas in some cases. I'm surprised to find that many experienced Excel users don't take advantage of the AutoFill feature – which can be a real time-saver.

Besides being a shortcut way to copy cells, AutoFill can quickly create a series of incremental values. For example, if you need a list of values from 1 to 100 to appear in A1:A100, you can do it with formulas. You enter 1 in cell A1, the formula `=A1+1` into cell A2, and then copy the formula to the 98 cells below.

You also can use AutoFill to create the series for you without using a formula. To do so, enter 1 into cell A1 and 2 into cell A2. Select A1:A2 and drag the fill handle down to cell A100. When you use AutoFill in this manner, Excel analyzes the selected cells and uses this information to complete the series. If cell A1 contained 1 and cell A2 contained 3, Excel recognizes this pattern and fills in 5, 7, 9, and so on. This also works with decreasing series (10, 9, 8, and so on) and dates. If no pattern is discernible in the selected cells, Excel performs a linear regression and fills in values on the calculated trend line.

Excel also recognizes common series names, such as days and months. If you enter Monday into a cell and then drag its fill handle, Excel fills in the successive days of the week. You also can create custom AutoFill lists by using the Custom Lists tab of the Options dialog box. Finally, if you drag the fill handle with the right mouse button, Excel displays a shortcut menu to let you select an AutoFill option.

	A	B	C
1	Gross Income	250,000	
2	Expenses	137,500	
3	Contributions	5,357	=5%*Net_Profit
4	Net Profit	107,143	=Gross_Income-Expenses-Contributions

Figure 9-12: An example of an intentional circular reference.

The Contributions cell contains the following formula:

```
=5%*Net_Profit
```

The Net Profit cell contains the following formula:

```
=Gross_Income-Expenses-Contributions
```

These formulas produce a resolvable circular reference. Excel keeps calculating until the formula results don't change anymore. To get a feel for how this works, substitute various values for Gross Income and Expenses. If the Iteration setting is off, Excel displays its Circular Reference message and won't display the correct result. If the Iteration setting is on, Excel keeps calculating until the Contributions value is, indeed, five percent of Net Profit. In other words, the result becomes increasingly more accurate until it converges on the final solution. For your convenience, I include a button on the worksheet that toggles the Iteration setting on and off by using a simple macro.



**Note**

Depending on your application, you may need to adjust the settings in the Maximum iterations field or the Maximum change field in the Options dialog box. For example, to increase accuracy, you can make the Maximum change field smaller. If the result doesn't converge after 100 iterations, you can increase the Maximum iterations field.

## Advanced Naming Techniques

As promised in the preceding chapter, this section describes some additional techniques that involve names.

### Sheet-Level Names

Usually, you can use a range name that you create anywhere within the workbook. In other words, names, by default, are “workbook level” names rather than “sheet level” names. But what if you have several worksheets in a workbook and you want to use the same name (such as Dept\_Total) on each sheet? In this case, you need to create sheet-level names.

To define the name Dept\_Total in more than one worksheet, activate the worksheet in which you want to define the name, choose **Insert • Name • Define**, and then, in the Names in workbook box, precede the name with the worksheet name and an exclamation point. For example, to define the name Dept\_Total on Sheet2, activate Sheet2 and enter the following in the Define Name dialog box:

```
Sheet2!Dept_Total
```

If the worksheet name contains at least one space, enclose the worksheet name in single quotation marks, like this:

```
'Adv Dept'!Dept_Total
```

You also can create a sheet-level name by using the Name box (located at the left side of the formula bar). Select the cell or range, click in the Name box, and enter the name, preceded by the sheet's name and an exclamation point (as shown previously). Press Enter to create the name.

When you write a formula that uses a sheet-level name on the sheet in which it's defined, you don't need to include the worksheet name in the range name (the Name box won't display the worksheet name either). If you use the name in a formula on a different worksheet, however, you must use the entire name (sheet name, exclamation point, and name).



**Note** Only the sheet-level names on the current sheet appear in the Name box. Similarly, only sheet-level names in the current sheet appear in the list when you open the Paste Name or Define Name dialog boxes.

Using sheet-level names can become complicated if you have an identical book-level name and sheet-level name (yes, Excel does allow this). In such a case, the sheet-level name takes precedence over the book-level name — but only in the worksheet in which you defined the sheet-level name. For example, you might have defined a book-level name of Total for a cell on Sheet1. You also can define a sheet-level name of Total (in, say Sheet2). When Sheet2 is active, Total refers to the sheet-level name. When any other sheet is active, Total refers to the book-level name. You can refer to a sheet-level name in a different worksheet, however, by preceding the name with the worksheet name and an exclamation point (such as Sheet1!Total). To make your life easier, just avoid using the same name at the book level and sheet level.

## Using Multisheet Names

Names even can extend into the third dimension; that is, they can extend across multiple worksheets in a workbook. You can't simply select the multisheet range and enter a name in the Name box, however. Excel makes you do a little additional work to define a multisheet name.

You must use the Define Name dialog box to create a multisheet name, and you must enter the reference in the Refers to box manually. The format for a multisheet reference is as follows:

```
FirstSheet:LastSheet!RangeReference
```

In Figure 9-13, a multisheet name is being defined for A1:C12 that extends across Sheet1, Sheet2, and Sheet3.

After the name is defined, you can use it in formulas. This name won't appear in the Name box, however, or in the Go To dialog box. In other words, Excel lets you define the name, but it doesn't give you a way to select automatically the cells to which the name refers.



Figure 9-13: Creating a multisheet name.

## Naming Constants

Even many advanced Excel users don't realize that you can give a name to an item that doesn't even appear in a cell. For example, if formulas in your worksheet use a sales tax rate, you would probably insert the tax rate value into a cell and use this cell reference in your formulas. To make things easier, you would probably also name this cell something like **SalesTax**.

Here's another way to do it: Choose **Insert • Name • Define** (or press **Ctrl+F3**) to bring up the Define Name dialog box. Enter the name (in this case, **SalesTax**) into the Names in workbook field. Then, click the Refers to box, delete its contents, and replace it with a value such as **.075** (see Figure 9-14). Don't precede the constant with an equal sign. Click OK to close the dialog box.

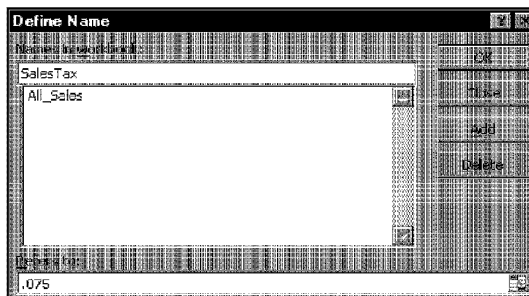


Figure 9-14: Defining a name that refers to a constant.

You just created a name that refers to a constant rather than a cell or range. If you type **=SalesTax** into a cell, this simple formula returns **.075**—the constant that you defined. You also can use this constant in a formula such as **=A1\*SalesTax**.

As with all names, named constants are stored with the workbook. They can be used on any worksheet in the workbook.

In the preceding example, the constant was a value. A constant also can be text, however. For example, you can define a constant for your company's name. If you work for Microsoft, you can define the name MS for Microsoft Corporation.



**Note** Named constants don't appear in the Name box or in the Go To dialog box—which makes sense, because these constants don't reside anywhere tangible. They do appear in the Paste Names dialog box, however, which *does* make sense, because you'll use these names in formulas.

As you might expect, you can change the value of the constant by accessing the Define Name dialog box and simply changing the value in the Refers to box. When you close the dialog box, Excel uses the new value to recalculate the formulas that use this name.

Although this technique is useful in many situations, the value is rather difficult to change. Having a constant located in a cell makes it much easier to modify. If the value is truly a "constant," however, you won't need to change it.

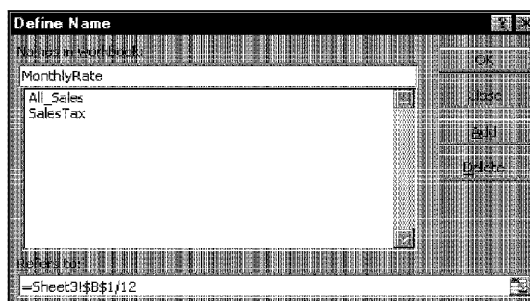
## Naming Formulas

This section takes the preceding section to the next logical level: naming formulas. Figure 9-15 shows an example of this. In this case, the name `MonthlyRate` refers to the following formula:

```
=Sheet3!$B$1/12
```

When you use the name `MonthlyRate` in a formula, it uses the value in B1 divided by 12. Notice that the cell reference is an absolute reference.

Naming formulas gets more interesting when you use relative references rather than absolute references. When you use the pointing technique to create a formula in the Refers to box, Excel always uses absolute cell references, which is unlike its behavior when you create a formula in a cell.

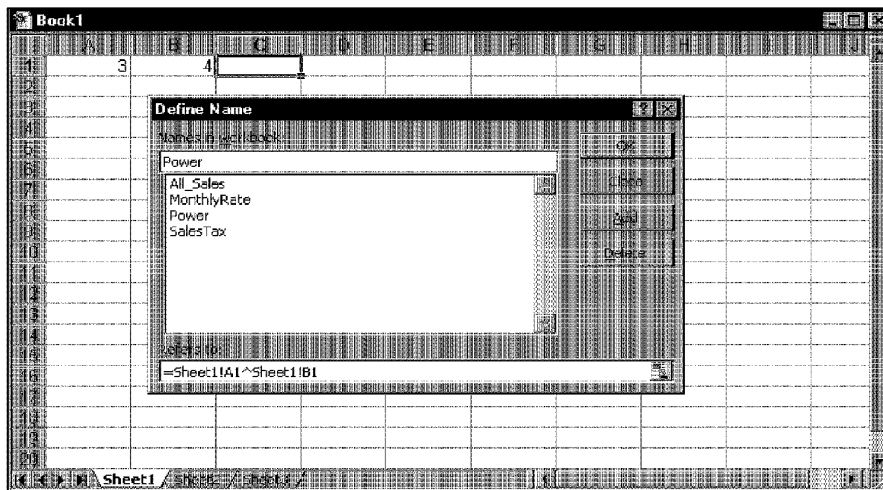


**Figure 9-15:** Excel lets you give a name to a formula that doesn't exist in the worksheet.

Figure 9-16 shows a name, *Power*, being created for the following formula:

```
=Sheet1!A1^Sheet1!B1
```

Notice that cell C1 is the active cell, which is very important. When you use this named formula in a worksheet, the cell references are always *relative* to the cell that contains the name. For example, if you enter **=POWER** into cell D12, cell D12 displays the result of B12 raised to the power of the value contained in cell C12.



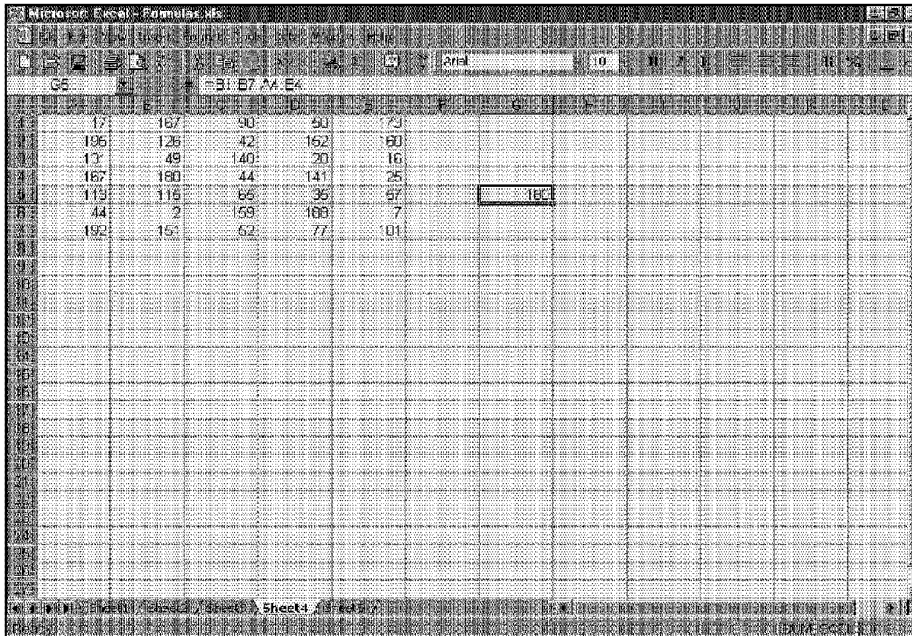
**Figure 9-16:** Naming a formula that uses relative cell references.

## Range Intersections

This section describes an interesting concept that is unique to Excel: *range intersections*. Excel uses an intersection operator — a space — to determine the overlapping references in two ranges. Figure 9-17 shows a simple example. The formula in cell G5 is

```
=B1:B7 A4:E4
```

and returns 180, the value in cell B4 — that is, the value at the intersection of the two ranges.



**Figure 9-17:** An example of an intersecting range.

The intersection operator is one of three *reference* operators for ranges. Table 9-5 lists these operators.

**Table 9-5**  
**Reference Operators for Ranges**

<b>Operator</b>	<b>What It Does</b>
:	Specifies a range
,	Specifies the union of two ranges
(space)	Specifies the intersection of two ranges

The real value of knowing about range intersections is apparent when you use names. Examine Figure 9-18, which shows a table of values. I selected the entire table and then used the Insert • name • Create command to create names automatically. Excel created the following names:



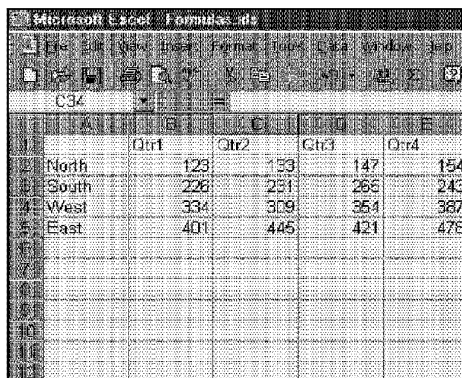
North	=Sheet1!\$B\$2:\$E\$2	Qtr1	=Sheet1!\$B\$2:\$B\$5
South	=Sheet1!\$B\$3:\$E\$3	Qtr2	=Sheet1!\$C\$2:\$C\$5
West	=Sheet1!\$B\$4:\$E\$4	Qtr3	=Sheet1!\$D\$2:\$D\$5
East	=Sheet1!\$B\$5:\$E\$5	Qtr4	=Sheet1!\$E\$2:\$E\$5

With these names defined, you'll find that you can create formulas that are very easy to read. For example, to calculate the total for Quarter 4, just use this formula:

```
=SUM(Qtr4)
```

But things really get interesting when you use the intersection operator. Move to any blank cell and enter the following formula:

```
=Qtr1 West
```



The screenshot shows a Microsoft Excel spreadsheet with a table. The table has five columns: Region, Qtr1, Qtr2, Qtr3, and Qtr4. The rows are North, South, West, and East. The values in the table are:

	Qtr1	Qtr2	Qtr3	Qtr4
North	123	133	147	154
South	226	231	266	243
West	334	309	354	387
East	401	445	421	478

**Figure 9-18:** This table demonstrates how to use range intersections.

This formula returns the value for the first quarter for the West region. In other words, it returns the value where the Qtr1 range intersects with the West range. Naming ranges in this manner can help you create very readable formulas.

## 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. Replacing cell or range references with their corresponding names is fairly easy, however.

## Using Row and Column Headings As “Names”

Beginning with Excel 97, you have access to a feature that lets you use “names” without actually defining them. To understand how this feature works, refer to the accompanying figure, which shows a typical table with row and column headers. Excel lets you use the row and column headers as names in your formulas (and you don’t have to define the names). For example, to refer to the cell that holds February sales for the South region, use the following formula:

```
=Feb_South
```

In other words, the formula returns the cell that intersects the Feb column and the South row. You can also use this technique with functions. Here’s a formula that returns the total sales for March:

```
=SUM(March)
```

Excel handles all the details for you. If you change a row or column heading, all the formulas change automatically to use the new label.

	Jan	Feb	Mar	Total
North	11	14	15	40
South	31	34	44	109
West	43	32	56	131
East	109	89	65	263

This technique has a few limitations. The labels are not “real” names—they don’t appear in the Define Name dialog box, nor do they appear in the Name box. For this reason, you can use this method only when the formula refers to cells on the same sheet. The real problem, however, is the inability to document the names. In other words, you can never tell for sure exactly what a name refers to. For that reason, I don’t recommend using this feature. Rather, take a few extra seconds and create a “real” range name.

To apply names to cell references in formulas after the fact, start by selecting the range that you want to modify. Then, choose **Insert • Name • Apply**. Excel displays the Apply Names dialog box, shown in Figure 9-19. Select the names that you want to apply by clicking them and then click **OK**. Excel replaces the range references with the names in the selected cells.

The Apply Names dialog box has some options. If you click the **Options** button, the dialog box expands to display even more options. Most of the time, the defaults work just fine. For more control over the names that you apply, however, you may want to use one or more of its options. These are described in Excel’s online Help.



**Figure 9-19:** The Apply Names dialog box lets you replace cell or range references with names.

## Tips for Working with Formulas

This chapter concludes with a few additional tips and pointers relevant to formulas.

### Don't "Hard Code" Values

When you create a formula, think twice before using a value in the formula. For example, if your formula calculates sales tax (which is 6.5 percent), you may be tempted to enter a formula such as the following:

```
+A1*.065
```

A better approach is to insert the sales tax rate in a cell and use the cell reference. Or, you can define it as a named constant by using the technique presented earlier in this chapter. Doing so makes modifying and maintaining your worksheet easier. For example, if the sales tax rate changed to 6.75 percent, you would have to modify every formula that uses the old value. If the tax rate is stored in a cell, you simply change one cell and Excel updates all the formulas.

### Using the Formula Bar As a Calculator

If you simply need to perform a calculation, you can use the formula bar as a calculator. For example, enter the following formula—but don't press Enter:

```
=(145*1.05)/12
```

If you press Enter, Excel enters the formula into the cell. But because this formula always returns the same result, you might prefer to store the formula's result rather than the formula. To do so, press F9, and then press Enter. Excel stores the formula's result (12.6875) rather than the formula. This also works if the formula uses cell references.

This is most useful when you use worksheet functions. For example, to enter the square root of 221 into a cell, enter `=SQRT(221)`, press F9, and then press Enter. Excel enters the result: 14.8660687473185. You also can use this technique to evaluate only part of a formula. Consider this formula:

```
=(145*1.05)/A1
```

If you want to convert to a value just the part in the parentheses, select the part of the formula that you want to evaluate (that is, select 145\*1.05). Then, press F9, followed by Enter. Excel converts the formula to the following:

```
=152.25/A1
```

## Making an Exact Copy of a Formula

As you know, when you copy a formula, Excel adjusts its cell references when you paste the formula to a different location. Sometimes, you may want to make an exact copy of the formula. One way to do this is to convert the cell references to absolute values, but this isn't always desirable. A better approach is to select the formula in edit mode and then copy it to the Clipboards as text. You can do this in several ways. Here's a step-by-step example of how to make an exact copy of the formula in A1 and copy it to A2:

1. Double-click A1 to get into edit mode.
2. Drag the mouse to select the entire formula. You can drag from left to right or from right to left.
3. Click the Copy button on the Standard toolbar. This copies the selected text to the Clipboards.
4. Press Enter to end edit mode.
5. Select cell A2.
6. Click the Paste button to paste the text into cell A2.

You also can use this technique to copy just *part* of a formula, to use that part in another formula. Just select the part of the formula that you want to copy by dragging the mouse; then, use any of the available techniques to copy the selection to the Clipboard. You can then paste the text to another cell.

Formulas (or parts of formulas) copied in this manner won't have their cell references adjusted when they are pasted to a new cell, because the formulas are being copied as text, not as actual formulas.

## Converting Formulas to Values

If you have a range of formulas that will always produce the same result (that is, dead formulas), you may want to convert them to values. As discussed in the previous chapter, you can use the Edit • Paste Special command to do this. Assume that range A1:A20 contains formulas that have calculated results that will never change or that you don't want to change. For example, if you use the @RAND function to create a set of random numbers, and you don't want Excel to recalculate the random numbers each time that you press Enter, convert the formulas to values. To convert these formulas to values:

1. Select A1:A20.
2. Click the Copy button.
3. Select Edit • Paste Special. Excel displays its Paste Special dialog box.
4. Click the Values option button and then click OK.
5. Press Enter or Esc to cancel paste mode.

## Array Formulas

Excel supports another type of formula called an *array formula*. Array formulas can be extremely powerful, because they let you work with complete ranges of cells rather than individual cells. You'll find that you can perform some amazing feats by using array formulas. This is a rather advanced concept, which is covered in Chapter 20.

## Summary

This chapter introduces the concept of formulas. Formulas are entered into cells and use values found in other cells to return a result. This chapter explains how to enter and edit formulas, when to use absolute cell references, how to identify errors in your formulas, and how to handle circular references (either accidental or intentional). It also explains how to set Excel to Manual recalculation mode—and why you would need to do so. The chapter continues by discussing some additional naming techniques that can make your formulas even more powerful. This chapter concludes with a series of tips that can help you get the most out of formulas.

• .....

# Using Worksheet Functions

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**T**he preceding chapter discussed formulas. This chapter continues with coverage of Excel's built-in worksheet functions.

## What Is a Function?

*Functions*, in essence, are built-in tools that you use in formulas. They can make your formulas perform powerful feats and save you a lot of time. Functions can do the following:

- Simplify your formulas
- Allow formulas to perform calculations that are otherwise impossible
- Speed up some editing tasks
- Allow “conditional” execution of formulas—giving them rudimentary decision-making capability

## Function Examples

A built-in function can simplify a formula significantly. To calculate the average of the values in ten cells (A1:A10) without using a function, you need to construct a formula like this:

```
=(A1+A2+A3+A4+A5+A6+A7+A8+A9+A10)/10
```

Not very pretty, is it? Even worse, you would need to edit this formula if you added another cell to the range. You can replace this formula with a much simpler one that uses one of Excel's built-in worksheet functions:

```
=AVERAGE(A1:A10)
```

# 10 CHAPTER

## In This Chapter

What Is a Function?

Function Arguments

Ways to Enter a  
Function

Function Examples

Creating  
Megaformulas

Next, look at how using a function can enable you to perform calculations that would not be possible otherwise. What if you need to determine the largest value in a range? A formula can't tell you the answer without using a function. Here's a simple formula that returns the largest value in the range A1:D100:

```
=MAX(A1:D100)
```

Functions also can sometimes eliminate manual editing. Assume that you have a worksheet that contains 1,000 names in cells A1:A1000, and all the names appear in all capital letters. Your boss sees the listing and informs you that the names will be mail-merged with a form letter and that all-uppercase is not acceptable; for example, JOHN F. CRANE must appear as John F. Crane. You *could* spend the next several hours reentering the list—or you could use a formula like the following, which uses a function to convert the text in cell A1 to proper case:

```
=PROPER(A1)
```

Enter this formula once in cell B1 and then copy it down to the next 999 rows. Then, select B1:B1000 and use the Edit • Paste Special command (with the Values option) to convert the formulas to values. Delete the original column, and you've just accomplished several hours of work in less than a minute.

One last example should convince you of the power of functions. Suppose that you have a worksheet that calculates sales commissions. If the salesperson sold more than \$100,000 of product, the commission rate is 7.5 percent; otherwise, the commission rate is 5.0 percent. Without using a function, you would have to create two different formulas and make sure that you use the correct formula for each sales amount. Here's a formula that uses the IF function to ensure that you calculate the correct commission, regardless of the sales amount:

```
=IF(A1<100000,A1*5%,A1*7.5%)
```

## More About Functions

All told, Excel includes more than 300 functions. And if that's not enough, you can purchase additional specialized functions from third-party suppliers, and even create your own custom functions (using VBA), if you're so inclined.

You can easily be overwhelmed by the sheer number of functions, but you'll probably find that you use only a dozen or so of the functions on a regular basis. And as you'll see, Excel's Paste Function dialog box (described later in this chapter) makes it easy to locate and insert a function, even if it's not one that you use frequently.



Appendix B contains a complete listing of Excel's worksheet functions, with a brief description of each.

## Function Arguments

In the preceding examples, you may have noticed that all the functions used parentheses. The information inside the parentheses is called an *argument*. Functions vary in how they use arguments. Depending on the function, a function may use:

- No arguments
- One argument
- A fixed number of arguments
- An indeterminate number of arguments
- Optional arguments

The RAND function, which returns a random number between 0 and 1, doesn't use an argument. Even if a function doesn't use an argument, however, you must still provide a set of empty parentheses, like this:

```
=RAND()
```

If a function uses more than one argument, you must separate each argument by a comma. The examples at the beginning of the chapter used cell references for arguments. Excel is quite flexible when it comes to function arguments, however. An argument can consist of a cell reference, literal values, literal text strings, or expressions.

### Accommodating Former 1-2-3 Users

If you've ever used any of the 1-2-3 spreadsheets (or any versions of Quattro Pro), you'll recall that these products require you to type an "at" sign (@) before a function name. Excel is smart enough to distinguish functions without you having to flag them with a symbol.

Because old habits die hard, however, Excel accepts @ symbols when you type functions in your formulas — but it removes them as soon as you enter the formula.

These competing products also use two dots (..) as a range operator — for example, A1..A10. Excel also lets you use this notation when you type formulas, but Excel replaces the notation with its own range operator, a colon (:).

This accommodation goes only so far, however. Excel still insists that you use the standard Excel function names, and it doesn't recognize or translate the function names used in other spreadsheets. For example, if you enter the 1-2-3 @AVG function, Excel flags it as an error (Excel's name for this function is AVERAGE).



## Using Names As Arguments

As you've seen, functions can use cell or range references for their arguments. When Excel calculates the formula, it simply uses the current contents of the cell or range to perform its calculations. The SUM function returns the sum of its argument(s). To calculate the sum of the values in A1:D20, you can use:

```
=SUM(A1:A20)
```

And, not surprisingly, if you've defined a name for A1:A20 (such as Sales), you can use the name in place of the reference:

```
=SUM(Sales)
```

In some cases, you may find it useful to use an entire column or row as an argument. For example, the formula that follows sums all values in column B:

```
=SUM(B:B)
```

This technique is particularly useful if the range that you're summing changes (if you're continually adding new sales figures, for instance). If you do use an entire row or column, just make sure that the row or column doesn't contain extraneous information that you don't want included in the sum. You might think that using such a large range (a column consists of 65,536 cells) might slow down calculation time — this isn't true. Excel's recalculation engine is quite efficient.

## Literal Arguments

A *literal argument* is a value or text string that you enter into a function. For example, the SQRT function takes one argument. In the following example, the formula uses a literal value for the function's argument:

```
=SQRT(225)
```

Using a literal argument with a simple function like this one defeats the purpose of using a formula. This formula always returns the same value, so it could just as easily be replaced with the value 15. Using literal arguments makes more sense with formulas that use more than one argument. For example, the LEFT function (which takes two arguments) returns characters from the beginning of its first argument; the second argument specifies the number of characters. If cell A1 contains the text Budget, the following formula returns the first letter, or *B*:

```
=LEFT(A1,1)
```

## Expressions As Arguments

Excel also lets you use *expressions* as arguments. Think of an expression as a formula within a formula. When Excel encounters an expression as a function's

argument, it evaluates the expression and then uses the result as the argument's value. Here's an example:

```
=SQRT((A1^2)+(A2^2))
```

This formula uses the SQRT function, and its single argument is the following expression:

```
(A1^2)+(A2^2)
```

When Excel evaluates the formula, it starts by evaluating the expression in the argument and then computes the square root of the result.

## Other Functions As Arguments

Because Excel can evaluate expressions as arguments, you shouldn't be surprised that these expressions can include other functions. Writing formulas that have functions within functions is sometimes known as *nesting* functions. Excel starts by evaluating the most deeply nested expression and works its way out. Here's an example of a nested function:

```
=SIN(RADIANS(B9))
```

The RADIANS function converts degrees to radians — which is the unit used by all of Excel's trigonometric functions. If cell B9 contains an angle in degrees, the RADIANS function converts it to radians, and then the SIN function computes the sine of the angle.

With a few exceptions, you can nest functions as deeply as you need, as long as you don't exceed the 1,024-character limit for a formula.

## Ways to Enter a Function

You have two ways available to enter a function into a formula: manually or by using the Paste Function dialog box.

### Entering a Function Manually

If you're familiar with a particular function — you know how many arguments it takes and the types of arguments — you may choose simply to type the function and its arguments into your formula. Often, this method is the most efficient.

## Changeable Range References in Excel 2000

Many functions contain a range reference as an argument. For example, the function that follows uses the range A10:A20:

```
=SUM(A10:A20)
```

If you add a new row between rows 10 and 20, Excel expands the formula's range reference for you automatically. If you add a new row between rows 12 and 13, the formula changes to the following:

```
=SUM(A10:A21)
```

In most cases, this is exactly what you want to happen.

In prior versions of Excel, if you inserted a new row at row 10, however, Excel would *not* include the new row in the range reference; that is, Excel wouldn't automatically expand the argument range reference to include rows that you add at the top or bottom of the range. Because this behavior often confused new users, Microsoft changed Excel's behavior in Excel 2000. In Excel 2000, when you add a row at any place in a referenced range, Excel changes the function that referenced the original range to include the new row automatically.



Tip

When you enter a function, Excel always converts the function's name to uppercase. Thus, always using lowercase when you type functions is a good idea: if Excel doesn't convert it to uppercase when you press Enter, then Excel doesn't recognize your entry as a function – which means that you spelled it incorrectly.

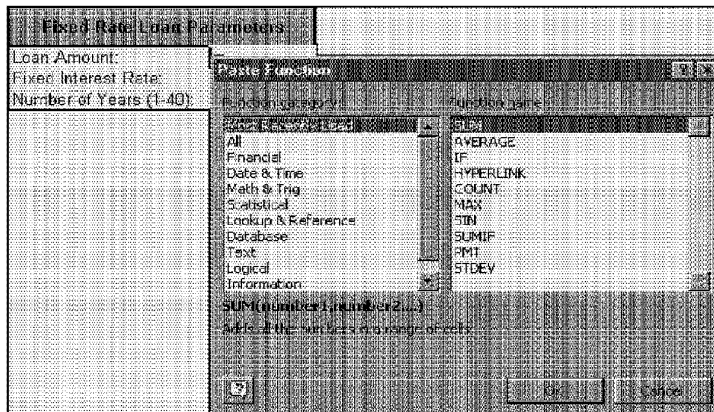
If you omit the closing parenthesis, Excel adds it for you automatically. For example, if you type `=SUM(A1:C12` and press Enter, Excel corrects the formula by adding the right parenthesis.

## Pasting a Function

Formula Palette assists you by providing a way to enter a function and its arguments in a semiautomated manner. Using the Formula Palette ensures that the function is spelled correctly and has the proper number of arguments in the correct order.

To insert a function, start by selecting the function from the Paste Function dialog box, shown in Figure 10-1. You can open this dialog box by using any of the following methods:

- Choose the Insert • Function command from the menu
- Click the Paste Function button on the Standard toolbar
- Press Shift+F3



**Figure 10-1:** The Paste Function dialog box.

The Paste Function dialog box shows the Function category list on the left side of the dialog box. When you select a category, the Function name list box displays the functions in the selected category.

The Most Recently Used category lists the functions that you've used most recently. The All category lists all the functions available across all categories. Use this if you know a function's name, but aren't sure of its category.

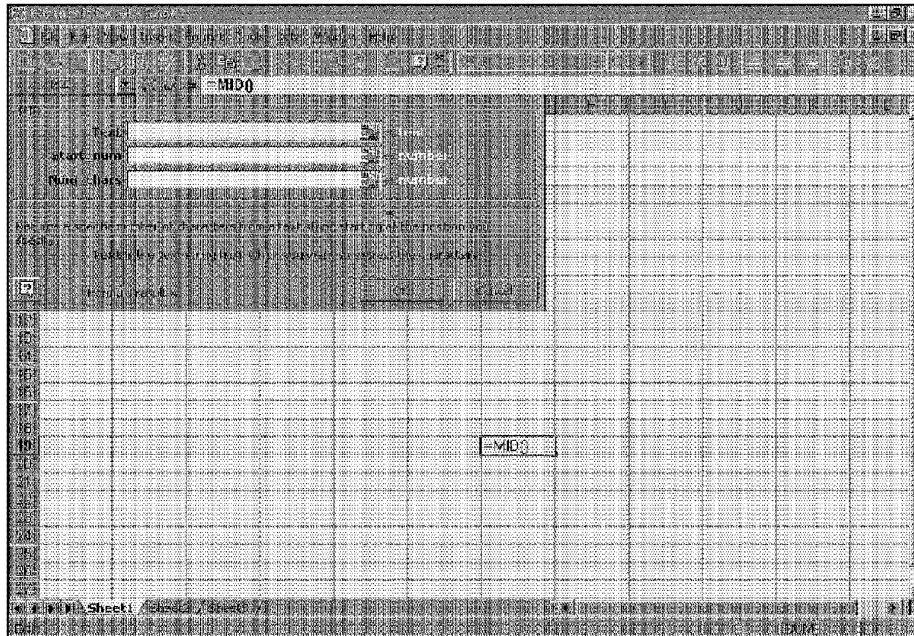


To select a function quickly in the Most Recently Used category, click the Edit Formula icon in the formula bar and then select the function from the function list (which occupies the space usually used by the Name box).

When you select a function in the Function name list box, notice that Excel displays the function (and its argument names) in the dialog box, along with a brief description of what the function does.

When you locate the function that you want to use, click OK. Excel's Formula Palette appears, as in Figure 10-2, and the Name box changes to the Formula List box. Use the Formula Palette to specify the arguments for the function. You can easily specify a range argument by clicking the Collapse Dialog button (the icon at the right edge of each box in the Formula Palette). Excel temporarily collapses the Formula Palette to a thin box, so that you can select a range in the worksheet. When you want to redisplay the Formula Palette, click the button again.

The Formula Palette usually appears directly below the formula bar, but you can move it to any other location by dragging it.



**Figure 10-2:** The Formula Palette.

### Inserting a function: An example

This section presents a step-by-step example that explains how to insert a function into a formula. The formula uses the AVERAGE function to compute the average of a range of cells. To insert a function into a formula, proceed as follows:

1. Open a new workbook and enter values into H1:H6 (any values will do).
2. Select cell H7. This cell will contain the formula.
3. Click the Insert Function button on the Standard toolbar. Excel displays its Paste Function dialog box.
4. Because the AVERAGE function is in the Statistical category, click Statistical in the Function category list box. The Function name list box displays the statistical functions.
5. Click AVERAGE in the Function name list box. The dialog box shows the function and its list of arguments. It also displays a brief description of the function.
6. Click the OK button. Excel closes the Paste Function dialog box and displays the Formula Palette (see Figure 10-3) to prompt you for the function's arguments.

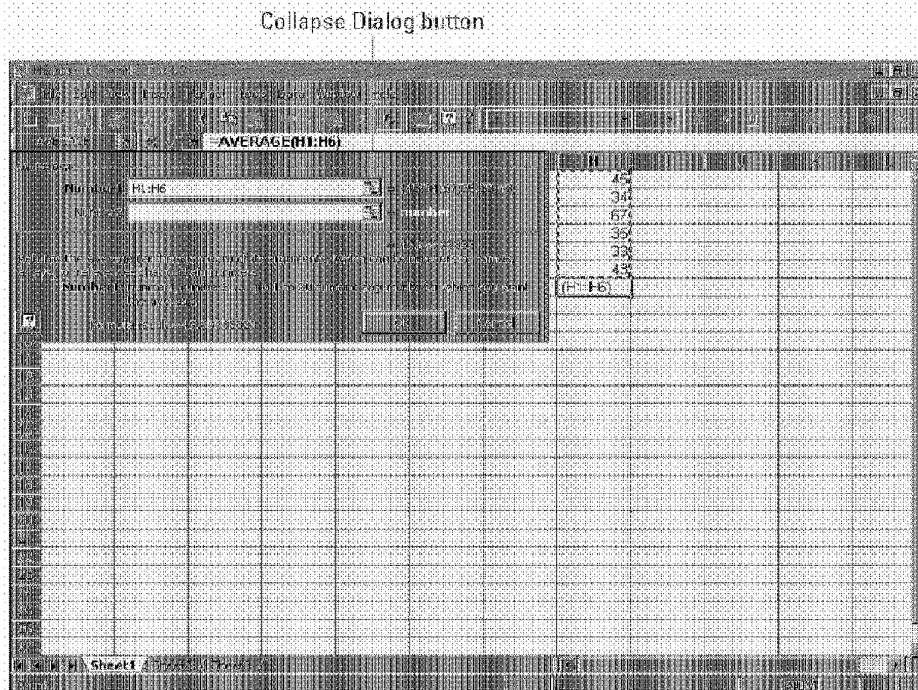
**Tip**

You may not need to complete Steps 7, 8, and 9 if Excel suggests the correct range when the Formula Palette appears.

7. Click the Collapse Dialog button at the right edge of the box labeled Number 1 to collapse the Formula Palette temporarily and shift to the worksheet, so that you can select a range.
8. Select the range H1:H6 in the worksheet. This range address appears in the collapsed box, and the formula bar shows the result.
9. Click the Collapse Dialog button again to redisplay the Formula Palette, which shows the formula result.
10. Because you're finding the average of only one range, you don't need to enter any additional arguments. Click the OK button.

Cell H7 now contains the following formula, which returns the average of the values in H1:H6:

```
=AVERAGE(H1:H6)
```

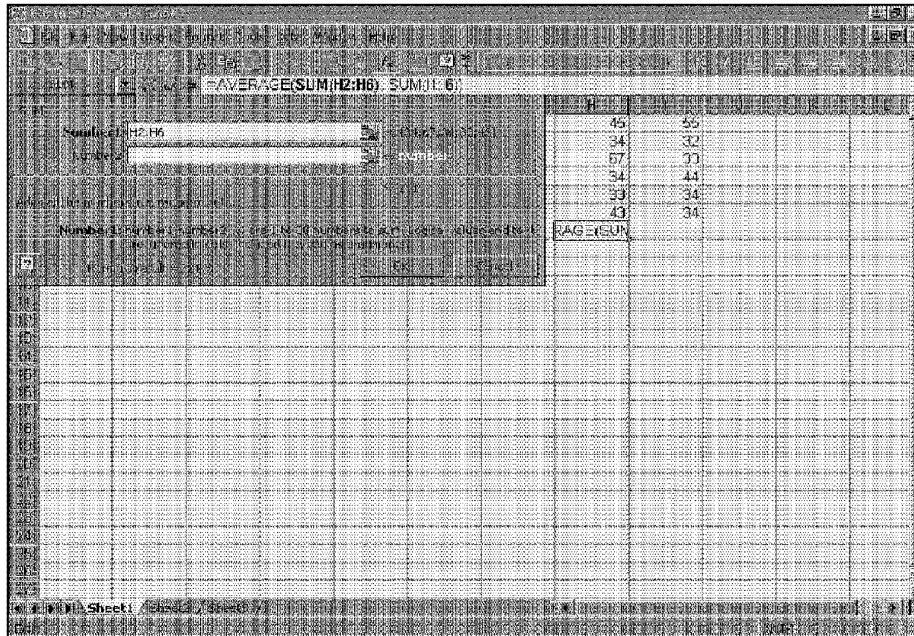


**Figure 10-3:** The Formula Palette, offering assistance with a function's arguments.

### More about entering functions

The following are some additional tips to keep in mind when you use the Formula Palette to enter functions:

- Click the Help button (or press F1) at any time to get help about the function that you selected.
- If you're starting a new formula, the Formula Palette automatically provides the initial equal sign for you.
- If the active cell is not empty when you invoke the Formula Palette, you will be able to edit the formula.
- You can use the Paste Function dialog box to insert a function into an existing formula. Just edit the formula and move the insertion point to the location where you want to insert the function. Then, open the Paste Function dialog box and select the function.
- If you change your mind about entering a function, click the Cancel button.
- The number of boxes that you see in the Formula Palette is determined by the number of arguments used by the function that you selected. If a function uses no arguments, you won't see any boxes. If the function uses a variable number of arguments (such as the AVERAGE function), Excel adds a new box every time that you enter an optional argument.
- On the right side of each box, you'll see the current value for each argument.
- A few functions, such as INDEX, have more than one form. If you choose such a function, Excel displays another dialog box that lets you choose which form you want to use.
- If you only need help remembering a function's arguments, type an equal sign and the function's name, and then press Ctrl+Shift+A. Excel inserts the function with placeholders for the arguments. You need to replace these placeholders with actual arguments.
- To locate a function quickly in the Function name list that appears in the Paste Function dialog box, open the list box, type the first letter of the function name, and then scroll to the desired function. For example, if you have selected the All category and want to insert the SIN function, click anywhere on the Function name list box and press S. Excel selects the first function that begins with S—very close to SIN.
- If you're using the Formula Palette and want to use a function as the argument for a function (a nested function), click in the box where you want the argument to appear. Then, open the Function List and select the function. Excel will insert the nested function and prompt you for its arguments.
- If the active cell contains a formula that uses one or more functions, the Formula Palette lets you edit each function. In the formula bar, click the function that you want to edit. Figure 10-4 shows a formula with multiple functions.



**Figure 10-4:** If the formula contains multiple functions, click the function in the formula bar to edit it.

## Function Examples

This section presents examples of formulas that use functions. It covers all categories listed in the Paste Function dialog box, but not every available function. For more information about a particular function, consult the online Help. For a list of all functions by category, use the Paste Function dialog box.



You can also look at Appendix B for more functions by category.

### Mathematical and trigonometric functions

Excel provides 50 functions in this category, more than enough to do some serious number crunching. The category includes common functions, such as SUM and INT, as well as plenty of esoteric functions.

#### INT

The INT function returns the integer (non-decimal) portion of a number by truncating all digits after the decimal point. The example that follows returns 412:

```
=INT(412.98)
```



**RAND**

The RAND function, which takes no arguments, returns a uniform random number that is greater than or equal to 0 and less than 1. “Uniform” means that all numbers have an equal chance of being generated. This function often is used in worksheets, to simulate events that aren’t completely predictable—such as winning lottery numbers—and returns a new result whenever Excel calculates the worksheet.

In the example that follows, the formula returns a random number between 0 and 12 (but 12 will never be generated):

```
=RAND()*12
```

The following formula generates a random integer between two values. The cell named Lower contains the lower bound, and the cell named Upper contains the upper bound:

```
=INT((Upper-Lower+1)*RAND()+Lower)
```

**Volatile Functions**

Some Excel functions belong to a special class of functions called *volatile*. No, these aren’t functions that cause your worksheet to explode. Rather, Excel recalculates a volatile function whenever it recalculates the workbook—even if the formula that contains the function is not involved in the recalculation.

The RAND function is an example of a volatile function, because it generates a new random number every time Excel calculates the worksheet. Other volatile functions are as follows:

AREAS	INDEX	OFFSET
CELL	INDIRECT	ROWS
COLUMNS	NOW	TODAY

A side effect of using these volatile functions is that Excel always prompts you to save the workbook—even if you made no changes. For example, if you open a workbook that contains any of these volatile functions, scroll around a bit (but don’t change anything), and then close the file, Excel asks whether you want to save the workbook.

You can circumvent this behavior by using Manual Recalculation mode, with the Recalculate before Save option turned off.

**ROMAN**

The ROMAN function converts a value to its Roman-numeral equivalent (hey, I never said *all* the functions were useful). Unfortunately for old-movie buffs, no

function exists to convert in the opposite direction. The function that follows returns MCMXCVIII:

```
=ROMAN(1998)
```

## ROUND

The ROUND function rounds a value to a specified digit to the left or right of the decimal point. This function is often used to control the precision of your calculation. ROUND takes two arguments: the first is the value to be rounded; the second is the digit. If the second argument is negative, the rounding occurs to the left of the decimal point. Table 10-1 demonstrates, with some examples, how this works.

**Table 10-1**  
**Examples of Using the ROUND Function**

<i>Function</i>	<i>Result</i>
=ROUND(123.457,2)	123.46
=ROUND(123.457,1)	123.50
=ROUND(123.457,0)	123.00
=ROUND(123.457,-1)	120.00
=ROUND(123.457,-2)	100.00
=ROUND(123.457,-3)	0.00



### Caution

Don't confuse rounding a value with number formatting applied to a value. When a formula references a cell that has been rounded with the ROUND function, the formula uses the rounded value. If a number has been formatted to *appear* rounded, formulas that refer to that cell use the actual value stored.



### Note

If your work involves rounding, also check out the ROUNDUP and ROUNDDOWN functions. In addition, the FLOOR and CEILING functions let you round to a specific multiple – for example, you can use FLOOR to round a value down to the nearest multiple of 10 (124.5 would be rounded to 120).

## PI

The PI function returns the value of  $\pi$  significant to 14 decimal places. It doesn't take any arguments and is simply a shortcut for the value 3.14159265358979. In the example that follows, the formula calculates the area of a circle (the radius is stored in a cell named Radius):

```
=PI()* (Radius^2)
```

## SIN

The SIN function returns the sine of an angle. The *sine* is defined as the ratio between the opposite side and the hypotenuse of a triangle. SIN takes one argument—the angle expressed in radians. To convert degrees to radians, use the RADIANS function (a DEGREES function also exists to do the opposite conversion). For example, if cell F21 contains an angle expressed in degrees, the formula that follows returns the sine:

```
=SIN(RADIANS(F21))
```

Excel contains the full complement of trigonometric functions. Consult the online Help for details.

## SQRT

The SQRT function returns the square root of its argument. If the argument is negative, this function returns an error. The example that follows returns 32:

```
=SQRT(1024)
```

To compute a cube root, raise the value to the  $1/3$  power. The example that follows returns the cube root of 32768—which is 32. Other roots can be calculated in a similar manner.

```
=32768^(1/3)
```

## SUM

If you analyze a random sample of workbooks, you'll likely discover that SUM is the most widely used function. It's also among the simplest. The SUM function takes from 1 to 30 arguments. To calculate the sum of three ranges (A1:A10, C1:10, and E1:E10), you use three arguments, like this:

```
=SUM(A1:A10,C1:10,E1:E10)
```

The arguments don't have to be all the same type. For example, you can mix and match single cell references, range references, and literals, as follows:

```
=SUM(A1,C1:10,125)
```

Because the SUM function is so popular, the Excel designers made it very accessible—automatic, in fact. To insert a formula that uses the SUM function, just click the AutoSum button on the Standard toolbar. Excel analyzes the context and suggests a range for an argument. If it suggests correctly (which it usually does), press Enter or click the AutoSum button again. If Excel's guess is incorrect, just drag the mouse and make the selection yourself. To insert a series of SUM formulas—to add several columns of numbers, for example—select the entire range and then click AutoSum. In this case, Excel knows exactly what you want, so it doesn't ask you to confirm it.

