Creating Charts That Show Trends

3

IN THIS CHAPTER

Choosing a Chart Type

You have two excellent choices when creating charts that show the progress of some value over time. Because Western cultures are used to seeing time progress from left to right, you are likely to choose a chart where the axis moves from left to right—whether it's a column chart, line chart, or area chart.

If you have only a few data points, you can use a column chart. Column charts work easily for 4 quarters or 12 months. Within the column chart category, you can choose between 2-D and 3-D styles. If you want to highlight one component of a sales trend, you can use a stacked column chart.

NOTE

This book recommends not using pyramid charts or cone charts because they distort your message. For an example, see "Lying with Shrinking Charts" in Chapter 14.

When you get beyond 12 data points, you should strongly consider switching to a line chart. A line chart can easily show trends for hundreds of periods. Line charts can be designed to show only the data points as markers or to connect the data points with a straight or smoothed line.

Figure 3.1 shows a chart of 9 data points. This is few enough data points that a column chart is meaningful. Figure 3.2 shows a chart of 100+ data points. With this detail, you should switch to a line chart in order to show the trend.

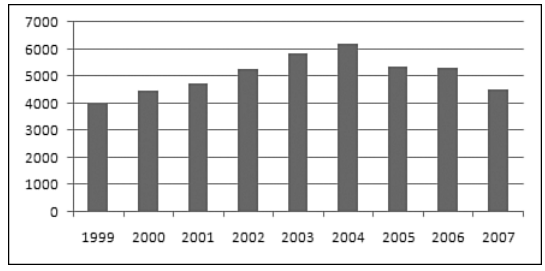


Figure 3.1
With 12 or fewer data points, column charts are viable and informative.

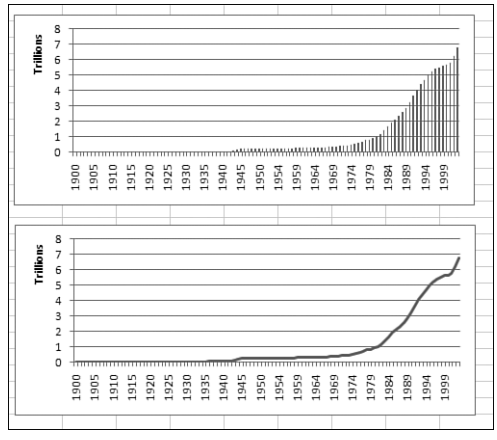


Figure 3.2
When you go beyond 12 data points, it is best to switch to a line chart without individual data points. The bottom chart in this figure shows the same data set as a line chart.

An area chart is a line chart where the area under the line is filled with a shading or color. This can be appropriate if you want to highlight a particular portion of the time series. If you have fewer data points, adding drop lines can help the reader determine the actual value for each time period.

If you are plotting stock market data, you can use stock charts to show the trend of stock data over time. You can also use high-low-close charts to show the trend of data that might occur in a range (for example, if you have to track a range of quality rankings for each day).

You might think that a bar chart could be used to show time trends. However, that would confuse your readers because they expect time to be represented from left to right. In very rare cases, you might use a bar chart to show a time trend—for example, if you had 40 or 50 points, all with very long category labels, and you needed a printed chart to legibly show detail for each point. As an example, Figure 3.3 shows sales for 45 daily dates. The chart would not work as a PowerPoint slide, but if it were printed as a full page on a letter-size piece of paper, the reader could analyze sales by weekday. Note that in the chart in Figure 3.3, weekend days are plotted in a different color than weekdays.

Pie charts are great for comparisons. If you are thinking about using a series of pie charts to show changes over time, however, you should instead use a 100% stacked column chart. Consider the charts in Figure 3.4. It is difficult for the reader's eye to compare the pie wedges from year to year. Did market share increase in 2005?

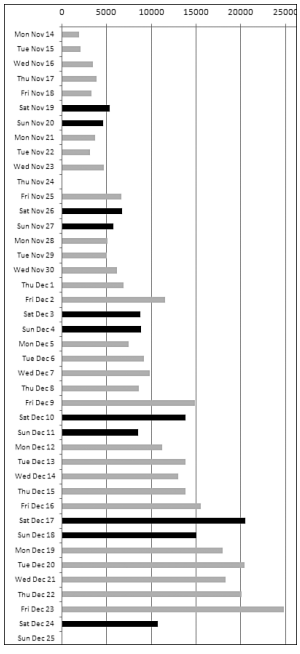


Figure 3.3
Although time series typically should run across the horizontal axis, this chart allows 45 points to be compared easily.

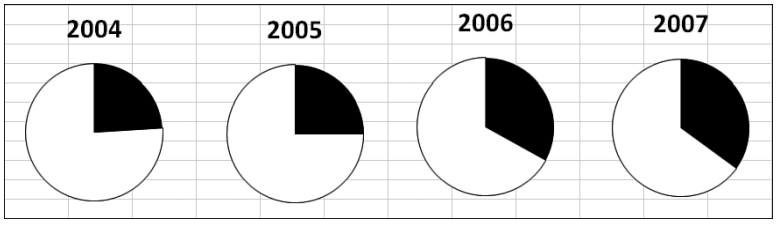


Figure 3.4
It is difficult to compare one pie to the next.

In Figure 3.5, the same data is plotted as a 100% stacked bar chart. Series lines guide the reader's eye from the market share from each year to the next year. The stacked bar chart is a much easier chart to read than the series of pie charts.

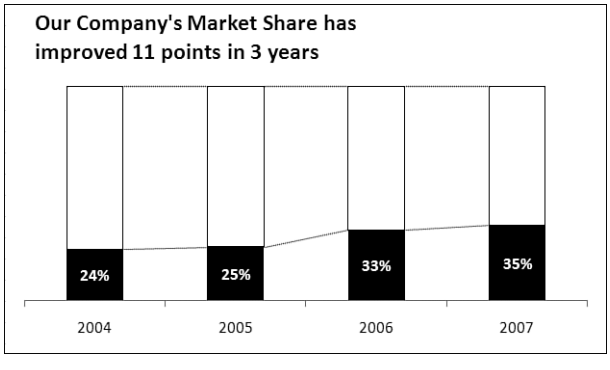


Figure 3.5
In a 100% stacked bar chart, the same data from Figure 3.4 is easier to read.

Understanding a Date-Based Axis Versus a Category-Based Axis

Excel offers two types of horizontal axes in a trend chart. Having the proper setting can ensure that your message is accurate.

If the spacing of events along the time axis is uniform, it does not matter whether you choose a date-based axis or a text-based axis. The results will be the same. In this case, it is fine to allow Excel to automatically choose the type of axis.

However, if the spacing of events along the time axis is haphazard, you definitely want to make sure that Excel is using a date-based axis.

CASE STUDY

Accurately Representing Data Using a Time-Based Axis

Figure 3.6 shows the spot price for a certain component used in your manufacturing plant. To find this data, you downloaded past purchase orders for that product. Your company doesn't purchase the component on the same day every month; therefore, you have an incomplete dataset. In the middle of the dataset, a strike closed one of the vendors, spiking the prices from the other vendors. Your purchasing department had stocked up before the strike and was able to dramatically slow its purchasing during the strike.

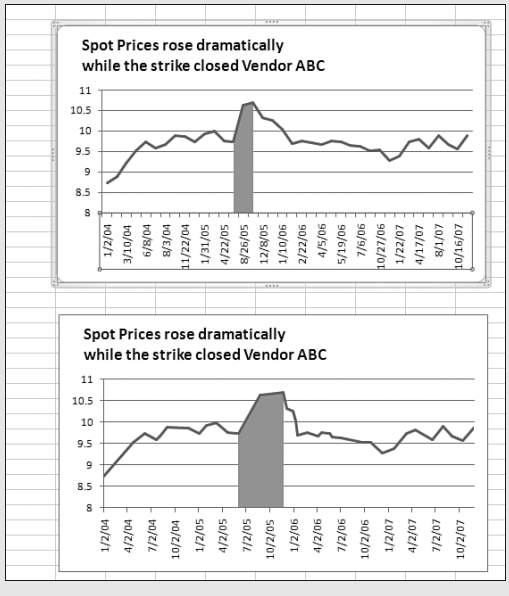


Figure 3.6
The top chart uses a text-based horizontal axis: Every event is plotted an equal distance from the next event. This leads to the shaded period being underreported.

In the top chart in Figure 3.6, the horizontal axis is set to a text-based axis, and every data point is plotted an equal distance apart. Because your purchasing department made only two purchases during the strike, it appears as if the time affected by the strike is very narrow. The bottom chart uses a date-based axis. In this axis, you can see that the strike actually lasted for half of 2005.

> **NOTE** To learn how to highlight a portion of a chart as shown in Figure 3.6, see "Highlighting a Section of Chart by Adding a Second Series," later in this chapter.

Usually, if your data contains dates, Excel defaults to a date-based axis. However, you should explicitly check to make sure that Excel is using the correct type of axis. A number of potential problems force Excel to choose a text-based axis instead of a date-based axis, such as dates that are stored as text in a spreadsheet and dates represented by numeric years. (See the list following Figure 3.7 for other potential problems.)

To explicitly choose an axis type, you follow these steps:

1. Right-click the horizontal axis and choose Format Axis.
2. In the Format Axis dialog box that appears, choose the Axis Options category.
3. Choose either Text Axis or Date Axis, as appropriate, from the Axis Type section (see Figure 3.7).

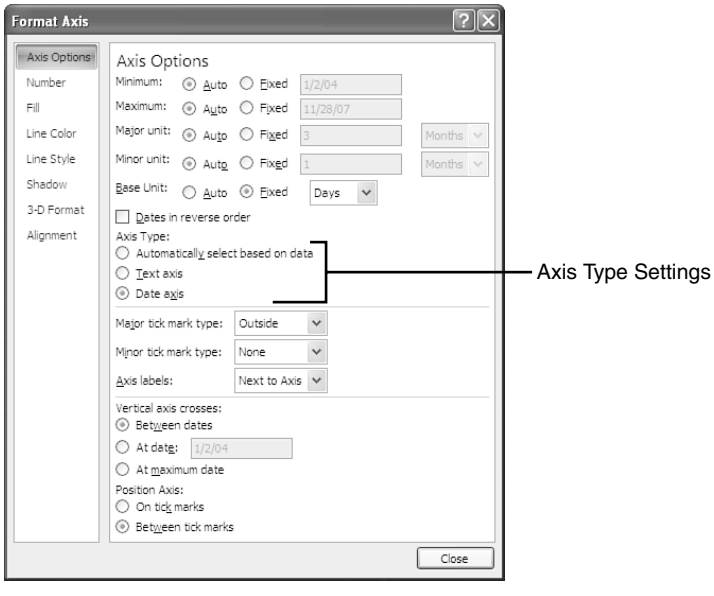


Figure 3.7
You can explicitly choose an axis type rather than letting Excel choose the default.