## SUMIF

The SUMIF function is useful for calculating conditional sums. Figure 10-5 displays a worksheet with a table that shows sales by month and by region. The SUMIF function is used in the formulas in column F. For example, the formula in F2 is as follows:

```
=SUMIF(B:B,E2,C:C)
```

Month	Region	Sales	Regional Summary	
Jan	North	16,491	North	64,485
Jan	South	14,657	South	55,089
Jan	West	3,522	West	45,668
Jan	East	22,041	East	61,646
Feb	North	2,061	<b>TOTAL</b>	<b>217,088</b>
Feb	South	21,813	<b>Monthly Summary</b>	
Feb	West	1,189	Jan	56,611
Feb	East	12,486	Feb	37,529
Mar	North	33,966	Mar	79,155
Mar	South	18,318	Apr	43,793
Mar	West	13,500	<b>TOTAL</b>	<b>217,088</b>
Mar	East	13,381		
Apr	North	1,977		
Apr	South	401		
Apr	West	27,477		
Apr	East	13,938		

**Figure 10-5:** The SUMIF function returns the sum of values if the values meet specified criteria.

SUMIF takes three arguments. The first argument is the range that you're using in the selection criteria—in this case, the entire column B. The second argument is the selection criteria, a region name in the example. The third argument is the range of values to sum if the criteria are met. In this example, the formula in F2 adds the values in column C only if the corresponding text in column B matches the region in column E.

The figure also shows the data summarized by month. The formula in F9 is the following:

```
=SUMIF(A:A,E9,C:C)
```

You also can use Excel's pivot table feature to perform these operations.



Pivot tables are covered in Chapter 25.

## Text Functions

Although Excel is primarily known for its numerical prowess, it has 23 built-in functions that are designed to manipulate text, a few of which are demonstrated in this section.

### CHAR

The CHAR function returns a single character that corresponds to the ANSI code specified in its argument (these codes range from 1 to 255). The CODE function performs the opposite conversion. The formula that follows returns the letter A:

```
=CHAR(65)
```

This function is most useful for returning symbols that are difficult or impossible to enter from the keyboard. For example, the formula that follows returns the copyright symbol (©):

```
=CHAR(169)
```

Figure 10-6 shows the characters returned by the CHAR function for arguments from 1 to 255 (using the Arial font).



Not all codes produce printable characters, and the characters may vary depending on the font used.

Code	Character
1	Space
2	Space
3	Space
4	Space
5	Space
6	Space
7	Space
8	Space
9	Space
10	Space
11	Space
12	Space
13	Space
14	Space
15	Space
16	Space
17	Space
18	Space
19	Space
20	Space
21	Space
22	Space
23	Space
24	Space
25	Space
26	A
27	B
28	C
29	D
30	E
31	F
32	G
33	H
34	I
35	J
36	K
37	L
38	M
39	N
40	O
41	P
42	Q
43	R
44	S
45	T
46	U
47	V
48	W
49	X
50	Y
51	Z
52	[
53	\
54	]
55	^
56	_
57	grave accent
58	a
59	b
60	c
61	d
62	e
63	f
64	g
65	h
66	i
67	j
68	k
69	l
70	m
71	n
72	o
73	p
74	q
75	r
76	s
77	t
78	u
79	v
80	w
81	x
82	y
83	z
84	{
85	
86	}
87	~
88	space
89	space
90	space
91	space
92	space
93	space
94	space
95	space
96	space
97	space
98	space
99	space
100	space
101	space
102	space
103	space
104	space
105	space
106	space
107	space
108	space
109	space
110	space
111	space
112	space
113	space
114	space
115	space
116	space
117	space
118	space
119	space
120	space
121	space
122	space
123	space
124	space
125	space
126	space
127	space
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243	space
244	space
245	space
246	space
247	space
248	space
249	space
250	space
251	space
252	space
253	space
254	space
255	space

Figure 10-6: Characters returned by the CHAR function.

## LEFT

The LEFT function returns a string of characters of a specified length from another string, beginning at the leftmost position. This function uses two arguments. The first argument is the string and the second argument (optional) is the number of characters. If the second argument is omitted, Excel extracts the first character from the text. In the example that follows, the formula returns the letter *B*:

```
=LEFT("B.B. King")
```

The formula that follows returns the string *Alber*:

```
=LEFT("Albert King",5)
```



**Note**

Excel also has a RIGHT function that extracts characters from the right of a string of characters and a MID function (described after the next section) that extracts characters from any position.

## LEN

The LEN function returns the number of characters in a string of text. For example, the following formula returns 12:

```
=LEN("Stratocaster")
```

If you don't want to count leading or trailing spaces, use the LEN function with a nested TRIM function. For example, if you want to know the number of characters in the text in cell A1 without counting spaces, use this formula:

```
=LEN(TRIM(A1))
```

## MID

The MID function returns characters from a text string. It takes three arguments. The first argument is the text string. The second argument is the position at which you want to begin extracting. The third argument is the number of characters that you want to extract. If cell A1 contains the text *Joe Louis Walker*, the formula that follows returns *Louis*:

```
=MID(A1,5,5)
```

## REPLACE

The REPLACE function replaces characters with other characters. The first argument is the text containing the string that you're replacing. The second argument is the character position at which you want to start replacing. The third argument is the number of characters to replace. The fourth argument is the new text that will replace the existing text. In the example that follows, the formula returns *Albert Collins*:

```
=REPLACE("Albert King",8,4,"Collins")
```

## SEARCH

The SEARCH function lets you identify the position in a string of text in which another string occurs. The function takes three arguments. The first argument is the text for which you're searching. The second argument is the string that you want to search. The third argument (optional) is the position at which you want to start searching. If you omit the third argument, Excel starts searching from the beginning of the text.

In the example that follows, assume that cell A1 contains the text *John Lee Hooker*. The formula searches for a space and returns 5, because the first space character was found at the fifth character position.

```
=SEARCH(" ",A1,1)
```

To find the second space in the text, use a nested SEARCH function that uses the result of the first search (incremented by one character) as the third argument:

```
=SEARCH(" ",A1,SEARCH(" ",A1,1)+1)
```

The following formula uses the LEFT function to return the characters to the left of the first space in the text in cell A1. For example, if A1 contains *Jimmy Dawkins*, the formula would return the first name *Jimmy*:

```
=LEFT(A1,SEARCH(" ",A1))
```

The preceding formula has a slight flaw: if the text in cell A1 contains no spaces, the formula results in an error. Here's an improved version that returns the entire string in A1 if it doesn't contain a space:

```
=IF(ISERROR(SEARCH(" ",A1)),A1,LEFT(A1,SEARCH(" ",A1)))
```

## UPPER

The UPPER function converts characters to uppercase. If cell A1 contains the text *Lucille*, the formula that follows returns *LUCILLE*:

```
=UPPER(A1)
```



**Note**

Excel also has a LOWER function (to convert to lowercase) and a PROPER function (to convert to proper case). In proper case, the first letter of each word is capitalized.

## Logical Functions

The Logical category contains only six functions (although several other functions could, arguably, be placed in this category). This section discusses three of these functions: IF, AND, and OR.

## IF

The IF function is one of the most important of all functions. This function can give your formulas decision-making capability.

The IF function takes three arguments. The first argument is a logical test that must return either TRUE or FALSE. The second argument is the result that you want the formula to display if the first argument is TRUE. The third argument is the result that you want the formula to display if the first argument is FALSE.

In the example that follows, the formula returns Positive if the value in cell A1 is greater than zero, and returns Negative otherwise:

```
=IF(A1>0,"Positive","Negative")
```

Notice that the first argument (A1>0) evaluates to logical TRUE or FALSE. This formula has a problem in that it returns the text Negative if the cell is blank or contains 0. The solution is to use a nested IF function to perform another logical test. The revised formula is as follows:

```
=IF(A1>0,"Positive",IF(A1<0,"Negative","Zero"))
```

The formula looks complicated, but when you break it down, you see that it's rather simple. Here's how the logic works. If A1 is greater than 0, the formula displays Positive, and nothing else is evaluated. If A1 is not greater than zero, however, the second argument is evaluated. The second argument is as follows:

```
IF(A1<0,"Negative","Zero")
```

This is simply another IF statement that performs the test on A1 again. If it's less than 0, the formula returns Negative. Otherwise, it returns Zero. You can nest IF statements as deeply as you need to — although it can get very confusing after three or four levels.

Using nested IF functions is quite common, so understanding how this concept works is in your best interest. Mastering IF will definitely help you to create more powerful formulas.

Figure 10-7 shows an example of using the IF function to calculate sales commissions. In this example, the usual commission rate is 5.5 percent of sales. If the total sales of a sales rep exceeds the sales goal, the commission rate is 6.25 percent. The formula in cell C6, shown next, uses the IF function to make a decision regarding which commission rate to use based on the sales amount:

```
=IF(B6>=SalesGoal,B5*BonusRate,B6*CommissionRate)
```



The screenshot shows an Excel spreadsheet with the following data:

Sales Rep	Sales	Commission
Alison	\$149,823	\$9,240
Baker	\$152,023	\$9,501
Cameron	\$209,122	\$13,070
Daily	\$122,023	\$6,711
Efrom	\$83,233	\$4,578
Franklin	\$209,323	\$13,083
Gomez	\$149,744	\$9,181
Harrison	\$159,872	\$9,992

Parameters shown above the table:

- Sales Goal: \$150,000
- Commission Rate: 5.50%
- Bonus Rate: 6.25%

**Figure 10-7:** Using the IF statement to calculate sales commissions.

## AND

The AND function returns a logical value (TRUE or FALSE) depending on the logical value of its arguments. If all its arguments return TRUE, the AND function returns TRUE. If at least one of its arguments returns FALSE, AND returns FALSE.

In the example that follows, the formula returns TRUE if the values in cells A1:A3 are all negative:

```
=AND(A1<0,A2<0,A3<0)
```

The formula that follows uses the AND function as the first argument for an IF function. If all three cells in A1:A3 are negative, this formula displays All Negative. If at least one is not negative, the formula returns Not All Negative:

```
=IF(AND(A1<0,A2<0,A3<0),"All Negative","Not All Negative")
```

## OR

The OR function is similar to the AND function, but it returns TRUE if at least one of its arguments is TRUE; otherwise, it returns FALSE. In the example that follows, the formula returns TRUE if the value in any of the cells—A1, A2, or A3—is negative:

```
=OR(A1<0,A2<0,A3<0)
```

## Information Functions

Excel's 15 functions in the Information category return a variety of information about cells. Many of these functions return a logical TRUE or FALSE.

**CELL**

The CELL function returns information about a particular cell. It takes two arguments. The first argument is a code for the type of information to display. The second argument is the address of the cell in which you're interested.

The example that follows uses the "type" code, which returns information about the type of data in the cell. It returns *b* if the cell is blank, *t* if it contains text (a label), or *v* if the cell contains a value or formula. For example, if cell A1 contains text, the following formula returns *t*:

```
=CELL("type",A1)
```

If the second argument contains a range reference, Excel uses the upper-left cell in the range.



Excel has other functions that let you determine the type of data in a cell. The following functions may be more useful: ISBLANK, ISERR, ISERROR, ISLOGICAL, ISNA, ISNONTEXT, ISNUMBER, ISREF, ISTEXT, and TYPE.

Table 10-2 lists the possible values for the first argument of the CELL function. When using the CELL function, make sure that you enclose the first argument in quotation marks.

**Table 10-2**  
**Codes for the CELL Function Info\_Type Argument**

<i>Type</i>	<i>What It Returns</i>
address	The cell's address
col	Column number of the cell
color	1 if the cell is formatted in color for negative values—otherwise, 0
contents	The contents of the cell
filename	Name and path of the file that contains the cell (returns empty text if the workbook has not been saved)
format	Text value corresponding to the number format of the cell
prefix	Text value corresponding to the label prefix of the cell; this is provided for 1-2-3 compatibility
protect	0 if the cell is not locked; 1 if the cell is locked
row	Row number of the cell
type	Text value corresponding to the type of data in the cell
width	Column width of the cell, rounded off to an integer

**INFO**

The INFO function takes one argument — a code for information about the operating environment. In the example that follows, the formula returns the path of the current folder (that is, the folder that Excel displays when you choose File • Open):

```
=INFO("directory")
```

Table 10-3 lists the valid codes for the INFO function. The codes must be enclosed in quotation marks.

**Table 10-3**  
**Codes for the INFO Function**

<i>Code</i>	<i>What It Returns</i>
directory	Path of the current folder
memavail	Amount of memory available, in bytes
memused	Amount of memory being used, in bytes
numfile	Number of worksheets in all open workbooks (including hidden workbooks and add-ins)
origin	Returns the cell reference of the top- and leftmost cell visible in the window, based on the current scrolling position
osversion	Current operating system version, as text
recalc	Current recalculation mode — Automatic or Manual
release	Version of Excel
system	Name of the operating environment — mac (for Macintosh) or pc dos (for Windows)
totmem	Total memory available on the system, in bytes

**ISERROR**

The ISERROR function returns TRUE if its argument returns an error value. Otherwise, it returns FALSE. This function is useful for controlling the display of errors in a worksheet.

Figure 10-8 shows a worksheet that is set up to track monthly sales. Each month, the worksheet is updated with two figures: the number of sales reps on staff and the total sales for the month. Formulas in columns E and F, respectively, calculate the percentage of the sales goal (Actual Sales divided by Sales Goal) and the average sales per sales rep. Notice that the formulas in column F display an error when the data is missing. Cell F2 contains a simple formula:

```
=D2/C2
```

To avoid displaying an error for missing data, change the formula to the following formula and copy it to the cells that follow. If the division results in an error, the formula displays nothing. Otherwise, it displays the result.

```
=IF(ISERROR(D2/C2), "", D2/C2)
```

Month	Sales Goal	Sales Reps	Actual Sales	Pct. Of Goal	Avg. Per Rep
January	500,000	9	510,233	102%	56,693
February	525,000	10	518,733	99%	51,873
March	550,000	10	569,844	104%	56,984
April	575,000	10	560,923	98%	56,092
May	600,000	11	601,923	100%	54,720
June	625,000			0%	#DIV/0!
July	650,000			0%	#DIV/0!
August	675,000			0%	#DIV/0!
September	700,000			0%	#DIV/0!
October	725,000			0%	#DIV/0!
November	750,000			0%	#DIV/0!
December	775,000			0%	#DIV/0!

**Figure 10-8:** This worksheet is displaying an error for formulas that refer to missing data.



Excel offers several other functions that let you trap error values: `ERROR.TYPE`, `ISERR`, and `ISNA`. Also, note that the preceding formula could have used the `ISBLANK` function to test for missing data.

## Date and Time Functions

If you use dates or times in your worksheets, you owe it to yourself to check out Excel's 14 functions that work with these types of values. This section demonstrates a few of these functions.



To work with dates and times, you should be familiar with Excel's serial number date-and-time system. Refer to Chapter 6.

### TODAY

The `TODAY` function takes no argument. It returns a date that corresponds to the current date—that is, the date set in the system. If you enter the following formula into a cell on June 16, 1998, the formula returns 6/16/98:

```
=TODAY()
```



Excel also has a NOW function that returns the current system date and the current system time.

### DATE

The DATE function displays a date based on its three arguments: year, month, and day. This function is useful if you want to create a date based on information in your worksheet. For example, if cell A1 contains 1998, cell B1 contains 12, and cell C1 contains 25, the following formula returns the date for December 25, 1998:

```
=DATE(A1,B1,C1)
```

### DAY

The DAY function returns the day of the month for a date. If cell A1 contains the date 12/25/98, the following formula returns 25:

```
=DAY(A1)
```



Excel also includes the YEAR and MONTH functions that extract from a date the year part and month part, respectively.

### WEEKDAY

The WEEKDAY function returns the day of the week for a date. It takes two arguments: the date and a code that specifies the type of result (the second argument is optional). The codes are listed in Table 10-4.

Table 10-4  
Codes for the WEEKDAY Function

Code	What It Returns
1 or omitted	Numbers 1-7, corresponding to Sunday through Saturday
2	Numbers 1-7, corresponding to Monday through Sunday
3	Numbers 0-6, corresponding to Monday through Sunday

If cell A1 contains 12/25/98, the formula that follows returns 6—which indicates that this date is a Friday:

```
=WEEKDAY(A1)
```



You also can format cells that contain dates to display the day of the week as part of the format. Use a custom format code of ddd (for abbreviated days of the week) or dddd (for fully spelled days of the week).

**TIME**

The TIME function displays a time based on its three arguments: hour, minute, and second. This function is useful if you want to create a time based on information in your worksheet. For example, if cell A1 contains 8, cell B1 contains 15, and cell C1 contains 0, the following formula returns 8:15:00 AM:

```
=TIME(A1,B1,C1)
```

**HOUR**

The HOUR function returns the hour for a time. If cell A1 contains the time 8:15:00 AM, the following formula returns 8:

```
=HOUR(A1)
```



Excel also includes the MINUTE and SECOND functions, which extract the minute part and second part, respectively, from a time.

**Financial Functions**

The Financial function category includes 16 functions that are designed to perform calculations that involve money.

**Depreciation functions**

Excel offers five functions to calculate depreciation of an asset over time. The function that you choose depends on the type of depreciation that you use. Figure 10-9 shows a chart that depicts how an asset is depreciated over time, using each of the five depreciation functions.

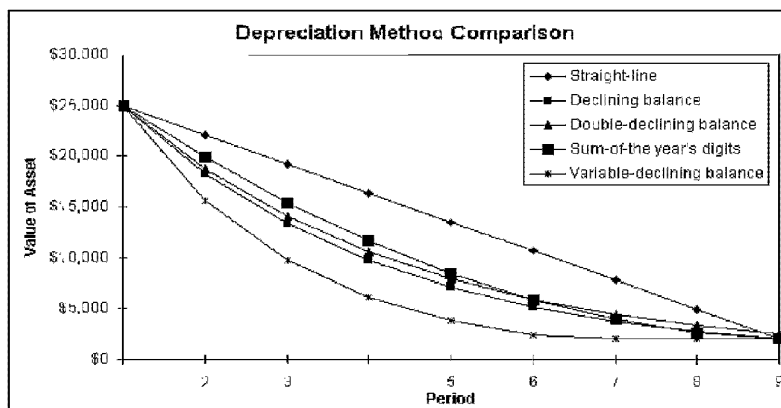


Figure 10-9: A comparison of Excel's five depreciation functions.

Table 10-5 summarizes the depreciation functions and the arguments used by each. For complete details, consult the online Help system.

**Table 10-5  
Excel's Depreciation Functions**

<i>Function</i>	<i>Depreciation Method</i>	<i>Arguments*</i>
SLN	Straight-line	Cost, Salvage, Life
DB	Declining balance	Cost, Salvage, Life, Period, [Month]
DDB	Double-declining balance	Cost, Salvage, Life, Period, Month, [Factor]
SYD	Sum-of-the year's digits	Cost, Salvage, Life, Period
VDB	Variable-declining balance	Cost, Salvage, Life, Start Period, End Period, [Factor], [No Switch]

\* Arguments in brackets are optional

The arguments for the depreciation functions are described as follows:

- **Cost:** Original cost of the asset.
- **Salvage:** Salvage cost of the asset after it has been fully depreciated.
- **Life:** Number of periods over which the asset will be depreciated.
- **Period:** Period in the Life for which the calculation is being made.
- **Month:** Number of months in the first year; if omitted, Excel uses 12.
- **Factor:** Rate at which the balance declines; if omitted, it is assumed to be 2 (that is, double-declining).
- **Rate:** Interest rate per period. If payments are made monthly, for example, you must divide the annual interest rate by 12.

### Loan and annuity functions

Table 10-6 lists the functions that can help you perform calculations related to loans and annuities.

Notice that these functions all use pretty much the same arguments — although the exact arguments that are used depend on the function. To use these functions successfully, you must understand how to specify the arguments correctly. The following list explains these arguments:

- **Nper:** Total number of payment periods. For a 30-year mortgage loan with monthly payments, Nper is 360.
- **Per:** Period in the loan for which the calculation is being made; it must be a number between 1 and Nper.

- **Pmt:** Fixed payment made each period for an annuity or a loan. This usually includes principal and interest (but not fees or taxes).
- **FV:** Future value (or a cash balance) after the last payment is made. The future value for a loan is 0. If FV is omitted, Excel uses 0.
- **Type:** Either 0 or 1, and indicates when payments are due. Use 0 if the payments are due at the end of the period, and 1 if they are due at the beginning of the period.
- **Guess:** Used only for the RATE function. It's your best guess of the internal rate of return. The closer your guess, the faster Excel can calculate the exact result.

**Table 10-6**  
**Loan and Annuity Functions**

<i>Function</i>	<i>Calculation</i>	<i>Arguments*</i>
FV	Future value	Rate, Nper, Pmt, [PV], [Type]
PV	Present value	Rate, Nper, Pmt, [FV], [Type]
PMT	Payment	Rate, Nper, PV, [FV], [Type]
PPMT	Principal payment	Rate, Per, Nper, PV, [FV], [Type]
IPMT	Interest payment	Rate, Per, Nper, PV, [FV], [Type]
ISPMT	Payment interest	Rate, Per, Nper, PV
RATE	Interest rate per period	Nper, Pmt, PV, [FV], [Type], [Guess]
NPER	Number of periods	Rate, Pmt, PV, [FV], [Type]

\* Arguments in brackets are optional



This book's CD-ROM contains an example workbook that demonstrates the use of the PMT, PPMT, and IPMT functions to calculate a fixed-interest amortization schedule.

## Lookup and Reference Functions

The 17 functions in the Lookup and Reference category, some of which are demonstrated in this section, are used to perform table lookups and obtain other types of information.

### VLOOKUP

The VLOOKUP function can be quite useful when you need to use a value from a table, such as a table of tax rates. This function retrieves text or a value from a table, based on a specific key in the first column of the table. The retrieved result is at a specified horizontal offset from the first row of the table.



Figure 10-10 shows an example of a lookup table (named PartsList) in range D2:F9. The worksheet is designed so that a user can enter a part number into cell B2 (which is named Part), and formulas in cells B4 and B5 return the appropriate information for the part by using the lookup table. The formulas are as follows:

- **Cell B4:** =VLOOKUP(Part,PartsList,2,FALSE)
- **Cell B5:** =VLOOKUP(Part,PartsList,3,FALSE)

Enter Part No -->		Part Number	Name	Unit Cost
	225	145	Mesh Rod	\$5.95
Name:	Toe Bolt	155	Puddle Joint	\$12.95
Unit Cost:	\$0.49	187	Penguin Bolt	\$1.29
		205	Finger Nut	\$0.98
		225	Toe Bolt	\$0.49
		319	Piano Nail	\$0.99
		377	Mule Pip	\$9.95

**Figure 10-10:** A vertical lookup table.

The formula in B4 looks up the value in the cell named Part in the first column of the table named PartsList. It returns the value in the column that corresponds to its third argument (column 2). The fourth argument tells Excel that it must find an exact match. If the fourth argument is TRUE (or omitted), Excel returns the next largest value that is less than the lookup value (the values in the first column must be in ascending order). Using an inexact match is useful for income tax tables, in which a line doesn't exist for every possible income.

If you enter a value that doesn't appear in the table, the formula returns #N/A. You can change the formula to produce a more user-friendly error message by using the ISNA function. The revised formula is as follows:

```
=IF(ISNA(VLOOKUP(Part,PartsList,2,FALSE)),"NotFound",VLOOKUP(Part,PartsList,2,FALSE))
```

If you enter a part that is not in the list, this formula returns Not Found rather than #N/A.



The HLOOKUP function works exactly like VLOOKUP except that it looks up the value horizontally in the table's first row.

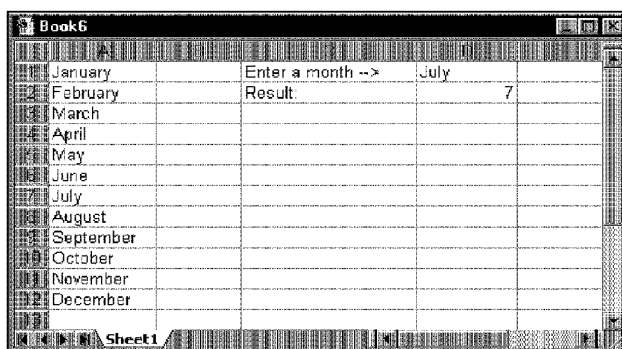
## MATCH

The MATCH function searches a range for a value or text and returns the relative row or column in which the item was found. Figure 10-11 shows a simple example. The worksheet contains the month names in A1:A12. Cell D2 contains the following formula:

```
=MATCH(D1,A1:A12,0)
```

The formula returns 7, because cell D1 contains July, and July is the seventh element in the range A1:A12.

The third argument for the MATCH function specifies the type of match that you want (0 means an exact match). Use the values of 1 and -1 when you are willing to accept an inexact match.



**Figure 10-11:** Using the MATCH function to return a relative position in a range.

## INDEX

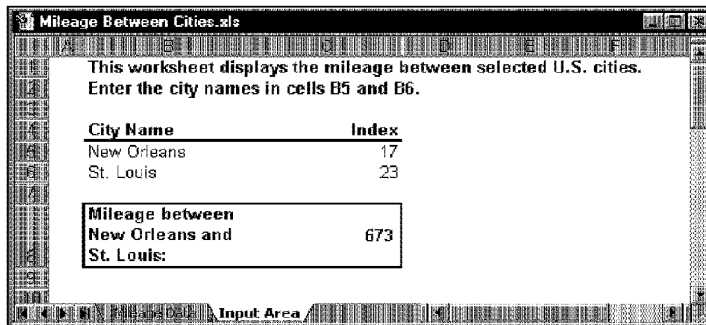
The INDEX function returns a value from a range using a row index (for a vertical range), column index (for a horizontal range), or both (for a two-dimensional range). The formula that follows returns the value in A1:J10 that is in its fifth row and third column:

```
=INDEX(A1:J10,5,3)
```



On the CD-ROM, you'll find a workbook that demonstrates the INDEX and MATCH functions. The workbook, shown in Figure 10-12, displays the mileage between selected U.S. cities.

The OFFSET function performs a similar function.



**Figure 10-12:** This workbook uses the INDEX and MATCH functions to look up the mileage between selected U.S. cities.

## INDIRECT

The INDIRECT function returns the value in a cell specified by its text argument. For example, the following formula returns the value (or text) in cell A1:

```
=INDIRECT("A1")
```

This function is most useful when you use a reference as its argument (not a literal, as shown previously). For example, suppose cell C9 contains the text Sales and, in your worksheet, you have defined the name Sales for cell A1; A1 (or Sales) contains the value 46. The following formula returns 46, the value in the cell named Sales:

```
=INDIRECT(C9)
```

This concept can be a bit difficult to grasp, but after you master it, you can put it to good use. Figure 10-13 shows a multisheet workbook with formulas that use the INDIRECT function to summarize the information in the other worksheets in the workbook. Cell B2 contains the following formula, which was copied to the other cells:

```
=INDIRECT("'"&$A2&"'!"&$B$1)
```

This formula builds a cell reference by using text in row 1 and column A. Excel evaluates the argument as follows:

```
'Denver'!Sales
```

The Denver sheet has a range named Sales. Therefore, the indirect function returns the value in the cell named Sales on the Denver worksheet.



This file is available on the book's CD-ROM.

City	Sales	Expenses	Net
Denver	466,090	131,099	336,991
San Diego	873,900	237,900	636,000
New York	987,220	378,309	608,911
Chicago	587,092	143,968	443,104

**Figure 10-13:** These formulas use the INDIRECT function to summarize values contained in the other workbooks.

## Statistical Functions

The Statistical category contains a whopping 80 functions that perform various calculations. Many of these are quite specialized, but several are useful for nonstatisticians.

### AVERAGE

The AVERAGE function returns the average (arithmetic mean) of a range of values. The *average* is the sum of the range divided by the number of values in the range. The formula that follows returns the average of the values in the range A1:A100:

```
=AVERAGE(A1:A100)
```

If the range argument contains blanks or text, Excel doesn't include these cells in the average calculation. As with the SUM formula, you can supply any number of arguments.



Excel also provides the MEDIAN function (which returns the middle-most value in a range) and the MODE function (which returns the value that appears most frequently in a range).

### COUNTIF

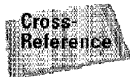
The COUNTIF function is useful if you want to count the number of times that a specific value occurs in a range. This function takes two arguments: the range that contains the value to count and a criterion used to determine what to count. Figure 10-14 shows a worksheet set up with student grades. The COUNTIF function is used in the formulas in column E. For example, the formula in E2 is as follows:

```
=COUNTIF(B:B,D2)
```

Notice that the first argument consists of a range reference for the entire column B, enabling you to insert new names easily without having to change the formulas.

Student	Grade	Grade	Count
Alien	C	A	6
Baker	C	B	7
Clemens	A	C	8
Daly	C	D	4
Elliot	B	F	1
Franklin	B		
Glassheimer	D		
Hawkins	A		
Ingrass	C		
Jackson	B		
King	B		
Lange	F		
Martin	D		
Nicholson	C		
Oswald	C		
Peterson	C		
Quincy	B		

**Figure 10-14:** Using the COUNTIF function to create a distribution of grades.



You also can use the Analysis ToolPak add-in to create frequency distributions. See Chapter 28 for details.

### COUNT, COUNTA, COUNTBLANK, and COUNTIF

The COUNT function returns the number of values in a range. The COUNTA function returns the number of nonblank cells in a range. For example, the following formula returns the number of nonempty cells in column A:

```
=COUNTA("A:A")
```

COUNTBLANK counts the number of blank cells in a range, and COUNTIF counts the number of cells within a range that meet the criteria that you specify in the argument.

### MAX and MIN

Use the MAX function to return the largest value in a range, and the MIN function to return the smallest value in a range. Both MAX and MIN ignore logical values and text. The following formula displays the largest and smallest values in a range named Data; using the concatenation operator causes the result to appear in a single cell:

```
"Smallest: "&MIN(Data)&" Largest: "&MAX(Data)
```

For example, if the values in Data range from 12 to 156, this formula returns Smallest: 12 Largest: 156.



MAXA and MINA are new to Excel 2000. These functions work like MAX and MIN, respectively, but MAXA and MINA don't ignore logical values and text.

### LARGE and SMALL

The LARGE function returns the *n*th-largest value in a range. For example, to display the second-largest value in a range named Data, use the following formula:

```
=LARGE(Data,2)
```

The SMALL function works just as you would expect; it returns the *n*th-smallest value in a range.

## Database Functions

Excel's Database function category consists of a dozen functions that you use when working with database tables (also known as lists) stored in a worksheet. These functions all begin with the letter *D*, and they all have non-database equivalents. For example, the DSUM function is a special version of the SUM function that returns the sum of values in a database that meet a specified criterion. A database table is a rectangular range with field names in the top row. Each subsequent row is considered a record in the database.

To use a database function, you must specify a special criteria range in the worksheet. This type of criteria range is the same one that you use with Excel's Data • Filter • Advanced Filter command.



This topic is discussed in Chapter 23.

The DSUM function calculates the sum of the values in a specified field, filtered by the criteria table. For example, to calculate the total sales for the North region, enter **North** under the Region field in the criteria range. Then, enter the following formula into any cell (this assumes that the database table is named Data and that the criteria range is named Criteria):

```
=DSUM(Data,"Sales",Criteria)
```

The formula returns the sum of the Sales field, but only for the records that meet the criteria in the range named Criteria. You can change the criteria, and the formula displays the new result. For example, to calculate the sales for January, enter **Jan** under the Month field in the Criteria range (and delete any other entries).

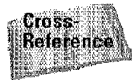
If you want to use several DSUM formulas, you can have each of them refer to a different criteria range (you can use as many criteria ranges as you need).

Excel's other database functions work exactly like the DSUM function.

## Analysis ToolPak Functions

When you begin to feel familiar with Excel's worksheet functions, you can explore those that are available when you load the Analysis ToolPak. This add-in provides you with dozens of additional worksheet functions.

When you load this add-in, the Paste Function dialog box displays a new category, Engineering. It also adds new functions to the following function categories: Financial, Date & Time, Math & Trig, and Information.



The Analysis ToolPak is discussed in Chapter 28. See Appendix B for a summary of the Analysis ToolPak function.

## Creating Megaformulas

Often, spreadsheets require intermediate formulas to produce a desired result. After you get the formulas working correctly, you often can eliminate the intermediate formulas and use a single *megaformula* instead (this term is my own—no official name exists for such a formula). The advantages? You use fewer cells (less clutter) and recalculation takes less time. Besides, people in the know will be impressed with your formula-building abilities. The disadvantage? The formula may be impossible to decipher or modify.

Imagine a worksheet with a column of people's names. And suppose that you've been asked to remove all middle names and middle initials from the names—but not all of 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 task is not a difficult one, it normally involves several intermediate formulas. Also assume that you want to use as few cells as possible in the solution.

Figure 10-15 shows the solution, which requires six intermediate formulas. The names are in column A; the end result is in column H. Columns B through G hold the intermediate formulas. Table 10-7 shows the formulas used in this worksheet, along with a brief description of each.

	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	Mr. Fred Kingsley	Mr. Fred Kingsley	4	9	9	Mr. Kingsley	Mr. Kingsley
6	J.P. Smithers	J.P. Smithers	5	#VALUE!	5	J.P. Smithers	J.P. Smithers

**Figure 10-15:** Removing the middle names and initials requires six intermediate formulas.

**Table 10-7**  
**Intermediate Formulas**

<i>Cell</i>	<i>Intermediate Formula</i>	<i>What It Does</i>
B1	=TRIM(A1)	Removes excess spaces
C1	=FIND(" ",B1,1)	Locates first space
D1	=FIND(" ",B1,C1+1)	Locates second space (returns an error if no second space exists)
E1	=IF(ISERROR(D1),C1,D1)	Uses the first space if no second space
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 huge formula (what I call a megaformula). You do so by starting with the end result and then replacing each cell reference with a copy of the formula in the cell referred to (but don't copy the equal 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 task as all the intermediate formulas — although it's virtually impossible for anyone (even the original author) to figure out. 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 copy of the intermediate formulas somewhere, in case you discover an error or need to make a change.

Your only limitation is that Excel's formulas can be no more than 1,024 characters. Because a megaformula is so complex, you may think that using one would slow down recalculation. Actually, the opposite is true. As a test, I created a worksheet that used a megaformula 20,000 times. Then, I created another worksheet that used six intermediate formulas rather than the megaformula. As you can see in Table 10-8, the megaformula recalculated faster and also resulted in a much smaller file.



This workbook is available on the CD-ROM.



**Table 10-8**  
**Intermediate Formulas Versus Megaformula**

<i>Method</i>	<i>Recalc Time (seconds)</i>	<i>File Size</i>
Intermediate formulas	9.2	7.1MB
Megaformula	5.1	2.5MB

## Creating Custom Functions

Although Excel offers more functions than you'll ever need, you may eventually search for a function that you need and not be able to find it. The solution is to create your own.

If you don't have the skills to create your own functions, you may be able to purchase custom Excel functions from a third-party provider that specializes in your industry. Or, you can hire a consultant to develop functions that meet your needs.

To create a custom function, you must be well-versed in Visual Basic for Applications (VBA). When you create a custom function, you can use it in your worksheet, just like the built-in functions.



Custom worksheet functions are covered in Chapter 36.

## Learning More About Functions

This chapter has just barely skimmed the surface. Excel has hundreds of functions that I haven't mentioned. To learn more about the functions available to you, I suggest that you browse through them by using the Paste Function dialog box and click the Help button when you see something that looks useful. The functions are thoroughly described in Excel's online Help system.

## Summary

This chapter discusses the built-in worksheet functions available in Excel. These functions are arranged by category, and you can enter them into your formulas either manually (by typing them) or by using the Paste Function dialog box and the Formula Palette. Many examples of functions across the various categories are also discussed.

• .....

# Worksheet Formatting

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**C**hapter 6 discussed number formatting, which enables you to change the way that Excel displays values in their cells. This chapter covers what I refer to as *stylistic* formatting, which is purely cosmetic.

## Overview of Stylistic Formatting

The stylistic formatting that you apply to worksheet cells doesn't affect the actual content of the cells. Rather, you should use stylistic formatting with the goal of making your work easier to read or more attractive. In this chapter, you'll learn about the following types of formatting:

- Using different type fonts, sizes, and attributes
- Changing the way the contents of cells are aligned within cells
- Using colors in the background or foreground of cells
- Using patterns for cell background
- Using borders around cells
- Using a graphic background for your worksheet



This book's CD-ROM contains a file that demonstrates many of the techniques used in this chapter.

## Why Bother Formatting?

Some users tend to shy away from formatting. After all, it doesn't do anything to make the worksheet more accurate, and formatting just takes valuable time.

I'll be the first to admit that stylistic formatting isn't essential for every workbook that you develop. If no one except you will ever see your workbook, you may not want to bother. If

# CHAPTER

## In This Chapter

Overview of Stylistic Formatting Working with Fonts

Changing Cell Alignment

Colors and Shading

Borders and Lines

Adding a Worksheet Background

AutoFormatting

Using Conditional Formatting

Using Named Styles

Controlling Styles with Templates

anyone else will use your workbook, however, I strongly suggest that you spend some time applying simple formatting. Figure 11-1 shows how even simple formatting can significantly improve a worksheet's readability.

**Before and After.xls:1**

Month	Revenue	Expenses	Net Income
Jan-97	31256	11832	19424
Feb-97	35944		
Mar-97	29833		
Apr-97	39832		
May-97	31443		
Jun-97	29444		
Jul-97	25445		
Aug-97	65984		
Sep-97	43012		
Oct-97	31339		
Nov-97	39083		
Dec-97	31444		
Annual	433059		

**Before and After.xls:2**

**Smith-Jackson Associates**  
*Income and Expenses*

Month	Revenue	Expenses	Net Income
<b>Jan-97</b>	31,256	11,832	19,424
<b>Feb-97</b>	35,944	12,322	23,622
<b>Mar-97</b>	29,833	10,983	18,850
<b>Apr-97</b>	39,832	15,433	24,399
<b>May-97</b>	31,443	18,933	12,510
<b>Jun-97</b>	29,444	8,922	19,522
<b>Jul-97</b>	25,445	9,122	16,323
<b>Aug-97</b>	65,984	21,033	44,951
<b>Sep-97</b>	43,012	11,390	31,622
<b>Oct-97</b>	31,339	12,540	18,799
<b>Nov-97</b>	39,083	13,221	25,862
<b>Dec-97</b>	31,444	14,435	17,009
<b>Annual</b>	\$ 433,059	\$ 180,166	\$ 272,893

**Figure 11-1:** Before and after applying simple stylistic formatting.

On the other hand, some users go overboard with formatting. I've downloaded many Excel worksheets from the Internet and online services, such as CompuServe. Some of these worksheets are hideous and don't convey a professional image. You disguise your work and make it difficult to read and understand if you use too many different fonts, font sizes, colors, and borders.

Eventually, you'll strike a happy medium with your stylistic formatting: not too much, but enough to clarify what you're trying to accomplish with your worksheet.

## When to Format

When you're developing a worksheet, you can apply stylistic formatting at any time. Some people prefer to format their work as they go along (I'm in this group). Others wait until the workbook is set up and then apply the formatting as the final step (the icing on the cake). The choice is yours.

## The Formatting Toolbar

Chapter 6 introduced the Formatting toolbar, shown in Figure 11-2, which you use to apply simple stylistic formatting quickly.



**Figure 11-2:** The Formatting toolbar contains many tools to apply formats.

In many cases, this toolbar may contain all the formatting tools that you need. But some types of formatting require that you use the Format Cells dialog box. This chapter covers the finer points of stylistic formatting, including options not available on the Formatting toolbar.

## The Format Cells Dialog Box

This chapter refers repeatedly to the Format Cells dialog box. This is a tabbed dialog box from which you can apply nearly any type of stylistic formatting (as well as number formatting). The formats that you choose in the Format Cells dialog box apply to the cells that you have selected at the time.

After selecting the cell or range to format, you can display the Format Cells dialog box by using any of the following methods:

- Choose the Format • Cells command
- Press Ctrl+1
- Right-click the selected cell or range and choose Format Cells from the shortcut menu

The Format Cells dialog box contains six tabs. When you first open this dialog box, you see the Number tab. You can choose another tab by clicking any of the other tabs. When you open this dialog box again, Excel displays the tab that you used last.

## Working with Fonts

Fonts are one of the elements that distinguish a *graphical user interface* (GUI), such as Windows, from a character-based interface (such as plain-old DOS). A GUI can display different fonts in different sizes and with different attributes (bold, italic, underline). A character-based display typically shows one font of the same size and may be capable of handling different font attributes.



You can use different fonts, sizes, or attributes in your worksheets to make various parts stand out, such as the headers for a table. You also can adjust the font size to make more information appear on a single page.

Reducing the font size so that your report fits on a certain number of pages isn't always necessary.



Excel has a handy option that automatically scales your printed output to fit on a specified number of pages, which is discussed in Chapter 12.

## About Fonts

When you select a font, Excel displays only the fonts that are installed on your system. Windows includes several fonts, and Microsoft Office 2000 includes many additional fonts that you can install on your system. You can acquire fonts from a variety of other sources, too, such as the Internet and online services. For best results, you should use TrueType fonts. You can display and print these fonts in any size, without the “jaggies” (jagged edges) that characterize nonscalable fonts.



Although you can obtain fonts from many different locations, remember that fonts take up space on your hard drive and use memory. In addition, using too many fonts in a workbook can confuse the reader. You may not ever need any fonts other than those that come with Windows.

If you plan to distribute a workbook to other users, you should stick with the fonts that are included with Windows. If you open a workbook and your system doesn't have the font with which the workbook was created, Windows attempts to use a similar font. Sometimes this works, and sometimes it doesn't. To be on the safe side, use the following fonts only if you plan to share your workbook with others:

- Arial
- Courier New
- Symbol
- Times New Roman
- Wingdings

## The Default Font

By default, the information that you enter into an Excel worksheet uses the 10-point Arial font. A font is described by its typeface (Arial, Times New Roman, Courier New, and so on) as well as by its size, measured in points (there are 72 points in one inch). Excel's row height, by default, is 12.75 points. Therefore, 10-point type entered into 12.75-point rows leaves a small amount of blank space between the characters in adjacent rows.

**Note**

If you have not manually changed a row's height, Excel automatically adjusts the row height based on the tallest text that you enter into the row. You can, of course, override this adjustment and change the row height to any size that you like by using 0.25-point increments. For example, if you enter a row height of 15.35, Excel makes the row 15.5 points high (it always rounds up).

The default font is the font specified by the Normal style for the workbook. All cells use the Normal style unless you specifically apply a different style. If you want to change the font for all cells that use the Normal style, you simply change the font used in the Normal style by using these steps:

1. Choose the **Format • Style** command. Excel displays the Style dialog box.
2. Make sure that **Normal** appears in the *Style name* drop-down box and click the **Modify** button. Excel displays the Format Cells dialog box.
3. Click the **Font** tab and choose the font and size that you want as the default.
4. Click **OK** to return to the Style dialog box.
5. Click **OK** again to close the Style dialog box.

The font for all cells that use the Normal style changes to the font that you specified. You can change the font for the Normal style at any time. Excel's style feature is discussed later in this chapter.

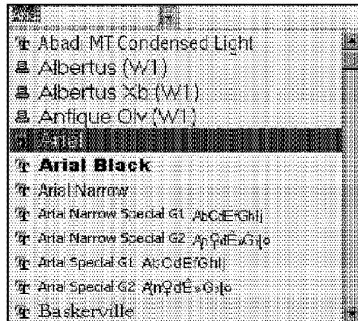
**Cross-Reference**

If you want to change the default font permanently, create a template named **book.xlt** that uses a different font for the Normal style. Templates are covered in Chapter 34.

## Changing Fonts in Excel 2000

Use the **Font** and **Font Size** tools on the **Formatting** toolbar to change the font or size for selected cells. Just select the cells, click the appropriate tool, and then choose the font or size from the drop-down list. In Excel 2000, you can see samples of the fonts when you open the **Font** list box on the **Formatting** toolbar (see Figure 11-3). If you prefer the behavior of earlier versions of Excel, in which you don't see font samples when you open this list box, you can change this behavior in the **Options** dialog box.

You also can use the **Font** tab in the **Format Cells** dialog box, as shown in Figure 11-4. This tab enables you to control several other attributes of the font—from a single dialog box—and preview the font before you select it. Notice that you also can change the font style (bold, italic), underlining, color, and effects (strikethrough, superscript, or subscript). If you click the check box labeled **Normal Font**, Excel displays the selections for the font defined for the Normal style.

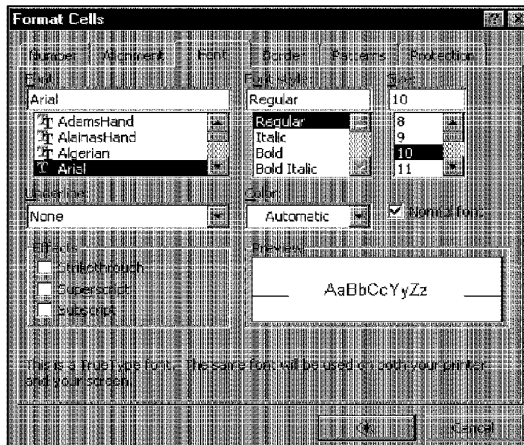


**Figure 11-3:** The Font list on the Formatting toolbar shows samples as well as choices.



**Note**

Notice in Figure 11-5 that Excel provides four different underlining styles. In the two accounting underline styles, dollar signs and percent signs aren't underlined. In the two nonaccounting underline styles, the entire cell contents are always underlined.



**Figure 11-4:** The Font tab in the Format Cells dialog box.

Figure 11-5 shows examples of font formatting.



Figure 11-5: Examples of font formatting.

## Using Multiple Formatting in One Cell

If a cell contains text (not a formula or a value), Excel also enables you to format individual characters in the cell. To do so, switch into edit mode (double-click the cell) and then select the characters that you want to format. You can select characters either by dragging the mouse over them or by holding down the Shift key as you press the left- or right-arrow key. Then, use any of the standard formatting techniques. The changes apply to only the selected characters in the cell. This technique doesn't work with cells that contain values or formulas.

Figure 11-6 shows a few examples of using different fonts, sizes, and attributes in a cell.

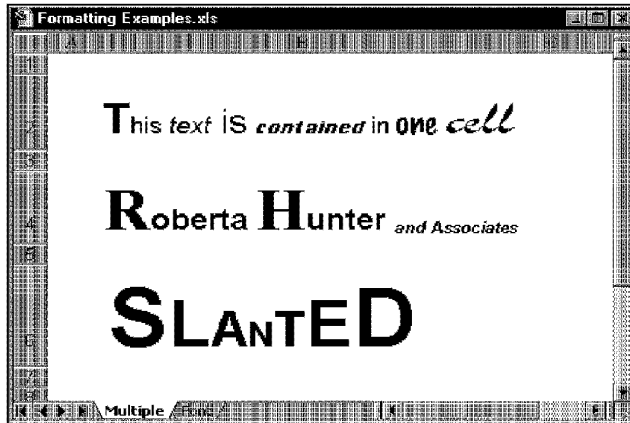
### Selecting Fonts and Attributes with Shortcut Keys

If you prefer to keep your hands on the keyboard, you can use the following shortcut keys to format a selected range quickly.

Ctrl+B	Bold
Ctrl+I	Italic
Ctrl+U	Underline
Ctrl+5	Strikethrough

These shortcut keys act as a toggle. For example, you can turn on and off bold by repeatedly pressing Ctrl+B.





**Figure 11-6:** You can use different fonts, sizes, or attributes for selected characters in text.

## Changing Cell Alignment

*Cell alignment* refers to how a cell's contents are situated in the cell. The contents of a cell can be aligned both vertically and horizontally. The effect that you see depends on the cell's height and width. For example, if the row uses standard height, you may not notice any changes in the cell's vertical alignment (but if you increase the row's height, these effects are apparent).



Excel also enables you to display text at a specified orientation—you choose the angle.

Figure 11-7 shows some examples of cells formatted with the various horizontal and vertical alignment options.

### Horizontal Alignment Options

You can apply most of the horizontal alignment options by using the tools on the Formatting toolbar. Or, you can use the Alignment tab in the Format Cells dialog box, as shown in Figure 11-8.

The horizontal alignment options are as follows:

- **General:** Aligns numbers to the right, aligns text to the left, and centers logical and error values. This option is the default alignment.

- **Left:** Aligns the cell contents to the left side of the cell. If the text is wider than the cell, it spills over to the cell to the right. If the cell to the right is not empty, the text is truncated and not completely visible.
- **Center:** Centers the cell contents in the cell. If the text is wider than the cell, it spills over to cells on either side, if they are empty. If the adjacent cells aren't empty, the text is truncated and not completely visible.
- **Right:** Aligns the cell contents to the right side of the cell. If the text is wider than the cell, it spills over to the cell to the left. If the cell to the left isn't empty, the text is truncated and not completely visible.
- **Fill:** Repeats the contents of the cell until the cell's width is filled. If cells to the right also are formatted with Fill alignment, they also are filled.
- **Justify:** Justifies the text to the left and right of the cell. This option is applicable only if the cell is formatted as wrapped text and uses more than one line.
- **Center across selection:** Centers the text over the selected columns. This option is useful for precisely centering a heading over a number of columns.

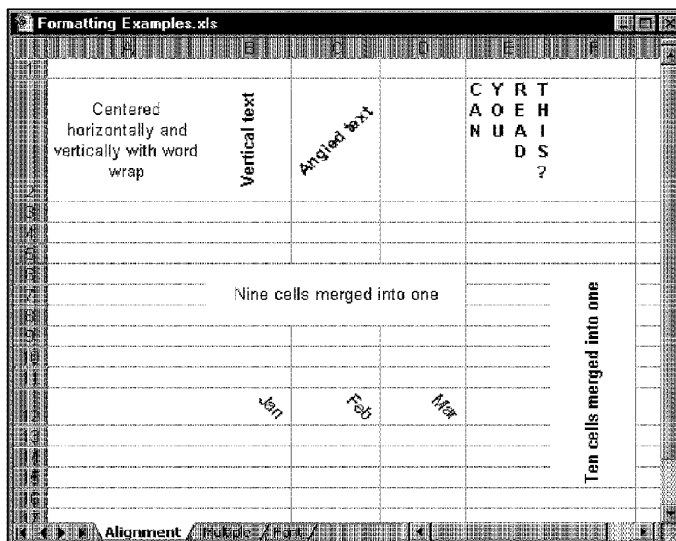
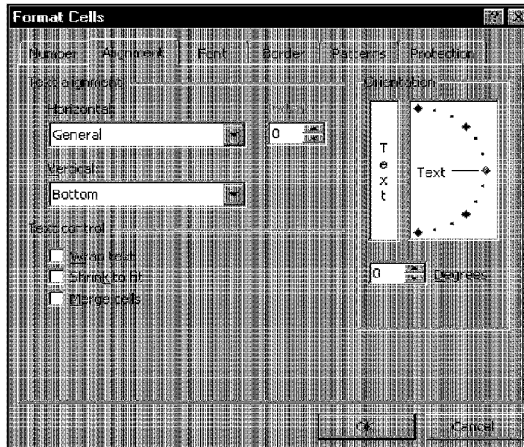


Figure 11-7: Examples of Excel's alignment options.



**Figure 11-8:** The Alignment panel in the Format Cells dialog box.

## Vertical Alignment Options

To change the vertical alignment, you must use the Alignment tab of the Format Cells dialog box (these options are not available on the Formatting toolbar). The vertical alignment options are as follows:

- **Top:** Aligns the cell contents to the top of the cell
- **Center:** Centers the cell contents vertically in the cell
- **Bottom:** Aligns the cell contents to the bottom of the cell
- **Justify:** Justifies the text vertically in the cell; this option is applicable only if the cell is formatted as wrapped text and uses more than one line

## Text Control Options

The Alignment tab of the Format Cells dialog box offers three additional options, which are discussed in the following sections.

### Wrap Text

The Wrap text option displays the text on multiple lines in the cell, if necessary. Use this option to display lengthy headings without having to make the columns too wide.

## Shrink to Fit

Excel includes a Shrink to fit option, which reduces the size of the text so that it fits into the cell without spilling over to the next cell.

If you apply wrap text formatting to a cell, you can't use the shrink-to-fit formatting.

## Merging Cells

When you merge cells, you don't combine the contents of cells. Rather, you combine a group of cells that occupy the same space into a single cell. Figure 11-9 shows two sets of merged cells. Range C3:G3 has been merged into a single cell that holds the table's title. Range B5:B9 has also been merged to hold a title for the table's rows.

Monthly Sales by Region				
Region	Jan	Feb	Mar	Q1
North	452	565	434	1,451
South	873	692	923	2,688
West	1,109	1,287	1,083	3,479
East	1,454	1,311	1,297	4,052
Total	3,888	4,055	3,727	11,670

**Figure 11-9:** The titles for this table appear in merged cells.

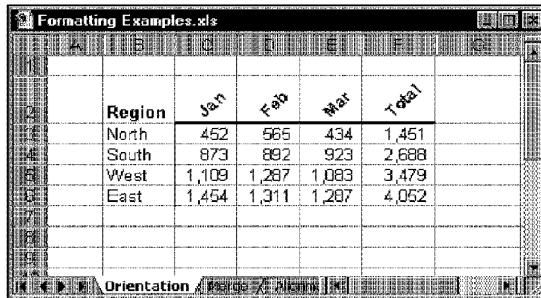
You can merge any number of cells, occupying any number of rows and columns. However, the range that you intend to merge should be empty, except for the upper-left cell. If any of the other cells that you intend to merge are not empty, Excel displays a warning.

To merge cells, select the cells that you want to merge and then click the Merge and Center tool on the Formatting toolbar. The only way to “unmerge” cells is to use the Format Cells dialog box. Select the merged cell(s), open the Format Cells dialog box, and, on the Alignment tab, remove the check from the Merge cells box.

## Changing a Cell's Orientation

You can display text horizontally, vertically, or specify an angle. To change the orientation, select the cell or range, open the Format Cells dialog box, and select the Alignment tab. Use the gauge to specify an angle between -90 and +90 degrees.

Figure 11-10 shows an example of text displayed at a 45-degree angle.



Region	Jan	Feb	Mar	Total
North	452	565	434	1,451
South	873	882	923	2,688
West	1,109	1,287	1,089	3,479
East	1,454	1,311	1,287	4,052

Figure 11-10: An example of rotated text.

## Colors and Shading

Excel provides the tools to create some very colorful worksheets. I've known people who avoid using color because they are uncertain of how the colors will translate when printed on a black-and-white printer. With Excel, that's not a valid concern. You can instruct Excel to ignore the colors when you print. Choose File • Page Setup to display the Page Setup dialog box. Click the Sheet tab and place a check in the Black and White check box.

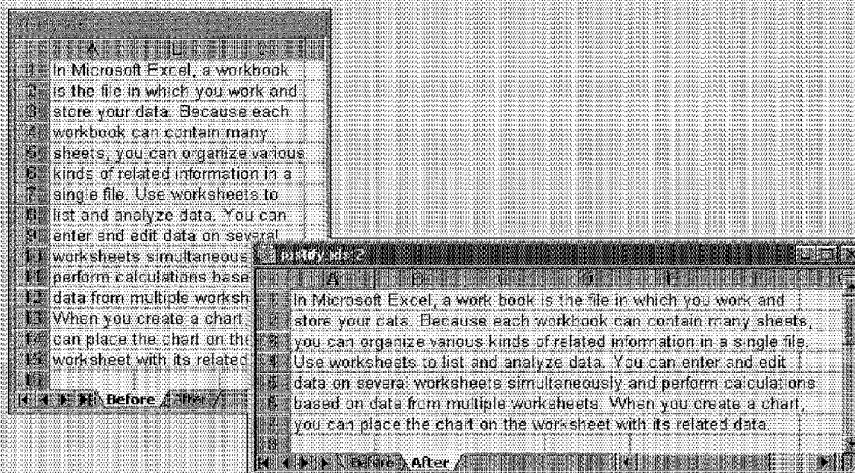
You control the color of the cell's text in the Font tab of the Format Cells dialog box, and you control the cell's background color in the Patterns tab. You can also use tools on the Formatting toolbar (Font Color and Fill Color) to change the color of these items.

A cell's background can be solid (one color) or consist of a pattern that uses two colors. To select a pattern, click the Pattern drop-down list in the Format Cells dialog box. It expands as shown in Figure 11-11. Choose a pattern from the top part of the box and a second color from the bottom part. The first pattern in the list is "None"—use this option if you want a solid background. The Sample box to the right shows how the colors and pattern will look. If you plan to print the worksheet, you need to experiment to see how the color patterns translate to your printer.

## Another Type of Justification

Excel provides another way to justify text, using its Edit • Fill • Justify command. This command has nothing to do with the alignment options discussed in this chapter. The Edit • Fill • Justify command is useful for rearranging text in cells so that it fits in a specified range. For example, you may import a text file that has very long lines of text.

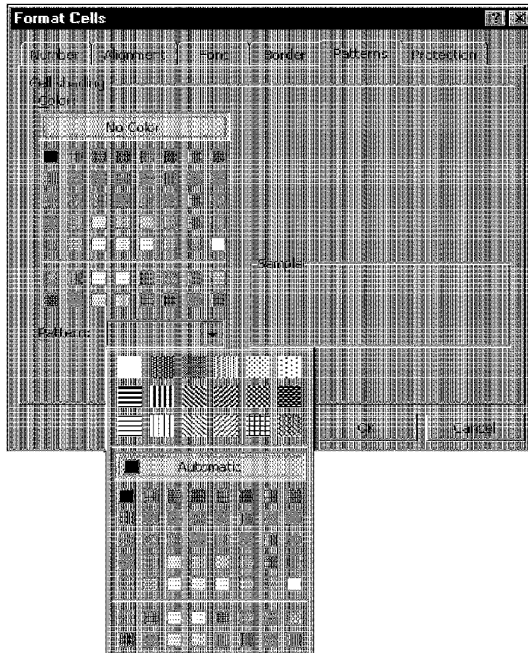
You easily can justify this text so that it's displayed in narrower lines. The accompanying figure shows a range of text before and after using the Edit • Fill • Justify command.



This command works with text in a single column. It essentially redistributes the text in the cells so that it fits into a specified range. You can make the text either wider (so that it uses fewer rows) or narrower (so that it uses more rows).

Select the cells that you want to justify (all in one column) and then extend the selection to the right so that the selection is as wide as you want the end result to be. Choose Edit • Fill • Justify, and Excel redistributes the text.

Blank rows serve as paragraph markers. If the range that you select isn't large enough to hold all the text, Excel warns you and allows you to continue or abort. Be careful, because justified text overwrites anything that gets in its way.



**Figure 11-11:** Choosing a pattern for a cell background.

You might want to use a background color to make a large table of data easier to read. You probably are familiar with computer printer paper that has alternating green-and-white horizontal shading (often referred to as “green bar”). You can use background colors to simulate this effect in Excel. See Figure 11-12 for an example.



**Tip**

Here’s a quick way to apply shading to every other row. This technique assumes that you want to shade every odd-numbered row in the range A1:F100. Start by shading A1:F1 with the color that you want. Then, select A1:F2 (row 1 is shaded and row 2 is not) and copy the range to the Clipboard. Next, select A3:F100 and choose Edit • Paste Special (with the Formats option).

To hide quickly the contents of a cell, make the background color the same as the font text color. The cell contents are still visible in the formula bar when you select the cell, however.

	Jan	Feb	Mar	Apr	May	Jun	Jul
AA-1287	4,351	2,591	3,324	2,044	1,506	4,512	2,100
AA-1289	4,149	1,583	1,504	4,130	1,672	558	4,100
AA-1291	1,197	4,289	3,752	2,854	4,039	730	1,100
AA-1293	976	1,717	3,746	2,045	4,953	3,208	4,100
AA-1295	2,385	1,090	2,862	1,363	1,227	946	4,100
AA-1297	2,349	648	2,975	4,280	1,556	3,961	1,100
AA-1299	547	2,435	564	368	3,449	2,884	1,100
AA-1301	4,846	1,482	1,074	3,543	2,438	6	1,100
AA-1303	727	923	137	1,022	3,573	1,388	1,100
AA-1305	2,733	3,855	3,068	4,470	1,715	1,272	1,100
AA-1307	2,945	4,748	743	734	4,943	433	2,100

**Figure 11-12:** Shading alternate lines can make a lengthy table easier to read.

## Borders and Lines

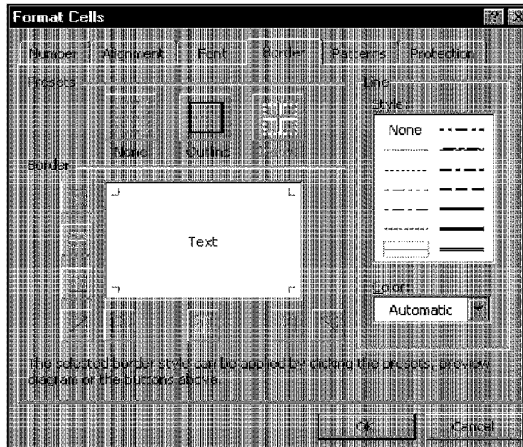
Borders often are used to group a range of similar cells or simply to delineate rows or columns. Excel offers 13 different styles of borders, as you can see on the Border tab in the Format Cells dialog box (see Figure 11-13). This dialog box works with the selected cell or range and enables you to specify which border style to use for each border of the selection.

Before you open this dialog box, select the cell or range to which you want to add borders. First, choose a line style and then choose the border position for the line style by clicking one of the icons.

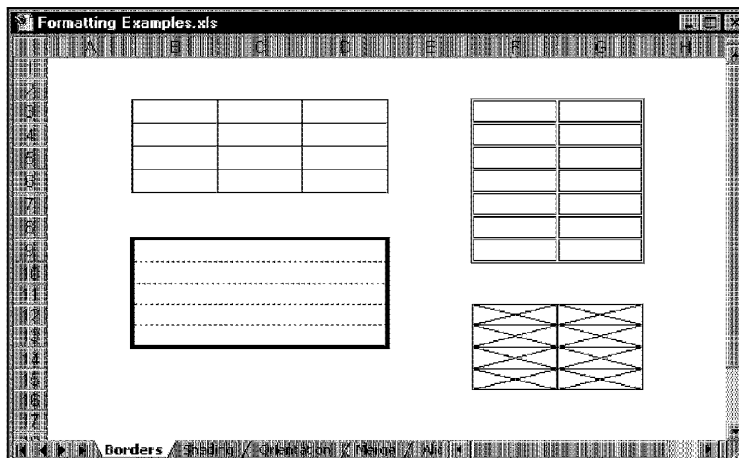
Notice that the Border tab has three “presets,” which can save you some clicking. If you want to remove all borders from the selection, click None. To put an outline around the selection, choose Outline preset. To put borders inside the selection, click Inside preset.

Excel displays the selected border style in the dialog box. You can choose different styles for different border positions and choose a color for the border. Using this dialog box may require some trial and error, but you’ll get the hang of it. Figure 11-14 shows examples of borders in a worksheet.





**Figure 11-13:** The Border tab of the Format Cells dialog box.



**Figure 11-14:** Examples of using borders in a worksheet.

When you apply diagonal lines to a cell or range, the selection looks like it has been crossed out.



**Tip**

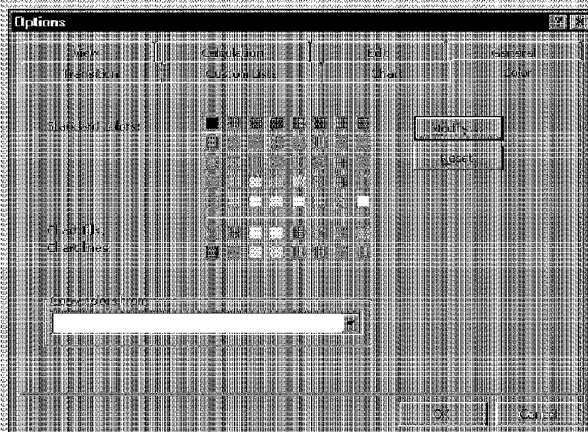
If you use border formatting in your worksheet, you might want to turn off the grid display, to make the borders more pronounced. Use the View tab of the Options dialog box to do this.

## About the Color Palette

Excel gives you 56 colors from which to choose. These colors are known as the *palette*. You can examine the colors in the palette by clicking the Color or Font Color tool on the Formatting toolbar. You may notice that these colors aren't necessarily unique (some are repeated).

Chances are, you're running Windows in a video mode that supports at least 256 colors. So, why can you use only 56 colors in Excel? Good question. That's just the way Excel was designed.

However, you're not limited to the 56 colors that some unknown techie in Redmond came up with. You can change the colors in the palette to whatever colors you like. To do so, open the Options dialog box and click the Color tab, as shown in the accompanying figure.



You'll see that the choice of colors for the palette seems to have some rationale. For example, the first 40 colors are designated standard colors. These are followed by 8 chart-fill colors and 8 chart-line colors.

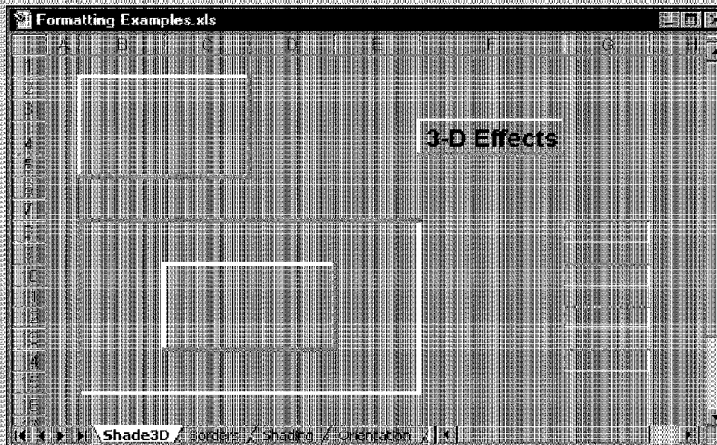
If you want to change a color, select it and click the Modify button. Excel responds with a dialog box named Colors. This dialog box has two tabs: Standard and Custom. Use either tab to select a new color (you have many more choices in the Custom tab). After you select the color, click OK, and the color that you selected replaces the previous color.

If your worksheet uses the replaced color, the new color takes over where that color appeared. If your system is using a video driver that supports only 16 colors, the system creates some of the colors by blending two colors (*dithering*). Dithered colors can be used for cell backgrounds, but text and lines are displayed using the nearest solid color. If you want to revert back to Excel's standard colors, click the Reset button.

Each workbook stores its own copy of the color palette, and you even can copy color palettes from another workbook (which must be open). Use the Options dialog box's drop-down box labeled Copy Colors From.

## Producing 3D Effects

You can use a combination of borders and background shading to produce attractive 3D effects on your worksheet. These 3D effects resemble raised or depressed tabs, as shown in the accompanying figure.



For the best results, use a light-gray background color. To produce a raised effect, apply a white border to the top and left side of the range, and a dark-gray border on the bottom and right side.

To produce a sunken effect, use a dark-gray border on the top and left side, and a white border on the bottom and right side. You can vary the line thickness to produce different effects.

You'll find the 3D Shading utility, which is part of the Power Utility Pak, on this book's CD-ROM.

## Adding a Worksheet Background

Excel also enables you to choose a graphics file to serve as a background for a worksheet — similar to the wallpaper that you may display on your Windows desktop. The image that you choose is repeated, so that it tiles the entire worksheet.

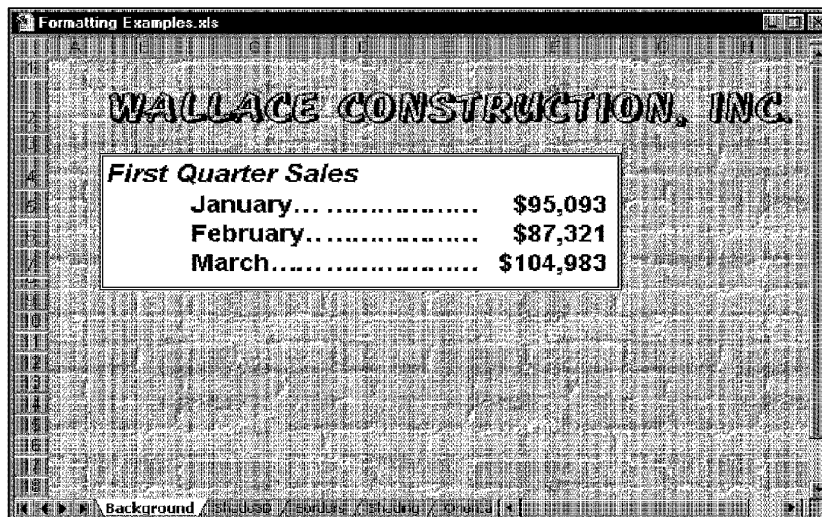


Thousands of background graphics files are available on the World Wide Web. Many Web sites use graphics files for backgrounds, and these files are designed to tile nicely. In addition, these files are usually very small. If you encounter a Web site that uses a good graphic as a background, you can save the file to your hard drive and use it in your Excel workbooks.

To add a background to a worksheet, choose **FormatSheet • Background**. Excel displays a dialog box that enables you to choose a graphics file. When you locate a file, click **OK**. Excel tiles your worksheet with the graphic. Some backgrounds make viewing text difficult, so you may want to use a solid background color for cells that contain text (see Figure 11-15). You'll also want to turn off the gridline display, because the gridlines show through the graphic.



The graphic background on a worksheet is for display only—it isn't printed when you print the worksheet.



**Figure 11-15:** This worksheet has a graphic background, but cells that contain text use a white background, which overrides the graphic.

## AutoFormatting

So far, this chapter has described the individual formatting commands and tools at your disposal. Excel also has an *AutoFormatting* feature that can automatically perform many types of formatting for you. Figure 11-16 shows an unformatted table in a worksheet (left side) and the same table formatted using one of Excel's AutoFormats.



You also can apply AutoFormatting to PivotTables; see Chapter 25.

## Copying Formats by Painting

If you want to copy the formats from one cell to another cell or range, you can select **Edit • Paste Special** and then click the **Formats** option. Or, use the **Format Painter** button on the **Standard** toolbar (the button with the paintbrush image).

Start by selecting the cell or range that has the formatting attributes you want to copy. Then, click the **Format Painter** button. Notice that the mouse pointer changes to include a paintbrush. Next, select the cells to which you want to apply the formats. Release the mouse button, and Excel completes the painting (and you don't have to clean the brush).

If you double-click the **Format Painter** button, you can paint multiple areas of the worksheet with the same formats. Excel applies the formats that you copy to each cell or range that you select. To get out of paint mode, click the **Format Painter** button again (or press **Esc**).

Month	Revenue	Expenses	Net Income
Jan-97	31256	11832	19424
Feb-97	35344	12322	23022
Mar-97	29833	10983	18850
Apr-97	39832	15433	24399
May-97	31443	18933	12510
Jun-97	28444	8922	19522
Jul-97	25446	9122	16323
Aug-97	65984	21033	44951
Sep-97	43012	11390	31622
Oct-97	31339	12540	18799
Nov-97	39083	13221	25862
Dec-97	31444	14436	17009
Annual	433059	160166	272893

**Figure 11-16:** A worksheet table before and after using AutoFormat.

## Using AutoFormats

To apply an AutoFormat, move the cell pointer anywhere within a table that you want to format; Excel determines the table's boundaries automatically. Then, choose **Format • AutoFormat**. Excel responds with the dialog box shown in Figure 11-17. Choose one of the 17 AutoFormats from the list and click **OK**. Excel formats the table for you.

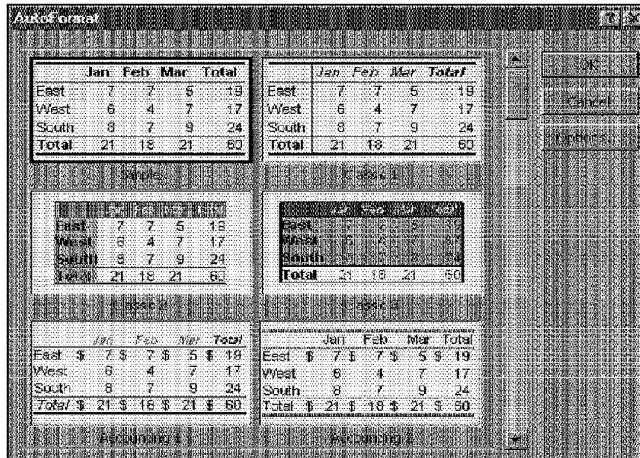


Figure 11-17: The AutoFormat dialog box.

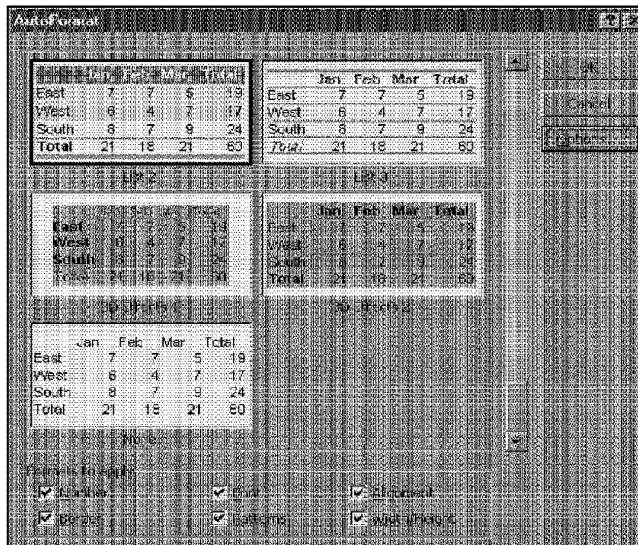
Excel applies AutoFormatting rather intelligently. For example, Excel analyzes the data contained in the table and then formats the table to handle items such as subtotals. Figure 11-18 shows an example of a table that contains a subtotal line for each department. When I applied an AutoFormat, Excel took these subtotals into account and produced an attractive table in about one second.

Region	State	Sales
West	California	572,000.00
West	Washington	302,250.00
West	Oregon	125,250.00
<b>West Total</b>		<b>1,569,569.00</b>
East	New York	272,250.00
East	New Jersey	272,250.00
East	Massachusetts	400,000.00
<b>East Total</b>		<b>1,692,937.00</b>
Midwest	Missouri	202,250.00
Midwest	Illinois	293,000.00
<b>Midwest Total</b>		<b>520,813.00</b>
<b>Grand Total</b>		<b>4,182,389.00</b>

Figure 11-18: AutoFormatting even accommodates subtotals in a table.

## Controlling AutoFormats

Although you can't define your own AutoFormats, you can control the type of formatting that is applied. When you click the Options button in the AutoFormat dialog box, the dialog box expands to show six options (see Figure 11-19).

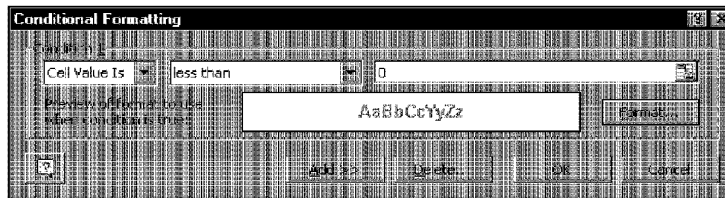


**Figure 11-19:** The AutoFormat dialog box, expanded to show its options.

Initially, the six check boxes are all checked—which means that Excel will apply formatting from all six categories. If you want it to skip one or more categories, just remove the check from the appropriate box before you click OK. For example, when I use AutoFormats, I hardly ever want Excel to change the column widths, so I turn off the Width/Height option. If you've already formatted the numbers, you may want to turn off the Number option.

## Using Conditional Formatting

Excel's conditional formatting feature changes cell formats based on the contents of the cell. For example, if the cell contains a negative number, the cell appears bold with a red background. To apply conditional formatting to a cell or range, select the range and then choose **Format • Conditional Formatting**. You'll see the dialog box shown in Figure 11-20, which enables you to specify up to three conditions for the selected cells.



**Figure 11-20:** Excel enables you to specify formats based on the cell's value.

The condition can be based on either the cell's value or a formula that you specify (the formula must be a logical formula and return either True or False). Follow these steps to apply conditional formatting:

1. In the first drop-down list, choose either Cell Value Is or Formula Is.
2. If you chose Cell Value Is in Step 1, specify the conditions by using the controls in the dialog box. For example, you can specify between 0 and 100. You can enter values or cell references.
3. If you chose Formula Is in Step 1, specify a reference to the formula. Remember, the formula must return either True or False.
4. Click the Format button and specify the formatting that will be used when the condition is true.
5. If you want to specify another conditional format for the selection, click the Add button. The dialog box expands so that you can repeat Steps 1 through 4 for another condition.
6. When you finish, click OK.



Conditional formatting is a great feature, but it's not foolproof. If you copy a value and paste it into a cell that has conditional formatting, the formatting will not be applied. In fact, copying a value to a cell that has conditional formatting wipes out the conditional formatting information. In other words, the feature works only for data that is entered into a cell manually or calculated by a formula.

## Using Named Styles

The *named style* feature—borrowed from word processing—is, perhaps, one of the most underutilized features in Excel (named styles may also be the most underutilized feature in word processors).

If you find that you continually are applying the same combination of fonts, lines, and shading in your worksheets, you can save time and effort if you create and use named styles. Named styles apply, in a single step, the formats that you specify, helping you to apply consistent formats across your worksheets.



The real power of styles lies in what happens when you change a component of a style; in this case, all the cells that use that named style automatically incorporate the change. Suppose that you apply a particular style to a dozen cells scattered throughout your worksheet. Later, you realize that these cells should have a font size of 14 points rather than 12 points. Rather than change each cell, simply edit the style. All cells with that particular style change automatically.

A style can consist of settings for six different attributes, although a style doesn't have to use all the attributes. You may recognize these attributes; they correspond to the six tabs in the Format Cells dialog box. The attributes that make up a style are the following:

- Number format
- Font (type, size, and color)
- Alignment (vertical and horizontal)
- Borders
- Pattern
- Protection (locked and hidden)

By default, all cells have the Normal style. In addition, Excel provides five other built-in styles—all of which control only the cell's number format. The styles that are available in every workbook are listed in Table 11-1. If these styles don't meet your needs (and they probably don't), you can easily create new styles.

**Table 11-1  
Excel's Built-In Styles**

<i>Style Name</i>	<i>Description</i>	<i>Number Format Example</i>
Normal	Excel's default style	1234
Comma*	Comma with two decimal places	1,234.00
Comma[0]	Comma with no decimal places	1,234
Currency*	Left-aligned dollar sign with two decimal places	\$1,234.00
Currency[0]	Left-aligned dollar sign with no decimal places	\$1,234
Percent*	Percent with no decimal places	12%

\* This style can be applied by clicking a button the Standard toolbar.

## Applying Styles

This section discusses the methods that you can use to apply existing styles to cells or ranges.

### Toolbar Buttons

As mentioned in the preceding section, you can use three buttons on the Standard toolbar to attach a particular style to a cell or range. You need to understand that when you use these buttons to format a value, you're really changing the cell's style. Consequently, if you later want to change the Normal style, cells formatted with any of these buttons won't be affected by the change.

### Using the Style Tool

If you plan to work with named styles, you might want to make an addition to one of your toolbars. In fact, I strongly suggest that you do so. Excel has a handy Style tool available. However, this tool (oddly) is not on any of the built-in toolbars — maybe this is why the named style feature is underutilized. To add the Style tool to a toolbar (the Formatting toolbar is a good choice), follow these steps:

1. Right-click any toolbar and choose **Customize** from the shortcut menu. Excel displays its **Customize** dialog box.
2. Click the **Commands** tab.
3. In the **Categories** list box, click **Formatting**. The **Buttons** box displays all available tools in the **Formatting** category.
4. Click the **Style** tool (it's a list box labeled *Style*) and drag it to your **Formatting** toolbar. If you drag the **Style** tool to the middle of the toolbar, the other tools scoot over to make room for it.
5. Click the **Close** button in the **Customize** dialog box.

The new **Style** tool displays the style of the selected cell and also lets you quickly apply a style — or even create a new style. To apply a style by using the **Style** tool, select the cell or range, open the **Style** list box, and then choose the style that you want to apply.

### Using the Format • Style Command

You also can apply a style by using the **Format • Style** command, which prompts Excel to display its **Style** dialog box. Just choose the style that you want to apply from the **Style Name** drop-down list. However, using the **Style** tool, as described in the previous section, is a much quicker way to apply a style.

The CD-ROM for this book contains a workbook that defines several styles. You may want to open this workbook and experiment.



## Modifying a Style

To change an existing file, open the Style dialog box. From the Style name drop-down box, choose the style that you want to modify. You can make changes to the check boxes to include or exclude any of the format categories, or you can click the Modify button to display the familiar Format Cells dialog box. Make the changes that you want and click OK. Click OK again to close the Style dialog box. Excel modifies all the cells formatted with the selected style by applying the new formatting.



You also can use the Style tool to change a style. Start by modifying the formatting of a cell that uses the style. Then, click inside the Style tool list box, select the style name, and press Enter. Excel asks whether you want to redefine the style based on the selection. Respond in the affirmative to change the style—and all of the cells that use the style.

## Deleting a Style

If you no longer need a style, you can delete it. To do so, open the Style dialog box, choose the style from the list, and then click Delete. All the cells that had the style revert back to the Normal style.

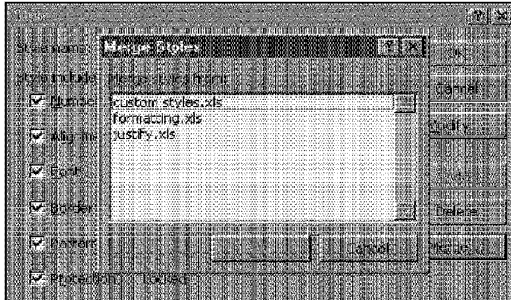
Suppose that you applied a style to a cell and then applied additional formatting. If you delete the style, the cell retains all of its additional formatting.

## Merging Styles from Other Workbooks

You may create one or more styles that you use frequently. Although you could go through the motions and create these styles for every new workbook, a better approach is to merge the styles from a workbook in which you previously created them.

To merge styles from another workbook, open both the workbook that contains the styles that you want to merge *and* the workbook into which you want to merge styles. From the workbook *into which* you want to merge styles, choose Format • Style and click the Merge button. Excel displays a list of all open workbooks, as shown in Figure 11-22. Select the workbook that contains the styles you want to merge and click OK. Excel copies styles from the workbook that you selected into the active workbook.

When you're merging styles, colors are based on the palette stored with the workbook in which you use the style. Therefore, if the two workbooks involved in the merge use different color palettes, the colors used in the styles may not look the same in each workbook.



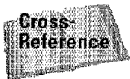
**Figure 11-22:** Merging styles from another workbook is a good way to make your workbooks look consistent.

## Controlling Styles with Templates

When you start Excel, it loads with several default settings, including the settings for stylistic formatting. If you spend a lot of time changing the default elements, you should know about templates.

Here's an example. You may prefer to use 12-point Arial rather than 10-point Arial as the default font. And maybe you prefer Wrap Text to be the default setting for alignment. Templates provide an easy way to change defaults.

The trick is to create a workbook with the Normal style modified to the way that you want it. Then, save the workbook as a template in your XLStart folder. After doing so, you can select File • New to display a dialog box from which you can choose the template for the new workbook. Template files also can store other named styles, providing you with an excellent way to give your workbooks a consistent look.



Chapter 34 discusses templates in detail.

## Summary

This chapter explores all topics related to stylistic formatting: different fonts and sizes, alignment options, applying colors and shading, and using borders and lines. It discusses Excel's AutoFormat feature, which can format a table of data automatically. The chapter concludes with a discussion of named styles, an important concept that can save you time and make your worksheets look more consistent.

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# Printing Your Work

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**M**any of the worksheets that you develop with Excel are designed to serve as printed reports. You'll find that printing from Excel is quite easy, and you can generate attractive, well-formatted reports with minimal effort. But, as you'll see, Excel has plenty of options that provide you with a great deal of control over the printed page. These options are explained in this chapter.

## One-Step Printing

The Print button on the Standard toolbar is a quick way to print the current worksheet, using the default settings. Just click the button, and Excel sends the worksheet to the printer. If you've changed any of the default print settings, Excel uses the new settings; otherwise, it uses the following default settings:

- Prints the active worksheet (or all selected worksheets), including any embedded charts or drawing objects
- Prints one copy
- Prints the entire worksheet
- Prints in portrait mode
- Doesn't scale the printed output
- Uses 1-inch margins for the top and bottom and .75-inch margins for the left and right
- Prints with no headers or footers
- For wide worksheets that span multiple pages, it prints down and then across

# 12

CHAPTER

## In This Chapter

One-Step Printing

Adjusting Your Print Settings

Settings in the Print Dialog Box

Settings in the Page Setup Dialog Box

Using Print Preview

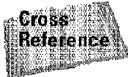
Dealing with Page Breaks

Using Custom Views

More About Printing

As you might suspect, you can change any of these default print settings.

When you print a worksheet, Excel prints only the *active area* of the worksheet. In other words, it won't print all four million cells — just those that have data in them. If the worksheet contains any embedded charts or drawing objects, they also are printed (unless you have modified the Print Object property of the object).



If you create a workbook based on a template, the template may contain different default print settings. Templates are discussed in Chapter 34.

## Adjusting Your Print Settings

You adjust Excel's various print settings in two different dialog boxes:

- The Print dialog box (accessed either with the File • Print command or Ctrl+P).
- The Page Setup dialog box (accessed with the File • Page Setup command). This is a tabbed dialog box with four tabs.

Both of these dialog boxes have a Print Preview button that previews the printed output onscreen.

## Settings in the Print Dialog Box

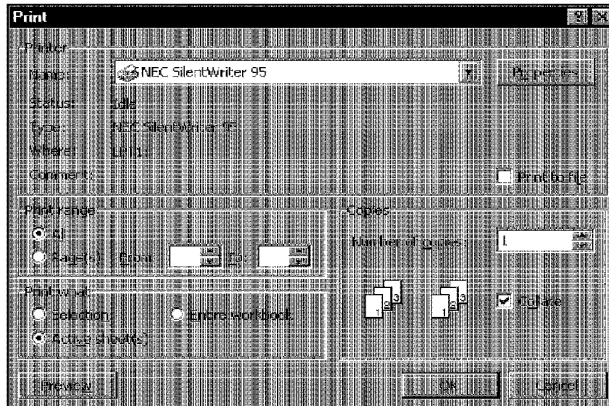
You actually start the printing process from the Print dialog box, unless you use the Print button on the Standard toolbar. After you select your print settings, click OK from the Print dialog box to print your work.

### Selecting a Printer

Before printing, make sure that you have selected the correct printer (applicable only if you have access to more than one printer) by using the Print dialog box, shown in Figure 12-1. You can select the printer from the Printer drop-down list. This dialog box also lists information about the selected printer, such as its status and where it's connected.



Clicking the Properties button displays a property box for the selected printer. The exact dialog box that you see depends on the printer. The Properties dialog box lets you adjust printer-specific settings. In most cases, you won't have to change any of these settings, but you should be familiar with the settings that you can change.



**Figure 12-1:** Select a printer in the Print dialog box.

If you check the **Print to file** check box, Excel stores the output in a file, prompting you for a filename before printing. The resulting file will *not* be a standard text file. Rather, it will include all the printer codes that are required to print your worksheet. Printing to a file is useful if you don't have immediate access to a printer. You can save the output to a file and then send this file to your printer at a later time.



**Tip** If you want to save your workbook as a text file, use the **File • Save As** command, and select one of the text file formats from the drop-down list labeled **Save as type**.

Before printing, you might want to view your worksheets in **Page Break Preview** mode. To enter this mode, choose the **View • Page Break Preview** command. The worksheet display changes, and you can see exactly what will be printed and where the page breaks occur. To change the print range, drag any of the dark borders. This feature is discussed in more detail later in this chapter.

After you print a worksheet (or view it in **Page Break Preview** mode), Excel displays dashed lines to indicate where the page breaks occur. This is a useful feature, because the display adjusts dynamically. For example, if you find that your printed output is too wide to fit on a single page, you can adjust the column widths (keeping an eye on the page-break display) until they are narrow enough to print on one page.



**Tip** If you don't want to see the page breaks displayed in your worksheet, open the **Options** dialog box, click the **View** tab, and remove the check mark from the **Automatic Page Breaks** check box.



## Printing Selected Pages

If your printed output uses multiple pages, you can select which pages to print, in the Print dialog box. In the Page range section, indicate the number of the first and last pages to print. You can either use the spinner controls or type the page numbers in the edit boxes.

## Specifying What to Print

The Print what section of the Print dialog box lets you specify what to print. You have three options:

- **Selection:** Prints only the range that you selected before issuing the File • Print command.
- **Selected sheet(s):** Prints the active sheet or sheets that you selected. You can select multiple sheets by pressing Ctrl and clicking the sheet tabs. If you select multiple sheets, Excel begins printing each sheet on a new page.
- **Entire workbook:** Prints the entire workbook, including chart sheets.



Tip

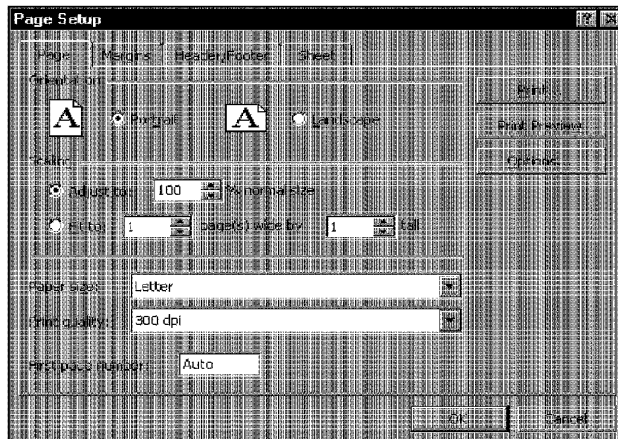
You can also select File • Print Area • Set Print Area to specify the range or ranges to print. Before you choose this command, select the range or ranges that you want to print. To clear the print area, select File • Print Area • Clear Print Area.

## Printing Multiple Copies

The Print dialog box also enables you to select the number of copies to print. The upper limit is 32,767 copies—not that anyone would ever need that many. You also can specify that you want the copies collated. If you choose this option, Excel prints the pages in order for each set of output. If you're printing only one page, Excel ignores the Collate setting.

## Settings in the Page Setup Dialog Box

Using the Page Setup dialog box, you can control page settings and margins, create headers and footers, and adjust sheet settings. Choose File • Page Setup to open the Page Setup dialog box; in Figure 12-2, you see the Page tab of the Page Setup dialog box.



**Figure 12-2:** You control page settings in the Page tab of the Page Setup dialog box.

## Controlling Page Settings

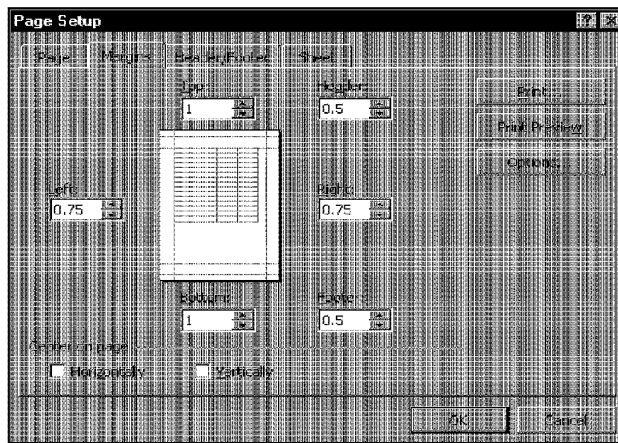
The Page tab of the Page Setup dialog box enables you to control the following settings:

- **Orientation:** Choose either Portrait (tall pages) or Landscape (wide pages). Landscape orientation might be useful if you have a wide range that doesn't fit on a vertically oriented page.
- **Scaling:** You can set a scaling factor manually or let Excel scale the output automatically to fit on the number of pages that you specify. Scaling can range from 10 percent to 400 percent of normal size. If you want to return to normal scaling, enter 100 in the box labeled % normal size.
- **Paper size:** This setting enables you to select the paper size that you're using. Click the box and see the choices.
- **Print quality:** If the installed printer supports it, you can change the printer's resolution—which is expressed in dots per inch (dpi). Higher numbers represent better print quality, but higher resolutions take longer to print.
- **First page number:** You can specify a page number for the first page. This is useful if the pages that you're printing will be part of a larger document and you want the page numbering to be consecutive. Use Auto if you want the beginning page number to be 1—or to correspond to the pages that you selected in the Print dialog box. If you're not printing page numbers in your header or footer, this setting is irrelevant.