A number of complications that require special handling can occur with your date fields. The following are some of the problems you might encounter:

- **Dates stored as text**—If your dates are stored as text dates instead of real dates, a date-based axis will never work. You have to use date functions to convert the text dates to real dates.
- **Dates represented by numeric years**—All your trend charts may have category values of 2005, 2006, 2007, and so on. Excel doesn't naturally recognize these as dates, but you can trick it into doing so.

- **Dates before 1900**—If your company has been around long enough that you are charting historical trends before January 1, 1900, you are sunk. In Excel's world, there are no dates before this time period.
- **Dates that are really time**—It is not difficult to imagine charts in which the horizontal axis contains periodic times throughout a day. You might want to use such a chart to show the number of people entering a bank. For such a chart, you need a time-based axis, but Excel will group all of the times from a single day into a single point. See "Using a Workaround to Display a Time-Scale Axis" for the rather complex steps needed to plot data by periods smaller than a day.
- **Dates that you need to appear as text in order to draw in a decorative element**—The case study, "Using a Decorative Element in a Chart," later in this chapter, shows a chart by designer Kyle Fletcher in which the dates are forced to be text.

Each of these situations is discussed in the following sections.

Converting Text Dates to Dates

If your cells contain text that looks like dates, the date-based axis will not work. In Figure 3.8, the data came from a legacy computer system. Each date was imported as text instead of as dates.

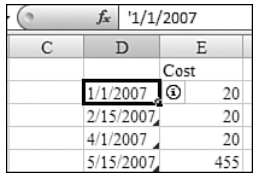


Figure 3.8 These dates are really text, as indicated by the apostrophe before the date in the formula bar.

This is a frustrating problem because text dates look exactly like real dates. You may not notice that they are text dates until you see that changing the axis to a date-based axis has no effect on the axis spacing.

If you select a cell that looks like a date cell, look in the formula bar, and see an apostrophe before the date, you know you have text dates (refer to Figure 3.8). This is Excel's arcane code to indicate that a date or number should be stored as text instead of a number.

CAUTION

Selecting a new format from the Format Cells dialog does not fix this problem, but it may prevent you from fixing the problem! If you import your data from a `.txt` file and choose to format that column as text, Excel changes the numeric format for the range to be text. After a range is formatted as text, you can never enter a formula, a number, or a date in the range. People try to select the range, change the format from text to numeric or date, and hope that this will fix the problem, but it

doesn't. After you change the format, you still have to use a method described in the section "Converting Text Dates to Real Dates," later in this chapter, to convert the text dates to numeric dates.

However, it is still worth changing the format from a text format to anything else. If you do not change the format, and you then insert a new column to the right of the bad dates, the new column inherits the text setting from the date column. This causes your new formula (the formula to convert text to dates) to fail. So, even though it doesn't solve your current problem, you should select the range, click the Dialog Launcher icon in the lower-right corner of the Number group on the Home ribbon, and change the format from Text to General. Figure 3.9 shows the More icon.

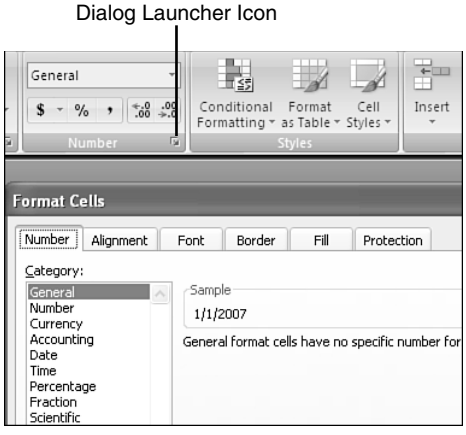


Figure 3.9
Many groups on the ribbon have this tiny More icon in the lower-right corner. Clicking this icon leads to the legacy dialog box.

Understanding How Excel Stores Dates and Time

On a Windows PC, Excel stores dates as the number of days since January 1, 1900. For a date such as 9/15/2007, Excel actually stores the value 39,340, but it formats the date to show you a value such as 09/15/2007.

On a Mac running Mac OS, Excel stores the dates as the number of days since January 1, 1904. The original designers of the Mac OS were trying to squeeze the OS into 64K of ROM. Since every byte mattered, it seemed unnecessary to add a couple lines of code to handle the fact that 1900 is not a leap year. Excel for the Mac adopted the 1904 convention. Excel for Windows, which needed to be compatible with Lotus 1-2-3, adopted the 1900 convention. As you will read in the next case study, the 1900 convention incorrectly made 1900 a leap year.

CASE STUDY

Comparing Date Systems

To see firsthand how important this information really is, try the following:

1. Enter the number 1 in cell A1.
2. Select cell A1. Press Ctrl+1 to access the Format Cells dialog. Change the numeric formatting to display the number as a date, using the *Wednesday, March 14, 2001 type. On a PC, you see that the number 1 is January 1, 1900.
3. Type 2 in cell A1. The date changes to January 2, 1900.

> **NOTE** If you type 60 in cell A1, you see Wednesday, February 29, 1900—a date that did not exist! When Mitch Kapor was having Lotus 1-2-3 programmed in 1982, the programmers missed the fact that there was not to be a leap year in 1900. Lotus was released with the mistake, and every competing spreadsheet had to reproduce exactly the same mistake to make sure that the billions of spreadsheets using dates produced the same results. While the 1900 date system works fine and reports the right day of the week for the 39,000 days since March 1, 1900, it reports the wrong day of the week for the 59 days from January 1, 1900, through February 28, 1900.

Now try this:

1. Select cell B5. Press Ctrl+; to enter today's date in the cell.
2. Again select cell B5. Press Ctrl+1 to display the Format Cells dialog. Change the number format from a date to a number.

Your date changes to a number in the 39,000 range (assuming that you are reading this in the 2007–2009 time frame).

This might sound like a lot of hassle, but it is all worth it. If you store your dates as real dates (that is, numbers formatted to display as a date), Excel can easily do all kinds of date math. You can figure out, for example, how many days exist between a due date and today by simply subtracting one date from another. Or you can use the WORKDAY function to figure out how many workdays have elapsed between a hire date and today.

Excel provides a complete complement of functions to deal with dates, including functions that convert data from text to dates and back.

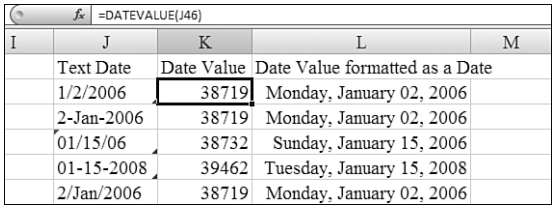
Excel stores times as decimal fractions of days. For example, you can enter noon today as `=TODAY()+0.5`. You can enter 9 a.m. as `=TODAY()+0.375`. Again, the number format handles converting the decimals to the appropriate display.

Converting Text Dates to Real Dates

The DATEVALUE function converts text that looks like a date into the equivalent serial number. You can then use the Format Cells dialog to display the number as a date.

The text version of a date can take a number of different formats. Say that your international date settings call for a month/day/year arrangement of the dates; Figure 3.10 shows a number of valid text formats that can be converted with the DATEVALUE function.

Figure 3.10
The *DATEVALUE* function can handle any of the date formats in column J.



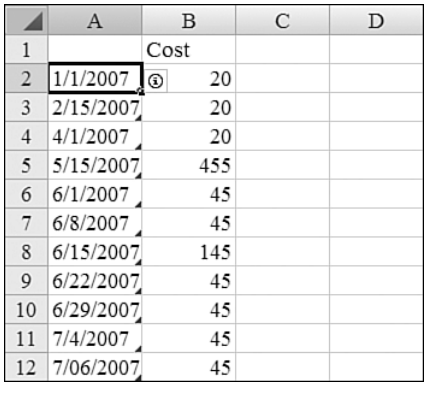
=DATEVALUE(J46)

I	J	K	L	M
	Text Date	Date Value	Date Value formatted as a Date	
	1/2/2006	38719	Monday, January 02, 2006	
	2-Jan-2006	38719	Monday, January 02, 2006	
	01/15/06	38732	Sunday, January 15, 2006	
	01-15-2008	39462	Tuesday, January 15, 2008	
	2/Jan/2006	38719	Monday, January 02, 2006	

After using the DATEVALUE function, you need to format the result as a date in order to display the numbers as dates.

Figure 3.11 shows a column of text dates. You follow these steps to convert them to real dates:

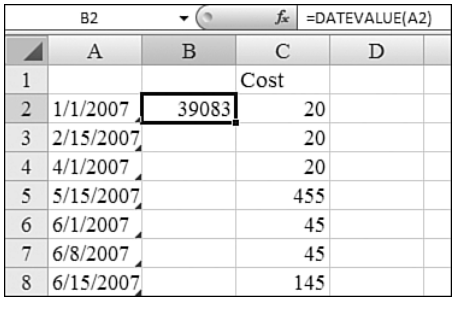
Figure 3.11
You need to convert these text dates to real dates before creating a chart.



	A	B	C	D
1		Cost		
2	1/1/2007	20		
3	2/15/2007	20		
4	4/1/2007	20		
5	5/15/2007	455		
6	6/1/2007	45		
7	6/8/2007	45		
8	6/15/2007	145		
9	6/22/2007	45		
10	6/29/2007	45		
11	7/4/2007	45		
12	7/06/2007	45		

1. Insert a blank column B by selecting cell B1 and then choosing Insert, Insert Sheet Columns on the Home ribbon. (Alternatively, use the Excel 2003 shortcut Alt+I+C.)
2. In cell B2, enter the formula `=DATEVALUE(A2)`. Excel displays a number in the 39,000 range in cell B2. You are halfway to the result (see Figure 3.12).