## Adjusting Margins

A margin is the blank space on the side of the page. Wider margins leave less space available for printing. You can control all four page margins from the Margins tab of the Page Setup dialog box, shown in Figure 12-3.

To change a margin, click the appropriate spinner (or you can enter a value directly).



**Figure 12-3:** The Margins tab of the Page Setup dialog box.

**Note**

The Preview box in the center of the dialog box is a bit deceiving, because it doesn't really show you how your changes look in relation to the page. Rather, it simply displays a darker line to let you know which margin you're adjusting.

In addition to the page margins, you can adjust the distance of the header from the top of the page and the distance of the footer from the bottom of the page. These settings should be less than the corresponding margin; otherwise, the header or footer may overlap with the printed output.

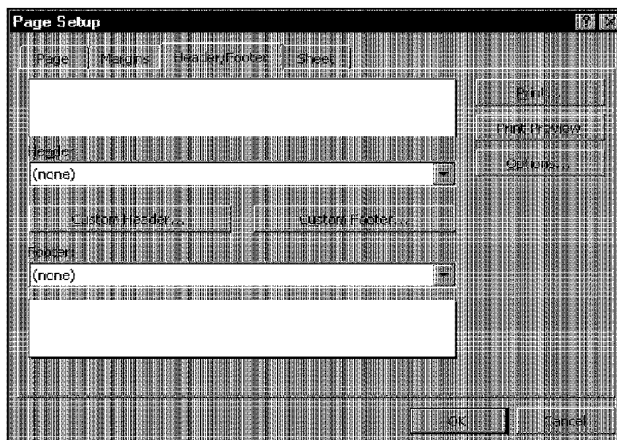
Normally, Excel aligns the printed page at the top and left margins. If you would like the output to be centered vertically or horizontally, check the appropriate check box.

You also can change the margins while you're previewing your output — ideal for last-minute adjustments before printing. Previewing is explained later in the chapter.

## Changing the Header or Footer

A *header* is a line of information that appears at the top of each printed page. A *footer* is a line of information that appears at the bottom of each printed page. You can align information in headers and footers at the left margin, in the center of the header or footer, and at the right margin. For example, you can create a header that prints your name at the left margin, the worksheet name centered in the header, and the page number at the right margin. By default, new workbooks do not have any headers or footers.

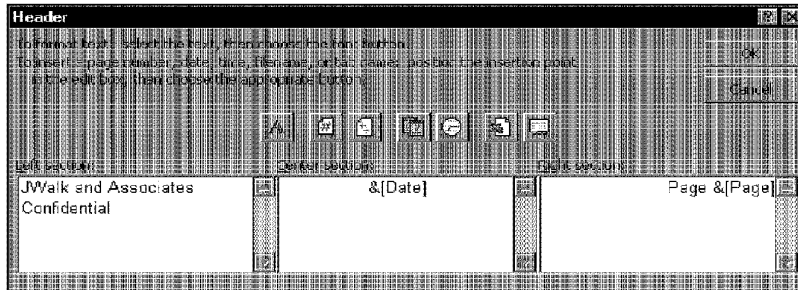
The Header/Footer tab of the Page Setup dialog box appears in Figure 12-4. This dialog box displays the current header and footer and gives you other header and footer options in the drop-down lists labeled Header and Footer.



**Figure 12-4:** The Header/Footer tab of the Page Setup dialog box.

When you click the Header (or Footer) drop-down list, Excel displays a list of predefined headers (or footers). If you see one that you like, select it. You then can see how it looks in context — which part is left-justified, centered, or right-justified. If you don't want a header or footer, choose the option labeled (none) for both the Header and Footer drop-down list boxes.

If you don't find a predefined header or footer that is exactly what you want, you can define a custom header or footer. Start by selecting a header or footer that's similar to the one that you want to create (you'll use the selected header or footer as the basis for the customized one). Click the Custom Header or Custom Footer button, and Excel displays a dialog box like the one shown in Figure 12-5.



**Figure 12-5:** If none of the predefined headers or footers is satisfactory, you can define a custom header or custom footer.

This dialog box enables you to enter text or codes in each of the three sections. To enter text, just click in the section and enter the text. To enter variable information, such as the current date or the page number, you can click one of the buttons. Clicking the button inserts a special code. The buttons and their functions are listed in Table 12-1.

**Table 12-1**  
**Custom Header/Footer Buttons and Their Functions**

<i>Button</i>	<i>Code</i>	<i>Function</i>
Font	Not applicable	Lets you choose a font for the selected text
Page Number	&[Page]	Inserts the page number
Total Pages	&[Pages]	Inserts the total number of pages to be printed
Date	&[Date]	Inserts the current date
Time	&[Time]	Inserts the current time
File	&[File]	Inserts the workbook name
Sheet	&[Tab]	Inserts the sheet's name

You can combine text and codes and insert as many codes as you like into each section. If the text that you enter uses an ampersand (&), you must enter the ampersand twice (because Excel uses an ampersand to signal a code). For example, to enter the text *Research & Development* into a section of a header or footer, enter **Research && Development**.

You also can use different fonts and sizes in your headers and footers. Just select the text that you want to change and then click the Font button. Excel displays its Fonts dialog box so that you can make your choice. If you don't change the font, Excel uses the font defined for the Normal style.



If the Print area box is blank, Excel prints the entire worksheet. You can activate this box and select a range (Excel will modify its definition of `Print_Area`), or you can enter a previously defined range name into the box.

### Print titles

Many worksheets are set up with titles in the first row and descriptive names in the first column. If such a worksheet requires more than one page, reading subsequent pages may be difficult, because the text in the first row and first column won't be printed on subsequent pages. Excel offers a simple solution: *print titles*.



Caution

Don't confuse print titles with headers; these are two different concepts. Headers appear at the top of each page and contain information such as the worksheet name, date, or page number. Print titles describe the data being printed, such as field names in a database table or list.

You can specify particular rows to repeat at the top of every printed page, or particular columns to repeat at the left of every printed page. To do so, just activate the appropriate box and select the rows or columns in the worksheet. Or, you can enter these references manually. For example, to specify rows 1 and 2 as repeating rows, enter `1:2`.

In the old days, users often were surprised to discover that print titles appeared twice on the first page of their printouts. This occurred because they defined a print area that included the print titles. Excel now handles this automatically, however, and doesn't print titles twice if they are part of the print area.



Tip

You can specify different print titles for each worksheet in the workbook. Excel remembers print titles by creating sheet-level names (`Print_Titles`).

### Print

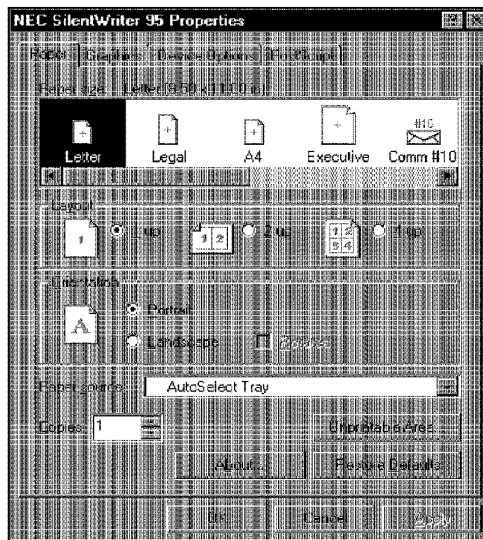
The section labeled Print contains five check boxes:

- **Gridlines:** If checked, Excel prints the gridlines to delineate cells. If you turn off the gridline display in the worksheet (in the View tab of the Options dialog box), Excel automatically removes the check from this box for you. In other words, the default setting for this option is determined by the gridline display in your worksheet.
- **Black and white:** If checked, Excel ignores any colors in the worksheet and prints everything in black and white. By taking advantage of this option, you can format your worksheet for viewing on your monitor and still get readable print output.
- **Draft quality:** If checked, Excel prints in draft mode. In draft mode, Excel doesn't print embedded charts or drawing objects, cell gridlines, or borders, which reduces the printing time.
- **Row and column headings:** If checked, Excel prints the row and column headings on the printout, enabling you to identify easily specific cells from a printout.

- **Comments:** If checked, Excel prints cell notes by using the option that you specify: either At the end of the sheet or As displayed on sheet.

## Printer-Specific Options

The Print dialog box has a button labeled Options (refer to Figure 2-2). Clicking this button displays another dialog box that enables you to adjust properties that are specific to the selected printer. See Figure 12-7 for an example. You can also open this dialog box from the Page Setup dialog box (click the Options button).



**Figure 12-7:** The Page Setup dialog box lets you set printer-specific options.

Some of the printer settings can be set directly from Excel. Other settings may not be accessible from Excel, and you can change them in this dialog box. For example, if your printer uses multiple paper trays, you can select which tray to use.

## Using Print Preview

Excel's print preview feature displays an image of the printed output on your screen. This is a handy feature that enables you to see the result of the options that you set, before you actually send the job to the printer. It'll save you lots of time — not to mention printing supplies.

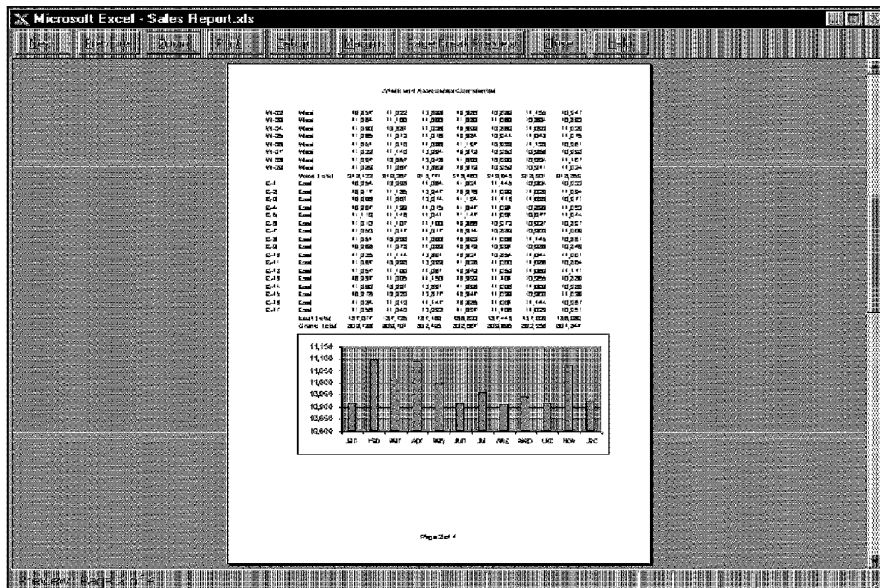


## Accessing Print Preview

Several ways exist to preview your document:

- Select the File • Print Preview command.
- Click the Print Preview button on the Standard toolbar. Or, you can press Shift and click the Print button on the Standard toolbar (the Print button serves a dual purpose).
- Click the Print Preview button in the Print dialog box.
- Click the Print Preview button in the Page Setup dialog box.

Any one of these methods changes Excel's window to a preview window, as shown in Figure 12-8.



**Figure 12-8:** The print preview feature enables you to see the printed output before you send it to the printer.

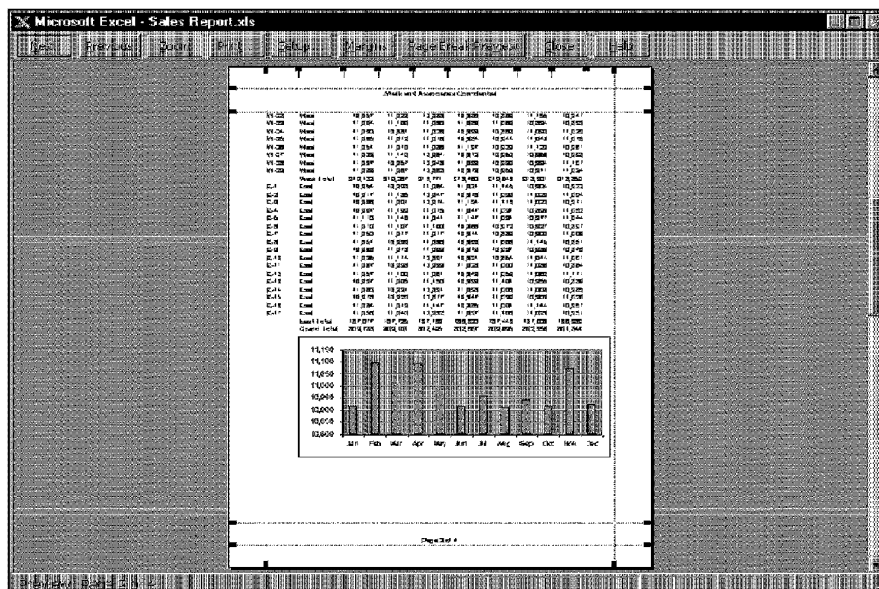
The preview window has several buttons along the top:

- **Next:** Displays an image of the next page.
- **Previous:** Displays an image of the previous page.

- **Zoom:** Zooms the display in or out. This button toggles between the two levels of zooming that are available. You also can simply click the preview image to toggle between zoom modes.
- **Print:** Sends the job to the printer.
- **Setup:** Displays the Page Setup dialog box, so that you can adjust some settings. When you close the dialog box, you return to the preview screen, so that you can see the effects of your changes.
- **Margins:** Displays adjustable columns and margins, described in the next section.
- **Page Break Preview:** Displays the worksheet in Page Break Preview mode.
- **Close:** Closes the preview window.
- **Help:** Displays help for the preview window.

## Making Changes While Previewing

When you click the Margins button in the preview window, Excel adds markers to the preview that indicate column borders and margins (see Figure 12-9). You can drag the column or margin markers to make changes that appear onscreen.



**Figure 12-9:** You can adjust column widths or margins directly from the print preview window.

For example, if you print a worksheet and discover that Excel is printing the last column on a second page, you can adjust the column widths or margins in the preview window to force all the columns to print on a single page. After you drag one of these markers, Excel updates the display so that you can see what effect it had.

When you make changes to the column widths in the preview window, these changes also are made to your worksheet. Similarly, changing the margins in the preview window changes the settings that appear in the Margins tab of the Page Setup dialog box.

## Dealing with Page Breaks

If you print lengthy reports, you know that it's often important to have control over the page breaks. For example, you normally wouldn't want a row to print on a page by itself. Fortunately, Excel gives you superb control over page breaks.

As you may have discovered, Excel handles page breaks automatically. After you print or preview your worksheet, it even displays dashed lines to indicate where page breaks occur. Sometimes, however, you'll want to force a page break—either a vertical or a horizontal one. For example, if your worksheet consists of several distinct areas, you may want to print each area on a separate sheet of paper.

### Inserting a Page Break

To insert a vertical manual page break, move the cell pointer to the cell that will begin the new page, but make sure that you place the pointer in column A; otherwise, you'll insert a vertical page break and a horizontal page break. For example, if you want row 14 to be the first row of a new page, select cell A14. Then, choose **Insert • Page Break**. Excel displays a dashed line to indicate the page break. The dashed line for manual page breaks is slightly thinner than the lines for natural page breaks.

To insert a horizontal page break, move the cell pointer to the cell that will begin the new page, but in this case, make sure that you place the pointer in row one. Select **Insert • Page Break** to create the page break.

### Removing a Page Break

To remove a vertical manual page break, move the cell pointer anywhere in the first row beneath the manual page break and then select **Insert • Remove Page Break** (this command appears only when you place the cell pointer in the first row following a manual page break).

To remove a horizontal manual page break, perform the same procedure, but position the cell pointer anywhere in the first column following a horizontal page break.



To remove all manual page breaks in the worksheet, click the Select All button (or press Ctrl+A); then, choose Insert • Remove Page Break.

## Using Page Break Preview

Page Break Preview mode makes dealing with page breaks easy. To use Page Break Preview, choose View • Page Break Preview. The screen changes, as shown in Figure 12-10.



**Figure 12-10:** Page Break Preview mode gives you a bird's-eye view of your worksheet and shows exactly where the page breaks occur.

When you enter Page Break Preview mode, Excel does the following:

- Changes the zoom factor so that you can see more of the worksheet
- Displays the page numbers overlaid on the pages
- Displays the current print range with a white background; nonprinting data appears with a gray background
- Displays all page breaks

When you're in Page Break Preview mode, you can drag the borders to change the print range or the page breaks. When you change the page breaks, Excel automatically adjusts the scaling so that the information fits on the pages, per your specifications.



**Note** In Page Break Preview mode, you still have access to all of Excel's commands. You can change the zoom factor if you find the text to be too small.

To return to normal viewing, select the View • Normal command.

## Using Custom Views

Workbooks commonly are used to store a variety of information, and often, several different reports are printed from such workbooks. If this sounds familiar, you need to know about Excel's custom views feature.

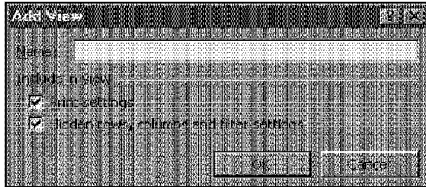
The custom views feature enables you to give names to various views of your worksheet, and you can quickly switch among these named views. A view includes settings for the following:

- Print settings, as specified in the Page Setup dialog box (optional)
- Hidden rows and columns (optional)
- Display settings, as specified in the Options Display dialog box
- Selected cells and ranges
- The active cell
- Window sizes and positions
- Frozen panes

For example, you might define a view that hides a few columns of numbers, another view with a print range defined as a summary range only, another view with the page setup set to landscape, and so on.

To create a named custom view, first set up your worksheet with the settings that you want to include in the view. These settings can include any of the settings listed previously. For example, you might create a view that has a specific range of cells defined as the print range. Then, select View • Custom Views, and Excel displays a dialog box that lists all named views. Initially, this list is empty, but you can click the Add button to add a view in the Add View dialog box, shown in Figure 12-11.

Enter a name for the view and make any adjustments to the check boxes. Click OK, and Excel saves the view. You can add as many views as you want and easily switch among them—just highlight the custom view that you want to display from the Custom Views dialog box and then click the Show button.



**Figure 12-11:** Use the Add View dialog box to supply a name for a new custom view.

## More About Printing

A few issues related to printing just don't fit anywhere other than a “miscellaneous” section. This section serves as that “miscellaneous” section and provides some additional information regarding printing.

### Problems with Fonts (When WYS Isn't WYG)

Sometimes, you may find that the printed output doesn't match what you see onscreen. You almost always can trace this problem to the fonts that you use. If your printer doesn't have a font that you use to display your worksheet, Windows attempts to match the font as best as it can. Often, the match just isn't good enough.

Simply using TrueType fonts almost always solves this problem; these scalable fonts are designed for both screen viewing and printing.

### Printing Noncontiguous Ranges on a Single Page

You may have discovered that Excel lets you specify a print area that consists of noncontiguous ranges (a multiple selection). For example, if you need to print, say, A1:C50, D20:F24, and M11:P16, you can press Ctrl while you select these ranges and then issue the File • Print command and choose the Selection option. Better yet, give this multiple selection a range name so that you can quickly choose the same ranges the next time.

Printing multiple ranges is a handy feature, but you may not like the fact that Excel prints each range on a new sheet of paper — and this behavior can't be changed.

You might consider creating live *snapshots* of the three ranges and pasting these snapshots to an empty area of the worksheet. Then, you can print this new area that consists of the snapshots, and Excel won't skip to a new page for each range.

To create a live snapshot of a range, select the range and copy it to the Clipboard. Then, to paste a live link (see the Note that follows), select the cell in which you want to paste the snapshot (an empty worksheet is a good choice), press and hold the Shift key, and choose Edit • Paste Picture Link. Repeat this procedure for the other ranges. After you paste them, you can rearrange the snapshots any way you like. Notice that these are truly live links: change a cell in the original range and the change appears in the linked picture. Figure 12-12 shows an example of snapshots made from several ranges.

The screenshot shows a Microsoft Excel window with a 'Picture' object placed on a worksheet. The object is a table titled 'Sales Report.xls' containing the following data:

Region	Jan	Feb	Mar
North	10984	11496	11043
North	11027	11575	10960
North	11011	11503	11093
North	10973	10931	11067
North	10965	11523	10963
North	10933	10972	10902
North	10948	11882	11002
North	10819	11344	11093
North	10908	11737	11049
North	10981	10984	11093
North	11080	11020	10965
<b>North Total</b>	<b>13009</b>	<b>12636</b>	<b>121174</b>
East	11092	11794	10947
East	11015	10916	11044
East	10810	11766	11032
East	10931	11423	10913
East	10819	11760	11023
East	10902	11090	11098
East	10847	11400	11003
East	10902	11732	11062
East	10817	11322	10973

**Figure 12-12:** These two objects are linked pictures of ranges that exist elsewhere in the workbook, which enables you to print nonadjacent ranges on a single sheet.

## Hiding Cells Before Printing

You may have a worksheet that contains confidential information. You may want to print the worksheet, but not the confidential parts. Several techniques prevent certain parts of a worksheet from printing:

- When you hide rows or columns, the hidden rows aren't printed.
- You can effectively hide cells or ranges by making the text color the same color as the background color.

- You can hide cells by using a custom number format that consists of three semicolons (;;;).
- You can mask off a confidential area of a worksheet by covering it with a rectangle object. Click the Rectangle tool on the Drawing toolbar and drag the rectangle to the proper size. For best results, you can make the rectangle white with no border.
- You can use a text box object, available by using the Text Box tool on the Drawing toolbar, to mask off a range. The advantage to using a text box is that you can add text to it with information about the concealed data (see Figure 12-13).

Name	Department	Date Hired	Salary	Supervisor
Bill Jones	Marketing	03/06/91		Rudolph
Julia Richardson	Sales	05/12/94		Winkler
Hank Snow	Operations	11/30/95		Kingsley
Marley Robins	Operations	01/04/99		Kingsley
Ted Smith	Sales	03/04/94		Winkler
Francine Snerd	Maintenance	12/15/93		Martinsdale
Lucille King	Administration	11/21/90		Wu

**Figure 12-13:** You can use a text box to hide confidential data so that it won't print.

If you find that you must regularly hide data before you print certain reports, consider using the custom views feature to create a named view that doesn't show the confidential information.

## Using a Template to Change Printing Defaults

If you are never satisfied with Excel's default print settings, you may want to create a template with the print settings that you use most often. After doing so, you can create a new workbook based on the template, and the workbook will have your own print settings for defaults.



Chapter 34 discusses template files.



## Summary

This chapter presents the basics — and some finer points — of printing in Excel. You learn how to use the Print dialog box and the Page Setup dialog box to control what gets printed and how it is printed. You also learn about the print preview feature that shows how the printed output will look before it hits the paper. The chapter covers features such as manual page breaks, custom views, Page Break Preview mode, tips on printing noncontiguous ranges on a single sheet, and hiding cells that contain confidential information.

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# Chart-Making Basics

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**C**harts — also known as graphs — have been an integral part of spreadsheets since the early days of Lotus 1-2-3. Charting features have improved significantly over the years, and you'll find that Excel provides you with the tools to create a wide variety of highly customizable charts. In fact, Excel has so much capability in this area that *two* chapters are needed to present the information. This chapter presents the basic information that you need to know to create charts and make simple modifications to them. Chapter 16 continues with a discussion of advanced options and a slew of chart-making tricks and techniques.

## Overview of Charts

Basically, a *chart* presents a table of numbers visually. Displaying data in a well-conceived chart can make the data more understandable, and you often can make your point more quickly as a result. Because a chart presents a picture, charts are particularly useful for understanding a lengthy series of numbers and their interrelationships. Making a chart helps you to spot trends and patterns that would be nearly impossible to identify when examining a range of numbers.

You create charts from numbers that appear in a worksheet. Before you can create a chart, you must enter some numbers in a worksheet. Normally, the data that is used by a chart resides in a single worksheet, within one file — but that's not a strict requirement. A single chart can use data from any number of worksheets or even from different workbooks.

When you create a chart in Excel, you have two options for where to place the chart:

# 13

CHAPTER

## In This Chapter

An Overview of Excel's Chart-Making Capability

When to Use an Embedded Chart and When to Use a Separate Chart Sheet

Using the Chart Wizard to Walk You Through the Steps to Create a Chart

A Discussion of Some Basic Chart Modifications

How to Change Excel's Default Chart Type

- Insert the chart directly into a worksheet as an object. A chart like the one that appears in Figure 13-1 is known as an *embedded* chart.
- Create the chart as a new chart sheet in your workbook (see Figure 13-2). A chart sheet differs from a worksheet in that a chart sheet can hold a single chart and doesn't have cells.

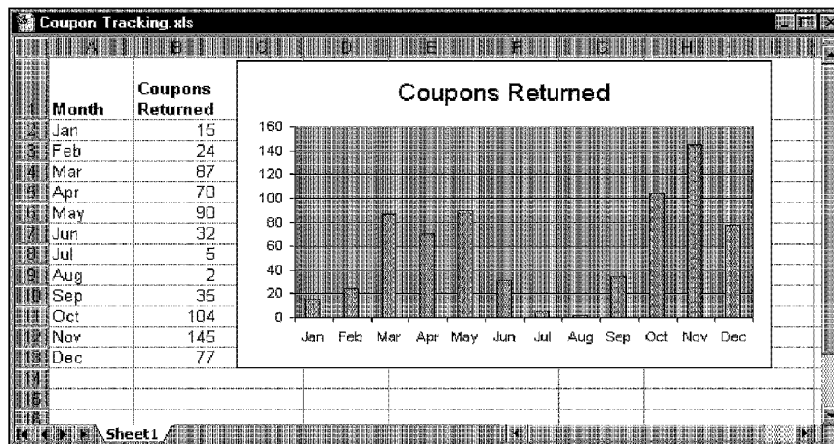


Figure 13-1: An embedded chart appears directly on a worksheet.

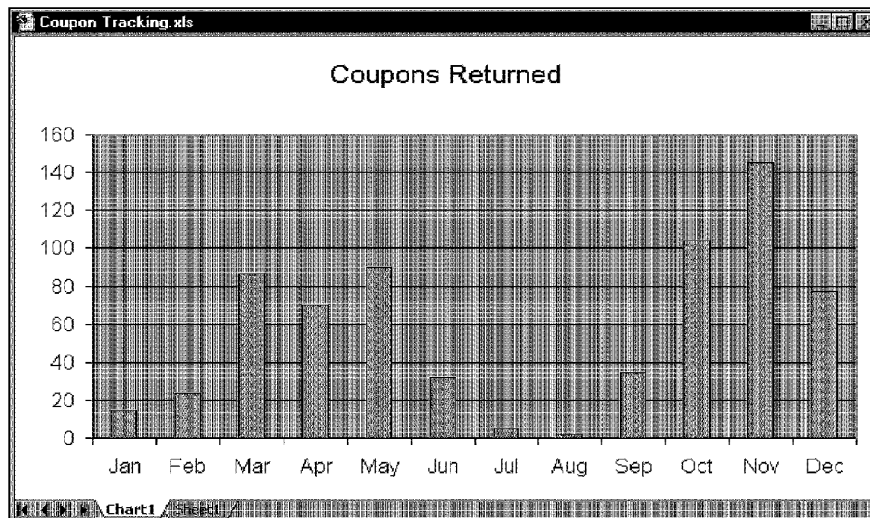


Figure 13-2: This chart appears on a separate chart sheet.

Each method has its advantages, as you'll discover later in this chapter. Regardless of the chart-making option that you choose, you have complete control over the chart's appearance. You can change the colors, move the legend, format the numbers on the scales, add gridlines, and so on.

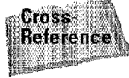
Converting a range of numbers into a chart is quite easy, and many people find this aspect of Excel to be rather fun. You can experiment with different chart types to determine the best way to make your case. If that isn't enough, you can make a variety of adjustments to your charts, such as adding annotations, clip art, and other bells and whistles. The real beauty of Excel's charts, however, lies in their connection to worksheet data—if the numbers in your worksheet change, the charts reflect those changes instantly.

## Chart Types

You're probably aware of the many types of charts: bar charts, line charts, pie charts, and so on. Excel enables you to create all the basic chart types, and even some esoteric chart types, such as radar charts and doughnut charts. Table 13-1 lists Excel's chart types and the number of subtypes associated with each.

**Table 13-1**  
**Excel Chart Types**

<i>Chart Type</i>	<i>Subtypes</i>
Area	6
Bar	6
Column	7
Combination	6
Line	7
Pie	6
Doughnut	2
Radar	3
XY (Scatter)	5
Surface	4
Bubble	2
Stock	4
Cylinder	7
Cone	7
Pyramid	7

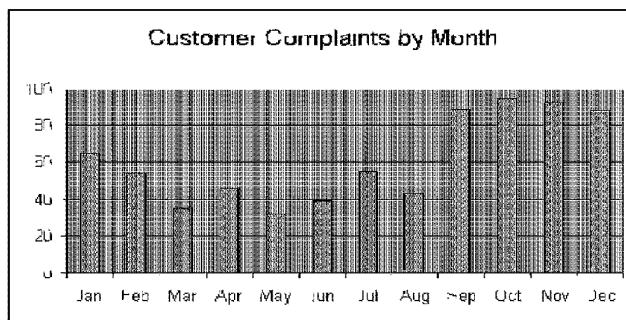


See the “Reference: Excel’s Chart Types” section later in this chapter for a complete listing of Excel’s chart types.

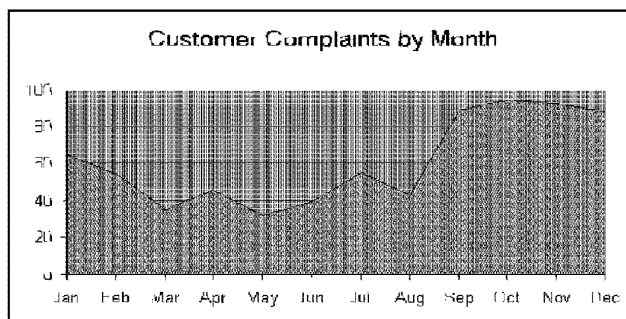
## Which Chart Type to Use?

Beginning chart makers commonly ask how to determine the most appropriate chart type for the data. No good answer exists to this question, and I’m not aware of any hard-and-fast rules for determining which chart type is best for your data. Perhaps the best rule is to use the chart type that gets your message across in the simplest way.

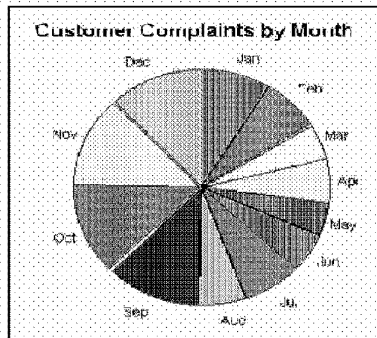
Figures 13-3, 13-4, and 13-5 show the same data plotted using three different chart types. Although all three charts represent the same information, they look quite different.



**Figure 13-3:** An example of a column chart.



**Figure 13-4:** An example of an area chart.



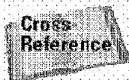
**Figure 13-5:** An example of a pie chart.

The column chart is probably the best choice for this particular set of data, because it clearly shows the information for each month in discrete units. The area chart may not be appropriate, because it seems to imply that the data (Excel calls each set of data that you chart a *data series*) is continuous—that points exist in between the 12 actual data points (this same argument could be made against using a line chart). The pie chart is simply too confusing. Pie charts are most appropriate for a data series in which you want to emphasize proportions. If you have too many data points, a pie chart can be impossible to interpret.

Fortunately, Excel makes changing a chart's type after you create the chart an easy procedure. Experiment with various chart types until you find the one that represents your data accurately and clearly—and as simply as possible.

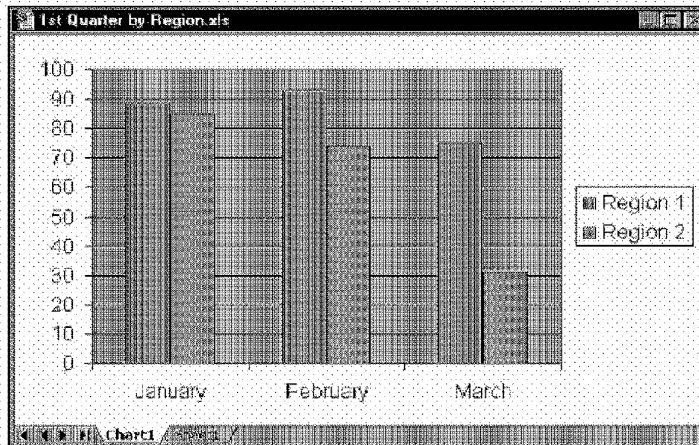
## The Chart Wizard

You use the Chart Wizard to create a chart. The Chart Wizard consists of a series of dialog boxes that guide you through the process of creating the exact chart that you need. Figure 13-6 shows the first of four Chart Wizard dialog boxes.



Chapter 3 presented a step-by-step introductory example that created a simple chart by using the Chart Wizard. If you're new to chart making, you may want to work through that example. The Chart Wizard is explained in detail later in this chapter.





**Figure 13-8:** This chart was generated with one keystroke.

In this simple example, Excel created its default chart type (which is a two-dimensional column chart) by using the default settings. For more control over the chart-making process, you'll want to use the Chart Wizard.

## How Excel Handles Charts

A chart is essentially an object that Excel creates. This object consists of one or more data series, displayed graphically; the appearance of the data series depends on the selected chart type. For example, if you create a line chart that uses two data series, the chart contains two lines—each representing one data series. You can distinguish each of the lines by its thickness, color, and data markers. The data series in the chart are linked to cells in the worksheet.

You can include a maximum of 255 data series in most charts; the exception is a standard pie chart, which can display only one data series. If your chart uses more than one data series, you may want to use a legend to help the reader identify each series. Excel also places a limit on the number of categories (or data points) in a data series: 32,000 (4,000 for 3D charts). Most users never run up against this limit.

Charts can use different numbers of axes:

- Common charts, such as column, line, and area charts, have a category axis and a value axis. The *category* axis normally is the horizontal axis, and the *value* axis normally is the vertical axis (this is reversed for bar charts, in which the bars extend from the left of the chart rather than from the bottom).



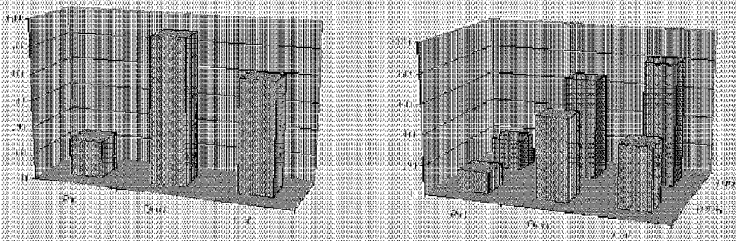
- Pie charts and doughnut charts have no axes (but they do have calories). A pie chart can display only one data series. A doughnut chart can display multiple data series.
- A radar chart is a special chart that has one axis for each point in the data series. The axes extend from the center of the chart.
- True 3D charts have three axes: a category axis, a value axis, and a series axis that extends into the third dimension. Refer to the upcoming sidebar, “3D or Not 3D? That Is the Question,” for a discussion about Excel’s 3D charts.

A chart is not stagnant. You can always change its type, add custom formatting, add new data series to it, or change an existing data series so that it uses data in a different range.

Before you create a chart, you need to determine whether you want it to be an embedded chart or a chart that resides on a chart sheet.

### 3D or Not 3D? That Is the Question

Some of Excel’s charts are referred to as *3D charts*. This terminology can be a bit confusing, because some of these so-called 3D charts aren’t technically 3D charts. Rather, they are 2D charts with a perspective look to them; that is, they appear to have some depth. The accompanying figure shows two “3D” charts.



The chart on the left isn’t a true 3D chart. It’s simply a 2D chart that uses perspective to add depth to the columns. The chart on the right is a true 3D chart, because the data series extend into the third dimension.

A true 3D chart has three axes: a value axis (the height dimension), a category axis (the width dimension), and a series axis (the depth dimension).

## Embedded Charts

An embedded chart basically floats on top of a worksheet, on the worksheet's draw layer. As with other drawing objects (such as a text box or a rectangle), you can move an embedded chart, resize it, change its proportions, adjust its borders, and perform other operations.

**Cross  
Reference**

Chapter 14 discusses Excel's drawing objects and the draw layer.

To make any changes to the actual chart in an embedded chart object, you must click it to select the chart; Excel's menus, which swap places with the toolbars when you select a chart, include commands that are appropriate for working with charts. In addition, a Chart menu replaces the Data menu. Using embedded charts enables you to print the chart next to the data that it uses.

Figure 13-9 shows an example of a report with a chart embedded.

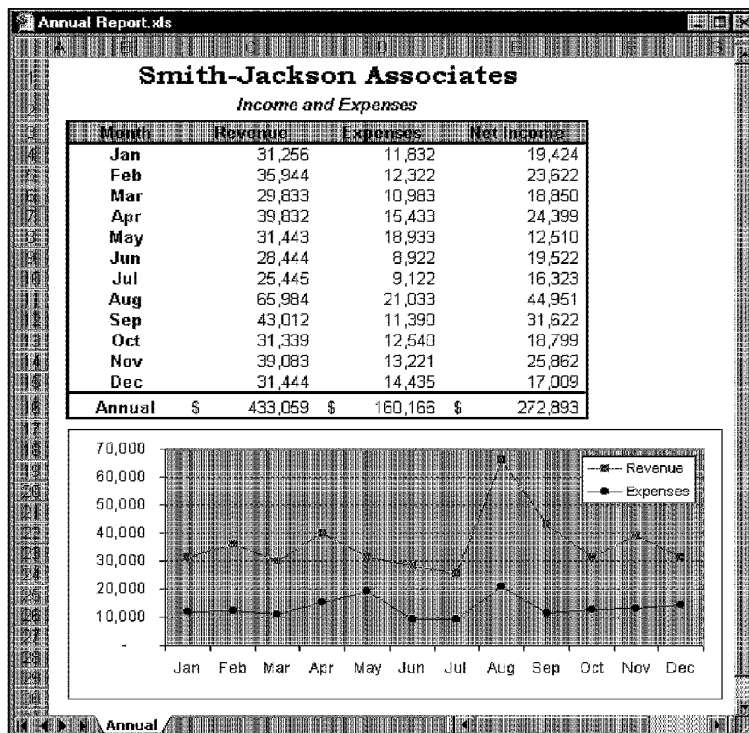


Figure 13-9: This report includes an embedded chart.

## Chart Sheets

When you create a chart on a chart sheet, the chart occupies the entire sheet. If you plan to print a chart on a page by itself, using a chart sheet is your best choice. If you have many charts to create, you may want to create each one on a separate chart sheet, to avoid cluttering your worksheet. This technique also makes locating a particular chart easier, because you can change the names of the chart sheets' tabs to correspond to the chart that it contains.

Excel's menus change when a chart sheet is active, similar to the way that they change when you select an embedded chart. The Chart menu replaces the Data menu, and other menus include commands that are appropriate for working with charts.

Excel displays a chart in a chart sheet in WYSIWYG mode: the printed chart looks just like the image on the chart sheet. If the chart doesn't fit in the window, you can use the scrollbars to scroll it or adjust the zoom factor.

You also can size the chart in a chart sheet according to the window size by using the View • Sized with Window command. When this setting is enabled, the chart adjusts itself when you resize the workbook window (it always fits perfectly in the window). In this mode, the chart that you're working on may or may not correspond to how it looks when printed.

If you create a chart on a chart sheet, you can easily convert it to an embedded chart. Choose Chart • Location and then select the worksheet that holds the embedded chart from the As object in list box. Excel deletes the chart sheet and moves the chart to the sheet that you specify. This operation also works in the opposite direction: You can relocate an embedded chart to a new chart sheet.

## Creating Charts

You can create both embedded charts and charts on chart sheets with or without the assistance of the Chart Wizard.



Excel always has a default chart type. Normally, the default is a column chart (but you can change this type, as you'll see later). If you create a chart without using the Chart Wizard, Excel creates the chart by using the default chart type. If you use the Chart Wizard, Excel prompts you for the chart type, so the default chart type becomes irrelevant.

## Creating an Embedded Chart with Chart Wizard

To invoke the Chart Wizard to create an embedded chart:

1. Select the data to be charted (optional).
2. Choose Insert • Chart (or, click the Chart Wizard tool on the Standard toolbar).
3. Make your choices in Steps 1 through 3 of the Chart Wizard.
4. In Step 4 of the Chart Wizard, select the option labeled As object in.

The Chart Wizard is explained in detail later in this chapter.

## Creating an Embedded Chart Directly

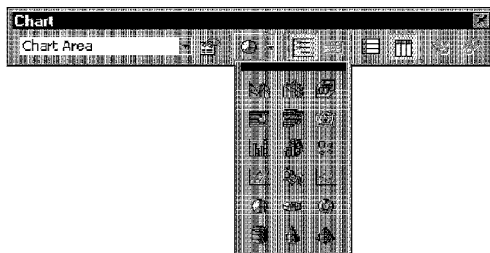
To create an embedded chart without using the Chart Wizard:

1. Make sure that the Chart toolbar is displayed.
2. Select the data to be charted.
3. Click the Chart Type tool on the Chart toolbar and then select a chart type from the displayed icons.

Excel adds the chart to the worksheet by using the default settings.



The Chart Type tool on the Chart toolbar displays an icon for the last selected chart. However, this tool works like a list box; you can expand it to display all 18 chart types (see Figure 13-10). Just click the arrow to display the additional chart types.



**Figure 13-10:** The Chart Type tool expands so that you can create the type of chart you want.

## The Chart Toolbar

The Chart toolbar appears when you click an embedded chart, activate a chart sheet, or choose View • Toolbars • Chart. This toolbar, shown in the accompanying figure, includes nine tools. You can use these tools to make some common chart changes:



- **Chart Objects:** When a chart is activated, you can select a particular chart element by using this drop-down list.
- **Format Selected Object:** Displays the Format dialog box for the selected chart element.
- **Chart Type:** Expands to display 18 chart types when you click the arrow. After it's expanded, you can drag this tool to a new location—creating, in effect, a miniature floating toolbar.
- **Legend:** Toggles the legend display in the selected chart.
- **Data Table:** Toggles the display of the data table in a chart.
- **By Row:** Plots the data by rows.
- **By Column:** Plots the data by columns.
- **Angle Text (Downward):** Displays the selected text at a  $-45$ -degree angle.
- **Angle Text (Upward):** Displays the selected text at a  $+45$ -degree angle.

If you press Shift while you click either of the Angle Text tools, Excel no longer angles the selected text.

Excel includes several other chart-related tools that aren't on the Chart toolbar. You can customize the toolbar to include these additional tools, which are located in the Charting category in the Customize dialog box.

In addition, several tools on the other toolbars work with charts, including the Color, Font Color, Bold, Italic, and Font tools.

## Creating a Chart on a Chart Sheet with the Chart Wizard

To start the Chart Wizard and create an embedded chart:

1. Select the data that you want to chart (optional).
2. Choose Insert • Chart (or click the Chart Wizard tool on the Standard toolbar).

3. Make your choices in Steps 1 through 3 of the Chart Wizard.
4. In Step 4 of the Chart Wizard, select the option labeled As new sheet.

To create a new chart on a chart sheet by using the default chart type, select the data to be charted and then press the F11 key. This command inserts a new chart sheet. The chart is created from the selected range, without accessing the Chart Wizard.

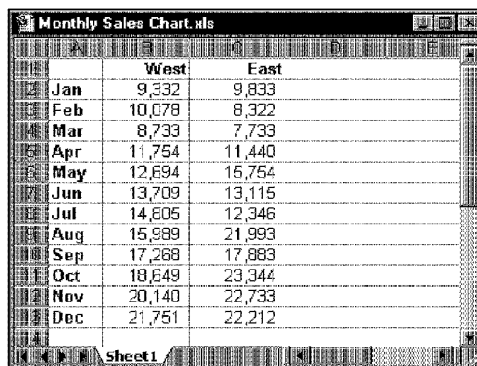
## Creating a Chart with the Chart Wizard

The Chart Wizard consists of four dialog boxes that prompt you for various settings for the chart. By the time that you reach the last dialog box, the chart is usually just what you need.

### Selecting the Data

Before you start the Chart Wizard, select the data that you want to include in the chart. This step isn't necessary, but it makes creating the chart easier for you. If you don't select the data before invoking the Chart Wizard, you can select it in the second Chart Wizard dialog box.

When you select the data, include items such as labels and series identifiers (row and column headings). Figure 13-11 shows a worksheet with a range of data set up for a chart. This data consists of monthly sales for two regions. You would select the entire range for this worksheet, including the month names and region names.



	West	East
Jan	9,332	9,833
Feb	10,078	8,322
Mar	8,733	7,733
Apr	11,754	11,440
May	12,694	15,754
Jun	13,709	13,115
Jul	14,605	12,346
Aug	15,889	21,993
Sep	17,268	17,883
Oct	18,649	23,344
Nov	20,140	22,733
Dec	21,751	22,212

Figure 13-11: Data to be charted.

The data that you plot doesn't have to be contiguous. You can press Ctrl and make a multiple selection. Figure 13-12 shows an example of how to select noncontiguous ranges for a chart. In this case, Excel uses only the selected cells for the chart.

	West	East	Combined
Jan	9,832	9,833	19,165
Feb	10,078	8,322	18,400
Mar	8,733	7,733	16,466
Apr	11,754	11,440	23,194
May	12,694	15,754	28,448
Jun	13,709	13,115	26,824
Jul	14,606	12,346	27,151
Aug	15,989	21,993	37,982
Sep	17,268	17,883	35,151
Oct	18,649	23,344	41,993
Nov	20,140	22,733	42,873
Dec	21,751	22,212	43,963

**Figure 13-12:** Selecting noncontiguous ranges to be charted.

After you select the data, start the Chart Wizard, either by clicking the Chart Wizard button on the Standard toolbar or by selecting **Insert • Chart**. Excel displays the first of four Chart Wizard dialog boxes.

At any time while using the Chart Wizard, you can go back to the preceding step by clicking the Back button. Or, you can click Finish to close the Chart Wizard. If you close the Chart Wizard early, Excel creates the chart by using the information that you provided up to that point.

Don't be too concerned about creating the perfect chart. You later can change, at any time, every choice that you make in the Chart Wizard.