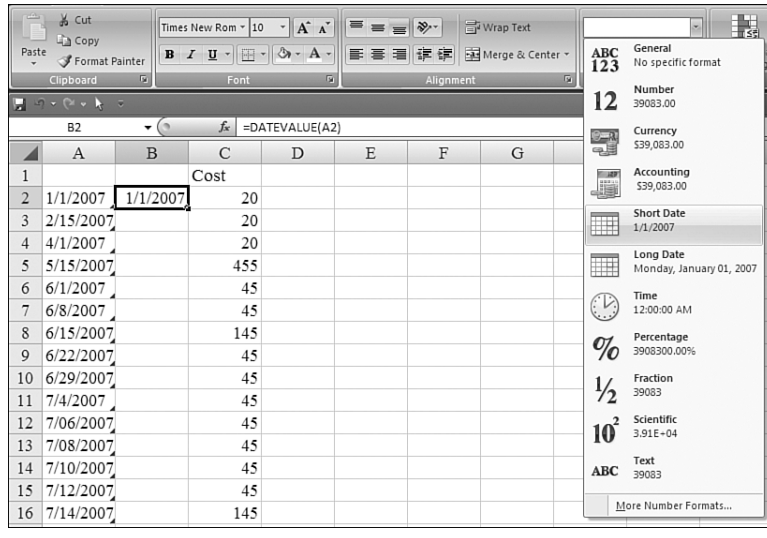
Figure 3.12
The result of the *DATEVALUE* function is a serial number. You still have to format the result as a date.



B2 =DATEVALUE(A2)

	A	B	C	D
1			Cost	
2	1/1/2007	39083	20	
3	2/15/2007		20	
4	4/1/2007		20	
5	5/15/2007		455	
6	6/1/2007		45	
7	6/8/2007		45	
8	6/15/2007		145	

3. Select cell B2. On the Home ribbon, select the drop-down at the top of the Number group and choose either Short Date or Long Date. Excel displays the number in cell B2 as a date (see Figure 3.13). (Alternatively, press Ctrl+1 and select any date format from the Number tab.)



	A	B	C
1			Cost
2	1/1/2007	1/1/2007	20
3	2/15/2007		20
4	4/1/2007		20
5	5/15/2007		455
6	6/1/2007		45
7	6/8/2007		45
8	6/15/2007		145
9	6/22/2007		45
10	6/29/2007		45
11	7/4/2007		45
12	7/06/2007		45
13	7/08/2007		45
14	7/10/2007		45
15	7/12/2007		45
16	7/14/2007		145

Figure 3.13
You can choose a date format from the Number drop-down on the Home ribbon.

4. Double-click the fill handle in the lower-right corner of cell B2. (The fill handle is the square dot in the lower-right corner of the active cell indicator.) Excel copies the formula from cell B2 down to your range of dates.
5. If some of the dates appear as #######, you need to make the column wider. To do so, double-click the border between the column B and column C headings.
6. To convert the live formulas in column B to be static values, while the range of dates in column B is selected, press Ctrl+C to copy and then on the Home ribbon, select Paste, Paste Values to convert the formulas to values. (Alternatively, you could use this shortcut: Right-click the right border of the selected range and hold the mouse button down as you drag right one column and then back to the original location. When you release the mouse button, choose Copy Here as Values Only from the contextual menu.)
7. Delete the original column A.

After you have converted the text dates to real dates, you can insert a line chart with markers. Excel automatically formats the chart with a date-based axis. In Figure 3.14, the top chart reflects cells that contain text dates. The bottom chart uses cells in which the text dates have been converted to numeric dates.

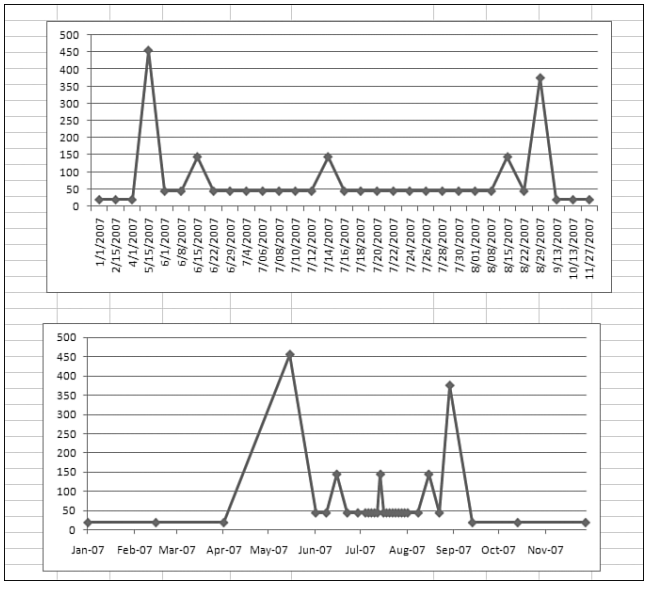


Figure 3.14
When your original data contains real dates, Excel automatically chooses a more accurate date-based axis. The bottom chart reflects a date-based axis.

TIP

There are other methods for converting the data shown in Figure 3.11 to dates. Here are some examples:

- Select any empty cell. Press Ctrl+C to copy. Select your dates. On the Home ribbon, select Paste, Paste Special. In the Paste Special dialog, choose Values in the Paste section and Add in the Operation section. Click OK.
- Select the text dates and then, on the Data ribbon, select Text to Columns, Finish.

Converting Bizarre Text Dates to Real Dates

When you rely on others for your source data, you are likely to encounter dates in all sorts of bizarre formats. While gathering data for this book, for example, I found a dataset where each date was listed as a range of dates. Each date was in the format 2/4-6/06, indicating that the data was collected from February 4 through the 6, 2006.

A number of functions, used in combination, can be useful when you're converting strange text dates to real dates:

- **`=DATE(2006,12,31)`**—This returns the serial number for December 31, 2006.
- **`=LEFT(A1,2)`**—This returns the two leftmost characters from cell A1.
- **`=RIGHT(A1,2)`**—This returns the two rightmost characters from cell A1.
- **`=MID(A1,3,2)`**—This returns the third and fourth characters from cell A2. (You read the function as "return the middle characters from A1, starting at character position 3, for a length of 2.")
- **`=FIND("/",A1)`**—This finds the position number of the first slash within A1.

You follow these steps to convert the text date ranges shown in Figure 3.15 to real dates:

Figure 3.15
A mix of *LEFT*, *RIGHT*, *MID*, and *FIND* functions parse this text to be used in the *DATE* function.

	A	B	C	D	E	F
1	Date	Year	Month	Day	Date	
2	2/1-4/01	2001	2	1	2/1/2001	
3	2/9-11/01	2001	2	9	2/9/2001	
4	2/10-12/01	2001	2	10	2/10/2001	
5	12/19-21/02	2002	12	19	12/19/2002	
6	*B2: =RIGHT(A2,2)+2000*					
7	*C2: =LEFT(A2,FIND("/",A2)-1)*					
8	*D2: =MID(A2,FIND("/",A2)+1,FIND("-",A2)-FIND("/",A2)-1)*					
9	*E2: =DATE(B2,C2,D2)*					
10						

1. Because the year is always the two rightmost characters in column A, in cell B2, enter the formula `=RIGHT(A2,2)`.
2. Because the month is the leftmost one or two characters in column A, ask Excel to find the first slash and then return the characters to the left of the slash. Enter `=FIND("/",A2)` to indicate that the slash is in second character position. Use `=LEFT(A2,FIND("/",A2)` to get the proper month number.
3. For the day, you can either choose to extract the first or last date of the range. To extract the first date, ask for the middle characters, starting one position after the slash. The logic to figure out if you then need one or two characters is a bit more complicated. You need to find the position of the dash, subtract the position of the slash, and then subtract 1. Therefore, use this formula in cell D2:
   `=MID(A2,FIND("/",A2)+1,FIND("-",A2)-FIND("/",A2)-1)`
4. Use the `DATE` function, as follows, in cell E2 to produce an actual date:
   `=DATE(B2,C2,D2)`

> **NOTE** Alternatively, you could use =DATEVALUE(LEFT(A2,FIND("–",A2)-1)&RIGHT(A2,3)).

Dates Not Recognized as Dates: Numeric Years

If you are plotting data where the only identifier is a numeric year, Excel does not automatically recognize this field as a date field.

In Figure 3.16, for example, data is plotted once a decade for the past 50 years and then yearly for the past decade. Column A contains four-digit years, such as 1955, 1965, and so on. The default chart shown in the top of the figure does not create a date-based axis. You know this to be true because the distance from 1955 to 1965 is the same as the distance from 1995 to 1996.

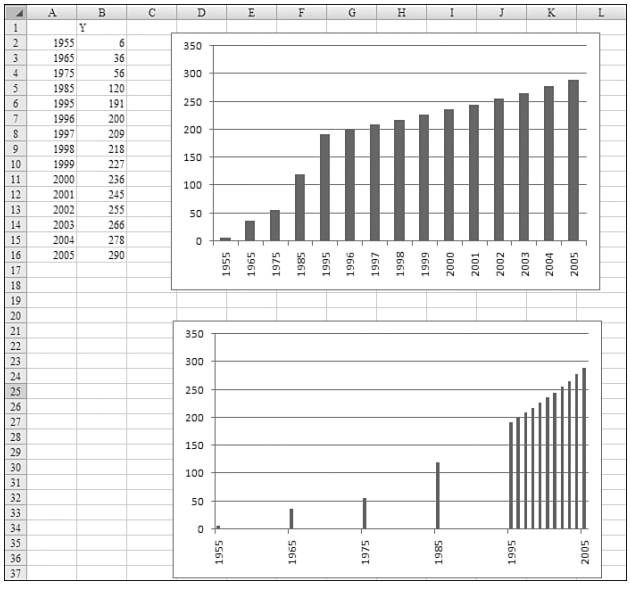


Figure 3.16
Excel does not recognize years as dates.

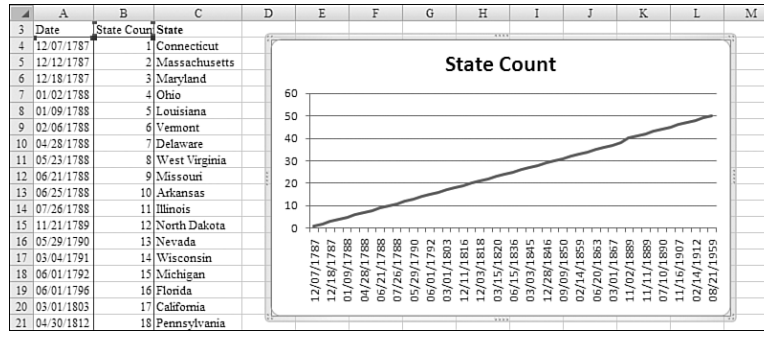
There are two solutions to this problem:

- Convert the years in column A to dates by using `=YEAR(A2,12,31)`. Format the resulting value with a yyyy custom number format. Excel then displays 2005 but actually stores the serial number for December 31, 2005.
- Convert the horizontal axis to a date-based axis. Excel then thinks that your chart is plotting daily dates from May 8, 1905, through June 27, 1905. Because no date format has been applied to the cells, they show up as the serial numbers 1955 through 2005. Excel displays the chart properly, even though the settings show that the base units are days.

Dates Not Recognized as Dates: Dates Before 1900

In Excel 2007, dates from January 1, 1900, through December 31, 9999, are recognized as valid dates. If you happen to be a company that was founded more than a demisesquicentennial before Microsoft was founded, however, you will potentially have company history going back before 1900.

Figure 3.17 shows a dataset stretching from 1787 through 1959. The accompanying chart would lead the reader to believe that the number of states in the United States grew at a constant rate, a statement that would cause Mr. Kessel, my eighth-grade geography teacher, to give me an F for this book.



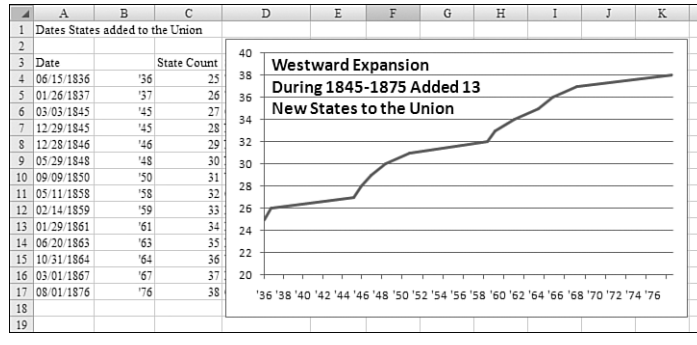
	A	B	C
3	Date	State Count	State
4	12/07/1787	1	Connecticut
5	12/12/1787	2	Massachusetts
6	12/18/1787	3	Maryland
7	01/02/1788	4	Ohio
8	01/09/1788	5	Louisiana
9	02/06/1788	6	Vermont
10	04/28/1788	7	Delaware
11	05/23/1788	8	West Virginia
12	06/21/1788	9	Missouri
13	06/25/1788	10	Arkansas
14	07/26/1788	11	Illinois
15	11/21/1789	12	North Dakota
16	05/29/1790	13	Nevada
17	03/04/1791	14	Wisconsin
18	06/01/1792	15	Michigan
19	06/01/1796	16	Florida
20	03/01/1803	17	California
21	04/30/1812	18	Pennsylvania

Figure 3.17
Dates from before 1900 are not valid Excel dates. A date-based axis is not possible in this case.

Formatting the chart to have a date-based axis does not work because Excel does not recognize dates before 1900 as valid dates. The next two sections discuss possible workarounds.

Using a Date-Based Axis with Dates Before 1900 Spanning Less Than 100 Years

In Figure 3.18, the dates in column A are text dates from the 1800s. Excel cannot automatically deal with dates from the 1800s, but it can deal with dates from the 1900s.



	A	B	C
1	Dates States added to the Union		
2			
3	Date		State Count
4	06/15/1836	'36	25
5	01/26/1837	'37	26
6	03/03/1845	'45	27
7	12/29/1845	'45	28
8	12/28/1846	'46	29
9	05/29/1848	'48	30
10	09/09/1850	'50	31
11	05/11/1858	'58	32
12	02/14/1859	'59	33
13	01/29/1861	'61	34
14	06/20/1863	'63	35
15	10/31/1864	'64	36
16	03/01/1867	'67	37
17	08/01/1876	'76	38
18			
19			

Figure 3.18
Transforming the 1800s dates to 1900s dates and using clever formatting allows Excel to plot this data with a date axis.

One solution is to transform the dates to be dates in the valid range of dates that Excel can recognize. You can use a date format with two years and a good title on the chart to explain that the dates are from the 1800s.

To create the chart in Figure 3.18, you follow these steps:

1. Insert a blank column B to hold the transformed dates.
2. Enter the formula `=DATE(100+RIGHT(A4,4),LEFT(A4,2),MID(A4,4,2))` in cell B4. This formula converts the 1836 date to a 1936 date.
3. Select cell B4. Press Ctrl+1 to open the Format Cells dialog. Choose the date format 3/14/01 from the Date category on the Number tab. This formats the 1936 date as 6/15/36. (You will later add a title to indicate that the dates are in the 1800s.)
4. Double-click the fill handle in cell B4 to copy the formula down to all cells.
5. Select the range B3:C17.

6. From the Insert ribbon, choose Charts, Line, 2-D Line, Line.
7. From the Layout ribbon, choose Legend, No Legend.
8. Right-click the vertical axis along the left side of the chart and choose Format Axis from the context menu.
9. In the Format Axis dialog that appears, on the Axis Options page, choose the Fixed option button next to Minimum and enter a fixed value of `20`.
10. Without closing the Format Axis dialog, click the dates in the horizontal axis in the chart. Excel automatically switches to formatting the horizontal axis, and the settings in the Format Axis dialog redraw to show the settings for the horizontal axis. In the Axis Type section, choose Date Axis. Click Close to close the dialog box.
11. From the Layout ribbon, choose Chart Title, Centered Overlay Title.
12. Click the State Count title. Type the new title `Westward Expansion<enter>During 1845-1875 Added 13<enter>New States to the Union`. Click outside the title to exit Text Edit mode.
13. Click the title once. You should have a solid selection rectangle around the title. On the Home ribbon, click the Decrease Font Size button. Click the Left Align button.
14. Carefully click the border of the title. Drag it so it appears in the top-left corner of the chart.
15. Select the dates in B4:B17. Press Ctrl+1 to access the Format Cells dialog. On the Number tab, click the Custom category. Type the custom number format `'yy`. This changes the values shown along the horizontal axis from m/d/yy format to show a two-digit year preceded by an apostrophe.

The result is the chart shown in Figure 3.18. The reader may believe that the chart is showing dates in the 1800s, but Excel is actually showing dates in the 1900s.

This method fails when you are trying to display more than 100 years of data points.

Using a Date-Based Axis with Dates Before 1900 Spanning More Than 100 Years

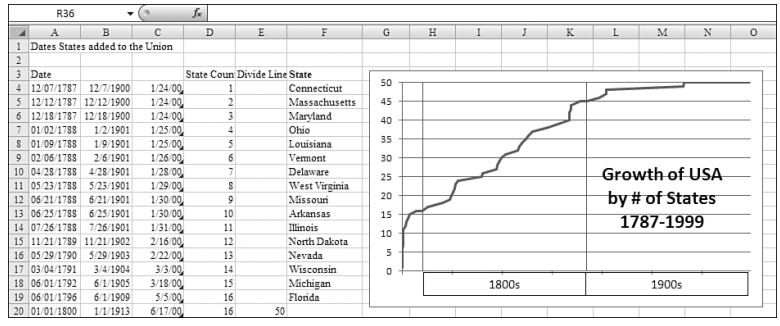
If you attempt to use the technique described in the preceding section on a chart that contains more than 100 years' worth of dates, the technique will fail.

Microsoft Excel 2007 doesn't do well with large datasets that span 100+ years. While I managed to create a date-based axis covering 630 years with 10 data points, a dataset covering 102 years and 40 points cannot display a date-based axis. As Figure 3.19 shows, however, it is possible to create this chart. To do so, you must transform your date axis into a scale that shows months, hide the axis, and add your own axis, using text boxes. These steps are not for the faint of heart.

You first need to transform the dates from the 1800s to the 1900s. You then transform the dates spanning 172 years into a range where each month in real time is represented by a single day. This results in a time span of six years. You then need to use care to completely hide the

labels along the horizontal axis and to replace them with text boxes showing the centuries. You then add a new data series to draw vertical lines at the change of each century.

To create the chart in Figure 3.19, you follow these steps:



	A	B	C	D	E	F
1	Dates States added to the Union					
2						
3	Date			State Coun	Divide Line	State
4	12/07/1787	12/7/1900	1/24/00	1		Connecticut
5	12/12/1787	12/12/1900	1/24/00	2		Massachusetts
6	12/18/1787	12/18/1900	1/24/00	3		Maryland
7	01/02/1788	1/2/1901	1/25/00	4		Ohio
8	01/09/1788	1/9/1901	1/25/00	5		Louisiana
9	02/06/1788	2/6/1901	1/26/00	6		Vermont
10	04/28/1788	4/28/1901	1/28/00	7		Delaware
11	05/23/1788	5/23/1901	1/29/00	8		West Virginia
12	06/21/1788	6/21/1901	1/30/00	9		Missouri
13	06/25/1788	6/25/1901	1/30/00	10		Arkansas
14	07/26/1788	7/26/1901	1/31/00	11		Illinois
15	11/21/1789	11/21/1902	2/16/00	12		North Dakota
16	05/29/1790	5/29/1903	2/22/00	13		Nevada
17	03/04/1791	3/4/1904	3/3/00	14		Wisconsin
18	06/01/1792	6/1/1905	3/18/00	15		Michigan
19	06/01/1796	6/1/1909	5/5/00	16		Florida
20	01/01/1800	1/1/1913	6/17/00	16	50	

Figure 3.19
This chart appears to show a date-based axis that spans 200+ years.

1. Insert new columns B and C.
2. In cell B4, enter the formula `=DATE(113+RIGHT(A4,4),LEFT(A4,2),MID(A4,4,2))`. This transforms the dates from 1787 to a valid Excel date in 1900. Format this cell with a short date format.
3. In cell C4, type the formula `=(YEAR(B4)-1899)*12+MONTH(B4)` to calculate a number of months. Format this cell as a short date. This formula now reduces 172 years into 172×12 into 2,064 days, where each day represents 1 month of real time.
4. Select cells B4:C4 and double-click the fill handle to copy the formula down to your range of data. The dates in column B span 1900 to 2072. The dates in column D span 1900 to 1907. Although the relative position of the data points is correct, you have to hide the axis labels that Excel draws in for the horizontal axis. It would therefore be helpful to draw in vertical lines to show where the axis switches from the 1700s to the 1800s and another line to show where the axis switches from the 1800s to the 1900s.
5. Insert a new column E to hold the data for the second series. This series contains just two nonzero points: one at 1800 and one at 1900. Enter the heading `Divide Line` in cell E3.
6. Look through the dates in column A. Insert a new row before the first date in the 1800s. In this new row, enter `01/01/1800` in column A. Copy the formulas in columns B and C. In column D, copy the point from the row above. In column E, enter the value `50`. This draws a single vertical bar from the horizontal axis up to a height of 50.
7. Repeat step 6 to add a new data point for January 1, 1900, and January 1, 2000.
8. Select C4:E55.
9. From the Insert ribbon, choose Charts, Line, Line.
10. On the Layout ribbon, choose Legend, None.