## Chart Wizard – Step 1 of 4

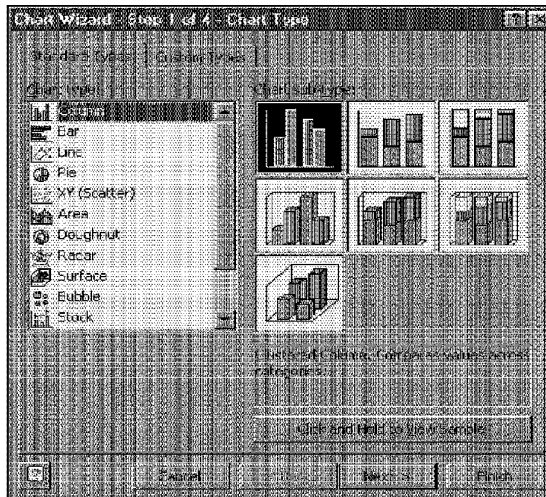
Figure 13-13 shows the first Chart Wizard dialog box, in which you select the chart type. This dialog box has two tabs: Standard Types and Custom Types. The Standard Types tab displays the 14 basic chart types and the subtypes for each. The Custom Types tab displays some customized charts (including user-defined custom charts).



**Tip**

When you work in the Custom Types tab, the dialog box shows a preview of your data with the selected chart type. In the Standard Types tab, you get a preview by clicking the button labeled **Click and Hold to View Sample**. When you click this button, keep the mouse button pressed.

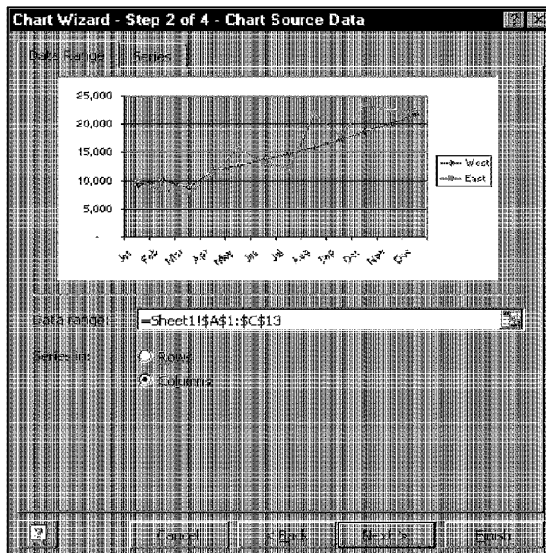
When you decide on a chart type and subtype, click the Next button to move to the next step.



**Figure 13-13:** The first of four Chart Wizard dialog boxes.

## Chart Wizard – Step 2 of 4

In the second step of the Chart Wizard (shown in Figure 13-14), you verify the data ranges and specify the orientation of the data (whether it's arranged in rows or columns). The orientation of the data has a drastic effect on the look of your chart. Usually, Excel guesses the orientation correctly — but not always.



**Figure 13-14:** In the second Chart Wizard dialog box, you verify the range and specify whether to plot by columns or rows.



If you select the Series tab, you can verify or change the data that is used for each series of the chart. Click the Next button to advance to the next dialog box.

## Chart Wizard – Step 3 of 4

In the third Chart Wizard dialog box, shown in Figure 13-15, you specify most of the options for the chart. This dialog box has six tabs:

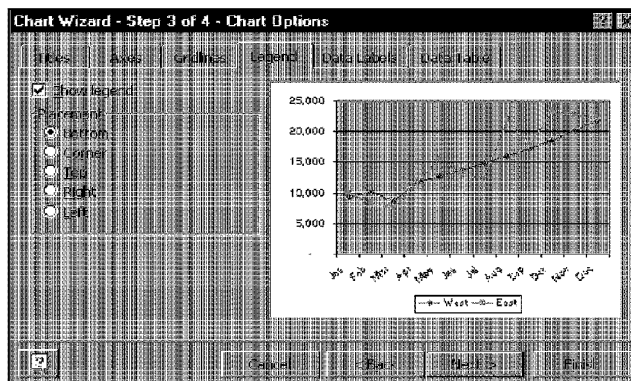
- **Titles:** Add titles to the chart.
- **Axes:** Turn on or off axes display and specify the type of axes.
- **Gridlines:** Specify gridlines, if any.
- **Legend:** Specify whether to include a legend and where to place it.
- **Data Labels:** Specify whether to show data labels and what type of labels.
- **Data Table:** Specify whether to display a table of the data.



**Note**

The options available depend on the type of chart that you selected in Step 1 of the Chart Wizard.

After you select the chart options, click Next to move to the final dialog box.

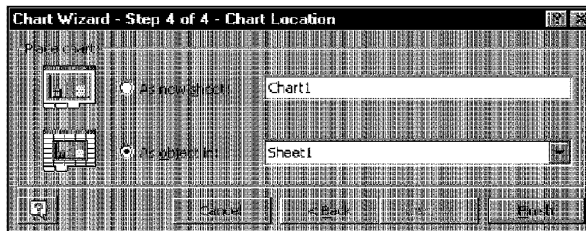


**Figure 13-15:** You specify the chart options in the third Chart Wizard dialog box.

## Chart Wizard – Step 4 of 4

Step 4 of the Chart Wizard, shown in Figure 13-16, lets you specify where to place the chart. Make your choice and click Finish.

Excel creates and displays the chart. If you place the chart on a worksheet, Excel centers it in the worksheet window and selects it.



**Figure 13-16:** Step 4 of the Chart Wizard asks you where to put the chart.

## Basic Chart Modifications

After you create a chart, you can modify it at any time. The modifications that you can make to a chart are extensive. This section covers some of the more common chart modifications:

- Moving and resizing the chart
- Changing a chart's location
- Changing the chart type
- Moving chart elements
- Deleting chart elements



Other types of chart modifications are discussed in Chapter 16.

### Activating a Chart

Before you can modify a chart, it must be activated. To activate an embedded chart, click it, which also activates the element that you click. To activate a chart on a chart sheet, just click its sheet tab.

### Moving and Resizing a Chart

If your chart is on a chart sheet, you can't move or resize it. You can, however, change the way that it's displayed by selecting **View • Sized with Window**.

If you embedded the chart, you can freely move and resize it. Click the chart's border to select the chart; eight handles (small black squares) appear on the chart's border. Drag the chart to move it, or drag any of the handles to resize the chart.

## Changing a Chart's Location

Use the Chart • Location command to relocate an embedded chart to a chart sheet, or convert a chart on a chart sheet to an embedded chart. This command displays the Chart Location dialog box.

**Tip**

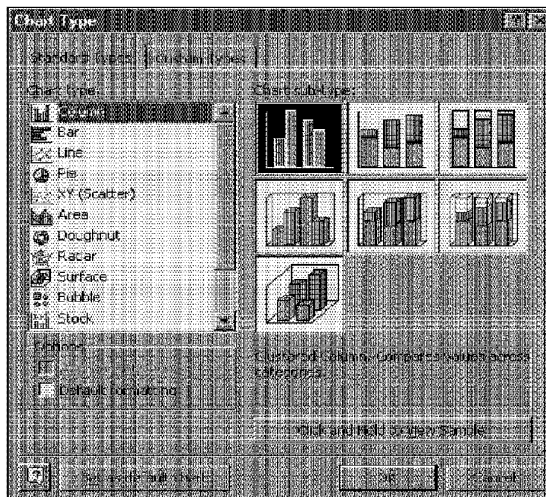
If you select an embedded chart and choose an existing chart sheet as its new location, Excel will ask if you'd like to embed the chart on the chart sheet. If you respond Yes, the chart sheet will contain an additional chart. This is a way to overcome the normal limit of one chart per chart sheet. Even better, you can delete the original chart on the chart sheet and then rearrange your embedded charts on a single chart sheet.

## Changing the Chart Type

To change the chart type of the active chart, use either of the following methods:

- Click the Chart Type button's drop-down arrow on the Chart toolbar. The button expands to show 18 basic chart types.
- Choose the Chart • Chart Type command.

The Chart • Chart Type command displays the dialog box shown in Figure 13-17. You may recognize this dialog box as the first of the Chart Wizard dialog boxes. Click the Standard Types tab to select one of the standard chart types (and a subtype), or click the Custom Types tab to select a customized chart. After you select a chart type, click OK; the selected chart will be changed to the type that you selected.



**Figure 13-17:** The Chart Type dialog box enables you to change the chart's type.



If you've customized some aspects of your chart, choosing a new chart type from the Custom Types tab may override some or all the changes that you've made. For example, if you've added gridlines to the chart and then select a custom chart type that doesn't use gridlines, your gridlines disappear. Therefore, you should make sure that you're satisfied with the chart before you make too many custom changes to it. However, you can always use Edit • Undo to reverse your actions.

In the Custom Types tab, if you click the User-defined option, the list box displays the name of any user-defined custom formats. If you haven't defined any custom formats, this box shows Default, referring to the default chart type. Changing the default chart type is discussed later in this chapter.



Chapter 16 explains how to create custom formats.

## Moving and Deleting Chart Elements

Some of the chart parts can be moved (any of the titles, the legend, or data labels). To move a chart element, simply click it to select it and then drag it to the desired location in the chart. To delete a chart element, select it and then press Delete.

## Other Modifications

When a chart is activated, you can select various parts of the chart to change. Modifying a chart is similar to everything else you do in Excel. First, you make a selection (in this case, select a chart part). Then, you issue a command to do something with the selection.

You can use the Fill Color tool on the Formatting toolbar to change colors. For example, if you want to change the color of a series, select the series and choose the color that you want from the Fill Color tool. You'll find that many other toolbar tools work with charts. For example, you can select the chart's legend and then click the Bold tool to make the legend text bold.

When you double-click a chart element (or press Ctrl+1 after selecting it), its Formatting dialog box appears, which varies, depending on the item selected. In most cases, the dialog box is of the tabbed variety. Many modifications are self-evident — for example, changing the font used in a title. Others, however, are a bit trickier.



Chapter 16 discusses these chart modifications in detail.

## Changing the Default Chart Type

The default chart type is mentioned many times in this chapter. Excel's default chart type is a 2D column chart with a light-gray plot area, a legend on the right, and horizontal gridlines.

If you don't like the looks of this chart or if you typically use a different type of chart, you can easily change the default chart in the following manner:

1. Select the Chart • Chart Type command.
2. Choose the chart type that you want to use as the default chart. This can be a chart from either the Standard Types tab or the Custom Types tab.
3. Click the button labeled Set as default chart type. You are asked to verify your choice.



If you have many charts of the same type to create, changing the default chart format to the chart type with which you're working is much more efficient than separately formatting each chart. Then, you can create all of your charts without having to select the chart type.

## Printing Charts

Printing embedded charts is nothing special; you print them the same way that you print a worksheet (see Chapter 12). As long as you include the embedded chart in the range that you want to print, Excel prints the chart as it appears onscreen.



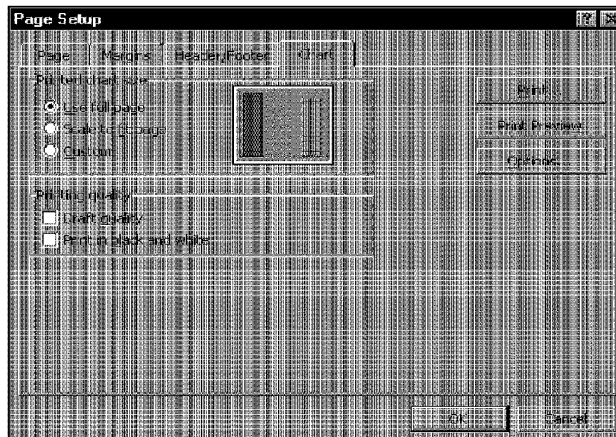
If you select an embedded chart and then choose File • Print (or click the Print button), Excel prints the chart on a page by itself and does *not* print the worksheet.

If you print in Draft mode, Excel doesn't print embedded charts. Also, if you don't want a particular embedded chart to appear on your printout, right-click the chart and choose Format Chart Area from the shortcut menu. Click the Properties tab in the Format Chart Area dialog box and remove the check mark from the Print Object check box.

If you created the chart on a chart sheet, Excel prints the chart on a page by itself. If you open Excel's Page Setup dialog box when the chart sheet is active, the Sheet tab is replaced with a tab named Chart. Figure 13-18 shows the Chart tab of the Page Setup dialog box.

This dialog box has several options:

- **Use full page:** Excel prints the chart to the full width and height of the page margins. This usually isn't a good choice, because the chart's relative proportions change and you lose the WYSIWYG advantage.
- **Scale to fit page:** Expands the chart proportionally in both dimensions until one dimension fills the space between the margins. This option usually results in the best printout.
- **Custom:** Prints the chart as it appears on your screen. Select View • Sized with Window to make the chart correspond to the window size and proportions. The chart prints at the current window size and proportions.



**Figure 13-18:** The Chart tab of the Page Setup dialog box.

The Printing quality options work just like those for worksheet pages. If you choose the Draft quality option for a chart sheet, Excel prints the chart, but its quality may not be high (the actual effect depends on your printer). Choosing the Print in black and white option prints the data series with black-and-white patterns rather than colors.



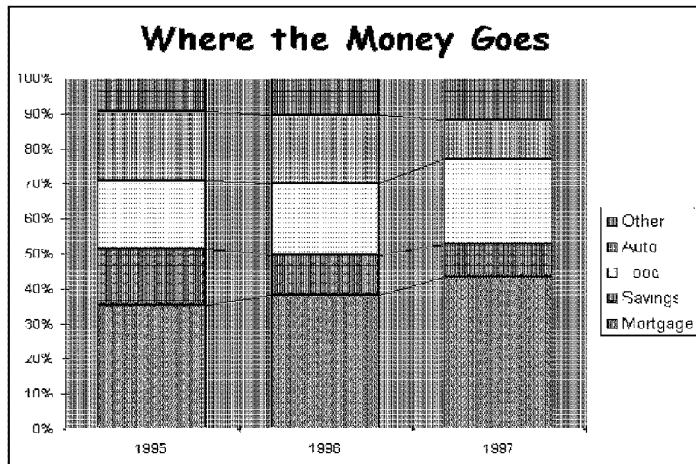
Because charts usually take longer to print than text, using the print preview feature before you print a chart is an especially good idea. This feature enables you to see what the printed output will look like, so that you can avoid surprises.

## Reference: Excel's Chart Types

For your reference, this chapter concludes with a discussion of Excel's chart types and a listing of the subtypes for each. This section may help you determine which chart type is best for your data.

### Column Charts

Column charts are one of the most common chart types. This type of chart is useful for displaying discrete data (as opposed to continuous data). You can have any number of data series, and the columns can be stacked on top of each other. Figure 13-19 shows an example of a column chart.



**Figure 13-19:** This stacked column chart displays each series as a percentage of the total. It may substitute for several pie charts.

Table 13-2 lists Excel's seven column chart subtypes.

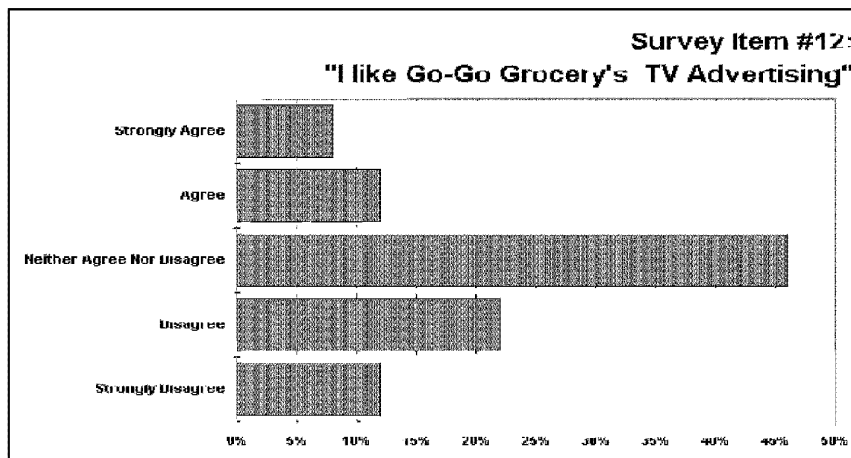
**Table 13-2  
Column Chart Subtypes**

<i>Chart Type</i>	<i>Description</i>
Clustered Column	Standard column chart.
Stacked Column	Column chart with data series stacked.
100% Stacked Column	Column chart with data series stacked and expressed as percentages.
3-D Clustered Column	Standard column chart with a perspective look.
3-D Stacked Column	Column chart with a perspective look. Data series are stacked and expressed as percentages.
3-D 100% Stacked Column	Column chart with a perspective look. Excel stacks the data series and expresses them as percentages.
3-D Column	A true 3D column chart with a third axis.

## Bar Charts

A *bar chart* is essentially a column chart that has been rotated 90 degrees to the left. The advantage in using a bar chart is that the category labels may be easier to

read (see Figure 13-20 for an example). You can include any number of data series in a bar chart. In addition, the bars can be stacked from left to right. Table 13-3 lists Excel's six bar chart subtypes.



**Figure 13-20:** If you have lengthy category labels, a bar chart may be a good choice.

Table 13-3 lists Excel's six bar chart subtypes.

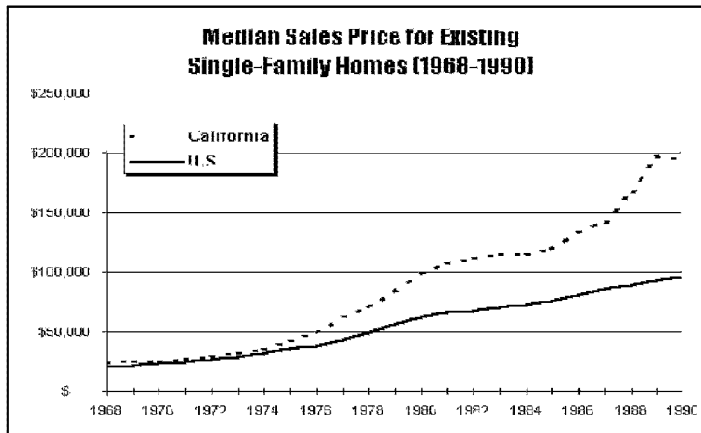
**Table 13-3**  
**Bar Chart Subtypes**

<b>Chart Type</b>	<b>Description</b>
Clustered Bar	Standard bar chart.
Stacked Bar	Bar chart with data series stacked.
100% Stacked Bar	Bar chart with data series stacked and expressed as percentages.
3-D Clustered Bar	Standard bar chart with a perspective look.
3-D Stacked Bar	Bar chart with a perspective look. Excel stacks data series and expresses them as percentages.
3-D 100% Stacked Bar	Bar chart with a perspective look. Excel stacks data series and expresses them as percentages.



## Line Charts

*Line charts* are frequently used to plot data that is continuous rather than discrete. For example, plotting daily sales as a line chart may let you spot trends over time. See Figure 13-21 for an example.



**Figure 13-21:** A line chart often can help you spot trends in your data.

Table 13-4 lists Excel's seven line chart subtypes.

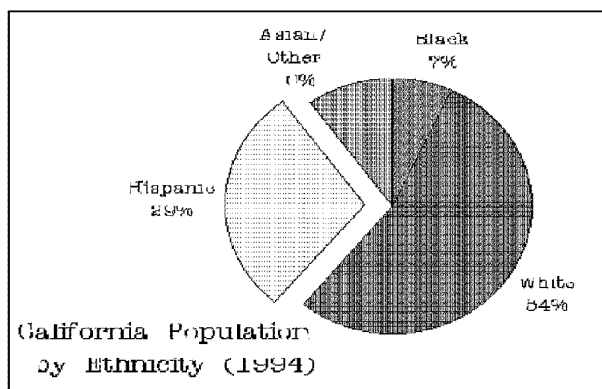
**Table 13-4**  
**Line Chart Subtypes**

<b>Chart Type</b>	<b>Description</b>
Line	Standard line chart.
Stacked Line	Line chart with stacked data series.
100% Stacked Line	Line chart with stacked data series expressed as percentages.
Line with Data Markers	Line chart with data markers.
Stacked Line with Data Markers	Line chart with stacked data series and data markers.
100% Stacked Line with Data Markers	Line chart with stacked data series and line markers, expressed as percentages.
3-D Line	A true 3D line chart with a third axis.

## Pie Charts

A *pie chart* is useful when you want to show relative proportions or contributions to a whole. Figure 13-22 shows an example of a pie chart. Generally, a pie chart should use no more than five or six data points; otherwise, it's difficult to interpret. A pie chart can use only one data series.

You can explode a slice of a pie chart. Activate the chart and select the slice that you want to explode. Then, drag it away from the center.

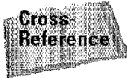


**Figure 13-22:** A pie chart with one slice exploded.

Table 13-5 lists Excel's six pie chart subtypes.

**Table 13-5**  
**Pie Chart Subtypes**

<b>Chart Type</b>	<b>Description</b>
Pie	Standard pie chart.
3-D Pie	Pie chart with perspective look.
Pie of Pie	Pie chart with one slice broken into another pie.
Exploded Pie	Pie chart with one or more slices exploded.
Exploded 3-D Pie	Pie chart with perspective look, with one or more slices exploded.
Bar of Pie	Pie chart with one slice broken into a column.

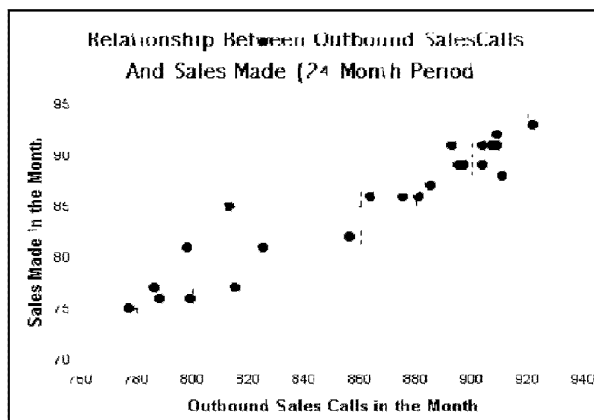


The Pie of Pie and Bar of Pie chart types enable you to display a second chart that clarifies one of the pie slices. You can use the Options tab of the Format Data Series dialog box to specify which data is assigned to the second chart. Refer to Chapter 16 for details.

## XY (Scatter) Charts

Another common chart type is *XY (Scatter) charts* (also known as *scattergrams*). An XY chart differs from the other chart types in that both axes display values (there is no category axis).

This type of chart often is used to show the relationship between two variables. Figure 13-23 shows an example of an XY chart that plots the relationship between sales calls and sales. The chart shows that these two variables are positively related: months in which more calls were made typically had higher sales volumes.



**Figure 13-23:** An XY (Scatter) chart.

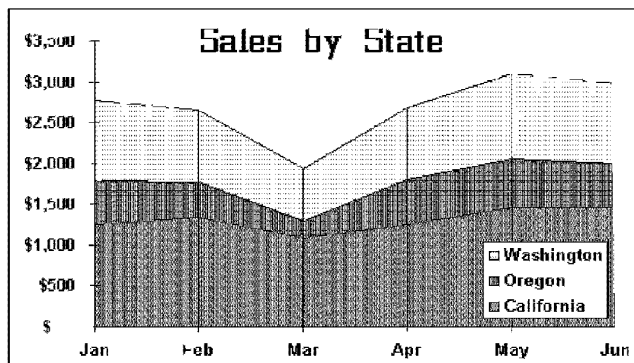
Table 13-6 lists Excel's five XY (Scatter) chart subtypes.

Table 13-6 XY (Scatter) Chart Subtypes	
Chart Type	Description
Scatter	XY chart with markers and no lines.
Scatter with Smoothed Lines	XY chart with markers and smoothed lines.
Scatter with Smoothed Lines and No Data Markers	XY chart with smoothed lines and no markers.

<b>Chart Type</b>	<b>Description</b>
Scatter with Lines	XY chart with lines and markers.
Scatter with Lines and No Data Markers	XY chart with lines and no markers.

## Area Charts

Think of an *area chart* as a line chart that has been colored in. Figure 13-24 shows an example of a stacked area chart. Stacking the data series enables you to see clearly the total plus the contribution by each series.



**Figure 13-24:** An area chart.

Table 13-7 lists Excel's six area chart subtypes.

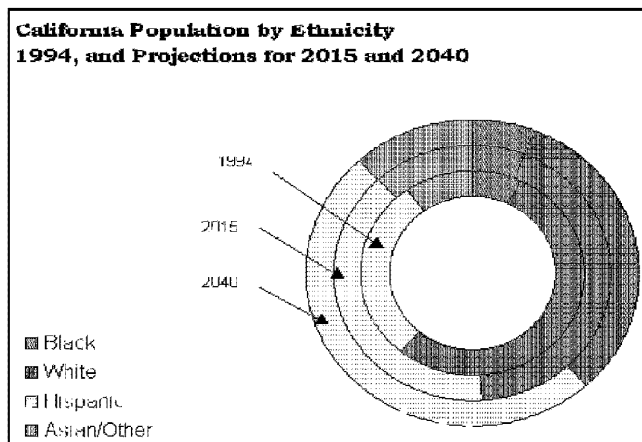
**Table 13-7**  
**Area Chart Subtypes**

<b>Chart Type</b>	<b>Description</b>
Area	Standard area chart.
Stacked Area	Area chart, data series stacked.
100% Stacked Area	Area chart, expressed as percentages.
3-D Area	A true 3D area chart with a third axis.
3-D Stacked Area	Area chart with a perspective look, data series stacked.
3-D 100% Stacked Area	Area chart with a perspective look, expressed as percentages.

## Doughnut Charts

A *doughnut chart* is similar to a pie chart, except that it has a hole in the middle. Unlike a pie chart, a doughnut chart can display more than one series of data. Figure 13-25 shows an example of a doughnut chart (the arrow and series descriptions were added manually; these items aren't part of a doughnut chart).

Notice that Excel displays the data series as concentric rings. As you can see, a doughnut chart with more than one series to chart can be difficult to interpret. Sometimes, a stacked column chart for such comparisons expresses your meaning better than a doughnut chart.



**Figure 13-25:** A doughnut chart.

Table 13-8 lists Excel's two doughnut chart subtypes.

<b>Table 13-8 Doughnut Chart Subtypes</b>	
<b>Chart Type</b>	<b>Subtype</b>
Doughnut	Standard doughnut chart.
Exploded Doughnut	Doughnut chart with all slices exploded.

## Radar Charts

You may not be familiar with radar charts. A *radar chart* has a separate axis for each category, and the axes extend from the center. The value of the data point is plotted on the appropriate axis. If all data points in a series have an identical value, it produces a perfect circle. See Figure 13-26 for an example of a radar chart.

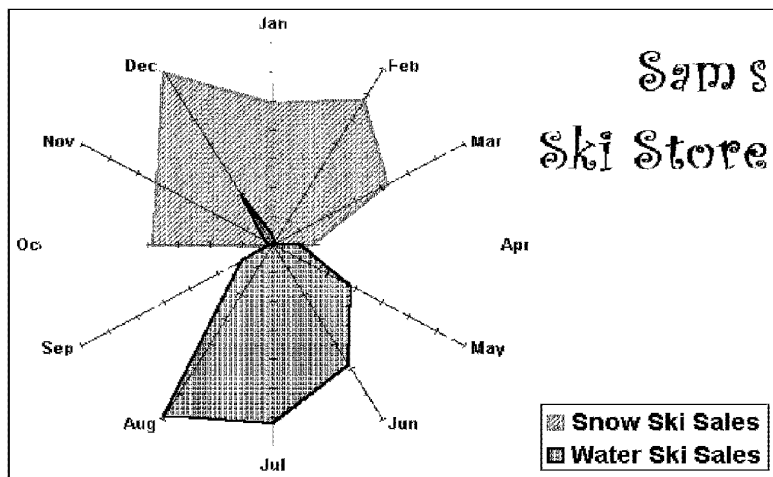


Figure 13-26: A radar chart.

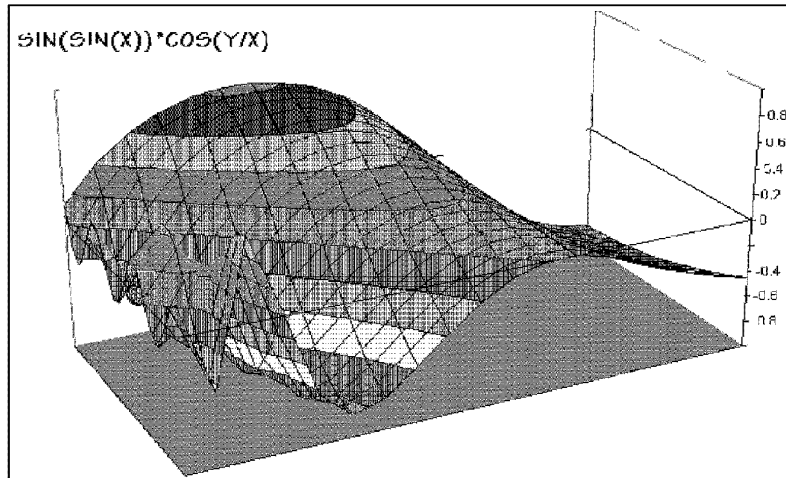
Table 13-9 lists Excel's three radar chart subtypes.

Table 13-9 Radar Chart Subtypes	
Chart Type	Subtype
Radar	Standard radar chart (lines only).
Radar with Data Markers	Radar chart with lines data markers.
Filled Radar	Radar chart with lines colored in.

## Surface Charts

*Surface charts* display two or more data series on a surface. As Figure 13-27 shows, these charts can be quite interesting. Unlike other charts, Excel uses color to distinguish values, not to distinguish the data series. You can change these colors

only by modifying the workbook's color palette, using the Color tab in the Options dialog box.



**Figure 13-27:** A surface chart.

Table 13-10 lists Excel's four 3D surface chart subtypes.

**Table 13-10**  
**Surface Chart Subtypes**

<i>Chart Type</i>	<i>Description</i>
3-D Surface	Standard 3D surface chart.
3-D Surface (wireframe)	3D surface chart with no colors.
Surface (top view)	3D surface chart, as viewed from above.
Surface (top view wireframe)	3D surface chart, as viewed from above, no color.

## Bubble Charts

Think of a bubble chart as an XY (Scatter) chart that can display an additional data series. That additional data series is represented by the size of the bubbles.

Figure 13-28 shows an example of a bubble chart. In this case, the chart displays the results of a weight-loss program. The x axis represents the original weight, the y axis

shows the length of time in the program, and the size of the bubbles represents the amount of weight lost.

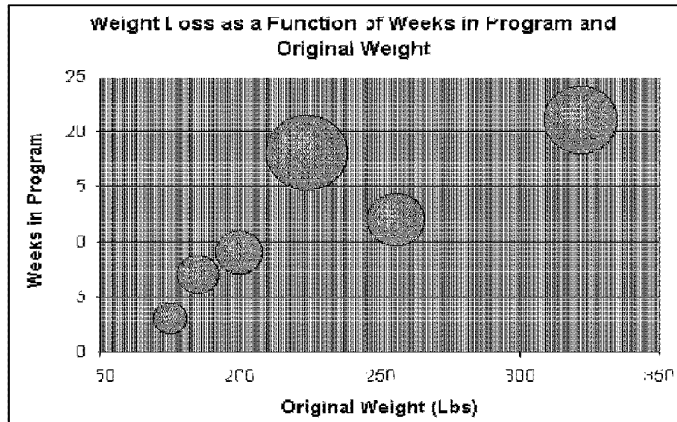


Figure 13-28: A bubble chart.

Table 13-11 lists Excel's two bubble chart subtypes.

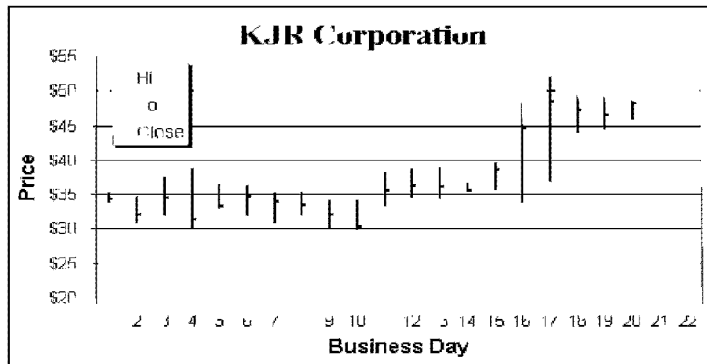
Table 13-11 Bubble Chart Subtypes	
<i>Chart Type</i>	<i>Subtype</i>
Bubble Chart	Standard bubble chart.
Bubble with 3-D effect	Bubble chart with 3D bubbles.

## Stock Charts

Stock charts are most useful for displaying stock market information. These charts require three to five data series, depending on the subtype.

Figure 13-29 shows an example of a stock chart. This chart uses the High-Low-Close subtype that requires three data series.





**Figure 13-29:** A stock chart.

Table 13-12 lists Excel's four stock chart subtypes.

<b>Table 13-12 Stock Chart Subtypes</b>	
<b>Chart Type</b>	<b>Subtype</b>
High-Low-Close	Displays the stock's high, low, and closing prices.
Open-High-Low-Close	Displays the stock's opening, high, low, and closing prices.
Volume-High-Low-Close	Displays the stock's volume, high, low, and closing prices.
Volume-Open-High-Low-Close	Displays the stock's volume, open, high, low, and closing prices.

## Cylinder, Cone, and Pyramid Charts

These three chart types are essentially the same — except for the shapes that are used. You usually can use these charts in place of a bar or column chart.

Figure 13-30 shows an example of a pyramid chart.

Each of these chart types has seven subtypes, which are described in Table 13-13.

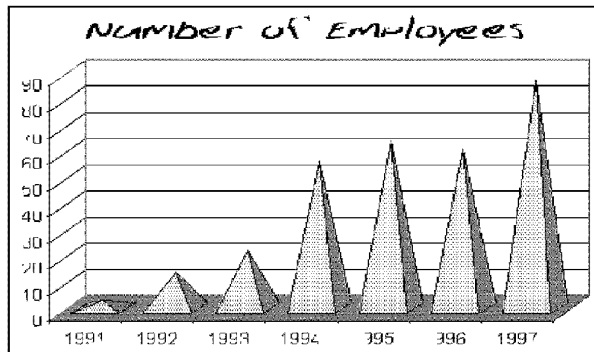


Figure 13-30: A pyramid chart.

Table 13-13  
Cylinder, Cone, and Pyramid Chart Subtypes

<i>Chart Type</i>	<i>Subtype</i>
Clustered Column	Standard column chart.
Stacked Column	Column chart with data series stacked.
100% Stacked Column	Column chart with data series stacked and expressed as percentages.
Clustered Bar	Standard bar chart.
Stacked Bar	Bar chart with data series stacked.
100% Stacked Bar	Bar chart with data series stacked and expressed as percentages.
3-D Column	A true 3D column chart with a third axis.

## Summary

This chapter introduces Excel's chart-making feature. Charts can be embedded on a worksheet or created in a separate chart sheet. You can either use the Chart Wizard to walk you through the chart-making process or create a default chart in a single step. This chapter also describes how to change the default chart type.

After a chart is created, you can make many types of modifications. A few simple modifications are discussed; Chapter 16 presents additional chart information.

Printing charts works much like printing worksheets, although you should be familiar with the page setup options when you're printing chart sheets. The chapter concludes with a complete listing and description of Excel's chart types and subtypes.

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# Enhancing Your Work with Pictures and Drawings

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**I**n Chapter 13, you learned how to create charts from the numbers in your worksheet. This chapter continues in the same vein by discussing pictures and drawings. Like charts, these objects can be placed on a worksheet's draw layer to add pizzazz to an otherwise boring report. (See the sidebar, "A Word About the Draw Layer," later in this chapter.)

This chapter discusses three major types of images:

- Bitmap and line-art graphics imported directly into a workbook or copied from the Clipboard
- Objects created by using Excel's drawing tools
- Objects inserted by using other Microsoft Office tools, such as WordArt and Organization Chart



Excel also can create another type of graphic image: maps. But that's the topic of Chapter 17.

## Importing Graphics Files

Excel can import a wide variety of graphics files into a worksheet. You have several choices:

- Use the Microsoft Clip Gallery to locate and insert an image

# 14

C H A P T E R

## In This Chapter

Importing Graphics Files

Using Excel's Drawing Tools

Using WordArt

Drawing Tips

A Gallery of Drawing Examples

- Directly import a graphic file
- Copy and paste the image by using the Windows Clipboard
- Import the image from a digital camera or scanner

## Using the Clip Gallery

The Clip Gallery is a shared application that is also accessible from other Microsoft Office products.

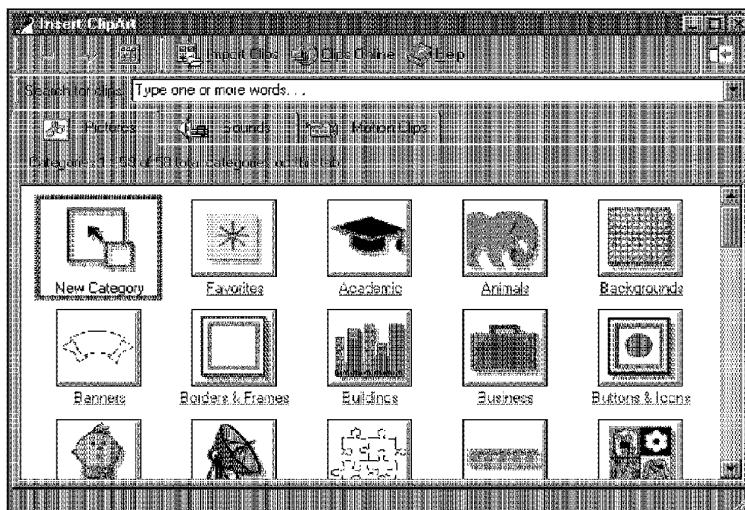


Besides providing an easy way to locate and insert images, the Clip Gallery enables you to insert sound and video files.



The Clip Gallery is available in both Excel 97 and Excel 2000, but the feature works a bit differently in Excel 2000. In addition, Excel 2000 gives you direct access to Microsoft's Clip Gallery Live on the Web.

You access the Clip Gallery by selecting the **Insert • Picture • Clip Art** command. This displays the Insert ClipArt dialog box, shown in Figure 14-1. Click the Pictures tab and then click a category, and the images in that category appear. Locate the image that you want and click it. A graphic menu pops up from which you can choose to insert the image, preview the image, add the image to your “favorites,” or find similar images. You can also search for clip art by keyword—just enter some text in the Search for clips box, and the matching images are displayed.



**Figure 14-1:** The Insert ClipArt dialog box enables you to insert pictures, sounds, or video.

If you select the insert option, the image is embedded in your worksheet. You can then either select additional images from the Clip Gallery or close the Insert ClipArt dialog box.

When an image is selected, Excel displays its Picture toolbar, which contains tools that enable you to adjust the image.



You also can add new files to the Clip Gallery. You might want to do this if you tend to insert a particular graphic file into your worksheets (such as your company logo). Use the Import Clips button to select the file and specify the category for the image.



If you can't find a suitable image, you can go online and browse through the clip art at Microsoft's Web site. In the Insert ClipArt dialog box, click the Clips Online button. Your Web browser will be activated, and you can view the images (or listen to the sounds) and download those that you want. Figure 14-2 shows Microsoft's online Clip Gallery

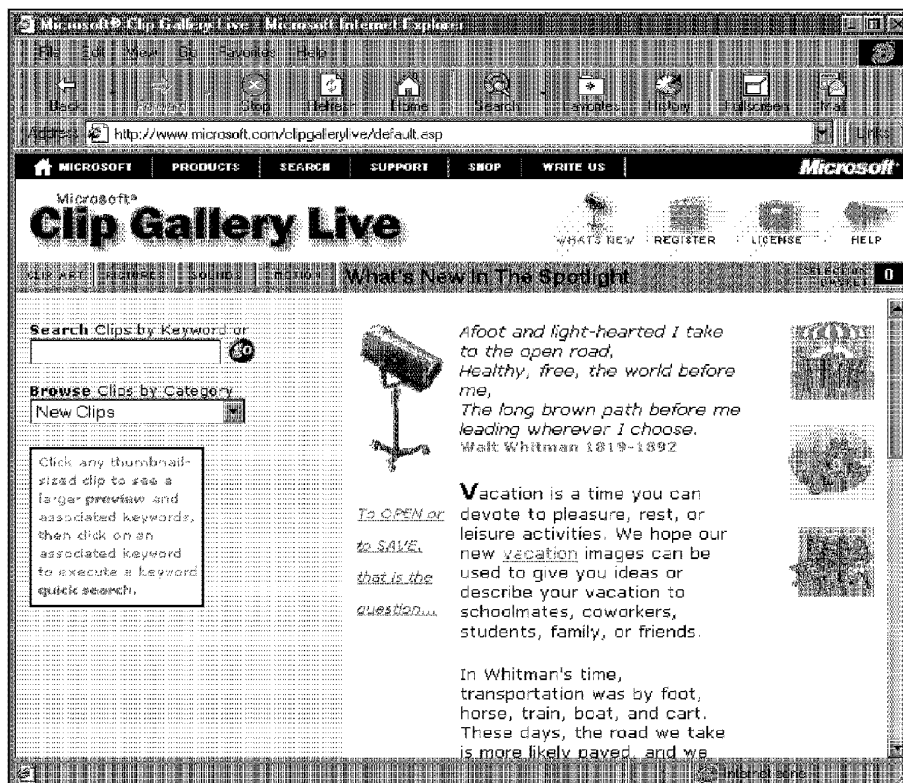
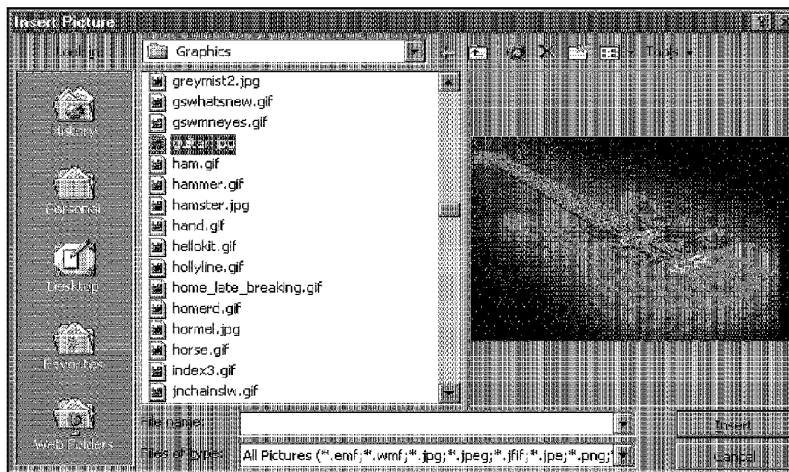


Figure 14-2: Microsoft's Clip Gallery Live enables you to download additional clip art.

## Importing Graphics Files

If the graphic image that you want to insert is available in a file, you can easily import the file into your worksheet by choosing **Insert • Picture • From File**. Excel displays the **Insert Picture** dialog box, shown in Figure 14-3. This dialog box works just like the **Open** dialog box. By default, it displays only the graphics files that Excel can import. If you choose the **Preview** option, Excel displays a preview of the selected file in the right panel of the dialog box.



**Figure 14-3:** The **Insert Picture** dialog box enables you to embed a picture in a worksheet.



Excel 2000 supports animated GIF files—sort of. If you insert an animated GIF file, the image will be animated only if you save your workbook as a Web page and then view it in a Web browser. Figure 14-4 shows an example of a graphics file in a worksheet.

Figure 14-4 shows an example of a graphic image in a worksheet.

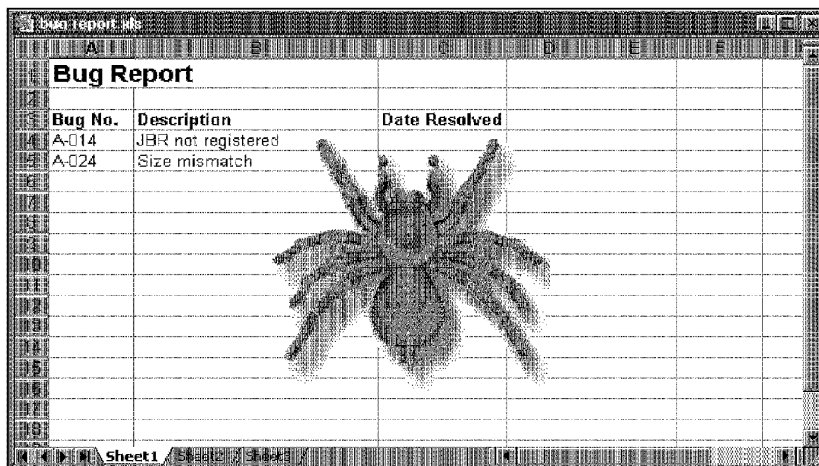


Figure 14-4: An example of a graphics file embedded in a worksheet.

## About Graphics Files

Graphics files come in two main categories: *bitmap* and *vector* (picture). Bitmap images are made up of discrete dots. They usually look pretty good at their original size, but often lose clarity if you increase or decrease the size. Vector-based images, on the other hand, retain their crispness, regardless of their size. Examples of common bitmap file formats include BMP, PCX, DIB, JPG, and GIF. Examples of common vector file formats include CGM, WMF, EPS, and DRW.

Bitmap files vary in the number of colors that they use (even black-and-white images use multiple colors, because these are usually gray-scale images). If you view a high-color bitmap graphic by using a video mode that displays only 16 or 256 colors, the image usually doesn't look very good.

You can find thousands of graphics files free for the taking on the Internet and online services such as CompuServe, America Online, and Prodigy.



Using bitmap graphics in a worksheet can dramatically increase the size of your workbook, resulting in more memory usage and longer load and save times.

Table 14-1 lists the graphics file types that Excel can import. The most common graphics file formats are GIF, JPG, and BMP.



**Table 14-1**  
**Graphics File Formats Supported by Excel**

<i>File Type</i>	<i>Description</i>
BMP	Windows bitmap
CDR	CorelDRAW graphics
CGM	Computer Graphics Metafiles
DIB	Windows bitmap
DRW	Micrografix Designer/Draw
DXF	AutoCAD format 2D
EMF	Windows Enhanced Metafile
EPS	Encapsulated PostScript
GIF	Graphic Interchange Format
HGL	HP Graphics Language
JPG	JPEG File Interchange Format
PCT	Macintosh graphics
PCD	Kodak Photo CD
PCX	Bitmap graphics
PNG	Portable Network Graphics
RLE	Windows bitmap
TGA	Targa graphics format
TIF	Tagged Interchange Format
WMF	Windows metafile
WPG	WordPerfect graphics



**Tip**

If you want to use a graphic image for a worksheet's background (similar to wallpaper on the Windows desktop), select **Format • Sheet • Background** and then select a graphics file. The selected graphics file is tiled on the worksheet. It won't be printed, however.