11. Right-click the numbers along the vertical axis and choose Format Axis. Change the Maximum option button to Fixed and enter the value `50`. This changes the vertical axis to show from 0 to 50.
12. On the Layout ribbon, use the Current Selection drop-down to select Series. There are now only two data points selected in the chart.
13. On the Design ribbon, choose Change Chart Type. Select the first icon in the column section—for a clustered column chart. This draws narrow columns—actually lines—at 1800 and 1900 on the chart. Note that the chart type change affects only the second series because you selected the Divide Line series in step 12.
14. Click the labels along the horizontal axis. These labels show wrong dates such as 1/23/02. On the Home ribbon, from the Font Color drop-down choose a white font. This causes the axis labels to disappear.
15. On the Insert ribbon, click the Text Box icon. On the chart, draw a text box from the 1800 line to the 1900 line, just below the horizontal axis. The mouse pointer changes into a crosshairs as you draw. You can make sure the vertical line in the crosshairs corresponds to the vertical dividing lines. After you create the text box, a flashing cursor appears inside the text box.
16. Type `1800s`. Click the edge of the text box to change it from a dashed line to a solid line.
17. While the text box is selected, choose Center Align from the Home ribbon. Choose Vertical Center Align. Choose Increase Font Size from the Home ribbon.
18. While the text box is still selected, choose Format, Shape Outline, Black on the Layout ribbon in order to outline the text box.
19. Click the text box and start to drag to the right. After you start to drag, hold down the Shift key to constrain the movement to the right. Hold down the Ctrl key to make an identical copy of the text box. When the left edge of the new text box is aligned with the vertical line at 1900, release the mouse button. (Note that you must start dragging before you hold down the Ctrl+Shift keys. Microsoft interprets Ctrl+Click as the shortcut to select an object's container.)
20. Click in the text box and change the text from `1800s` to `1900s`.
21. On the Layout ribbon, choose Chart Title, Centered Overlay Title. The title Chart Title appears, and it is selected.
22. Click inside the Chart Title text area to enter Text Entry mode. Overwrite the default text in the title by typing `Growth of USA`, pressing Enter, typing `by # of States`, pressing Enter, and typing `1787-1999`.
23. Click on the border of the chart title to exit Text Entry mode.
24. Drag the chart title to a new location in the lower-right corner of the chart.

The result is a chart that appears to show a line chart that spans 217 years. The line is appropriately scaled, using a date-based axis.

Using a Workaround to Display a Time-Scale Axis

The developers who create Microsoft Excel are careful in the Format Axis dialog box to call the option a *date axis*. The technical writers who write Excel Help refer to a *time-scale axis*. The developers get a point here for accuracy because Excel absolutely cannot natively handle an axis that is based on time.

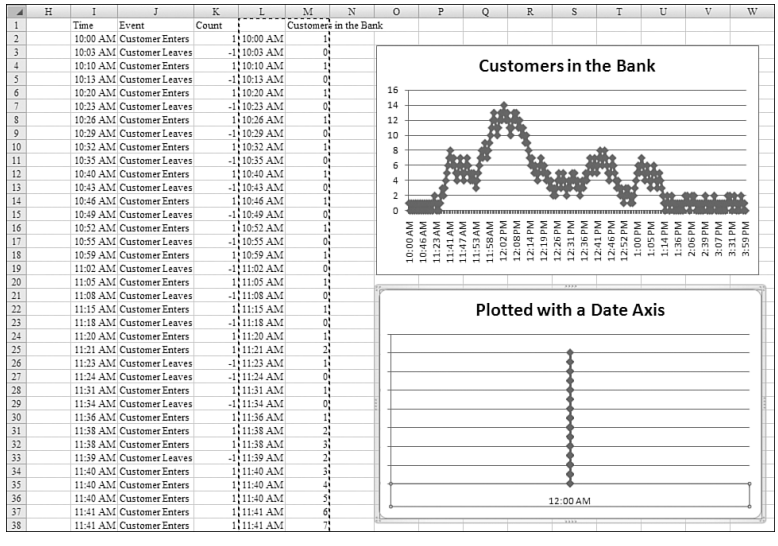
The data in Figure 3.20 is used to analyze queuing times. In column A, it logs the time that customers entered a busy bank. Times range from when the bank opened at 10 a.m. until the bank closed at 4:00 p.m.

After you enter planned staffing levels in column C, the model calculates when the customer will move from the queue to an open teller window and when he or she will leave, based on an average of three minutes per transaction.

Data in columns I:M record the number of people in the bank every time someone enters or leaves. This data is definitely not spaced equally. Only a few customers arrive in the 10:00 hour, while many customers enter the bank during the lunch hour.

The top chart in Figure 3.20 plots the number of customers on a text-based axis. Because each customer arrival or departure merits a new point, the one hour from noon until 1 p.m. takes up 41% of the horizontal width of the chart. In reality, this one-hour period merits only 16% of the chart. It sounds like a perfect use for a time-series axis, right?

The bottom chart is an identical chart where the axis is converted to show the data on a date-based axis. This is a complete disaster. In a date-based axis, all time information is discarded. The entire set of 300 points is plotted in a single vertical line.



	Time	Event	Count		Customers in the Bank
2	10:00 AM	Customer Enters	1	10:00 AM	1
3	10:03 AM	Customer Leaves	-1	10:03 AM	0
4	10:10 AM	Customer Enters	1	10:10 AM	1
5	10:13 AM	Customer Leaves	-1	10:13 AM	0
6	10:20 AM	Customer Enters	1	10:20 AM	1
7	10:23 AM	Customer Leaves	-1	10:23 AM	0
8	10:26 AM	Customer Enters	1	10:26 AM	1
9	10:29 AM	Customer Leaves	-1	10:29 AM	0
10	10:32 AM	Customer Enters	1	10:32 AM	1
11	10:35 AM	Customer Leaves	-1	10:35 AM	0
12	10:40 AM	Customer Enters	1	10:40 AM	1
13	10:43 AM	Customer Leaves	-1	10:43 AM	0
14	10:46 AM	Customer Enters	1	10:46 AM	1
15	10:49 AM	Customer Leaves	-1	10:49 AM	0
16	10:52 AM	Customer Enters	1	10:52 AM	1
17	10:55 AM	Customer Leaves	-1	10:55 AM	0
18	10:59 AM	Customer Enters	1	10:59 AM	1
19	11:02 AM	Customer Leaves	-1	11:02 AM	0
20	11:05 AM	Customer Enters	1	11:05 AM	1
21	11:08 AM	Customer Leaves	-1	11:08 AM	0
22	11:15 AM	Customer Enters	1	11:15 AM	1
23	11:18 AM	Customer Leaves	-1	11:18 AM	0
24	11:20 AM	Customer Enters	1	11:20 AM	1
25	11:21 AM	Customer Enters	1	11:21 AM	2
26	11:23 AM	Customer Leaves	-1	11:23 AM	1
27	11:24 AM	Customer Leaves	-1	11:24 AM	0
28	11:31 AM	Customer Enters	1	11:31 AM	1
29	11:34 AM	Customer Leaves	-1	11:34 AM	0
30	11:36 AM	Customer Enters	1	11:36 AM	1
31	11:38 AM	Customer Enters	1	11:38 AM	2
32	11:38 AM	Customer Enters	1	11:38 AM	3
33	11:39 AM	Customer Leaves	-1	11:39 AM	2
34	11:40 AM	Customer Enters	1	11:40 AM	3
35	11:40 AM	Customer Enters	1	11:40 AM	4
36	11:40 AM	Customer Enters	1	11:40 AM	5
37	11:41 AM	Customer Enters	1	11:41 AM	6
38	11:41 AM	Customer Enters	1	11:41 AM	7

Figure 3.20
Excel cannot show a time-series axis that contains times.

The solution to this problem involves converting the hours to a different time scale (similar to the 1800s date example in the preceding section). Perhaps each hour could be represented by a single year. The 10:00 hour could be represented by 2010, and the 3:00 hour could be represented by 2015 (because 3:00 is the 15:00 hour on a 24-hour clock).

In this example, you manipulate the labels along the vertical axis using a clever custom number format. A few new settings on the Format Axis dialog ensure that an axis label appears every hour.

You follow these steps to create a chart that appears to have a time-based axis:

> **NOTE** In the original chart, a time appeared in column I, and a formula in column L simply copied this time so that it would be adjacent to the customer count in column M. In step 1, the transformation formula is applied to column L.

1. In cell L2, enter the following formula to translate the time to a date:
   `=ROUND(DATE(HOUR(I2)+2000,1,1)+MINUTE(I2)/60*364,0)`

   Because each hour will represent a single year, the years argument of the `DATE` function is `=HOUR(I2)+2000`. This returns values from 2010 through 2013. The other arguments in the date function are `1` and `1` to return January 1 of the year. Outside the date function, the minute of the time cell is scaled up to show a value from 1 to 365, using `MINUTE(I2)/60*36`. The entire formula is rounded to the nearest integer because Excel would normally ignore any time values.
2. Select cell L2. Double-click the fill handle to copy this formula down to all the data points. The results of this formula ranges from January 1, 2010 (representing the customer who walked in at 10 a.m.), to 12/25/2015 (representing the customer who walked in at 3:57 p.m.).
3. Select cells L1:M303.
4. From the Insert ribbon, choose Charts, Line, Line with Markers.
5. On the Layout ribbon, choose Legend, None. (I hope that after studying Software Quality Metrics (SQM) data for Excel 2007, Microsoft finally realizes that 500 million people instantly turn off the legend in every chart that has a single data series.)
6. Right-click the labels along the horizontal axis and choose Format Axis to display the Format Axis dialog box, where you make the following selections:
   - In the Axis Type section, choose Date Axis.
   - For Major Unit, choose Fixed, 1 Years.
   - For Minor Unit, choose Fixed, 1 Days.
   - For Base Unit, choose Fixed, Days.

   Click Close to close the Format Axis dialog.
7. Return to the transformed dates in column L. Select L2:L303.

8. Press Ctrl+1 to display the Format Cells dialog. On the Number tab, choose the Custom category. A custom number format of yy would display 10 for 2010 and 15 for 2015. Instead, use a custom number format of yy":00". This causes Excel to display 10:00 for 2010 and 15:00 for 2015. This is fairly sneaky, eh?

As you can see in Figure 3.21, the chart now allocates one-sixth of the horizontal axis to each hour. This is an improvement in accuracy over either of the charts in Figure 3.20. The additional chart in Figure 3.21 uses a similar methodology to show the wait time for each customer who enters the bank. If my bank offered 12-minute wait times, I would be finding a new bank.