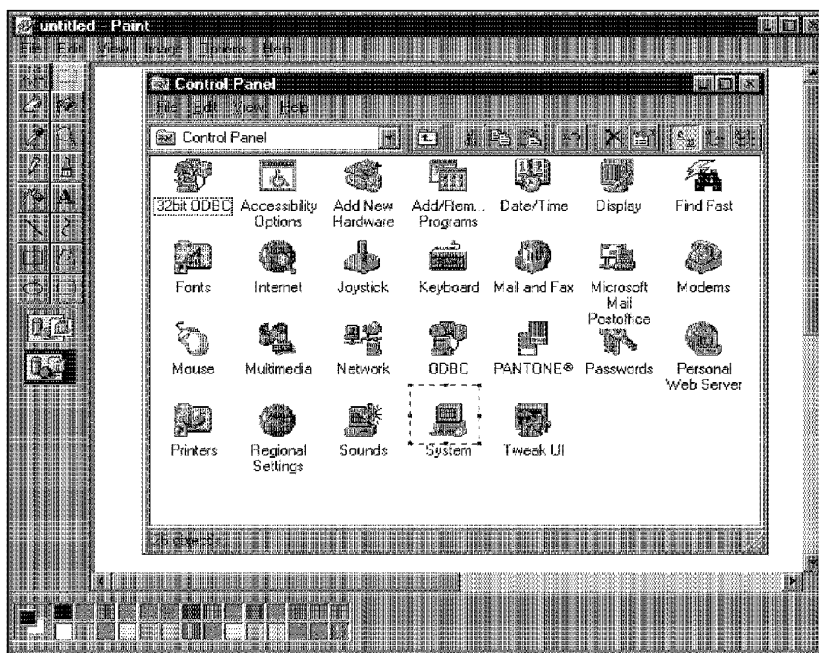
## Copying Graphics by Using the Clipboard

In some cases, you may want to use a graphic image that is not stored in a separate file or that is in a file that Excel can't import. For example, you may have a drawing program that uses a file format that Excel doesn't support. You may be able to export the file to a supported format, but it may be easier to load the file into the drawing program and copy the image to the Clipboard. Then, you can activate Excel

and paste the image to the draw layer. (See the sidebar, “A Word About the Draw Layer,” later in this chapter.)

This capability also is useful if you don't want to copy an entire image. For example, a drawing may consist of several components, and you may want to use only one element in Excel. In this case, using the Clipboard is the only route.

Suppose that you see a graphic displayed onscreen but you can't select it—it may be part of a program's logo, for example. In this case, you can copy the entire screen to the Clipboard and then paste it into Excel. Most of the time, you don't want the entire screen—just a portion of it. The solution is to capture the entire screen (or window), copy it to the Windows Paint program, and then copy just the part that you want (or crop out what you don't want) and paste it to your Excel worksheet. Figure 14-5 demonstrates this technique using Paint. In this case, a window was copied and pasted to Paint.



**Figure 14-5:** The window was captured and pasted to Paint. You can copy the part that you want and paste it to Excel.

Use the following keyboard commands, as needed:

**PrintScreen:** Copies the entire screen to the Clipboard

**Alt+PrintScreen:** Copies the active window to the Clipboard

## Importing from a Digital Camera or Scanner

You can bring in an image directly from a digital camera or a scanner. To use this feature, make sure that your device is connected and set up properly. Then, choose **Insert • Picture • From Scanner or Camera**. The exact procedure varies, depending on your camera or scanner. In most cases, the image appears in Microsoft Photo Editor. You can adjust the image, if necessary, and then select **File • Exit and Return to Excel**.



Importing images from a digital camera or scanner is a new feature in Excel 2000.

## Modifying Pictures

When you insert a picture on a worksheet, you can modify the picture in various ways by using the Picture toolbar, shown in Figure 14-6. This toolbar appears automatically when you select a picture object. The tools are described in Table 14-2, in left-to-right order on the toolbar.



**Figure 14-6:** The Picture toolbar enables you to adjust a picture.

**Table 14-2**  
**The Tools on the Picture Toolbar**

<i>Tool Name</i>	<i>What the Tool Does</i>
Insert Picture from File	Displays the Insert Picture dialog box.
Image Control	Enables you to change a picture to gray-scale, black and white, or a watermark (semitransparent).
More Contrast	Increases the contrast of the picture.
Less Contrast	Decreases the contrast of the picture.
More Brightness	Increases the brightness of the picture.
Less Brightness	Decreases the brightness of the picture.
Crop	Crops the picture. After clicking this tool, drag any of the picture's handles to make the picture smaller.
Line Style	Selects a border for the picture.
Format Picture	Displays the Format Picture dialog box.
Set Transparent Color	Selects a color that will be transparent. Underlying cell contents appear through the selected transparent color. This option is not available for all types of pictures.
Reset Picture	Returns the picture to its original state.

## A Word About the Draw Layer

Every worksheet and chart sheet has a *draw layer*, an invisible surface that is completely independent of the cells on a worksheet (or the chart on a chart sheet). The draw layer can hold graphic images, drawings, embedded charts, OLE objects, and so on.

Objects placed on the draw layer can be moved, resized, copied, and deleted—with no effect on any other elements in the worksheet. Objects on the draw layer have properties that relate to how they are moved and sized when underlying cells are moved and sized. When you right-click a graphic object and choose Format Object from the shortcut menu, you get a tabbed dialog box (see the accompanying figure). Click the Properties tab to adjust how the object moves or resizes with its underlying cells. Your choices are as follows:

- **Move and size with cells:** If this option is selected, the object appears to be attached to the cells beneath it. For example, if you insert rows above the object, the object moves down. If you increase the column width, the object gets wider.
- **Move but don't size with cells:** If this option is checked, the object moves if rows or columns are inserted, but it never changes its size if you change row heights or column widths.
- **Don't move or size with cells:** This option makes the object completely independent of the underlying cells.

The preceding options control how an object is moved or sized with respect to the underlying cells. Excel also enables you to “attach” an object to a cell. In the Edit panel of the Options dialog box, place a check mark next to the check box labeled Cut, copy, and sort objects with cells. After you do so, graphic objects on the draw layer are attached to the underlying cells.

Because a chart sheet doesn't have cells, objects placed on a chart sheet don't have these options. Such objects do have a property, however, that relates to how the object is sized if the chart size is changed.

## Using Excel's Drawing Tools

The discussion so far has focused on using graphic images from other sources. If your needs involve simple (or not so simple) graphic shapes, you can use the drawing tools built into Excel to create a variety of graphics.

Beginning with Excel 97, the drawing features have been improved significantly. These tools also are available in the other Microsoft Office applications.

### The Drawing Toolbar

Excel's drawing tools are available from the Drawing toolbar, shown in Figure 14.7. The drawing objects feature is one of the few features in Excel that's not available from the menus. Notice that the Standard toolbar has a tool named Drawing. Clicking

this tool toggles the Drawing toolbar on and off. Normally, the Drawing toolbar appears at the bottom of Excel's window, but (as with all toolbars) you can place it anywhere that you like. As you'll see, this toolbar includes more than meets the eye.



**Figure 14-7:** Display the Drawing toolbar to create and modify drawings.

Table 14-3 describes the tools in the Drawing toolbar. The tools are listed in the order in which they appear, from left to right.

**Table 14-3**  
**The Tools on the Drawing Toolbar**

<i>Tool Name</i>	<i>What the Tool Does</i>
Draw	Displays a menu with choices that enable you to manipulate drawn objects.
Select Objects	Selects one or more graphic objects. If you have several objects and you want to select a group of them, use this tool to drag the outline so that it surrounds all the objects. Click the button again to return to normal selection mode.
Free Rotate	Lets you freely rotate a drawn object.
AutoShapes	Displays a menu of seven categories of shapes. Drag this menu to create an AutoShapes toolbar. You also can display the AutoShapes toolbar with the Insert • Picture • AutoShapes command.
Line	Inserts a line.
Arrow	Inserts an arrow.
Rectangle	Inserts a rectangle or a square.
Oval	Inserts an oval or a circle.
Text Box	Inserts a free-floating box into which you type text.
WordArt	Displays the WordArt Gallery dialog box, which enables you to create attractive titles using text. You also can display this dialog box by selecting Insert • Picture • WordArt.
Insert Clip Art	Displays the Insert ClipArt dialog box. You can also display this dialog box with the Insert • Picture • Clip Art command.
Fill Color	Select a fill color or fill effect for an object.
Line Color	Select the line color for an object.

<i>Tool Name</i>	<i>What the Tool Does</i>
Font Color	Select a font color for text objects.
Line Style	Specify the width of the lines in an object.
Dash Style	Specify the style of the lines in an object.
Arrow Style	Specify the arrow style for arrows.
Shadows	Specify the type of shadow for an object and settings for the shadow.
3-D	Specify the type of perspective effect for an object and settings for the effect.



Insert Clip Art and Line Color are two new tools of Excel 2000.

## Drawing AutoShapes

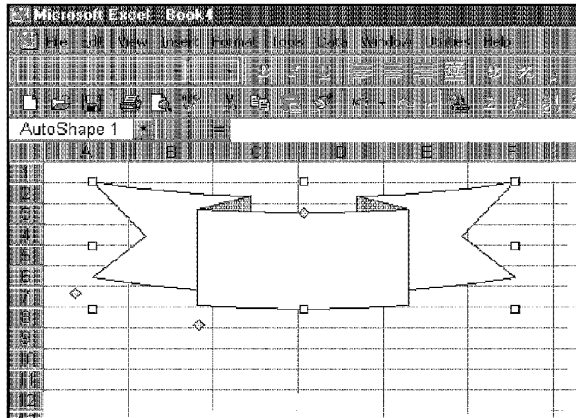
Drawing objects with the AutoShapes tool is quite intuitive. The AutoShapes tool expands to display the following shape categories:

- **Lines:** Six styles of lines, including arrows and freehand-drawing capabilities.
- **Connectors:** Nine styles of lines designed to indicate connections between other objects. These objects automatically “snap to” other objects.
- **Basic Shapes:** Thirty-two basic shapes, including standard shapes, such as boxes and circles, and nonstandard shapes, such as a smiley face and a heart.
- **Block Arrows:** Twenty-eight arrow shapes.
- **Flowchart:** Twenty-seven shapes suitable for flowchart diagrams.
- **Stars and Banners:** Sixteen stars and banners. Stars are handy for drawing attention to a particular cell.
- **Callouts:** Twenty callouts, suitable for annotating cells.
- **More AutoShapes:** In Excel 2000, you can get even more AutoShapes. Clicking this button brings up a dialog box named More AutoShapes—which contains several additional shapes (actually, these are clip art images).



More AutoShapes is a new feature of Excel 2000.

Click a tool and then drag in the worksheet to create the shape (the mouse pointer changes shape, reminding you that you’re in draw mode). When you release the mouse button, the object is selected and its name appears in the Name box (see Figure 14-8).



**Figure 14-8:** This shape was drawn on the worksheet. Its name, AutoShape1, appears in the Name box.

## Formatting AutoShape Objects

You can format the AutoShape objects at any time. First, you must select the object. If the object is filled with a color or pattern, you can click anywhere on the object to select it. If the object is not filled, you must click the object's border.

You can make some modifications by using the toolbar buttons—for example, change the fill color. Other modifications require that you use the Format AutoShape dialog box. After selecting one or more objects, you can bring up this dialog box by using any of the following techniques:

- Choose the Format • AutoShape command
- Press Ctrl+1
- Double-click the object
- Right-click the object and choose Format AutoShape from the shortcut menu

The Format AutoShape dialog box has several tabs, the number of which depends on the type of object and whether it contains text. Each of these tabs is discussed in the following sections.

### The Colors and Lines tab

Select the Colors and Lines tab to adjust the colors, lines, and arrow used in the object.

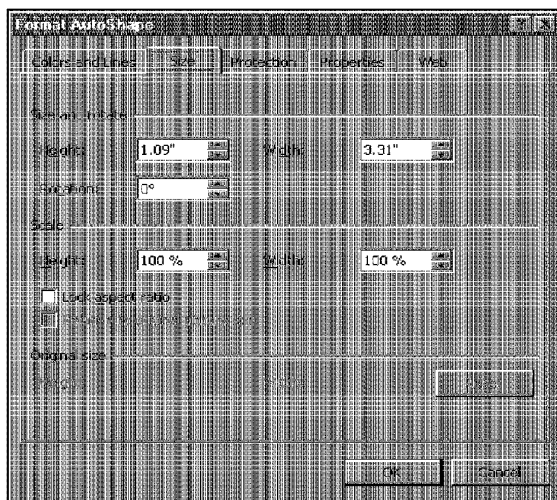
This dialog box contains more than meets the eye, and it can lead to other dialog boxes. For example, click the Color drop-down list and you can select Fill Effects—

which brings up another multitabbed dialog box that enables you to specify a wide variety of fill effects.

Beginning with Excel 97, you'll find many new types of fill effects. Spend some time experimenting with these effects, and I'm sure that you'll be impressed.

### The Size panel

The Size tab of the Format AutoShape dialog box (shown in Figure 14-9) enables you to adjust the size, rotation, and scale of the object. If the object is a picture, you can use the Reset button to return the object to its original dimensions and rotation.



**Figure 14-9:** The size tab of the Format AutoShape dialog box.



**Note**

Contrary to what you might expect, if you rotate an object that contains text, the text *will not* rotate along with the object. You can also change the object's size directly by dragging the object. You can change the rotation directly by clicking the Free Rotate tool on the Drawing toolbar.

### The Protection tab

The Protection tab determines whether the object is “locked.” Locking has no effect, however, unless the worksheet is protected and the Objects option is in effect. You can protect the worksheet with the Tools • Protection • Protect Sheet command.



**Tip**

Locking an object prevents the object from being moved or resized. After you format all of your objects to your satisfaction, you should lock all objects and protect the sheet.

### The Properties tab

The Properties tab of the Format AutoShape dialog box determines how an object is moved and sized with respect to the underlying cells. (See the sidebar “A Word About the Draw Layer,” earlier in this chapter.)

### The Font tab

The Font tab appears only if the shape contains text. It should be familiar, because its options are the same as for formatting cells.

### The Alignment tab

The Alignment tab appears only if the shape contains text. You can specify the vertical and horizontal alignment of the text, and choose the orientation. Unlike text that is contained in cells, you cannot specify an angle for the orientation (you’re limited to 90 degrees).

If you click the Automatic size option, the shape’s size adjusts to fit the text that it contains.

### The Margins tab

The Margins tab appears only if the shape contains text. Use the controls in this panel to adjust the amount of space along the sides of the text.

### The Web tab

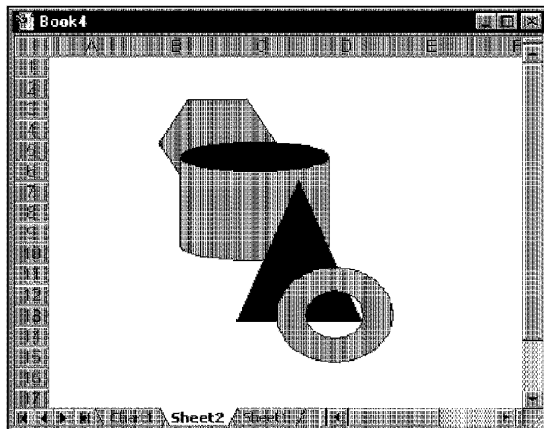
If you plan to save your worksheet as a Web page, you can specify some alternative text for the object in this tab. The alternative text appears when the user hovers the mouse pointer over the image in a Web browser.



The Web tab is a new feature of Excel 2000.

## Changing the Stack Order of Objects

As you add drawing objects to the draw layer of a worksheet, you’ll find that objects are “stacked” on top of each other in the order in which you add them. New objects are stacked on top of older objects. Figure 14-10 shows an example of drawing objects stacked on top of one another.



**Figure 14-10:** These drawing objects are stacked on top of one another.

If you find that an object is obscuring part of another, you can change the order in this stack. Right-click the object and select **Order** from the shortcut menu. This leads to a submenu with the following choices:

- **Bring to Front:** Brings the object to the top of the stack.
- **Send to Back:** Sends the object to the bottom of the stack.
- **Bring Forward:** Brings the object one step higher toward the top of the stack.
- **Send Backward:** Sends the object one step lower toward the bottom of the stack.

## Grouping Objects

Excel enables you to combine two or more drawing objects into a single object, which is known as *grouping*. For example, if you create a design that uses four separate drawing objects, you can combine them into a group. Then, you can manipulate this group as a single object (move it, resize it, and so on).

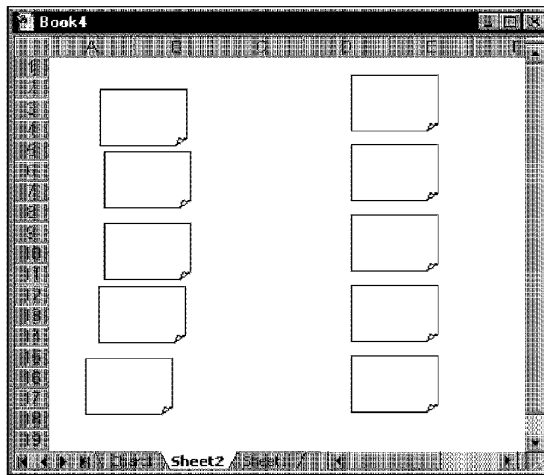
To group two or more objects, select all the objects and then right-click. Choose **Grouping • Group** from the shortcut menu.

Later, if you need to modify one of the objects in the group, you can ungroup them by right-clicking and selecting **Grouping • Ungroup** from the shortcut menu. This breaks the object into its original components.

## Aligning Objects

When you have several drawing objects on a worksheet, you may want to align these objects with each other. You can either drag the objects (which isn't very precise) or use the automatic alignment options.

Figure 14-11 shows objects before and after they were aligned to the left.



**Figure 14-11:** The objects on the left are not aligned. Those on the right are aligned to the left.

To align objects, start by selecting them. Then, click the Draw tool on the Drawing toolbar. This tool expands to show a menu. Select the Align or Distribute menu option, followed by any of the six alignment options: Align Left, Align Center, Align Right, Align Top, Align Middle, or Align Bottom.



Unfortunately, you can't specify which object is used as the basis for the alignment. When you're aligning objects to the left, they are always aligned with the leftmost object. When you're aligning objects to the top, they are always aligned with the topmost object. Alignment in other directions works the same way.

## Spacing Objects Evenly

Excel can also “distribute” three or more objects such that they are equally spaced, horizontally or vertically. Select the objects and then click the Draw tool on the Drawing toolbar. This tool expands to show a menu. Select the Align or Distribute menu option, followed by either Distribute Horizontally or Distribute Vertically.

## Changing the AutoShape Defaults

You can change the default settings for the AutoShapes that you draw. For example, if you prefer a particular text color or fill color, you can set these as the defaults for all new AutoShapes that you draw.

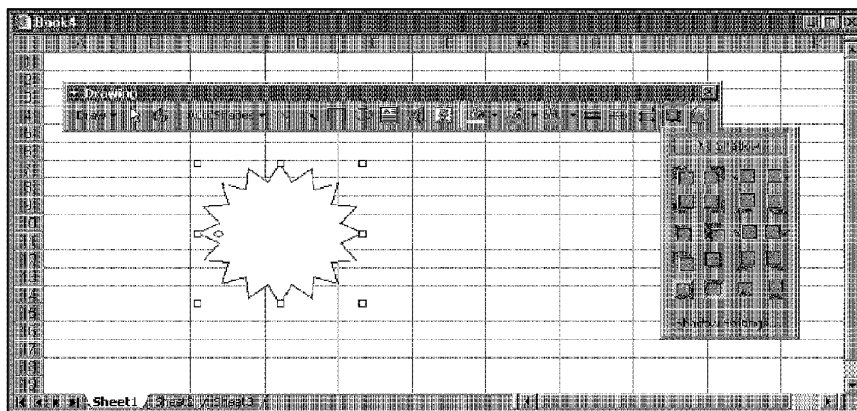
To change the default settings, create an object and format it as you like. You can change colors, fill effects, line widths and styles, and shadow or 3D effects. Then, select the formatted object, right-click, and select Set AutoShape Defaults from the shortcut menu. You can also access this command from the Draw tool on the Drawing toolbar (this tool expands to show a menu).

## Adding Shadows and 3D Effects

You can apply attractive shadow and 3D effects to AutoShapes (except for those in the Line and Connectors categories). Use the Shadow and 3D tools on the Drawing toolbar to apply these effects.

Shadows and 3D effects are mutually exclusive. In other words, you can apply either a shadow or a 3D effect to an AutoShape—not both.

To apply either of these effects, select an AutoShape that you've drawn on a worksheet and then click either the Shadow or the 3D tool. The tool expands to show a list of options (see Figure 14-12). Select an option, and it's applied to the selected shape.

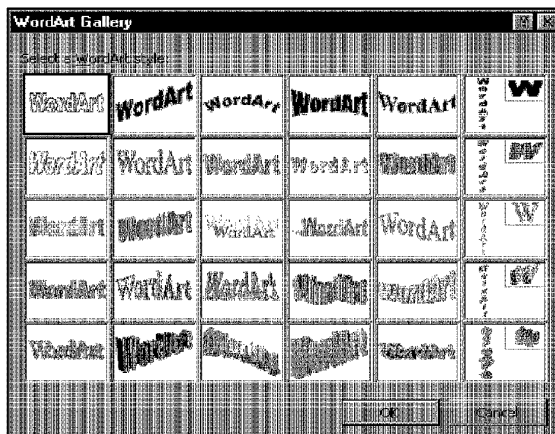


**Figure 14-12:** Clicking the Shadow tool displays a list of shadow options.

You can adjust the Shadow or 3D settings by clicking the appropriate tool and then selecting the Shadow Settings or 3D Settings option. Both of these options display a toolbar that enables you to fine-tune the effect. You'll find that *lots* of options are available, and they're all quite straightforward. The best way to become familiar with these effects is to experiment.

## Using WordArt

WordArt is an application that's included with Microsoft Office. You can insert a WordArt image either by using the WordArt tool on the Drawing toolbar or by selecting **Insert • Picture • WordArt**. Either method displays the WordArt Gallery dialog box (see Figure 14-13). Select a style and then enter your text in the next dialog box. Click OK, and the image is inserted in the worksheet.



**Figure 14-13:** The WordArt Gallery dialog box enables you to select a general style for your image.

When you select a WordArt image, Excel displays the WordArt toolbar. Use these tools to modify the WordArt image. You'll find that you have *lots* of flexibility with these tools. In addition, you can use the Shadow and 3D tools to further manipulate the image. Figure 14-14 shows an example of a WordArt image inserted on a worksheet.



Figure 14-14: An example of WordArt.

## Drawing Tips

Although drawing objects is quite intuitive, several tips can make this task easier. This section lists some tips and techniques that you should know:

- To create an object with the same height and width, press Shift while you draw the object.
- To constrain a line or arrow object to angles that are divisible by 15 degrees, press Shift while you draw the object.
- To make an object snap to the worksheet row and column gridlines, press the Alt key while you draw the object.
- If you press Alt while moving an object, its upper-left corner snaps to the row and column gridlines.
- To select multiple objects, press Ctrl while you click them. Or, use the Select Objects tool on the Drawing toolbar to select objects by “lassoing” them.
- To select all objects on a worksheet, select Edit • Go To (or press F5) and then click the Special button in the Go To dialog box. Choose the Objects option button and click OK. All objects are selected. Use this technique if you want to delete all objects (select them all and then press Delete).
- You can insert text into most of the AutoShapes (the exceptions are the shapes in the Connectors and Lines categories). To add text to a shape, right-click it and select Add Text from the shortcut menu.
- You might find that working with drawing objects is easier if you turn off the worksheet grid line. The snap-to-gridline features work, even if the grid lines aren't visible.

- You can control how objects appear onscreen by using the View tab of the Options dialog box. Normally, the Show All option is selected. You can hide all objects by choosing Hide All, or display objects as placeholders by choosing Show Placeholders (this may speed up things if you have complex objects that take a long time to redraw).
- To copy an object with the mouse, single-click it to select it and then press Ctrl while you drag it.
- If an object contains text, you can rotate the text 90 degrees by using the Alignment tab on the Format Object dialog box.
- By default, drawn objects are printed along with the worksheet. If you don't want the objects to print, access the Sheet panel of the Page Setup dialog box and select the Draft option. Or, right-click the object, select Format from the shortcut menu, and then uncheck the Print Object check box in the Properties panel.
- If you want the underlying cell contents to show through a drawn object, access the Colors and Lines tab in the Format dialog box and then set the Fill option to No Fill. You can also select the Semi-transparent option, which enables you to choose a fill color *and* have the cell contents show.
- If you save your file as a Web page, each drawn object is stored as a separate GIF file.

## A Gallery of Drawing Examples

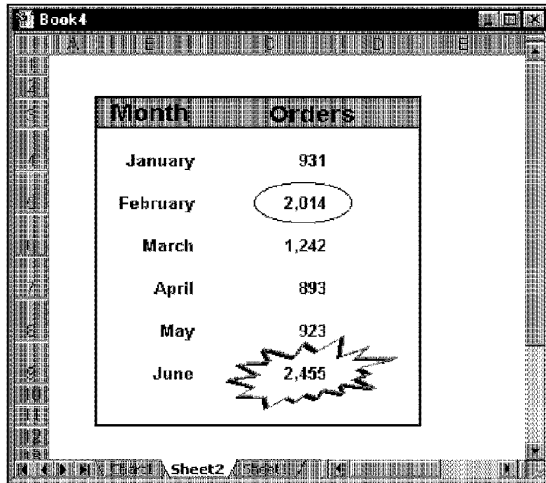
This section provides you with some examples of using Excel's drawing tools. Perhaps these examples will get your own creative juices flowing.

### Calling Attention to a Cell

The AutoShapes in the Stars and Banners category are useful for calling attention to a particular cell or range to make it stand out from the others. Figure 14-15 shows two examples (one subtle, one more flamboyant) of how you can make one cell's value jump out.

### Creating Shapes with Shadow and 3D Effects

Figure 14-16 shows a sample of several objects that have various shadow and 3D effects applied. As you can see, the effects can be quite varied.



Month	Orders
January	931
February	2,014
March	1,242
April	893
May	923
June	2,455

**Figure 14-15:** Two ways of making a particular cell stand out.

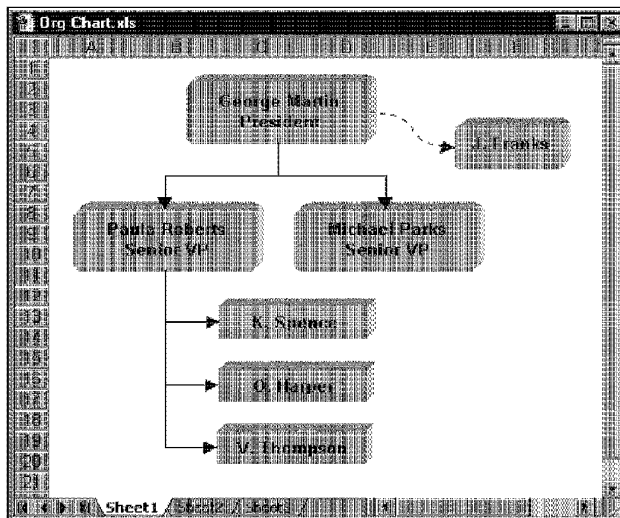


**Figure 14-16:** These objects use shadow or 3D effects.



## Creating Organizational Charts

Figure 14-17 shows a simple organizational chart that was created with the AutoShape drawing tools. The shapes in the Connectors and Flowchart categories were used and then 3D effects were added. To make the box size consistent, one box was created and then copied several times.



**Figure 14-17:** This organizational chart was created with Excel's drawing tools.

You can also create an organizational chart by selecting **Insert • Picture • Organization Chart**. This starts the Microsoft Organization Chart application that inserts an OLE object into the worksheet.

## Changing the Look of Cell Comments

If a cell contains a cell comment, you can replace the normal comment box with any of the AutoShapes in the Callouts category. Select the cell comment and then click the Draw tool on the Drawing toolbar. This tool expands to show a menu. Select **Change AutoShape • Callouts**, followed by the desired callout shape. Figure 14-18 shows an example of cell comments that use different AutoShapes.

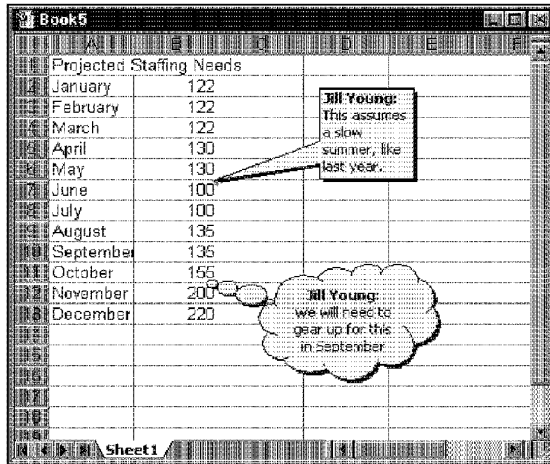


Figure 14-18: These cell comments use different AutoShapes.

## Linking Text in an Object to a Cell

As an alternative to typing text directly into an object, consider creating a link to a cell. After doing so, the text displayed in the object reflects the current contents of the linked cell. Figure 14-19 shows an AutoShape that is linked to a cell. The shape is selected; notice that the edit line displays a formula.

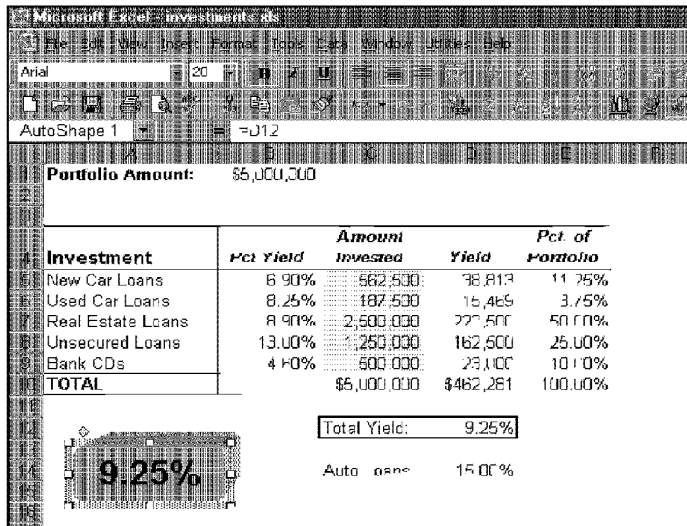


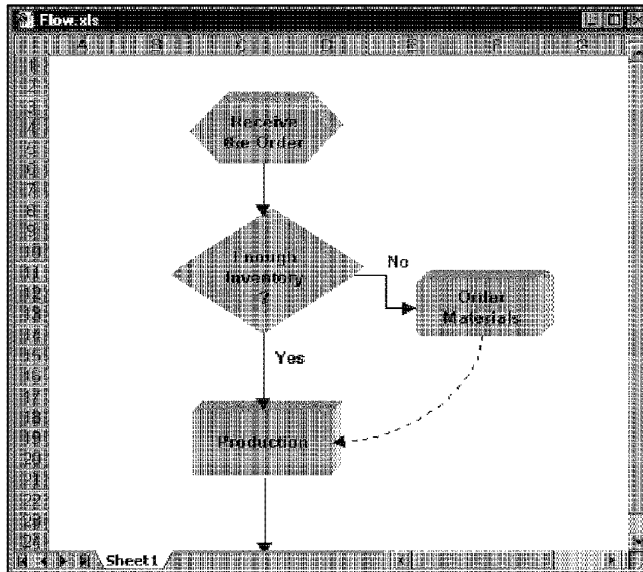
Figure 14-19: The text in the AutoShape is linked to cell D12.

To link an AutoShape to a cell, select the object and then click in the edit line. Enter a simple cell reference, such as =A1, and press Enter. You can format the text in the shape independent of the format of the cell. For best results, access the shape's Format dialog box and change the following settings:

- Automatic margins (Margins tab)
- Automatic size (Alignment tab)
- Center Horizontal alignment and Center Vertical alignment (Alignment tab)

## Creating Flow Diagrams

You also can create flow diagrams by using the drawing tools. The shapes in the Connectors and Flowchart categories are most useful. This capability often is useful to describe how a process or system works. Figure 14-20 shows an example of a flow diagram. After creating the diagram, all the objects were selected and grouped together so that the diagram could be moved as a single unit.



**Figure 14-20:** This flow diagram was created with Excel's drawing tools.

## Annotating a Chart

One of the most common uses of the drawing tools is to annotate a chart. For example, you can add descriptive text with an arrow, to call attention to a certain data point. This technique works for both embedded charts and charts on chart sheets. Figure 14-21 shows an example of an embedded chart that has been annotated.

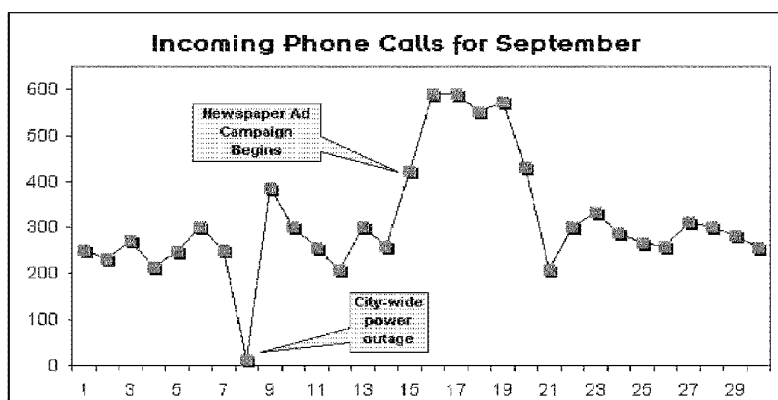


Figure 14-21: Annotating a chart with the drawing tools.

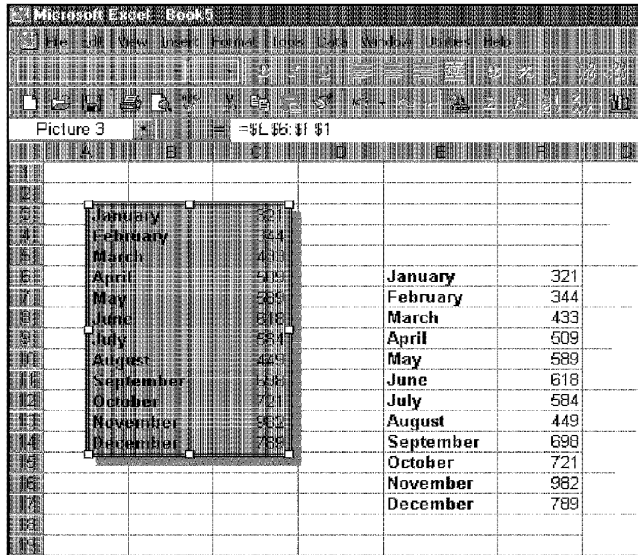
## Pasting Pictures of Cells

One of Excel's best-kept secrets is its ability to copy and paste pictures of cells. You can copy a cell or range and then paste a picture of the cell or range on any worksheet. The picture can be static or linked. With a linked picture, the link is to the cells. In other words, if you change the contents of a cell that's in a picture, the picture changes.

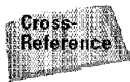
To create a picture of a cell or range, select a range and choose **Edit • Copy**. Then press **Shift** and click the **Edit** menu (pressing **Shift** is essential). Choose **Paste Picture** to create a static picture, or choose **Paste Picture Link** to paste a linked picture of the selection.

If you don't hold down **Shift** when you select the **Edit** menu, the **Paste Picture** and **Paste Picture Link** commands do not appear.

Figure 14-22 shows an example of a linked picture, with some additional formatting to the picture object (fill color and a shadow). Notice that the picture displays a cell reference in the formula bar.



**Figure 14-22:** This picture is linked to the cells in E6:F17.



Using linked pictures is particularly useful for printing noncontiguous ranges. See “Printing Noncontiguous Ranges on a Single Page” in Chapter 12 for more information.

## Summary

This chapter covers several types of graphic information that you can add to a worksheet’s draw layer: imported graphic images, objects that you draw by using Excel’s drawing tools, and other objects, such as WordArt or an OLE object, from Microsoft’s Organization Chart application. Several examples demonstrate some ways that you can use these objects in your workbooks.

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# Putting It All Together

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**T**he preceding chapters present basic information about how Excel works. But you probably already realize that simply knowing the commands and shortcuts won't help you create successful workbooks. This chapter helps you to tie everything together, and provides some pointers and examples to help you develop workbooks that do what you want them to do.

## The Audience for Spreadsheets

Before you get too far into this chapter, pause and think about spreadsheets in general. Spreadsheets can be classified in many ways, but the following two broad categories provide a useful place to start:

- Spreadsheets that you develop for your own use
- Spreadsheets that others will use

As you'll see, the way in which you develop your spreadsheet — and the amount of time and effort that you put into it — often depends on who is the ultimate user (you alone or others).

## Developing Spreadsheets for Yourself

If you're the only person who will use a particular spreadsheet, you should be less concerned with issues such as security, ease of use, and error handling than you would be if you were creating the spreadsheet for others. After all, you develop the spreadsheet and thus know how it is designed. If an error occurs, you can simply track down the source and correct the problem.

# 15

CHAPTER

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The Audience for Spreadsheets

Characteristics of a Successful Spreadsheet

Uses for Spreadsheets

Steps in Creating a Spreadsheet

A Workbook That's Easy to Maintain

When Things Go Wrong

Where to Go from Here

.....

### Quick-and-dirty spreadsheets

Chances are good that many of the spreadsheets you develop for your own use are “quick-and-dirty” — usually fairly small and developed to solve a problem or answer a question quickly. For example, you’re about to buy a new car and want to figure out your monthly payment for various loan amounts. Or, you need to generate a chart that shows your company’s monthly sales, so you quickly enter 12 values, whip off a chart, and paste it into your word processing document.

In these examples, you don’t really care what the spreadsheet looks like, as long as it gives you the correct answer (or in the case of the second example, produces a nice-looking chart). You can probably input the entire model in a few minutes, and you certainly won’t take the time to document your work. In many cases, you won’t even bother to save the file.

### For-your-eyes-only spreadsheets

As the name implies, this category includes spreadsheets created by you that no one else will ever see or use. One example is a file in which you keep information that is 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-related, 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 such).

Spreadsheets that are for your eyes only differ from the quick-and-dirty ones in that you use them more than once; therefore, you save these spreadsheets to files. Again, though, these are spreadsheets that are not worth spending a great deal of time on — you may apply some simple formatting, but that’s about it (after all, you don’t really need to impress yourself — or do you?). Like the quick-and-dirty kind, this type of spreadsheet lacks any type of error detection, because you already understand how the formulas are set up and, thus, know enough to avoid inputting data that produces erroneous results. If an error does crop up, you probably immediately know what caused it.

Spreadsheets in this category 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 accoutrements to it nearly every time I use it: more summary formulas, better formatting, and even a chart that displays income by month. My latest modification was to add a trend line to the chart to project income based on past trends.

## Developing Spreadsheets for Others

If others will use a spreadsheet that you are developing, you need to pay a lot more attention to minor details. Because of this, such a spreadsheet usually takes longer to create than one that only you will see. The amount of extra effort depends, in

large part, on the experience level of the other users. A spreadsheet that will be utilized by an inexperienced computer user is often the most difficult to develop, simply because you need to make sure that it's "bulletproof." In other words, you don't want the user to mess things up (erase a formula, for example). In addition, you have to make perfectly clear how the spreadsheet should be used. This often means adding more formatting and instructions for the user.

As you'll discover in later chapters, you can use Excel as a complete application-development environment and create sophisticated applications that may not even look like a normal spreadsheet. Doing so almost always requires using macros and custom interface elements, such as buttons, custom toolbars, and custom menus.

## Characteristics of a Successful Spreadsheet

You create a spreadsheet to accomplish some end result, which could be any of thousands of things. If the spreadsheet is successful, it meets most or all of the following criteria (some of which are appropriate only if the spreadsheet is used by others):

- It enables the end user to perform a task that he or she probably would not be able to do otherwise — or a task that would take *much* longer to do manually.
- It's the appropriate solution to the problem.

Using a spreadsheet isn't always the most suitable approach. For example, you can create an organizational chart with Excel, but if you create organizational charts for a living, you're better off with a software product designed specifically for that task.

- It accomplishes its goal.

This may seem like an obvious prerequisite, but I've seen many spreadsheets that fail to meet this test.

- It produces accurate results.

As you may have discovered by now, creating formulas that produce the wrong results is quite easy. In most cases, returning no answer is better than returning an incorrect one.

- It doesn't let the user accidentally (or intentionally) delete or modify important components.

Excel has built-in features to help in this area (see "Applying Appropriate Protection," later in this chapter).

- It doesn't let the user enter inappropriate data.

Excel data-validation features make this type of checking easier than ever.



- It's laid out clearly so that the user always knows how to proceed.  
I've opened far too many spreadsheets and not had a clue as to how to proceed—or even what the purpose of the spreadsheet was.
- Its formulas and macros are well documented so that, if necessary, they can be changed.
- It is designed so that it can be modified in simple ways without making major changes.

You can create spreadsheets at many different levels, ranging from simple fill-in-the-blank templates to extremely complex applications that utilize custom menus and dialog boxes, and that may not even look like spreadsheets. The remainder of this chapter focuses on relatively simple spreadsheets—those that can be produced by using only the information presented in Parts I and II of this book.

## Uses for Spreadsheets

Millions of spreadsheets are in daily use throughout the world. Many fit into the quick-and-dirty or for-your-eyes-only classifications described previously. Of the spreadsheets with lasting value, however, the majority probably fit into one or more of the following broad categories:

- Financial or data-analysis models
- Reports and presentations
- List-management worksheets
- Workbooks that enable database access

These types of spreadsheets are discussed in the following sections.

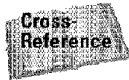
### Financial or Data-Analysis Models

Before the days of personal computers, large companies relied on mainframe systems to do their financial analysis. Smaller companies used sheets of accounting paper. But things have changed dramatically over the past decade, and now companies of all sizes can use personal computers to perform sophisticated analyses, in the blink of an eye.

This category of spreadsheets covers a wide variety of applications, including budgeting, investment analysis, modeling, and statistical data analysis. These applications can range from simple tables of numbers to sophisticated mathematical models designed for “what-if” analyses.

One common type of spreadsheet is a *budget spreadsheet*, which typically has months along the top and budget categories along the left. Each intersecting cell contains a projected expense — for example, telephone expenses for June. Budgets use SUM formulas (and maybe SUBTOTAL formulas) to calculate annual totals and totals for each category. Excel's multisheet feature enables you to store on separate sheets the budgets for different departments or divisions.

Budget categories often are arranged hierarchically. For example, you could have a category called Personnel that consists of subcategories such as Salary, Benefits, Bonus, and so on (see Figure 15-1). In such a case, you could create additional formulas to calculate category totals.



Excel's outlining feature is ideal for creating formulas to calculate category totals, which is the topic of Chapter 18.

Outlined Budget.xls						
	Jan	Feb	Mar	Q1	Apr	May
<b>Marketing</b>						
Salaries	35,000	35,000	35,000	105,000	35,000	35,000
Benefits	7,350	7,350	7,350	22,050	7,350	7,350
Bonus	0	0	0	0	0	0
<b>Total Personnel</b>	<b>42,350</b>	<b>42,350</b>	<b>42,350</b>	<b>127,050</b>	<b>42,350</b>	<b>42,350</b>
Office	2,250	2,250	2,250	6,750	2,250	2,250
Computer	900	900	900	2,700	900	900
<b>Total Supplies</b>	<b>3,150</b>	<b>3,150</b>	<b>3,150</b>	<b>9,450</b>	<b>3,150</b>	<b>3,150</b>
Transportation	3,000	3,000	3,000	9,000	5,500	3,000
Hotel	1,050	1,050	1,050	3,150	3,400	1,050
Meals	500	500	500	1,500	1,250	500
<b>Total Travel</b>	<b>4,550</b>	<b>4,550</b>	<b>4,550</b>	<b>13,650</b>	<b>10,150</b>	<b>4,550</b>
Computers	4,500	4,500	4,500	13,500	4,500	4,500
Cociers	1,100	1,100	1,100	3,300	1,100	1,100
Other	950	950	950	2,850	950	950
<b>Total Equipment</b>	<b>6,550</b>	<b>6,550</b>	<b>6,550</b>	<b>19,650</b>	<b>6,550</b>	<b>6,550</b>
Lease	2,000	2,000	2,000	6,000	2,500	2,500
Utilities	450	450	450	1,350	450	450
Taxes	540	540	540	1,620	540	540
Other	1,200	1,200	1,200	3,600	1,200	1,200
Telephone	875	875	875	2,625	875	875
Postage	250	250	250	750	250	250
<b>Total Facility</b>	<b>5,315</b>	<b>5,315</b>	<b>5,315</b>	<b>15,945</b>	<b>5,815</b>	<b>5,815</b>
<b>Total Marketing</b>	<b>61,915</b>	<b>61,915</b>	<b>61,915</b>	<b>185,745</b>	<b>68,015</b>	<b>62,415</b>
<b>Operations</b>						
Salaries	210,000	210,000	210,000	630,000	215,000	215,000
Benefits	44,100	44,100	44,100	132,300	45,150	45,150

**Figure 15-1:** This budget worksheet uses formulas to calculate subtotals within each category.

Another type of financial application is a *what-if model*. A what-if model calculates formulas by using assumptions that are specified in a series of input cells. For example, you can create an amortization spreadsheet that calculates details for a loan, based on the loan amount, the interest rate, and the term of the loan. This model would have three input cells. Excel's Scenario Manager is designed to make this type of model easier to handle.

**Cross-Reference**

Chapter 26 discusses various ways to set up what-if models.

## Reports and Presentations

Some spreadsheets are designed primarily for their end result: printed output. These spreadsheets take advantage of Excel's formatting and chart-making features to produce attractive, boardroom-quality output.

Of course, any spreadsheet can produce good, quality reports, so spreadsheets in this category often fall into another category, as well.

**Note**

Nowadays, instead of printing your work, you may display it in the form of a Web page, either on the Internet or on your corporate intranet. The new HTML features in Excel 2000 make this task easier than ever.