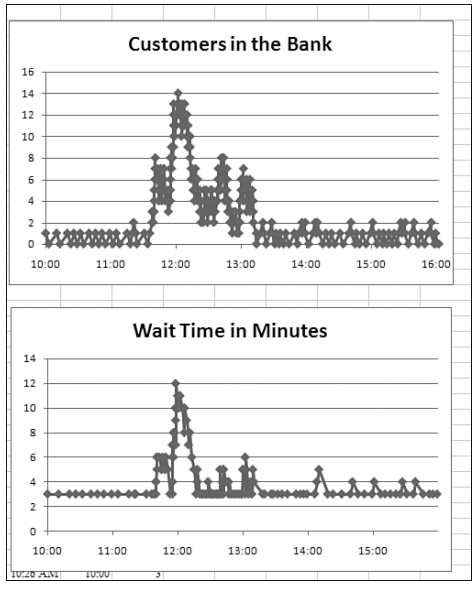
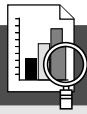


Figure 3.21
These charts show the number of customers in the bank and their expected wait times.

Converting Dates to Text to Add a Decorative Chart Element

There are times when you want to force the category axis to be a text-based axis so that you have a bit more control.

In the following case study, professional designer Kyle Fletcher used Adobe Illustrator to produce a chart for a music industry publication. Kyle needed to separate sales before and after a specific event. Using Illustrator, Kyle drew his chart and created a gap between the pre-event and post-event columns. In order to replicate this effect in Excel, you need to use a text-based axis.

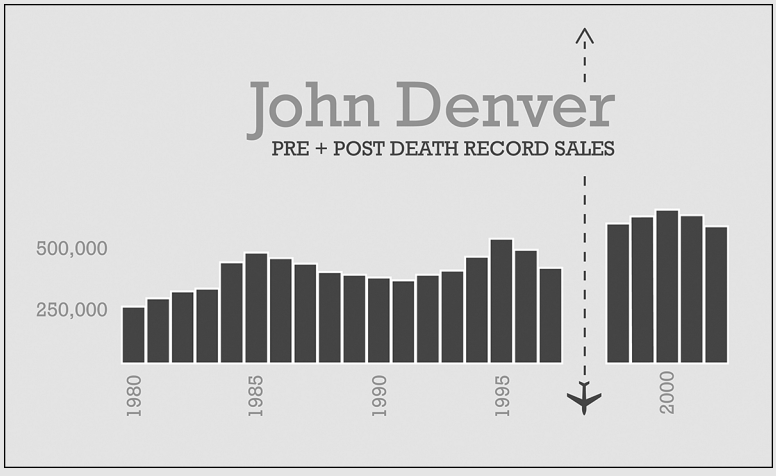


DESIGNING CHARTS LIKE THE PROS

Kyle Fletcher: Using a Decorative Element in a Chart

When commissioned to create a chart for a record industry publication, designer Kyle Fletcher (of www.KyleFletcher.com) created the chart shown in Figure 3.22 using Illustrator. This chart is mostly devoid of chartjunk; it has no gridlines and no axis lines. The only extra element is a separator line used to break the chart into two sections. This separator line takes up the width of an entire column and serves to break the single chart into two charts.

Figure 3.22
This chart from a magazine article uses a vertical element to break the sales trend into two sections.



©2005 Kyle Fletcher. Used with Permission.

You follow these steps to create a chart like this one:

> **NOTE** The original dataset has year-ending dates in column A and sales in column B.

1. Insert a blank column to the right of the year-ending dates. Enter the formula `=YEAR(A2)` in cell B2. (Converting from dates to numbers ensures that Excel chooses a text-based axis.)
2. While B2 is selected, choose the number format from the drop-down in the Number group on the Home ribbon. Click the Decrease Decimal icon twice to remove the decimals.
3. Insert a blank row between 1997 and 1998. For the year, enter a space. For the sales column, leave the column blank.
4. Change the Sales heading in C1 to John Denver. This will be the start of the title.
5. Select cells B1:C25.
6. On the Insert ribbon, choose Charts, Column, Clustered Column. The initial chart appears as shown in Figure 3.23.

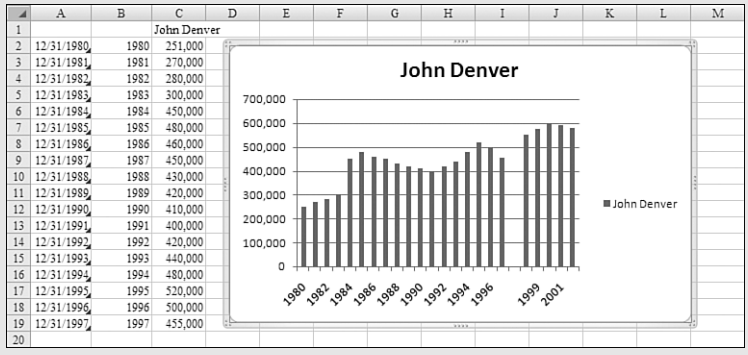


Figure 3.23
The default chart created by Excel.

7. On the Layout ribbon, choose Legend, None. Then choose Gridlines, Primary Horizontal Gridlines, None.
8. Left-click the numbers in the vertical axis. On the Layout ribbon, choose Format, Shape Outline, No Outline. This removes the vertical line next to the numbers.
9. With the axis still selected, use the Font drop-down on the Home ribbon to choose the Rockwell font. Change the font color to orange.
10. Right-click a number along the vertical axis and choose Format Axis. In the Format Axis dialog that appears, specify the following:
    - For Minimum, select Fixed, 0.
    - For Maximum, select Fixed, 600000.
    - For Major Unit, select Fixed, 250000.

    Click the Close button. Excel now displays only 0, 250,000, and 500,000 along the vertical axis.
11. Left-click one of the columns to select the data series. On the Layout ribbon, choose Format, Fill, Tan, Darker 50%. Right-click a column and choose Format Data Series. Change the gap width from 150% to 37%. This makes the columns wider, with less of a gap between them.
12. Select the title. Click at the right end of the title to put the title in Text Edit mode. Press the Enter key and then type **PRE + POST DEATH RECORD SALES**.
13. Use the mouse to highlight the characters in the first line of the title. On the Home ribbon, choose Rockwell from the font drop-down. Choose an orange color for the font. Change the font size to 36.
14. Use the mouse to highlight the characters in the second line of the title. Move the mouse cursor up and to the right to activate the mini toolbar. Select Rockwell Condensed as the font. Turn off bold. Choose a tan color as the font color. Choose 18 point.
15. Resize the overall chart to extend from E2 to 024.
16. Left-click one of the years along the category axis. On the Format ribbon, choose Shape Outline, No Outline to remove the line in the x-axis. In the Home ribbon, choose the orange font color. Choose the Rockwell font. The labels along the x-axis remain a source of difficulty. In Kyle's chart, he only showed labels for 1980, 1985, 1990, 1995, and 2000. If you tried to turn on every fifth label, your gap column between 1997 and 1998 would throw off the label for 2000.
17. Go back to the source data and clear the year entries for 1981 through 1984, 1986 through 1989, and so on. As you clear an entry in the worksheet, the corresponding entry along the chart axis disappears.

18. Reselect the chart. On the Insert ribbon, choose Shapes. In the Shapes gallery that appears, choose a line with a single arrow. Start drawing just below the baseline, in between the 1997 and 1998 bars. Hold down the Shift key and draw upward, toward the top of the chart.
19. From the Format ribbon, select Shape Outline, Weight, 2¼ point. Next choose Shape Outline, Dashes and then select the fourth dash type. Choose Shape Outline, Tan Background 2, Darker 50%.
20. With the chart selected, choose Insert, Clip Art. In the Clip Art pane, choose Clip Art on Office Online. Search for `airplane`. For Filter by Type, choose Clip Art. Page through until you find a suitable shape and then click the check box under that shape. In the header above the clip art, you now have the link Download 1 Item. Click that link and then click Download Now. If prompted to do so, choose Open with Clip Organizer. When the clip appears in Microsoft Clip Organizer, choose the drop-down next to the clip and choose Copy.
21. Return to Excel, select the chart, and press Ctrl+V to paste. The clip is initially too large. Use the resizing handles to shrink the airplane. Drag the airplane into position beneath the baseline. Use the green rotate handle to change the orientation of the airplane.

Figure 3.24 shows the final chart in Excel.

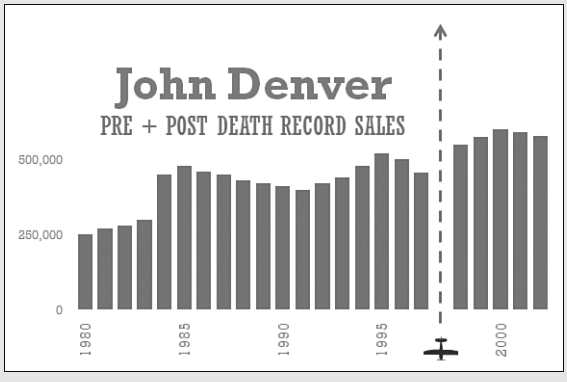


Figure 3.24
The chart produced in Excel resembles the original chart from Illustrator.

While this chart is close to the original, there are a few elements of the Excel chart that cannot exactly match the chart drawn in Illustrator:

- The Excel chart shows a value of 0 along the y-axis, whereas the Illustrator chart does not. You could remove this 0 by adding a rectangular shape on top of the 0 and formatting it as white with no border or by using a custom number format of #, ##0;;.
- In Kyle's chart, the dashed arrow line actually goes behind the title. In Excel, any drawing objects appear on top of the title, and the Send to Back option is grayed out on the Drawing Tools Format ribbon. I chose to move the title out of the way rather than have the arrow cross the title. If you eliminated the title and replaced it with a text box, you could format the text box with a solid white fill and no outline in order to have the arrow appear behind the text box.

It requires more than 20 steps, but with Excel, you can emulate a chart designed with professional design tools. The chart in this example clearly shows the trend of record sales before and after the event. Anyone who is remotely news savvy will understand the meaning of the chart without needing any additional text or title.

> **NOTE** Kyle Fletcher is fresh out of design school and available for hire. Check out his witty annual report at www.KyleFletcher.com.

Using a Chart to Communicate Effectively

A long time ago, in a past job, a McKinsey & Company team investigated opportunities for growth at the company where I was employed. I was chosen to be part of the team because I knew how to get the data out of the mainframe.

The consultants at McKinsey & Company knew how to make great charts. Every sheet of grid paper would be turned sideways, and they would build a landscape chart that was an awesome communication tool simply by using a pencil. After drawing the charts by hand, they would send off the charts to someone in the home office who would generate the charts on a computer. This was a great technique. Long before touching Excel, someone would sit down to figure out what the message should be.