## List Management

Another common use for spreadsheets is *list management*, in which a list is essentially a database table stored in a worksheet. A database table consists of field names in the top row and records in the rows below. Beginning with Excel 97, worksheets have 65,536 rows — which means that the potential for list-management applications has improved dramatically.

Excel has some handy tools that enable you to manipulate lists in a variety of ways (see Figure 15-2).

**Cross-Reference**

List management is the topic of Chapter 23.

## Database Access

Another category of spreadsheets works with data stored in external databases. You can use Excel to query external databases and bring in a subset of the data that meets criteria that you specify. Then, you can do what you want with this data, independent of the original database.

**Cross-Reference**

Spreadsheets that use external databases are covered in Chapter 24.

Month	SalesRep	Type	UnitCost	Quantity	TotalSale
March	Wilson	New	175	5	875
March	Wilson	New	140	3	420
February	Franks	Existing	225	1	225
March	Wilson	New	125	5	625
January	Pe	Top 10 AutoFilter			450
March	Sh				280
February	Pe				1350
March	Je				280
February	Sh				900
January	Wi				560
January	Wi				375
January	Sheldon	New	225	6	1350
February	Sheldon	New	175	5	875
January	Robinson	New	140	3	420
February	Sheldon	New	125	2	250
March	Sheldon	New	140	6	840
March	Jenkins	Existing	225	3	675
January	Robinson	New	225	2	450
March	Sheldon	New	225	6	1350
February	Wilson	New	140	3	420

Figure 15-2: Excel makes working with lists of data easy.

## Turnkey Applications

A *turnkey application* refers to a spreadsheet solution that is programmed to work as a standalone application. Such an application always requires macros, and may involve creating custom menus and custom toolbars.

These applications are large-scale projects that are designed to be used by many people or for a long time. They often interact with other systems (such as a corporate database) and must be very stable. Although this book touches on some elements of developing such applications, they are beyond this book's scope.

## Steps in Creating a Spreadsheet

This section discusses the basic steps that you may follow to create a spreadsheet. This discussion assumes that you're creating a workbook that others may use, so you may skip some of these steps if the spreadsheet is for you only. These steps are for relatively simple spreadsheets—those that don't use macros, custom toolbars, or other advanced features. And, of course, these are only basic guidelines. Everyone eventually develops his or her own style, and you may find a method that works better for you. The basic steps are as follows:

1. Think about what you want to accomplish.
2. Consider the audience.

3. Design the workbook layout.
4. Enter data and formulas.
5. Apply appropriate formatting.
6. Test your spreadsheet.
7. Apply protection as necessary.
8. Document your work.

Each of these steps is discussed in the following sections.

## Developing a Plan

If you're like me, when you set out to create a new spreadsheet, you may have a tendency to jump right in and get to work. Tempting as it may be to create something concrete as quickly as possible, try to restrain yourself. The end product is almost always better if you take some time to determine exactly what you're trying to accomplish and come up with a plan of action. The time that you spend at this stage usually saves you more time later in the project.

Developing a plan for a spreadsheet may involve answering the following questions and collecting the necessary information that is involved:

- How is the problem currently being addressed? And what's wrong with the current solution?
- Is a spreadsheet really the best solution to the problem?
- How long will the spreadsheet be used?
- How many people will be using it?
- What type of output, if any, will be required?
- Does data already exist that can be imported?
- Will the requirements for this project change over time?

The point here is to attempt to learn as much as possible about the project that you're developing. With that information, you can determine a plan of action — which may even mean *not* using a spreadsheet for the solution.

## Considering the Audience

If you'll be the only user of the workbook that you're developing, you can skip this step. But if others will be using your workbook, take some time to find out about

these people. Answering the following questions often prevents having to make changes later:

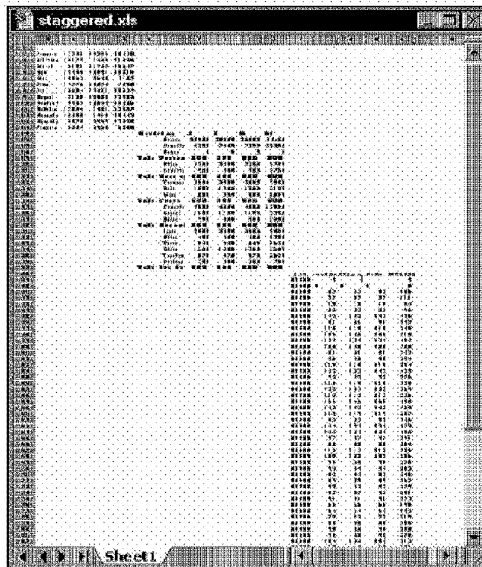
- **How experienced are the users?** Can they perform basic operations, such as copying, inserting rows, and so on? Don't assume that everyone knows as much as you do.
- **What software will they be using?** For example, if you develop your spreadsheet by using Excel 2000, you need to be aware that it can't be loaded into Excel 95 or earlier versions unless you first save the file in the older format. Users with older versions won't be able to take advantage of the newer features.
- **What hardware will they be using?** If your spreadsheet takes 3 minutes to calculate on your Pentium-based system, it may well take 20 minutes on a slower 486 system. Also, be aware of different video modes. If you develop your spreadsheet by using a 1024 X 768 video mode, users with an 800 X 600 or 640 X 480 display will have a much smaller viewing area.
- **Do you want to allow changes?** Often, you want to make sure that your formulas don't get modified. If so, you'll need to perform some basic protection (see "Applying Appropriate Protection," later in this chapter).

## Designing the Workbook Layout

An important consideration is how you want to lay out the workbook. Before the days of multisheet workbooks, this was a lot more difficult than it is today. When your file has only a single worksheet, you have to plan it carefully to ensure that making a change doesn't affect something else.

Spreadsheets often consist of distinct blocks of information. In the old days, spreadsheet designers often used a layout like the one shown in Figure 15-3. This example is for a spreadsheet that has three main blocks: an input area, a calculation area, and a report area. This *offset block layout* minimizes the possibility of damage. For example, deleting a column or changing its width affects only one area. If the areas were laid out vertically, this would not be the case.

Because Excel uses multiple worksheets in a file, however, this type of layout is rarely necessary. Using a separate worksheet for each block is much easier and more efficient. An added advantage is that you can access the various blocks simply by clicking the tab (which can be named appropriately).



**Figure 15-3:** This offset block layout is one way to organize a worksheet.

## Entering Data and Formulas

This phase of the spreadsheet development process is often where people begin. But if you've thought through the problem, considered the users, and created an appropriate layout, this phase should go more smoothly than if you jumped right in without the preliminary steps.

The more that you know about Excel, the easier this phase is. Formulas are just one part of a spreadsheet. Sometimes, you may need to incorporate one or more of the following features (all of which are discussed later in the book):

- Workbook consolidation
- List management
- External databases
- Outlining
- Data validation
- Conditional formatting
- Hyperlinks

- Statistical analysis
- Pivot tables
- Scenario management
- Solver
- Mapping
- Interaction with other applications
- Custom menus or toolbars (which require macros)

## Applying Appropriate Formatting

Many people prefer to format their work as they go along. If that's not your style, this step must be performed before you unleash your efforts to the end-users. As I mentioned in Chapter 11, almost all worksheets benefit from some stylistic formatting. At the very least, you need to adjust the number formats so that the values appear correctly. If the worksheet will be used by others, make sure that any color combinations you use will be visible for those running on a monochrome system (such as a notebook computer).

Of all the basic steps in creating a spreadsheet, formatting is the one with the most variety. Although beauty may be in the eye of the beholder, there are some guidelines that you might want to consider:

- **Preformat all numeric cells.** Use number formats that are appropriate for the numbers and make sure that the columns are wide enough to handle the maximum values. For example, if a cell is designed to hold an interest rate, format it with a percent sign. And if you create an amortization schedule, make sure that the columns are wide enough to handle large amounts.
- **Use only basic fonts.** If others will be using your workbook, stick to the basic TrueType fonts that come with Windows. Otherwise, the fonts may not translate well, and the user may see a string of asterisks rather than a value.
- **Don't go overboard with fonts.** As a rule of thumb, never use more than two different typefaces in a single workbook. Usually, one works just fine (Arial is a good choice). If you use different font sizes, do so sparingly.
- **Be careful with color.** Colored text or cell backgrounds can make your workbook much easier to use. For example, if you use a lookup table, you can use color to clarify where the table's boundaries are. Or, you may want to color-code the cells that will accept user input. Overuse of colors makes your spreadsheet look gaudy and unprofessional, however. Also, make sure that color combinations will work if the workbook is opened on a monochrome notebook computer.



- **Consider identifying the active area.** Many spreadsheets are set up using only a few cells—the active area. Inexperienced users often scroll away from the active area and get lost. One technique is to hide all rows and columns that aren't used. Or, you can apply a color background (such as light gray) to all unused cells. This makes the cells in use very clear.
- **Remove extraneous elements.** In some cases, you can simplify things significantly by removing elements that might get in the way or cause the screen to appear more confusing than it is. These elements include automatic page breaks, gridlines, row and column headers, and sheet tabs. These options, which you set in the View panel of the Options dialog box, are saved with the worksheet.

## Testing the Spreadsheet

Before you actually use your newly created spreadsheet for real work, you should test it thoroughly. This is even more critical if others will be using your spreadsheet. If you've distributed 20 copies of your file and then discover a major error in a formula, you'll have to do a "recall" and send out a corrected copy. Obviously, catching the errors before you send out a spreadsheet is much easier.

Testing basically is the process of ensuring that the formulas produce correct results under all possible circumstances. I don't know of any specific rules for testing a worksheet, so you're pretty much on your own here. I can, however, offer a few guidelines:

- **Test with all potential versions.** If some of your end-users are using older versions of Excel, it's critical that you test your work using all the other versions. Saving your file in an older format means that others can open your file with an older version of Excel. It does *not* guarantee that everything will still work correctly!
- **Try extreme input values.** If your worksheet is set up to perform calculations using input cells, spend some time and enter very large or very small numbers and observe the effects on the formulas. If the user should enter a percentage, see what happens if you enter a large value. If a positive number is expected, try entering a negative number. This also is a good way to ensure that your columns are wide enough.
- **Provide data validation.** Although you can't expect your formulas to yield usable results for invalid entries (garbage in, garbage out), you may want to use Excel's data validation features to ensure that data entered is of the proper type.
- **Use dummy data.** If you have a budget application, for example, try entering 1 into each nonformula cell. This is a good way to make sure that all of your SUM formulas refer to the correct ranges. An incorrect formula usually stands out from the others.
- **Familiarize yourself with Excel's auditing tools.** Excel has several useful tools that can help you track down erroneous formulas.



Excel's auditing tools are discussed in Chapter 31.

## Applying Appropriate Protection

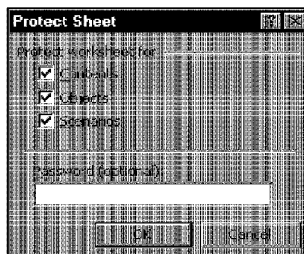
A spreadsheet can be quite fragile. Deleting a single formula often has a ripple effect and causes other formulas to produce an error value or, even worse, incorrect results. I've seen cases in which an inexperienced user deleted a critical formula, panicked, and cemented the mistake by saving the file and reopening it — only to discover, of course, that the original (good) version had been overwritten.

You can circumvent such problems by using the protection features built into Excel. The following are the two general types of protection:

- Sheet protection
- Workbook protection

### Protecting Sheets

The Tools • Protection • Protect Sheet command displays the dialog box shown in Figure 15-4.



**Figure 15-4:** The Protect Sheet dialog box.

This dialog box has three check boxes:

- **Contents:** Cells that have their Locked property turned on can't be changed.
- **Objects:** Drawing objects (including embedded charts) that have their Locked property turned on can't be selected.
- **Scenarios:** Defined scenarios that have their Prevent Changes property turned on can't be changed (see Chapter 26 for a discussion of scenario management).

You may provide a password in the Protect Sheet dialog box. If you enter a password, the password must be reentered before the sheet can be unprotected. If you don't supply a password, anyone can unprotect the sheet.

By default, all cells have their Locked property turned on. Before protecting a worksheet, you'll normally want to turn off the Locked property for input cells.

You can change the Locked property of a cell or object by accessing its Format dialog box and clicking the Protection tab. Cells have an additional property: Hidden. This name is a bit misleading, because it doesn't actually hide the cell. Rather, it prevents the cell contents from being displayed in the formula bar. You can use the Hidden property to prevent others from seeing your formulas.

**Note**

You can't change a cell's Locked property while the sheet is protected. You must unprotect the sheet to make any changes, and then protect it again.

**Note**

Protection isn't just for worksheets that others will be using. Many people protect worksheets to prevent themselves from accidentally deleting cells.

## Protecting Workbooks

The second type of protection is workbook protection. The Tools \* Protection \* Protect Workbook command displays the dialog box shown in Figure 15-5.

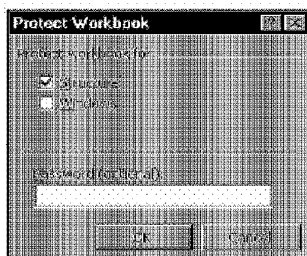


Figure 15-5: The Protect Workbook dialog box.

This dialog box has two check boxes:

- **Structure:** Protects the workbook window from being moved or resized.
- **Windows:** Prevents any of the following changes to a workbook: adding a sheet, deleting a sheet, moving a sheet, renaming a sheet, hiding a sheet, or unhiding a sheet.

Again, you can determine whether to supply a password, depending on the level of protection that you need.

## Documenting Your Work

The final step in the spreadsheet-creation process is documenting your work. Making some notes about your spreadsheet is always a good idea. After all, you may need to modify the spreadsheet later. The elegant formula that you create

today may be completely meaningless when you need to change it in six months. The following sections provide some general tips on documenting your spreadsheets.

### Use the Properties Dialog Box

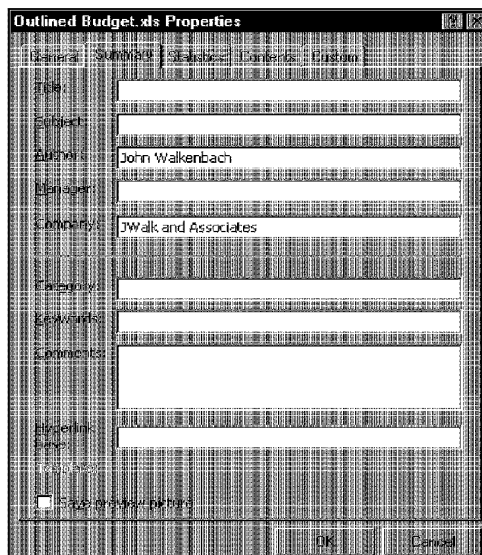
The File • Properties command displays the Properties dialog box (the Summary tab is shown in Figure 15-6). You may want to take a few minutes to fill in the missing information and enter some comments in the Comments box.

### Use Cell Comments

As you know, you can document individual cells by using the Insert • Comment command. The comment appears when you move the mouse pointer over the cell. If you don't like the idea of seeing the cell comments appear, adjust this setting in the View tab of the Options dialog box. Unfortunately, this setting applies to all workbooks, so if you turn off the note indicator for one workbook, you turn it off for all of them.

### Use a Separate Worksheet

Perhaps the best way to document a workbook is to insert a new worksheet and store your comments there. Some people also like to keep a running tally of any modifications that they make. You can hide the worksheet so that others can't see it.



**Figure 15-6:** The Summary tab of the Properties dialog box.

## A Workbook That's Easy to Maintain

One of the cardinal rules of “spreadsheets” is that things change. You may have a sales-tracking spreadsheet that you’ve been using for years, and it works perfectly well. But then you’re informed that the company has bought out one of your competitors, and the sales regions will be restructured. Your sales-tracking workbook suddenly no longer applies.

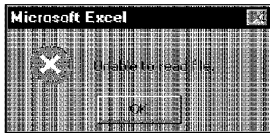
You often can save yourself lots of time by planning for the inevitable changes. You can do a few things to make your worksheets as modifiable as possible:

- **Avoid hard-coding values in formulas.** For example, assume that you have formulas that calculate sales commissions by using a commission rate of 12.5 percent. Rather than use the value .125 in the formulas, enter it into a cell and use the cell reference. Or, use the technique described in Chapter 9 (see “Naming constants”) to create a named constant.
- **Use names whenever possible.** Cell and range names make your formulas easier to read and more understandable. When the time comes to modify your formulas, you may be able to modify just the range to which a name refers.
- **Use simplified formulas.** Beginning users sometimes create formulas that are more complicated than they need to be. Often, this is because they don’t know about a particular built-in function. As you gain more experience with Excel, be on the lookout for useful functions that can make your formulas simple and clear. Such formulas are much easier to modify, when needed.
- **Use a flexible layout.** Rather than try to cram everything into a single worksheet, use multiple worksheets. You’ll find that this makes expanding much easier, should the need arise.
- **Use named styles.** Using named styles makes obtaining consistent formatting much easier if you need to add new data to accommodate a change. This feature is discussed in Chapter 11 (see “Using Named Styles”).
- **Keep it clean.** Keeping your workbooks clean and free of extraneous information is also a good idea. For example, if the workbook has empty worksheets, remove them. If you created names that you no longer use, delete them. If you no longer need a range of cells that you used to perform a quick calculation, delete the range.

## When Things Go Wrong

Many types of errors can occur when you work with Excel (or any spreadsheet, for that matter). These errors range from inconvenient errors that can be easily corrected to disastrous, irreparable errors.

For example, a formula may return an error value when a certain cell that it uses contains a zero. Normally, you can isolate the problem and correct the formula, so that the error doesn't appear anymore (this is an example of an easily corrected error). A potentially disastrous error is when you open a worksheet and Excel reports that it can't read the file. Figure 15-7 shows the message that you get. Unless you made a recent backup, you could be in deep trouble. Unfortunately, this type of error (a corrupted file) occurs more often than you might think.



**Figure 15-7:** When you see an error message like this, you better have a recent backup available.

Good testing helps you to avoid problems with your formulas. Making modifications to your work, however, may result in a formula that no longer works. For example, you may add a new column to the worksheet, and the formulas don't pick up the expanded cell reference. This is an example of when using names could eliminate the need to adjust the formulas.

You will encounter cases in which a formula just doesn't work as it should. When this happens, try to isolate the problem as simply as possible. I've found that a good way to deal with such formulas is to create a new workbook with a very simplified example of what I'm trying to accomplish. Sometimes, looking at the problem in a different context can shed new light on it.

The only way to prevent disasters—such as a corrupt file—is to develop good backup habits. If a file is important, you should never have only one copy of it. You should get in the habit of making a daily backup on a different storage medium.

## Where to Go from Here

This chapter concludes Part II. If you're following the book in sequential-chapter order, you now have enough knowledge to put Excel to good use.

Excel has many more features that may interest you, however, which are covered in the remaining chapters. Even if you're satisfied with what you already know about Excel, I strongly suggest that you at least browse through the remaining chapters. You may see something that can save you hours.

## Summary

This chapter distinguishes two general categories of spreadsheets: those that you create for yourself only and those that others will use. The approach that you take depends on the end-user. This chapter also covers the characteristics of a successful spreadsheet, basic types of spreadsheets, basic steps that you may follow to create a spreadsheet, and features in Excel that let you protect various parts of your work. The chapter concludes with some tips on how to make your spreadsheets easier to maintain and how to handle some common types of errors.

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# Advanced Features

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P A R T I



## In This Part

**Chapter 16**  
Advanced Charting

**Chapter 17**  
Creating Maps with  
Microsoft Map

**Chapter 18**  
Creating and Using  
Worksheet Outlines

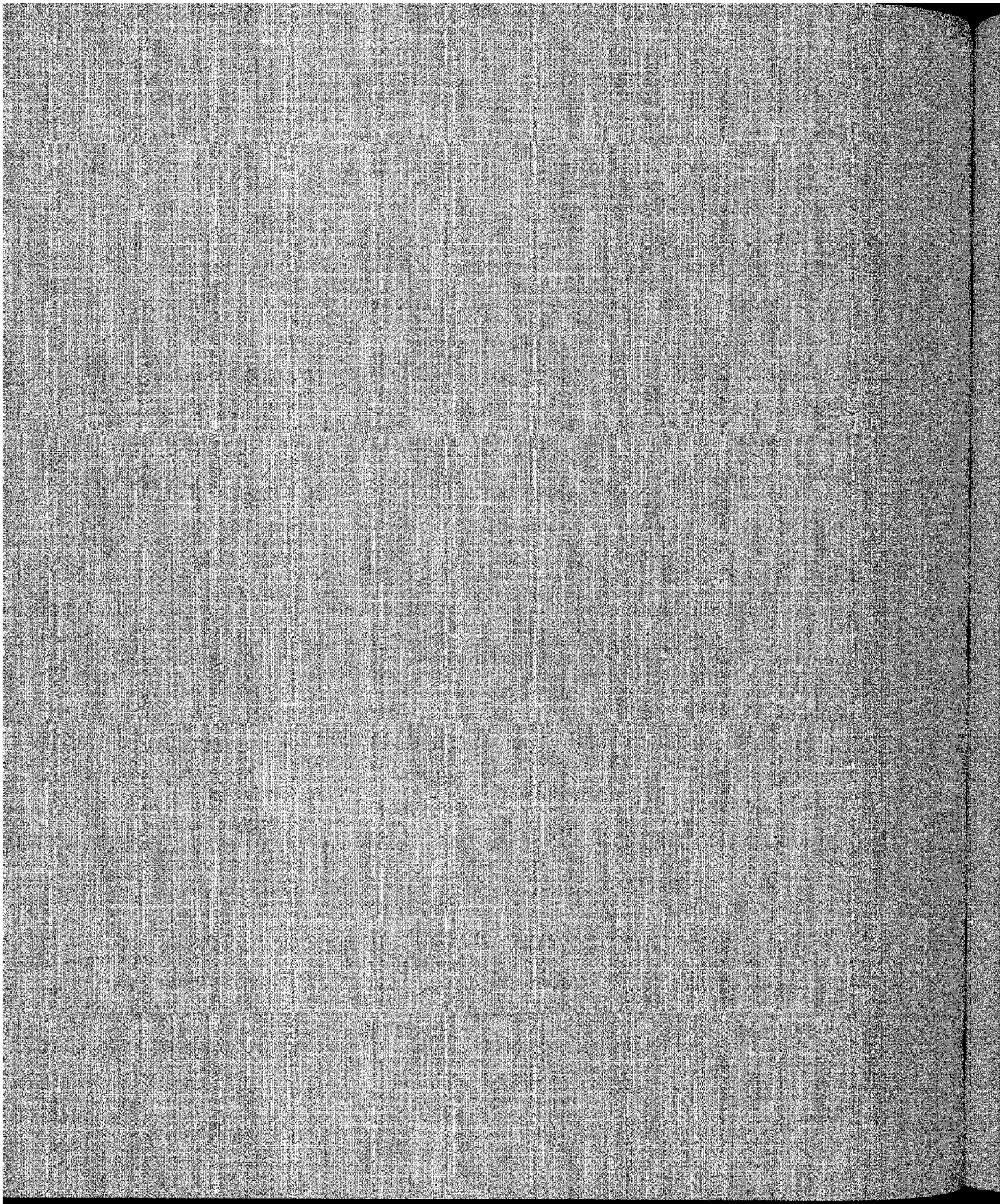
**Chapter 19**  
Linking and  
Consolidating  
Worksheets

**Chapter 20**  
Creating and Using  
Array Formulas

**Chapter 21**  
Using Excel in a  
Workgroup







# Advanced Charting

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**C**hapter 13 introduces charting. This chapter takes the topic to the next level. You learn how to customize your charts to the maximum, so that they look exactly as you want. I also share some slick charting tricks that I've picked up over the years.

## Chart Customization: An Overview

Often, the basic chart that Excel creates is sufficient for your needs. If you're using a chart to get a quick visual impression of your data, a chart that's based on one of the standard chart types usually does just fine. But, if you want to create the most effective chart possible, you probably want to take advantage of the additional customization techniques available in Excel.

Customizing a chart involves changing its appearance, as well as possibly adding new elements to it. These changes can be purely cosmetic (such as changing colors or modifying line widths) or quite substantial (such as changing the axis scales or rotating a 3D chart). New elements that you might add include features such as a data table, a trendline, or error bars.



**Note**

Before you can customize a chart, you must activate it on a chart sheet, by clicking its sheet tab. To activate an embedded chart, click the chart's border. To deactivate an embedded chart, just click anywhere in the worksheet.



**Tip**

In some cases, you may prefer to work with an embedded chart in a separate window. For example, if the embedded chart is larger than the workbook window, working with it in its own window is much easier. To display an embedded chart in a window, right-click the chart's border and select Chart Window from the shortcut menu.

# 16

CHAPTER

## In This Chapter

Customizing Charts

Background Elements

Plot Area

Working with Chart Titles

Working with the Legend

Changing Gridlines

Modifying the Axes

Working with Data Series

Creating Combination Charts

Using Secondary Axes

Creating Custom Chart Types

Working with 3D Charts

Chart-Making Tricks

Here's a partial list of the customizations that you can make to a chart:

- Change any colors, patterns, line widths, marker styles, and fonts.
- Change the data ranges that the chart uses, add a new chart series, or delete an existing series.
- Choose which gridlines to display.
- Determine the size and placement of the legend (or delete it altogether).
- Determine where the axes cross.
- Adjust the axis scales by specifying a maximum and minimum, changing the tick marks and labels, and so on. You also can specify that a scale be represented in logarithmic units.
- Add titles for the chart and axes, as well as free-floating text anywhere in the chart.
- Add error bars and trendlines to a data series.
- Display the data points in reverse order.
- Rotate a 3D chart to get a better view or to add impact.
- Replace line-chart markers with bitmaps.



You can easily become overwhelmed with all the chart customization options. However, the more that you work with charts, the easier it becomes. Even advanced users tend to experiment a great deal with chart customization, and they rely heavily on trial and error—a technique that I strongly recommend.

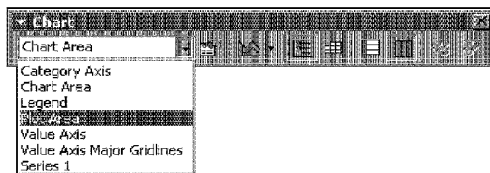
## Elements of a Chart

Before chart modifications are discussed, a brief digression is necessary to discuss the various elements of a chart. The number and type of elements in a chart varies with the type of chart—for example, pie charts don't have axes, and only 3D charts have walls and floors.

When a chart is activated, you can select various parts of the chart with which to work. Modifying a chart is similar to everything else that you do in Excel: First you make a selection (in this case, select a chart element) and then you issue a command to do something with the selection. Unlike a worksheet selection, with a chart selection, you can select only one chart element at a time. The exceptions are elements that consist of multiple parts, such as gridlines. Selecting one gridline selects them all.

You select a chart element by clicking it. The name of the selected item appears in the Name box. When a chart is activated, you can't access the Name box; it's simply a convenient place for Excel to display the chart element's name.

The Chart toolbar, which is displayed when you select a chart, contains a tool called Chart Objects (see Figure 16-1). This is a drop-down list of all the named elements in a chart. Rather than selecting a chart element by clicking it, you can use this list to select the chart element that you want to work with.



**Figure 16-1:** The Chart Objects tool in the Chart toolbar provides another way to select a chart element.



**Tip**

Yet another way to select a chart element is to use the keyboard. When a chart is activated, press the up arrow or down arrow to cycle through all parts in the chart. When a data series is selected, press the right arrow or left arrow to select individual points in the series.

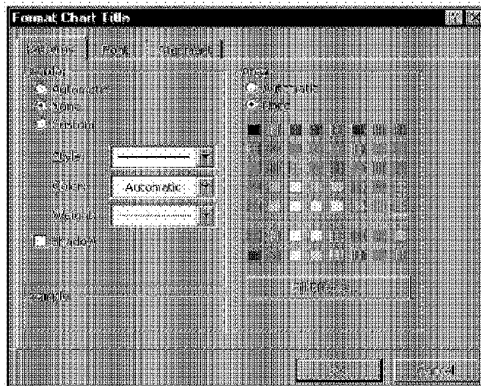
Table 16-1 lists the various elements of a chart (not all of these parts appear in every chart). You might want to create a chart and practice selecting some of these parts—or use the Chart Objects tool in the Chart toolbar to examine the element names.

## Using the Format Dialog Box

When a chart element is selected, you can access the element's Format dialog box to format or set options for the element. Each chart element has a unique Format dialog box. You can access this dialog box by using any of the following methods:

- Select the **Format • Selected Part Name** command (the Format menu displays the actual name of the selected part)
- Double-click a chart part
- Select the chart element and press **Ctrl+I**
- Right-click the chart element and choose the **Format** command from the shortcut menu

Any of these methods displays a tabbed Format dialog box that enables you to make many changes to the selected chart element. For example, Figure 16-2 shows the dialog box that appears when the chart's title is selected.



**Figure 16-2:** The Format dialog box for a chart's title. Each chart element has its own Format dialog box.

In the following sections, the details of the various types of chart modifications are discussed in depth.

**Table 16-1**  
**Chart Elements**

<i>Part</i>	<i>Description</i>
Category Axis	The axis that represents the chart's categories.
Category Title	The title for the category axis.
Chart Area	The chart's background.
Chart Title	The chart's title.
Corners	The corners of 3D charts (except 3D pie charts). Select the corners if you want to rotate a 3D chart by using a mouse.
Data Label	A data label for a point in a series. The name is preceded by the series and the point. Example: Series 1 Point 1 Data Label.

<b>Part</b>	<b>Description</b>
Data Labels	Data labels for a series. The name is preceded by the series. Example: Series 1 Data Labels.
Data Table	The chart's data table.
Down-Bars	Down-bars in a stock market chart.
Dropline	A dropline that extends from the data point downward to the axis.
Error Bars	Error bars for a series. The name is preceded by the series. Example: Series 1 Error Bars.
Floor	The floor of a 3D chart.
Gridlines	A chart can have major and minor gridlines for each axis. The element is named using the axis and the type of gridlines. Example: Value Axis Major Gridlines.
High-Low Lines	High-low lines in a stock market chart.
Legend Entry	One of the text entries inside of a legend.
Legend Key	One of the keys inside of a legend.
Legend	The chart's legend.
Plot Area	The chart's Plot Area — the actual chart, without the legend.
Point	A point in a data series. The name is preceded by the series. Example: Series 1 Point 2.
Series Axis	The axis that represents the chart's series (3D charts only).
Series	A line that connects a series.
Trendline	A trendline for a data series.
Up-Bars	Up-bars in a stock market chart.
Value Axis Title	The title for the value axis.
Value Axis	The axis that represents the chart's values. A Secondary Value Axis may also exist.
Walls	The walls of a 3D chart only (except 3D pie charts).

## Chart Background Elements

As mentioned in the preceding section, a chart consists of many elements. This section discusses two of those elements: the Chart Area and the Plot Area. These chart items provide a background for other elements in the chart.

## The Chart Area

The Chart Area is an object that contains all other elements in the chart. You can think of it as a chart's master background. You can't change the size of the Chart Area. For an embedded chart, it's always the same size as the embedded chart object. For a chart sheet, the Chart Area is always the entire sheet.

The following are the three tabs of the Chart Area dialog box and some key points about each:

- **Patterns tab:** Enables you to change the Chart Area's color and patterns (including fill effects) and add a border, if you like.
- **Font tab:** Enables you to change the properties of *all fonts used in the chart*. Changing the font doesn't affect fonts that you have previously changed, however. For example, if you make the chart's title 20-point Arial and then change the font to 8-point Arial in the Format Chart Area dialog box, the title's font is not affected.
- **Properties tab:** Enables you to specify how the chart is moved and sized with respect to the underlying cells. You also can set the Locked property and specify whether the chart will be printed.



Note

If you delete the Chart Area, you delete the entire chart.



Note

Prior to Excel 97, clicking an embedded chart selected the chart object. You could then adjust its properties. To activate the chart, you actually had to double-click it. Beginning with Excel 97, clicking an embedded chart activates the chart contained inside the chart object. You can adjust the chart object's properties by using the Properties tab of the Format dialog box. To select the chart object itself, press Ctrl while you click the chart. You might want to select the chart object to change its name by using the Name box.

## The Plot Area

The Chart Area of a chart contains the Plot Area, which is the part of the chart that contains the actual chart. The Plot Area is unlike the Chart Area in that you can resize and reposition the Plot Area. The Format Plot Area dialog box has only one tab: Patterns. This tab enables you to change the color and pattern of the Plot Area and adjust its borders.


 Tip

When you select a chart element, you'll find that many of the toolbar buttons that you normally use for worksheet formatting also work with the selected chart element. For example, if you select the chart's Plot Area, you can change its color by using the Fill Color tool on the Formatting toolbar. If you select an element that contains text, you can use the Font Color tool to change the color of the text.

## Working with Chart Titles

A chart can have as many as five different titles:

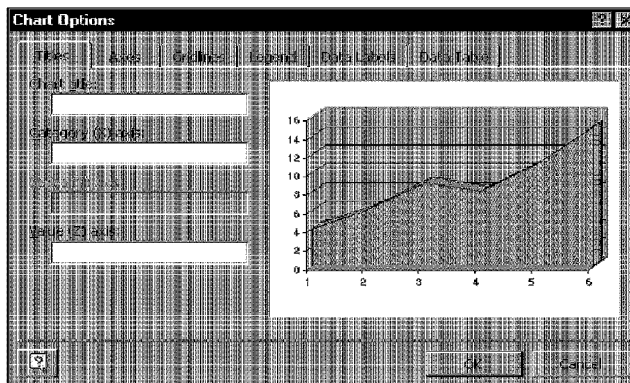
- Chart title
- Category (X) axis title
- Value (Y) axis title
- Second category (X) axis title
- Second value (Y) axis title

The number of titles that you can use depends on the chart type. For example, a pie chart supports only a chart title, because it has no axes.

To add titles to a chart, activate the chart and use the Chart • Options command. Excel displays the Chart Options dialog box. Click the Titles tab and enter text for the title or titles (see Figure 16-3).


 Tip

The titles that Excel adds are placed in the appropriate position, but you can drag them anywhere.



**Figure 16-3:** The Titles tab of the Chart Options dialog box lets you add titles to a chart.



To modify a chart title's properties, access its Format dialog box. This dialog box has tabs for the following:

- **Patterns:** Change the background color and borders
- **Font:** Change the font, size, color, and attributes
- **Alignment:** Adjust the vertical and horizontal alignment and orientation

Tip

Text in a chart is not limited to titles. In fact, you can add free-floating text anywhere that you want. To do so, select any part of the chart except a title or data label. Then, type the text in the formula bar and press Enter. Excel adds a Text Box AutoShape that contains the text. You can move the Text Box wherever you want it and format it to your liking.

## Working with the Legend

If you create your chart with the Chart Wizard, you have an option (in Step 3) to include a legend. If you change your mind, you can easily delete the legend or add one if it doesn't exist.

To add a legend to your chart, use the Chart • Options command and then click the Legend tab in the Chart Options dialog box. Place a check mark in the Show legend check box. You also can specify where to place the legend by using the Placement option buttons.

The quickest way to remove a legend is to select the legend and then press Delete. To move a legend, click and drag it to the desired location. Or, you can use the legend's Format dialog box to position the legend (using the Placement tab).

A chart's legend consists of text and keys. A *key* is a small graphic that corresponds to the chart's series. You can select individual text items within a legend and format them separately by using the Format Legend Entry dialog box (which has only a single panel: Font). For example, you may want to make the text bold, to draw attention to a particular data series.

Note

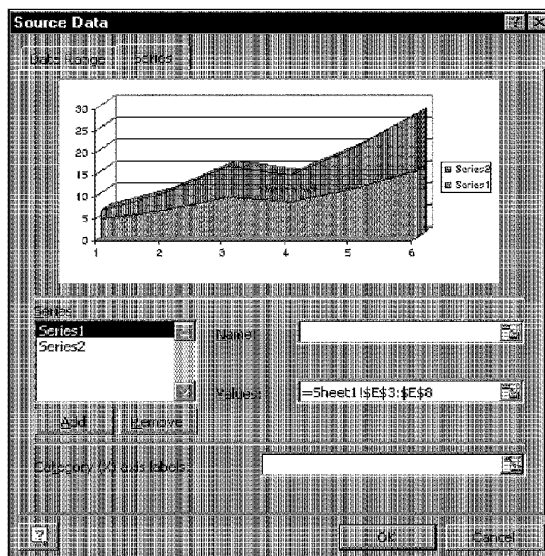
You can't use the Chart toolbar's Select Object drop-down list to select a legend entry or legend key. You must either click the item or select the legend itself, and then press the right arrow until the element that you want is selected.

The Legend tool in the Chart toolbar acts as a toggle. Use this button to add a legend, if one doesn't exist, and to remove the legend, if one exists.

Tip

After you move a legend from its default position, you may want to change the size of the Plot Area to fill in the gap left by the legend. Just select the Plot Area and drag a border to make it the desired size.

If you didn't include legend text when you originally selected the cells to create the chart, Excel displays *Series 1*, *Series 2*, and so on in the legend. To add series names, choose Chart • Source Data and then select the Series tab in the Source Data dialog box (refer to Figure 16-4). Select a series from the Series list box, activate the Name box, and then either specify a cell reference that contains the label or directly enter the series name.

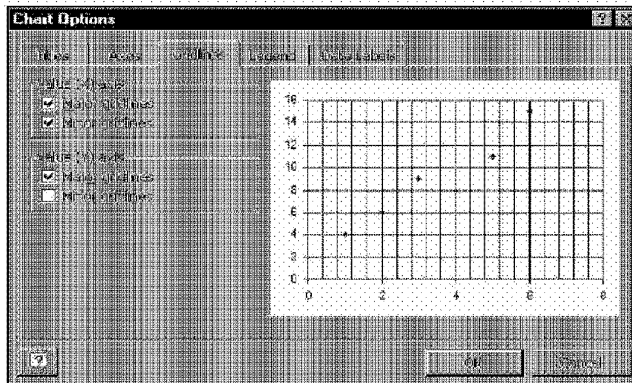


**Figure 16-4:** Use the Series tab of the Source Data dialog box to change the name of a data series.

## Changing Gridlines

Gridlines can help you to determine what the chart series represents numerically. Gridlines simply extend the tick marks on the axes. Some charts look better with gridlines; others appear more cluttered. You can decide whether gridlines can enhance your chart. Sometimes, horizontal gridlines alone are enough, although XY charts often benefit from both horizontal and vertical gridlines.

To add or remove gridlines, choose Chart • Options and then select the Gridlines tab. This Chart Options dialog box is shown in Figure 16-5.



**Figure 16-5:** The Gridlines tab of the Chart Options dialog box lets you add or remove gridlines from the chart.

Each axis has two sets of gridlines: major and minor. *Major* units display a label. *Minor* units are located between the labels. You can choose which to add or remove by checking or unchecking the appropriate check boxes. If you're working with a true 3D chart, the dialog box has options for three sets of gridlines.

To modify the properties of a set of gridlines, select one gridline in the set and access the Format Gridlines dialog box. This dialog has two tabs:

- **Patterns:** Changes the line style, width, and color
- **Scale:** Adjusts the scale used on the axis

The next section presents an in-depth discussion of scaling.

## Modifying the Axes

Charts vary in the number of axes that they use. Pie and doughnut charts have no axes. All 2D charts have two axes (three, if you use a secondary-value axis; four, if you use a secondary-category axis in an XY chart). True 3D charts have three axes. Excel gives you a lot of control over these axes. To modify any aspect of an axis, access its Format Axis dialog box, which has five tabs:

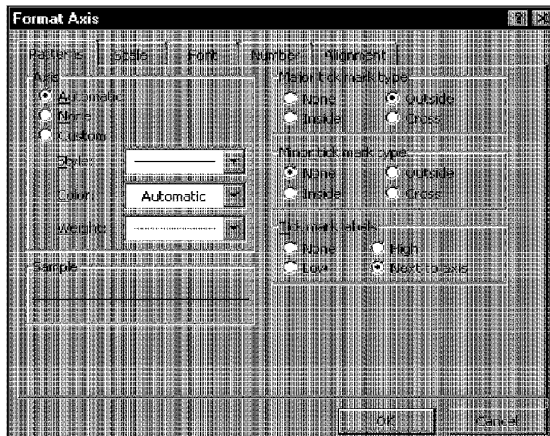
- **Patterns:** Change the axis line width, tick marks, and placement of tick mark labels
- **Scale:** Adjust the minimum and maximum axis values, units for major and minor gridlines, and other properties

- **Font:** Adjust the font used for the axis labels
- **Number:** Adjust the number format for the axis labels
- **Alignment:** Specify the orientation for the axis labels

Because the axes' properties can dramatically affect the chart's look, the Patterns and Scale dialog box tabs are discussed separately, in the following sections.

## Axes Patterns

Figure 16-6 shows the Patterns tab of the Format Axis dialog box.



**Figure 16-6:** The Patterns tab of the Format Axis dialog box.

This tab has four sections:

- **Axis:** Controls the line characteristics of the axis (the style, color, and weight of the line).
- **Major tick mark type:** Controls how the major tick marks appear. You can select None (no tick marks), Inside (inside the axis), Outside (outside the axis), or Cross (on both sides of the axis).
- **Minor tick mark type:** Controls how the minor tick marks appear. You can select None (no tick marks), Inside (inside the axis), Outside (outside the axis), or Cross (on both sides of the axis).

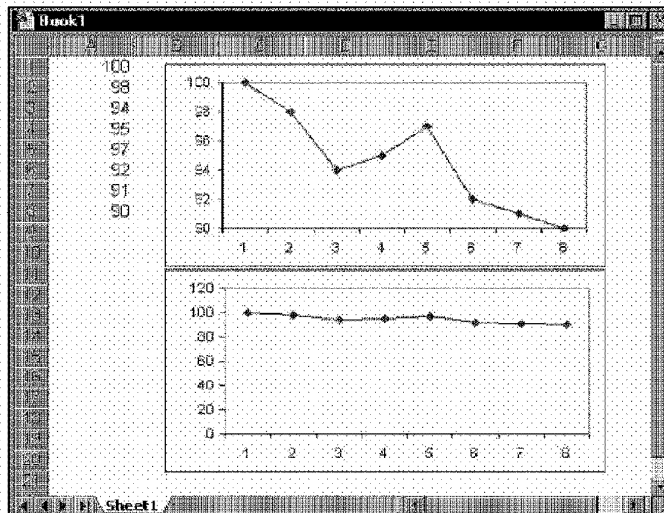
- **Tick mark labels:** Controls where the axis labels appear. Normally, the labels appear next to the axis. You can, however, specify that the labels appear High (at the top of the chart), Low (at the bottom of the chart), or not at all (None). These options are useful when the axis doesn't appear in its normal position, at the edge of the Plot Area.

**Note**

Major tick marks are the axis tick marks that normally have labels next to them. Minor tick marks are between the major tick marks.

## Axes Scales

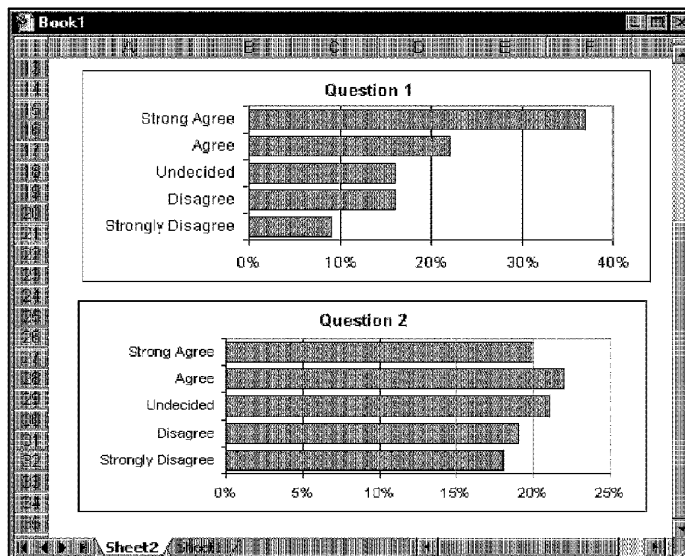
Adjusting the scale of a value axis can dramatically affect the chart's appearance. Manipulating the scale, in some cases, can present a false picture of the data. Figure 16-7 shows two charts that use the same data; the only difference between the charts is that the Minimum value has been adjusted on the value axis scale. In the first chart, the differences are quite apparent. In the second chart, little difference is apparent between the data points.



**Figure 16-7:** These two charts use the same data but different scales.

The actual scale that you use depends on the situation. No hard-and-fast rules exist about scale, except that you shouldn't misrepresent data by manipulating the chart to prove a point that doesn't exist.

If you're preparing several charts that use similarly scaled data, keeping the scales the same is a good idea, so that the charts can be compared more easily. The charts in Figure 16-8 show the distribution of responses for a survey. Because the same scale was not used on the value axes, however, comparing the responses across survey items is difficult. All charts in the series should have the same scale.



**Figure 16-8:** These charts use different scales on the value axis, making a comparison between the two difficult.

Excel automatically determines the scale for your charts. You can, however, override Excel's choice in the Scale tab of the Format Axis dialog box (see Figure 16-9).

**Note**

The Scale tab varies slightly, depending on which axis is selected.

This dialog box offers the following options:

- **Minimum:** Enter a minimum value for the axis. If the check box is checked, Excel determines this value automatically.
- **Maximum:** Enter a maximum value for the axis. If the check box is checked, Excel determines this value automatically.

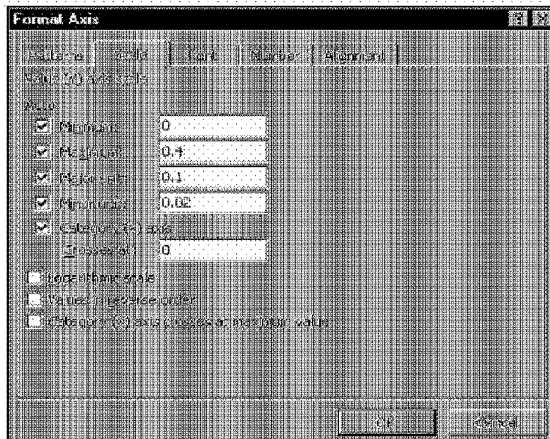


Figure 16-9: The Scale tab of the Format Axis dialog box.