You should do the same thing: Even if you have data in Excel, before you start to create a chart, it's a good idea to analyze the data to see what message you are trying to present.

The McKinsey & Company group used a couple of simple techniques to always get the point across:

- To help the reader interpret a chart, include the message in the title. Rather than use an Excel-generated title such as "Sales," you can actually use a two- or three-line title such as "Sales have grown every quarter except for Q3, when a strike impacted production."
- If the chart is talking about one particular data point, draw that column in a contrasting color. For example, all the columns might be white, but the Q3 bar could be black. This draws the reader's eye to the bar that you are trying to emphasize. If you are presenting data on screen, use red for negative periods and blue or green for positive periods.

The following sections present some Excel trickery that allows you to highlight a certain section of a line chart or to highlight a portion of a column chart. In these examples, you will often be spending some time up front in Excel, adding formulas to get your data series looking correct before creating the chart.

> **TIP** If you would like a great book about the theory of creating charts that communicate well, check out Gene Zelazny's *Say It with Charts Complete Toolkit*. Gene is the chart guru at McKinsey & Company who trained the consultants who taught me the simple charting rules. While Say It with Charts doesn't discuss computer techniques for producing charts, it does challenge you to think about the best way to present data with charts and includes numerous examples of excellent charts at work. Visit www.zelazny.com for more information.

Using a Long, Meaningful Title to Explain Your Point

If you are a data analyst, you are probably more adept at making sense of numbers and trends than are the readers of your chart. Rather than hoping that the reader will discover the message you are trying to make, why not add the message as the title of the chart?

Figure 3.25 shows a default chart in Excel. Both the legend and the title use the "Market Share" heading from cell B71. You certainly don't need those words on the chart twice.

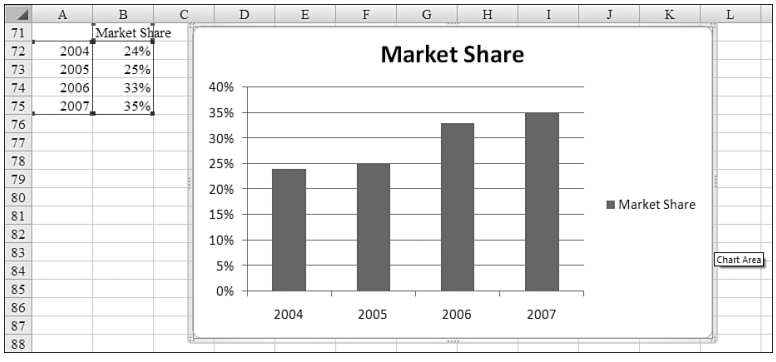


Figure 3.25
By default, Excel uses an unimaginative title taken from the heading of the data series.

You follow these steps to remove the legend, add data labels, and add a meaningful title:

1. From the Layout ribbon, choose Legend, None and then choose Data Labels, Outside End.
2. Click the title in the chart. Click again to put the title in Edit mode.
3. Backspace to remove the current title. Type **`Market share has improved`**, press Enter, and type **`13 points since 2002`**.
4. To format text while in Edit mode, you would have to select all the characters with the mouse. Instead, click the dotted border around the title. The border becomes solid. You can now use the formatting icons on the Home ribbon to format the title.
5. On the Home ribbon, choose left-justified and then click the Decrease Font Size button until the title looks right.
6. Click the border of the chart title and drag it so the title is in the upper-left corner of the chart.

The result, shown in Figure 3.26, provides a message to assist the reader of the chart.

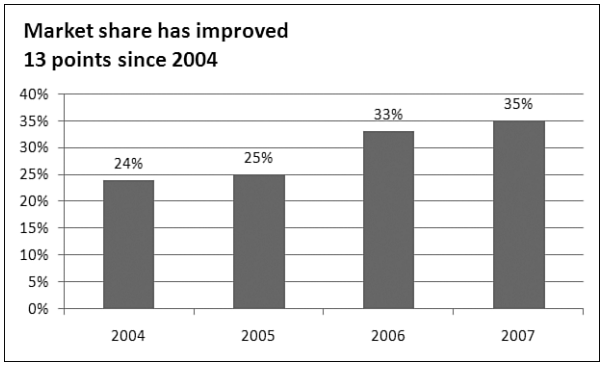


Figure 3.26
You can tell the reader the point of the chart with the title.

Resizing a Chart Title

When you click a chart title to select it, a bounding box with four resizing handles appears. At least they look like resizing handles; actually, they are not. You do not have explicit control to resize the title. It feels like you should be able to stretch the title horizontally or vertically, as if it was a text box, but you cannot. The only real control you have to make a text box taller is by inserting carriage returns in the title, but you can only type carriage returns when you are in Text Edit mode.

The first click on a title selects the title object. A solid bounding box appears around the title. At this point, you can use most of the formatting commands on the Home ribbon to format the title. You click the Increase/Decrease Font Size buttons to change the font of all of the characters. Excel automatically resizes the bounding box around the title. If you do not explicitly have carriage returns in the title where you want the lines to be broken, you are likely to experience frustration at this point.

When you have the solid bounding box around the title, you could carefully right-click the bounding box and choose Edit Text. However, simply left-clicking a second time inside the bounding box also puts the title in Text Edit mode, as indicated by a dashed line in the bounding box. In Text Edit mode, you can select specific characters in the title and then move the mouse pointer up and to the right to access the mini toolbar and the formatting commands available there. You can edit specific characters within the title in order to create a larger title and a smaller subtitle, as shown in Figure 3.27.

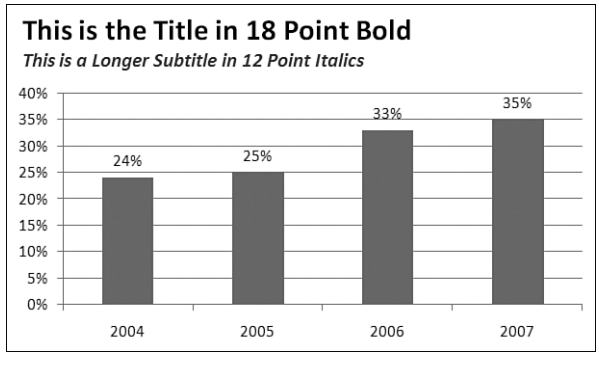


Figure 3.27
By selecting characters in Text Edit mode, you can create a title/subtitle effect.

You cannot move the title when you are in Text Edit mode. To exit Text Edit mode, you right-click the title and choose Exit Edit Text or simply left-click the bounding box around the title. When the bounding box is solid, you can click anywhere on the border except the resizing handles and drag to reposition the title.

Deleting the Title and Using a Text Box

If you are frustrated that the title cannot be resized, you can delete the title and use a text box for the title instead. The title in Figure 3.28 is actually a text box. Note the eight resizing handles on the text box instead of the four resizing handles that appear around a title.

Thanks to all these resizing handles, you can actually stretch the bounding box horizontally or vertically.

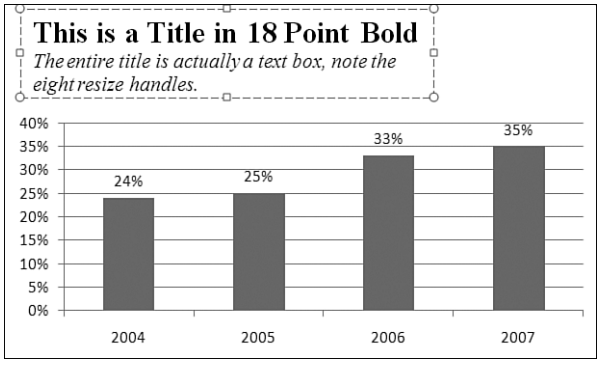


Figure 3.28
Instead of a title, this chart uses a text box for additional flexibility.

To create the text box shown in Figure 3.28, you follow these steps:

1. Delete the original title by choosing Chart Title, None from the Layout ribbon. Excel resizes the plot area to fill the space that the title formerly occupied.
2. Select the plot area by clicking some whitespace inside the plot area. Eight resizing handles now surround the plot area. Drag the top resizing handle down in order to make room for the title.
3. On the Insert ribbon, click the Text Box icon.
4. Click and drag inside the chart area to create a text box.
5. Click inside the text box and type a title. Press the Enter key to begin a new line. If you don't press the Enter key, Excel word-wraps and begins a new line when text reaches the right end of the text box.
6. Select the characters in the text box that make up the main title and use either the mini toolbar or the tools on the Home ribbon to make the title 18 point, bold, and Times New Roman.
7. Select the remaining text that makes up the subtitle in the text box and use the tools on the Home ribbon to make the subtitle be 12 point, italics, Times New Roman.

Microsoft advertises that all text can easily be made into WordArt. However, when you use the WordArt drop-downs in a title, you are not allowed to use the Transform commands found under Text Effects on the Drawing Tools Format ribbon. When you use the WordArt menus on a text box, however, all the Transform commands are available (see Figure 3.29).

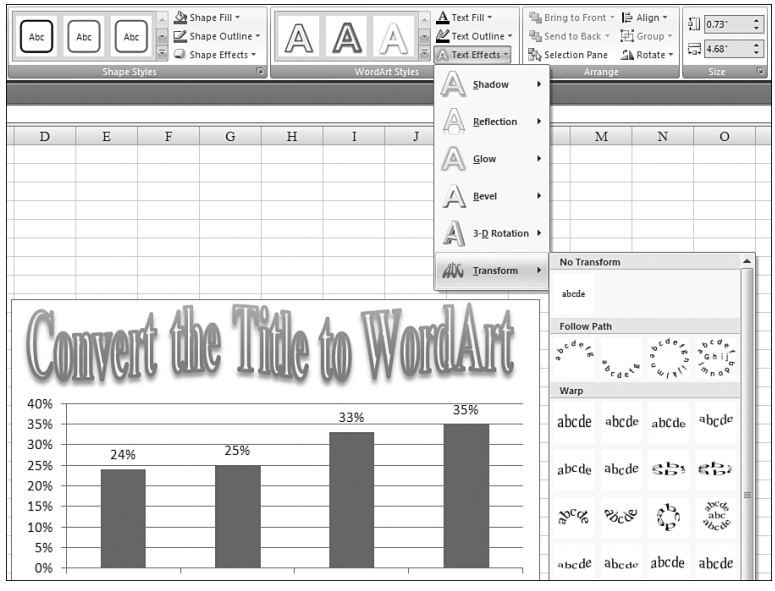


Figure 3.29
Using a text box instead of a title allows more formatting options.