- **Major unit:** Enter the number of units between major tick marks. If the check box is checked, Excel determines this value automatically.
- **Minor unit:** Enter the number of units between minor tick marks. If the check box is checked, Excel determines this value automatically.
- **Axis Type axis Crosses at:** Position the axis at a different location. By default, it's at the edge of the Plot Area. The exact wording of this option (*Axis Type*) varies, depending on which axis is selected.
- **Logarithmic scale:** Use a logarithmic scale for the axes. A log scale primarily is useful for scientific applications in which the values to plot have an extremely large range. You receive an error message if the scale includes 0 or negative values.
- **Values in reverse order:** Make the scale values extend in the opposite direction. For a value axis, for example, selecting this option displays the smallest scale value at the top and the largest at the bottom (the opposite of how it normally appears).
- **Axis Type crosses at maximum value:** Position the axes at the maximum value of the perpendicular axis (normally, the axis is positioned at the minimum value of the perpendicular axis). The exact wording of this option (*Axis Type*) varies, depending on which axis is selected.

## Working with Data Series

Every chart consists of one or more data series. Each series is based on data that is stored in a worksheet. This data translates into chart columns, lines, pie slices, and so on. This section discusses most of the customizations that you can perform with a chart's data series.

To work with a data series, you must first select it. Activate the chart and then click the data series that you want to select. In a column chart, click a column; in a line chart, click a line; and so on. Make sure that you select the entire series and not just a single point. You may find it easier to select the series by using the Chart Object tool in the Chart toolbar.

When you select a data series, Excel displays the series name in the Name box (for example, Series 1, or the actual name of the series), and the SERIES formula in the formula bar. A selected data series has a small square on each element of the series. In addition, the cells used for the selected series are outlined in color.

Many customizations that you perform with a data series use the Format Data Series dialog box, which has as many as seven tabs. The number of tabs varies, depending on the type of chart. For example, a pie chart has four tabs, and a 3D column chart has four tabs. Line and column charts have six tabs, and XY (scatter) charts have seven tabs. The possible tabs in the Format Data Series dialog box are as follows:

- **Axis:** Specify which value axis to use for the selected data series. This is applicable only if the chart has two value axes.
- **Data Labels:** Display labels next to each data point.
- **Options:** Change options specific to the chart type.
- **Patterns:** Change the color, pattern, and border style for the data series. For line charts, change the color and style of the data marker in this tab.
- **Series Order:** Specify the order in which the data series are plotted.
- **Shape:** Specify the shape of the columns (in 3D column charts only).
- **X Error Bars:** Add or modify error bars for the X axis. This is available only for XY charts.
- **Y Error Bars:** Add or modify error bars for the Y axis.

The sections that follow discuss many of these dialog box options.



## Deleting a Data Series

To delete a data series in a chart, select the data series and press the Delete key. The data series is removed from the chart. The data in the worksheet, of course, remains intact.

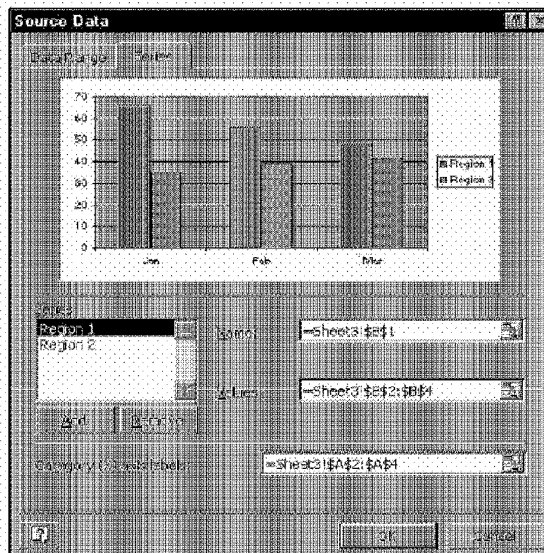
### Note

You can delete all data series from a chart. If you do so, the chart appears empty. It retains its settings, however. Therefore, you can add a data series to an empty chart and it again looks like a chart.

## Adding a New Data Series to a Chart

A common need is to add another data series to an existing chart. You *could* re-create the chart and include the new data series, but usually adding the data to the existing chart is easier. Excel provides several ways to add a new data series to a chart:

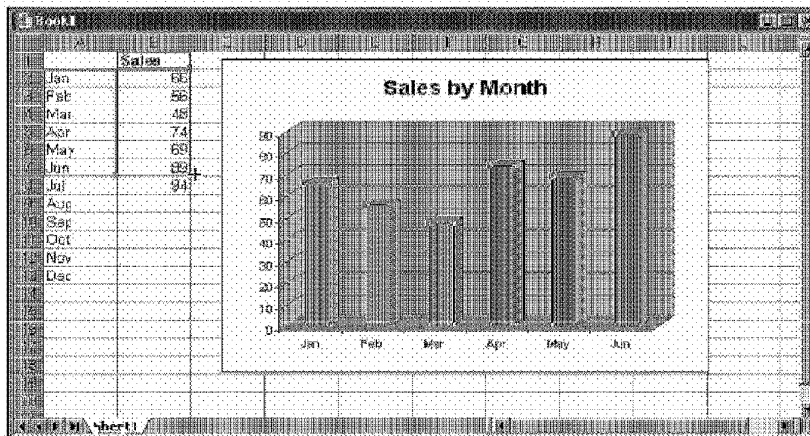
- Activate the chart and select Chart • Source Data. In the Source Data dialog box, click the Series tab (see Figure 16-10). Click the Add button and then specify the data range in the Values box (you can enter the range address or point to it).



**Figure 16-10:** Use the Source Data dialog box to add a new data series to a chart.



lower-right corner of the range outline to extend or contract the data series. Figure 16-12 shows an example of how this looks. In this figure, the data series needs to be extended to include the data for July. If the chart uses a range for the category axis, you'll also need to extend that range.



**Figure 16-12:** To change the range used in a chart's data series, select the data series and drag the small dot at the lower-right corner of the range outline.

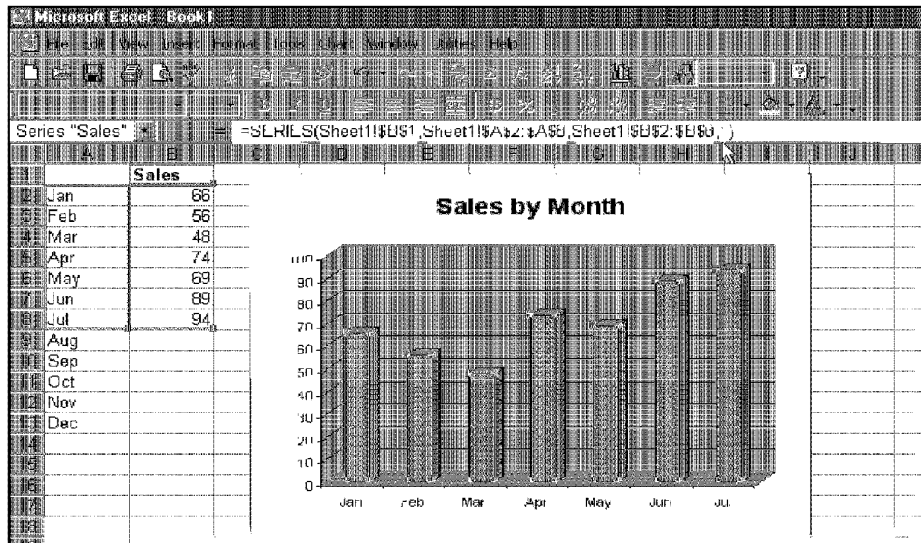
You can drag the outline in either direction, so you can use this technique to expand or contract a range used in a data series.

### Using the Data Source Dialog Box

To update the chart to reflect a different data range, activate the chart and select **Chart • Source Data**. Click the **Series** tab and then select the series from the **Series** list box. Adjust the range in the **Name** box (you can edit the range reference or point to the new range).

### Editing the SERIES Formula

Every data series in a chart has an associated **SERIES** formula, which appears in the formula bar when you select a data series in a chart (see Figure 16-13). You can edit the range references in the **SERIES** formula directly. You can even enter a new **SERIES** formula manually—which adds a new series to the chart (however, easier ways to do this exist, as described previously).



**Figure 16-13:** When you select a data series, its SERIES formula appears in the formula bar.

A SERIES formula consists of a SERIES function with four arguments. The syntax is as follows:

```
=SERIES(Name_ref, Categories, Values, Plot_order)
```

Excel uses absolute cell references in the SERIES function. To change the data that a series uses, edit the cell references (third argument) in the formula bar. The first and second arguments are optional and may not appear in the SERIES formula. If the series doesn't have a name, the Name\_ref argument is missing and Excel uses dummy series names in the legend (Series1, Series2, and so on). If no category names exist, the Categories argument is missing, and Excel uses dummy labels (1, 2, 3, and so on).



If the data series uses category labels, make sure that you adjust the reference for the category labels also. This is the second argument in the SERIES formula.

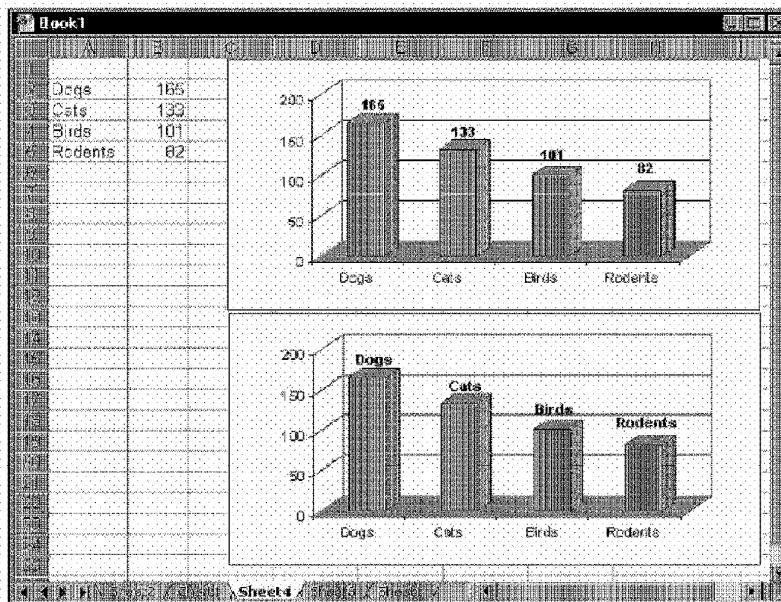
### Using Names in SERIES Formulas

Perhaps the best way to handle data ranges that change over time is to use named ranges. Create names for the data ranges that you use in the chart and then edit the SERIES formula. Replace each range reference with the corresponding range name.

After making this change, the chart uses the named ranges. If you add new data to the range, just change the definition for the name, and the chart is updated.

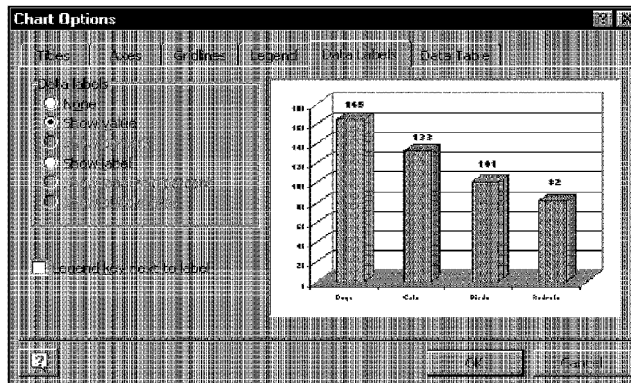
## Displaying Data Labels in a Chart

Sometimes, you may want your chart to display the actual data values for each point. Or, you may want to display the category label for each data point. Figure 16-14 shows an example of both of these options.



**Figure 16-14:** The top chart has data labels for each data point; the bottom chart has category labels for each point.

You specify data labels in the Data Labels tab of the Chart Options dialog box (see Figure 16-15). This tab has several options. Note that not all options are available for all chart types. If you select the check box labeled Show legend key next to label, each label displays its legend key next to it.



**Figure 16-15:** The Data Labels tab of the Chart Options dialog box.

The data labels are linked to the worksheet, so if your data changes, the labels also change. If you want to override the data label with other text, select the label and enter the new text (or even a cell reference) in the formula bar.

Often, you'll find that the data labels aren't positioned properly—for example, a label may be obscured by another data point. If you select an individual label, you can drag the label to a better location.



**Tip**

After you add data labels to a series, format the labels by using the Format Data Labels dialog box.

As you work with data labels, you may discover that Excel's Data Labels feature leaves a bit to be desired. For example, it would be nice to be able to specify a range of text to be used for the data labels. This would be particularly useful in *XY* charts in which you want to identify each data point with a particular text item. Unfortunately, this isn't possible. You can add data labels and then manually edit each label—or, you can use the Chart Data Labeler utility that's included with my Power Utility Pak (use the coupon in the back of the book to get your copy).

## Handling Missing Data

Sometimes, data that you're charting may be missing one or more data points. Excel offers several ways to handle the missing data. You don't control this in the Format Data Series dialog box (as you might expect). Rather, you must select the chart, choose Tools • Options, and then click the Chart tab, which is shown in Figure 16-16. The reason for putting this setting in the Options dialog box is known only to the Excel design team.

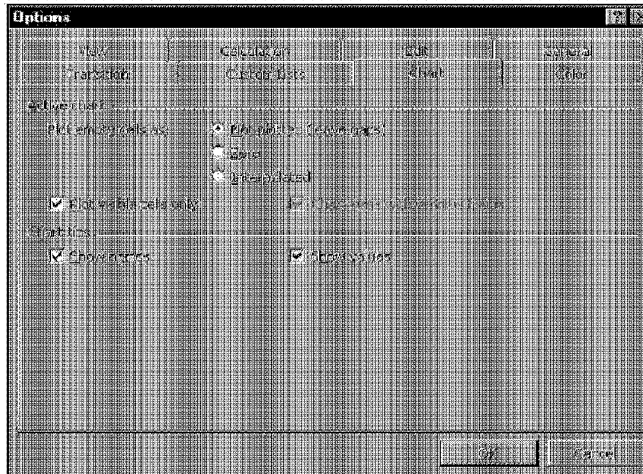


Figure 16-16: The Chart tab of the Options dialog box.

**Note**

A chart must be activated when you select the Tools • Options command, or the options in the Chart panel are grayed.

The options that you set apply to the entire active chart, and you can't set a different option for different series in the same chart.

The following are the *options* in the Chart panel for the active chart:

- **Not plotted (leave gaps):** Missing data is simply ignored, and the data series will have a gap.
- **Zero:** Missing data is treated as zero.
- **Interpolated:** Missing data is calculated by using data on either side of the missing point(s). This option is available only for line charts.

## Controlling a Data Series by Hiding Data

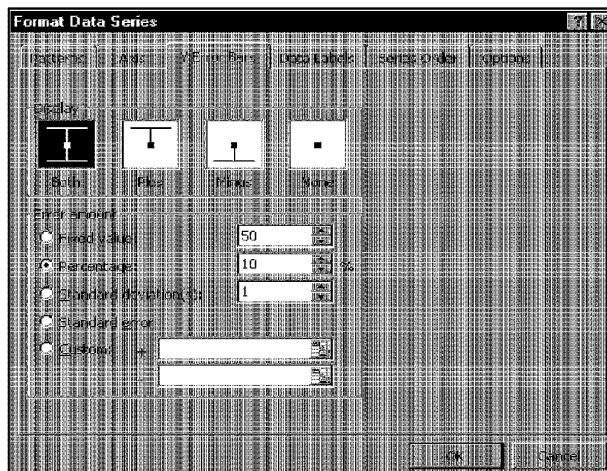
Usually, Excel doesn't plot data that is in a hidden row or column. You can sometimes use this to your advantage, because it's an easy way to control what data appears in the chart. If you're working with outlines or data filtering (both of which use hidden rows), however, you may not like the idea that hidden data is removed from your chart. To override this, activate the chart and select the Tools • Options command. In the Options dialog box, click the Chart tab and remove the check mark from the check box labeled Plot visible cells only.

**Note**

The Plot visible cells only setting applies only to the active chart. A chart must be activated when you open the Options dialog box. Otherwise, the option is grayed. This is another example of a setting that shows up in an unexpected dialog box.

## Adding Error Bars

For certain chart types, you can add error bars to your chart. Error bars often are used to indicate “plus or minus” information that reflects uncertainty in the data. Error bars are appropriate only for area, bar, column, line, and *XY* charts. Click the *Y* Error Bars tab in the Format Data Series dialog box to display the options shown in Figure 16-17.



**Figure 16-17:** The *Y* Error Bars tab of the Format Data Series dialog box.

A data series in an *XY* chart can have error bars for both the *X* values and *Y* values. Excel enables you to specify several types of error bars:

- **Fixed value:** The error bars are fixed by an amount that you specify.
- **Percentage:** The error bars are a percentage of each value.
- **Standard deviation(s):** The error bars are in the number of standard-deviation units that you specify (Excel calculates the standard deviation of the data series).
- **Standard error:** The error bars are one standard error unit (Excel calculates the standard error of the data series).



- **Custom:** The error bar units for the upper or lower error bars are set by you. You can enter either a value or a range reference that holds the error values that you want to plot as error bars.

Figure 16-18 shows a chart with error bars added. After you add error bars, you can access the Format Error Bars dialog box to modify the error bars. For example, you can control the line style and color of the error bars.

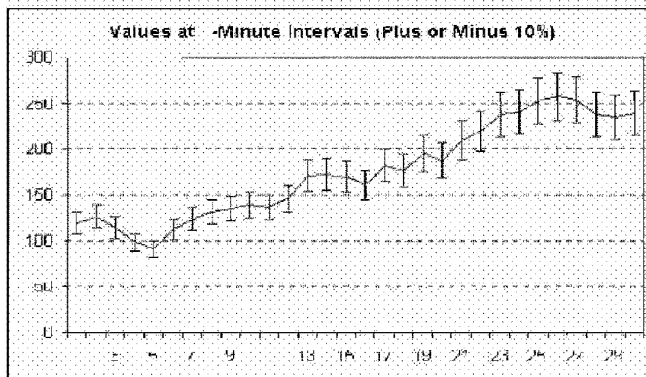
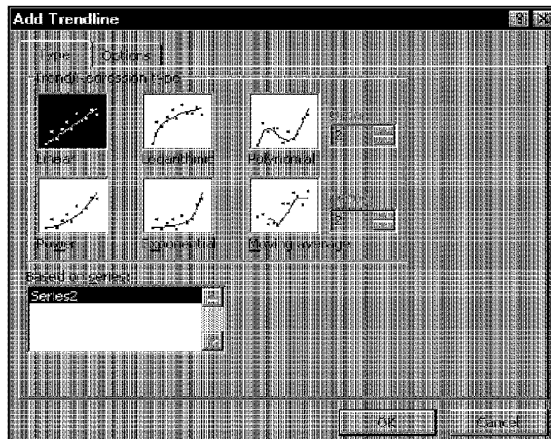


Figure 16-18: This chart has error bars added to the data series.

## Adding a Trendline

When you're plotting data over time, you may want to plot a trendline that describes the data. A *trendline* points out general trends in your data. In some cases, you can forecast future data with trendlines. A single series can have more than one trendline.

Excel makes adding a trendline to a chart quite simple. Although you might expect this option to be in the Format Data Series dialog box, it's not. The place to go is the Add Trendline dialog box, shown in Figure 16-19, which you access by selecting Chart • Add Trendline. This command is available only when a data series is selected.



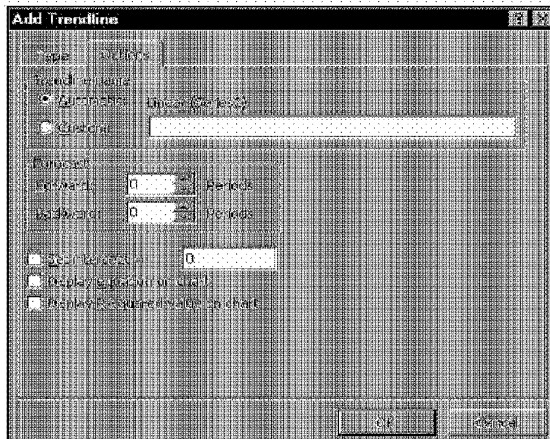
**Figure 16-19:** The Add Trendline dialog box offers several types of automatic trendlines.

The type of trendline that you choose depends on your data. Linear trends are most common, but some data can be described more effectively with another type. One of the options on the Type tab is Moving average, which is useful for smoothing out “noisy” data. The Moving average option enables you to specify the number of data points to include in each average. For example, if you select 5, Excel averages every five data points.

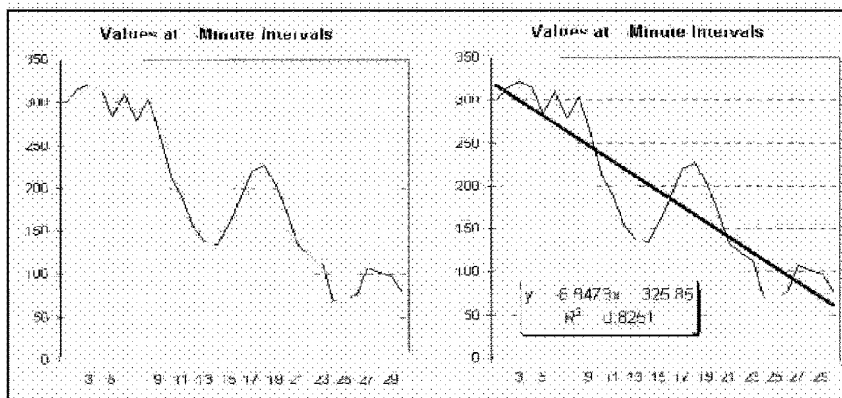
When you click the Options tab in the Add Trendline dialog box, Excel displays the options shown in Figure 16-20.

The Options tab enables you to specify a name to appear in the legend and the number of periods that you want to forecast. Additional options let you set the intercept value, specify that the equation used for the trendline should appear on the chart, and choose whether the R-squared value appears on the chart.

Figure 16-21 shows two charts. The chart on the left depicts a data series without a trendline. The chart on the right is the same chart, but a linear trendline has been added that shows the trend in the data.



**Figure 16-20:** The Options tab in the Add Trendline dialog box enables you to smooth or forecast data.



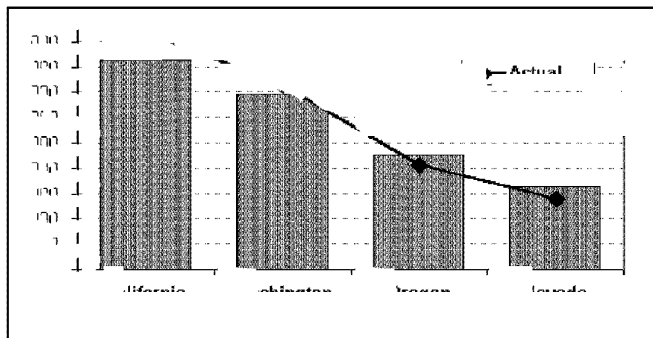
**Figure 16-21:** Before (chart on the left) and after (chart on the right) adding a linear trendline to a chart.

When Excel inserts a trendline, it may look like a new data series, but it's not. It's a new chart element with a name, such as Series 1 Trendline 1. You can double-click a trendline to change its formatting or its options.

## Creating Combination Charts

A *combination chart* is a single chart that consists of series that use different chart types. For example, you may have a chart that shows both columns and lines. A combination chart also can use a single type (all columns, for example), but include a second value axis. A combination chart requires at least two data series.

Creating a combination chart simply involves changing one or more of the data series to a different chart type. Select the data series and then choose Chart • Chart Type. In the Chart Type dialog box, select the chart type that you want to apply to the selected series. Figure 16-22 shows an example of a combination chart.



**Figure 16-22:** This combination chart uses columns and a line.



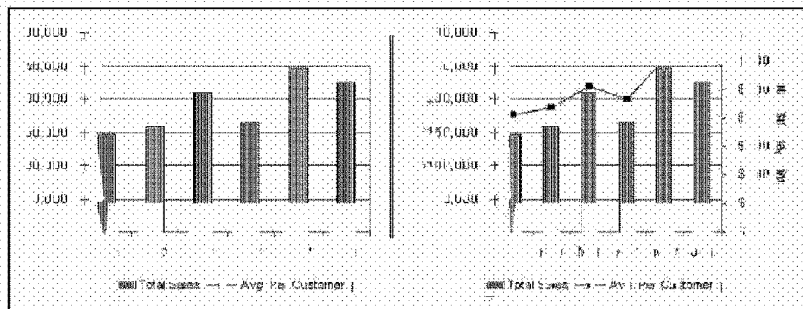
**Note** In some cases, you can't combine chart types. For example, you can't combine a 2D chart type with a 3D chart type. If you choose an incompatible chart type for the series, Excel lets you know.

You can't create combination 3D charts, but if you use a 3D column or 3D bar chart, you can change the shape of the columns or bars. Select a series and access the Format Data Series dialog box. Click the Shape tab and then choose the shape for the selected series.

## Using Secondary Axes

If you need to plot data series that have drastically different scales, you probably want to use a *secondary scale*. For example, assume that you want to create a chart that shows monthly sales, along with the average amount sold per customer. These two data series use different scales (the average sales values are much smaller than the total sales). Consequently, the average sales data range is virtually invisible in the chart.

The solution is to use a secondary axis for the second data series. Figure 16-23 shows two charts. The first uses a single value axis, and the second data series (a line) is hardly visible. The second chart uses a secondary axis for the second data series — which makes it easy to see.



**Figure 16-23:** These charts show the same data, but the chart on the right uses a secondary axis for the second data series.

To specify a secondary axis, select the data series in the chart and then access the Format Data Series dialog box. Click the Axis tab and choose the Secondary axis option.

## Displaying a Data Table

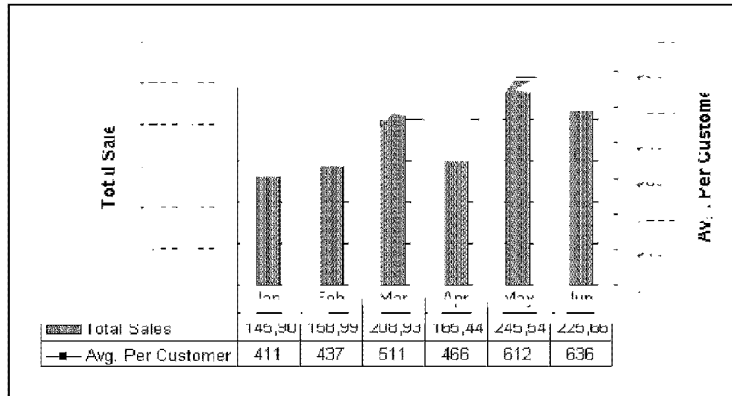
In some cases, you may want to display a *data table*, which displays the chart's data in tabular form, directly in the chart.

To add a data table to a chart, choose Chart • Chart Options and select the Data Table tab in the Chart Options dialog box. Place a check mark next to the option labeled Show data table. You also can choose to display the legend keys in the data table. Figure 16-24 shows a chart with a data table.

To adjust the formatting or font used in the data table, access the Format Data Table dialog box.

## Creating Custom Chart Types

Excel comes with quite a few custom chart types that you can select from the Custom Types tab of the Chart Type dialog box. Each of these custom chart types is simply a standard chart that has been formatted. In fact, you can duplicate any of these custom chart types just by applying the appropriate formatting.



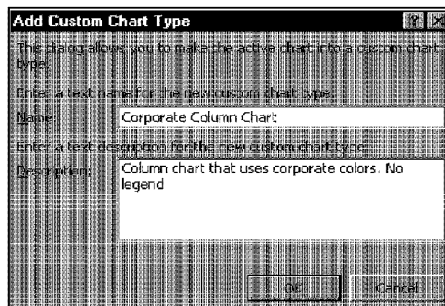
**Figure 16-24:** This chart includes a data table.

As you might expect, you can create your own custom chart types, called *user-defined* custom chart types.

The first step in designing a custom chart type is to create a chart that's customized the way that you want. For example, you can set any of the colors, fill effects, or line styles; change the scales; modify fonts and type sizes; add gridlines; add a formatted title; and even add free-floating text or graphic images.

When you're satisfied with the chart, choose **Chart • Chart Type** to display the Chart Type dialog box. Click the Custom Types tab and then select the User-defined option. This displays a list of all user-defined custom chart types.

Click the Add button, which displays the Add Custom Chart Type dialog box, as shown in Figure 16-25. Enter a name for the new chart type and a description. Click OK, and your custom chart type is added to the list.



**Figure 16-25:** The Custom Chart Type dialog box.

## How Custom Chart Types Are Stored

The custom chart types that you can select from the Chart Types dialog box are stored in a workbook named `Xl8galry.xls`, located in the Excel (or Office) folder. If you open `Xl8galry`, you can see that it contains only chart sheets — one for each custom chart type.

Also notice that the series formulas for these charts don't refer to actual worksheet ranges. Rather, the series formulas use arrays entered directly into the series formulas. This makes the charts completely independent of any specific worksheet range.

If you create a user-defined custom chart type, it's stored in a file called `xlusrgal.xls`, also in the Excel folder. Each custom chart type that you create is stored as a chart sheet.

If you want your coworkers to have access to your custom chart types, simply put a copy of your `xlusrgal.xls` file into their Excel (or Office) folders. By copying the file, you enable everyone in your workgroup to produce consistent-looking charts.

## Working with 3D Charts

One of the most interesting classes of Excel charts is its 3D charts. Certain situations benefit from the use of 3D charts, because you can depict changes over two different dimensions. Even a simple column chart commands more attention if you present it as a 3D chart. Not all charts that are labeled “3D” are true 3D charts, however. A true 3D chart has three axes. Some of Excel's 3D charts are simply 2D charts with a perspective look to them.

### Modifying 3D Charts

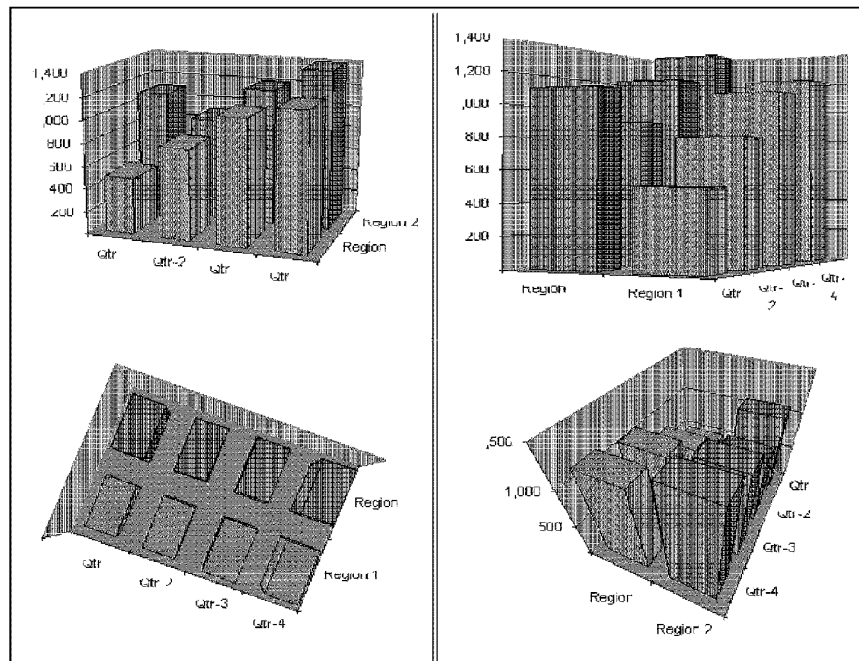
All 3D charts have a few additional parts that you can customize. For example, most 3D charts have a *floor* and *walls*, and the true 3D charts also have an additional axis. You can select these chart elements and format them to your liking. This chapter doesn't go into the details, because the formatting options are quite straightforward. Generally, 3D formatting options work just like the other chart elements.

### Rotating 3D Charts

When you start flirting with the third dimension, you have a great deal of flexibility regarding the viewpoint for your charts. Figure 16-26 shows a 3D column chart that has been rotated to show four different views.

You can rotate a 3D chart in one of the following two ways:

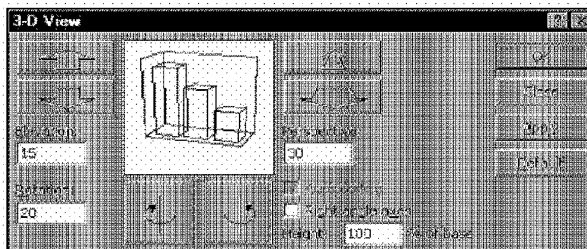
- Activate the 3D chart and choose the Chart • 3D View command. The dialog box shown in Figure 16-27 appears. You can make your rotations and perspective changes by clicking the appropriate controls. The sample that you see in the dialog box is *not* your actual chart. The displayed sample just gives you an idea of the types of changes that you're making. Make the adjustments and then choose OK to make them permanent (or click Apply to apply them to your chart without closing the dialog box).



**Figure 16-26:** Four different views of the same chart.

- Rotate the chart in real time by dragging corners with the mouse. Click one of the corners of the chart. Black handles appear, and the word *Corners* appears in the Name box. You can drag one of these black handles and rotate the chart's 3D box to your satisfaction. This method definitely takes some practice. If your chart gets totally messed up, choose Chart • 3D View and then select the Default button to return to the standard 3D view.





**Figure 16-27:** The 3D View dialog box enables you to rotate and change the perspective of a 3D chart. You also can drag the chart with the mouse.

**Tip**

When you rotate a 3D chart, hold down the Ctrl key while you drag, to see an outline of the entire chart—not just the axes. This technique is helpful, because when you drag only the chart's axes, you can easily lose your bearings and end up with a strange-looking chart.

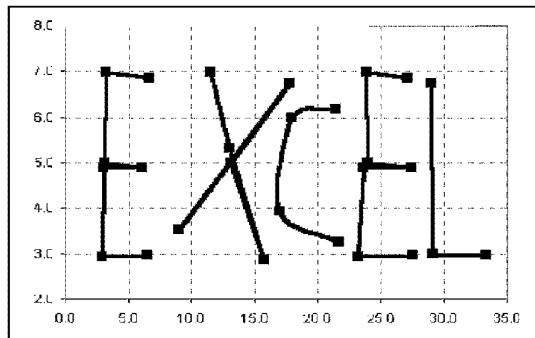
## Chart-Making Tricks

In this section, I share chart-making tricks that I've picked up over the years. Some use little-known features; others are undocumented, as far as I can tell. Several tricks enable you to make charts that you may have considered impossible to create.

### Changing a Worksheet Value by Dragging

Excel provides an interesting chart-making feature that also can be somewhat dangerous. This feature lets you change the value in a worksheet by dragging the data markers on two-dimensional line charts, bar charts, column charts, XY charts, and bubble charts.

Here's how it works. Select an individual data point in a chart series (not the entire series) and then drag the point in the direction in which you want to adjust the value. As you drag the data marker, the corresponding value in the worksheet changes to correspond to the data point's new position on the chart. Figure 16-28 shows the result of dragging the data points around on an XY chart with five data series.



**Figure 16-28:** This XY chart has five data series.

If the value of a data point that you move is the result of a formula, Excel displays the Goal Seek dialog box (goal seeking is discussed in Chapter 27). Use this dialog box to specify the cell that Excel should adjust to make the formula produce the result that you pointed out on the chart. This technique is useful if you know what a chart should look like and you want to determine the values that will produce the chart. Obviously, this feature also can be dangerous, because you inadvertently can change values that you shouldn't—so be careful.

## Unlinking a Chart from Its Data Range

A nice thing about charts is that they are linked to data that is stored in a worksheet. You also can unlink a data series so that it no longer relies on the worksheet data.

To unlink a data series, select the data series and then activate the formula bar. Press F9, and the series formula converts its range references to arrays that hold the values (see the formula bar in Figure 16-29). If you unlink all the series in the chart, you create a dead graph that uses no data in a worksheet. If you want, however, you can edit the individual values in the arrays.

## Creating Picture Charts

Excel makes it easy to incorporate a pattern, texture, or graphic file for elements in your chart. Figure 16-30 shows an example of a column chart that displays a graphic.

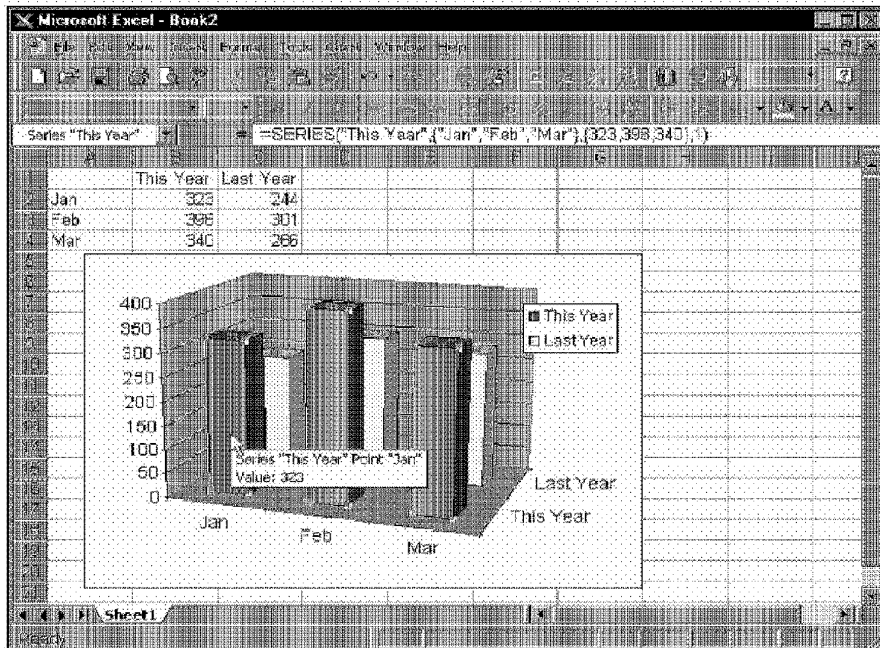


Figure 16-29: This data series no longer uses data in a worksheet.

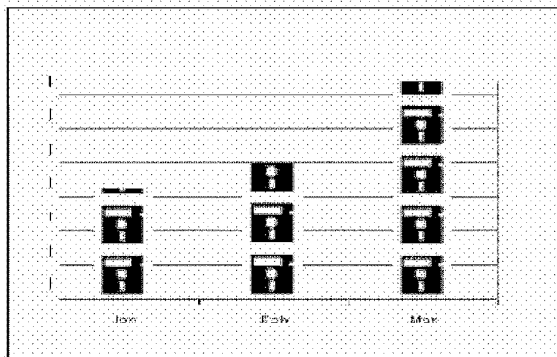


Figure 16-30: This column chart uses a graphic image.

The following sections describe how to create picture charts, using two methods.

### Using a Graphic File to Create a Picture Chart

To convert a data series to pictures, start with a column or bar chart (either standard or 3D). Then, access the chart's Format Data Series dialog box and select the Patterns tab. Click the Fill Effects button to get the Fill Effects dialog box. Click the Picture tab and then click the Select Picture button to locate the graphics file that you want to use.



Use the Fill Effects dialog box to specify some options for the image.

### Using the Clipboard to Create a Picture Chart

This section describes another way to create a picture chart—a method for which the image that you want to use doesn't have to exist in a file. This technique works if the image can be copied to the Clipboard. It's also the only way to get pictures into the data points for a line or *XY* chart.

The first step is to locate the image that you want to use and copy it to the Clipboard. Generally, simpler images work better. You may want to paste it into Excel first, where you can adjust the size, remove the borders, and add a background color, if desired. Or you can create the image by using Excel's drawing tools. In either case, copy the image to the Clipboard.

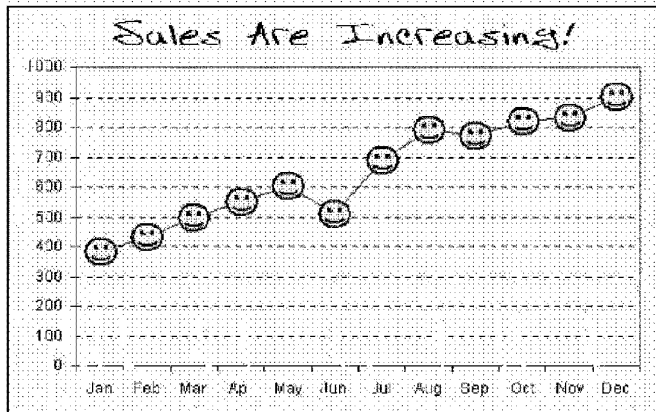
When the image is on the Clipboard, activate the chart, select the data series, and then choose **Edit • Paste**. Your chart is converted. You also can paste the image to a single point in the data series, rather than to the entire data series—simply select the point before you paste.

This technique also works with data markers in line charts, *XY* (scatter) charts, or bubble charts. Figure 16-31 shows an example of a line chart that uses a smiley face instead of the normal data markers. I created this graphic by using Excel's drawing tools (it's one of the AutoShapes in the Basic Shapes category).

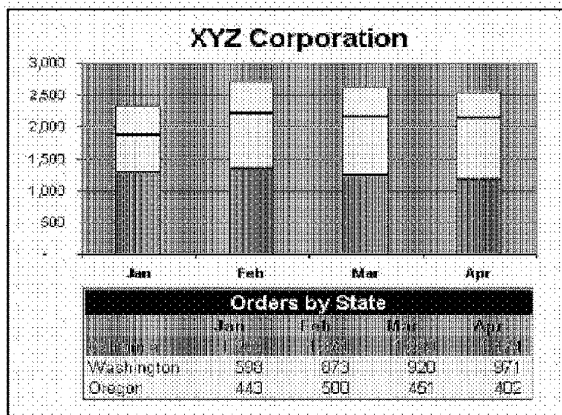
### Pasting Linked Pictures to Charts

Another useful charting technique involves pasting linked pictures to a chart. Excel doesn't let you do this directly, but this pasting is possible if you know a few tricks. The technique is useful, for example, if you want your chart to include the data that's used by the chart—but the data table feature (discussed earlier in this chapter) isn't flexible enough for you.

Figure 16-32 shows an example of a data range pasted to a chart as a linked picture. If the data changes, the changes are reflected in the chart as well as in the linked picture. Notice that the effect is similar to using a data table, but it allows more formatting options.



**Figure 16-31:** A line chart after replacing the data markers with a copied graphic image.



**Figure 16-32:** This chart uses a linked picture to display the data used in the chart series.

Here are the steps to create the linked picture:

1. Create the chart as usual and format the data range to your liking.
2. Select the data range, press Shift, and select Edit • Copy Picture. Excel displays a dialog box — accept the default options. This copies the range to the Clipboard as a picture.

3. Activate the chart and paste the Clipboard contents. You'll probably have to resize the Plot Area to accommodate the pasted image.
4. The image that is pasted is a picture, but not a linked picture. To convert the image to a linked picture, select it and then enter the range reference in the formula bar (or simply point it out). For this example, I entered `=Sheet1!A1:E5`.

The picture is now a linked picture. Changing any of the cells that are used in the chart's SERIES formula is reflected immediately in the linked picture.

## Simple Gantt Charts

Creating a simple Gantt chart isn't difficult when using Excel, but it does require some setup work. *Gantt charts* are used to represent the time required to perform each task in a project. Figure 16-33 shows data that was used to create the Gantt chart in Figure 16-34.



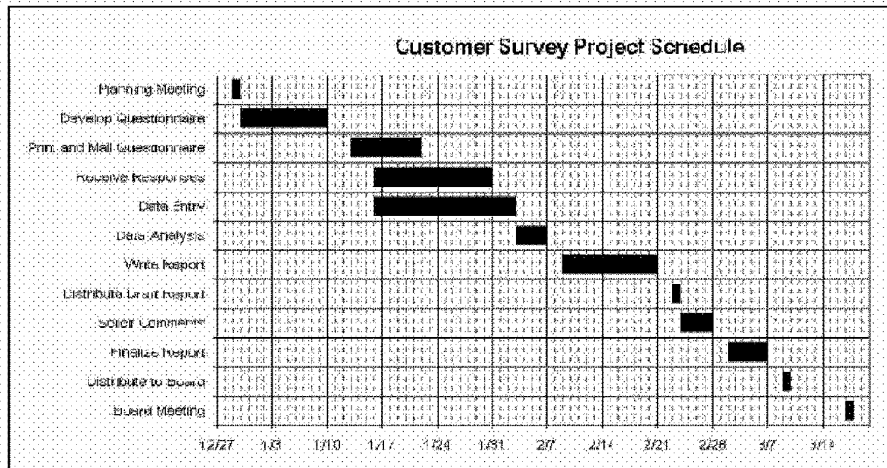
A workbook that demonstrates this technique is available on the companion CD-ROM.

Task	Start Date	Duration	End Date
Planning Meeting	12/29/98	1	12/29/98
Develop Questionnaire	12/30/98	11	01/09/99
Print and Mail Questionnaire	01/13/99	9	01/21/99
Receive Responses	01/16/99	15	01/30/99
Data Entry	01/16/99	18	02/02/99
Data Analysis	02/03/99	4	02/06/99
Write Report	02/09/99	12	02/20/99
Distribute Draft Report	02/23/99	1	02/23/99
Solicit Comments	02/24/99	4	02/27/99
Finalize Report	03/02/99	5	03/06/99
Distribute to Board	03/09/99	1	03/09/99
Board Meeting	03/17/99	1	03/17/99

**Figure 16-33:** Data used in the Gantt chart.

Here are the steps to create this chart:

1. Enter the data as shown in Figure 16-33. The formula in cell D2, which was copied to the rows below it, is `=B2+C2-1`.
2. Use the Chart Wizard to create a stacked bar chart from the range A2:C13. Use the second subtype, which is labeled Stacked Bar.



**Figure 16-34:** You can create a Gantt chart from a bar chart.

3. In Step 2 of the Chart Wizard, select the Columns option. Also, notice that Excel incorrectly uses the first two columns as the Category axis labels.
4. In Step 2 of the Chart Wizard, click the Series tab and add a new data series. Then, set the chart's series to the following:
  - Series 1: B2:B13
  - Series 2: C2:C13
  - Category (x) axis labels: A2:A13
5. In Step 3 of the Chart Wizard, remove the legend and then click Finish to create an embedded chart.
6. Adjust the height of the chart so that all the axis labels are visible. You can also accomplish this by using a smaller font size.
7. Access the Format Axis dialog box for the horizontal axis. Adjust the horizontal axis Minimum and Maximum scale values to correspond to the earliest and latest dates in the data (note that you can enter a date into the Minimum or Maximum edit box). You might also want to change the date format for the axis labels.
8. Access the Format Axis dialog box for the vertical axis. In the Scale tab, select the option labeled Categories in reverse order, and also set the option labeled Value (y) axis crosses at maximum category.