Because a text box is resizable and that you can use WordArt Transform commands, a text box works perfectly: You can move or resize the chart, and the text box moves with the chart and resizes appropriately.

Highlighting One Column

If your chart title is calling out information about a specific data point, you can highlight that point to help focus the reader's attention on it. While the tools on the Design ribbon don't allow this, you can easily achieve the effect quickly by using the Format ribbon.

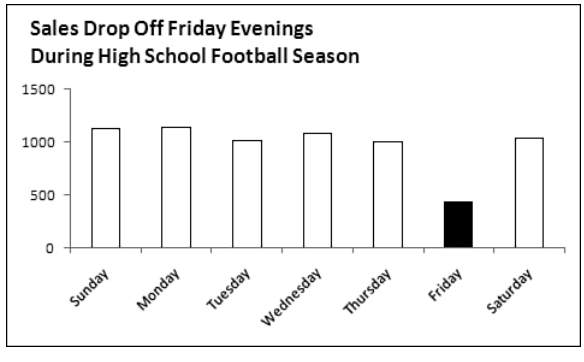


Figure 3.30
The column for Friday is highlighted in a contrasting color, and it is also identified in the title.

To create the chart in Figure 3.30, you follow these steps:

1. Create a column chart by choosing Column, Clustered Column from the Insert ribbon.
2. Click any of the columns to select the entire series.

3. On the Format ribbon, choose Shape Fill, White. At this point, the columns are invisible. (Invisible bars are great for creating waterfall charts, discussed in Chapter 4, "Creating Charts That Show Differences.") However, in this case, you want to outline the bars.
4. From the Format ribbon, choose Shape Outline, Black. Choose Shape Outline, Weight, 1 point. All your columns are now white, with black outline.
5. Click the Friday column in the chart. The first click on the series selects the whole series. A second click selects just one data point. (If you accidentally click outside the series, you might inadvertently deselect the series.) If all the columns have handles, click Friday again.
6. From the Format ribbon, choose Shape Fill, Black.
7. On the Layout ribbon, turn off the legend and the gridlines.
8. Type a title, as shown in Figure 3.30, pressing Enter after the first line of the title. On the Home ribbon, change the title font size to 14 point, left-aligned.
9. Right-click the numbers along the vertical axis and choose Format Axis. Change Major Unit to Fixed, 500.

The result is a simple chart that calls attention to Friday sales.

Replacing Columns with Arrows

You can use columns shaped like arrows to make a special point. For example, if you have good news to report about consistent growth, you might want to replace the columns in the chart with arrow shapes in order to further indicate the positive growth.

You follow these steps to convert columns to arrows:

1. Create a column chart showing a single series.
2. In an empty section of the worksheet, insert a new block arrow shape. From the Insert ribbon, choose Shapes, Arrows, Up Arrow. Click and drag in the worksheet to draw the arrow.
3. Select the arrow. Press Ctrl+C to copy the arrow to the Clipboard.
4. Select the chart. Click a column to select all the columns in the data series.
5. Press Ctrl+V to paste the arrow. Excel fills the columns with a picture of the block arrow.
6. If desired, choose Format Selection from the Format ribbon. Reduce the gap setting from 150% to 75% to make the arrows wider.

The new chart is shown in the bottom half of Figure 3.31. After creating the chart, you can delete the arrow created in step 2 by clicking the arrow and press the Delete key.

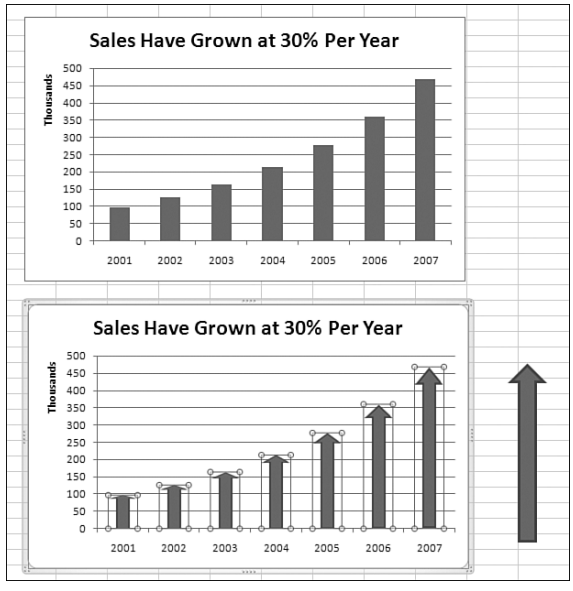


Figure 3.31
Arrows further emphasize the upward growth of sales.

Highlighting a Section of Chart by Adding a Second Series

The chart in Figure 3.32 shows a sales trend over one year. The business was affected by road construction that diverted traffic flow from the main road in front of the business.

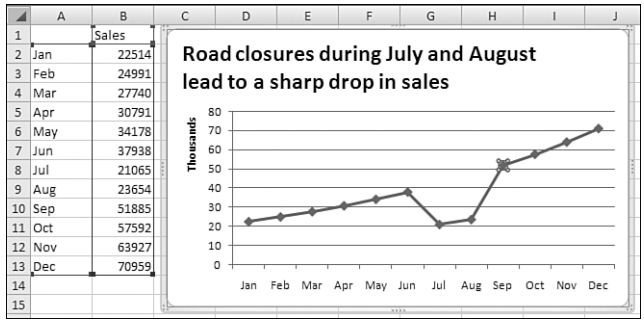


Figure 3.32
It would be best to highlight the road construction months in the chart to further emphasize the title.

The title calls out the July and August time period, but it would be cool to actually highlight that section of the chart. You follow these steps to add an area chart series to the chart:

1. Begin a new series in column C, next to the original data. To highlight July and August, add numbers to column C for the July and August points, plus the previous point, June. In cell C7, enter the formula of `=B7`. Copy this formula to June, July, and August.

2. Click the chart. A blue bounding box appears around B2:B13 in the worksheet. Drag the lower-right corner of the blue bounding box to the right to extend the series to include the three values in column C. Initially, this line shows up as a red line on top of a portion of the existing blue line.
3. On the Layout ribbon, use the Current Selection drop-down to choose Series 2. This is the series you just added.
4. While Series 2 is selected, choose Design, Change Chart Type. Select the first area chart thumbnail. Click OK. Excel draws a red area chart beneath the line segment of June through August.
5. On the Format ribbon, use the Current Selection drop-down to reselect Series 2. Then choose Shape Fill, White, Background 1, Darker 25%.

The top chart in Figure 3.33 shows the gray highlight extending from the horizontal axis up to the data line for the two line segments.

Alternatively, you could replace the numbers in column C with 70,000 in order to draw a gray rectangle behind the months, as shown in the bottom chart in Figure 3.33.

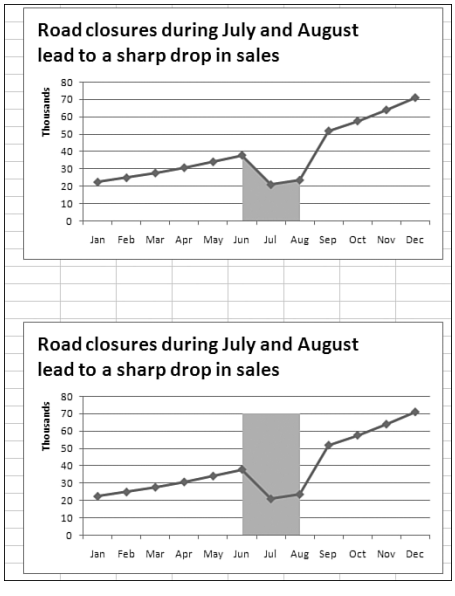


Figure 3.33
A second series, with only three points, is used to highlight a section of the chart.

Changing Line Type Midstream

Consider the top chart in Figure 3.34. The title indicates that cash balances improved after a new management team arrived. This chart initially seems to indicate an impressive turnaround. However, if you study the chart axis carefully, you see that the final Q3 and Q4 numbers are labeled Q3F and Q4F to indicate that they are forecast numbers.

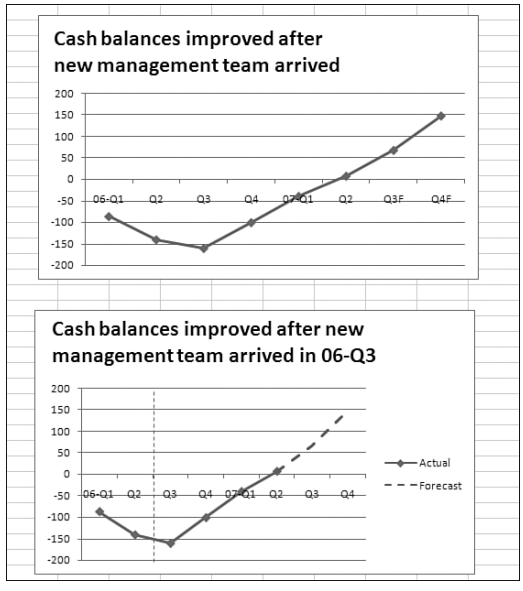


Figure 3.34
It is not clear in the top chart that the last two points are forecasts.

It is misleading to represent forecast numbers as part of the actual results line. It would be ideal if you could change the line type at that point to indicate that the last two data points are forecasts. To do so, you follow these steps:

1. Change the heading above column B from Cash Balances to Actual.
2. Add the new heading Forecast in column C.
3. Because the last actual data point is for Q2 of 2007, move the numbers for Q3 and Q4 of 2007 from column B to column C.
4. To force Excel to connect the actual and the forecast line, copy the last actual data point (the 7 for Q2) over to the Forecast column. This one data point—the connecting point for the two lines—will be in both the forecast and actual columns.
5. Change the last two labels in column A from Q3F to just Q3 and from Q4F to just Q4.
6. Click the existing chart. A bounding box appears around B2:B9. Grab the lower-right blue handle and drag outward to encompass B2:C9. A second series is added to the chart as a red line.
7. On the Layout ribbon, choose Legend, Legend at Right.
8. Click the red line. In the Format ribbon, you should see that the Current Selection drop-down indicates Series "Forecast."
9. Select Format, Shape Outline, Dashes and then select the fourth dash option. The red line changes to a dashed line.

10. While the forecast series is selected, choose Design, Change Chart Type. Choose a chart type that does not have markers.
11. Because the chart title indicates that a new management team arrived, but it does not indicate when the team arrived, change the title to indicate that the team arrived in Q3 of 2006.
12. On the Insert ribbon, select Shapes, Line. Draw a vertical line between Q2 and Q3 of 2006, holding down the Shift key while drawing to keep the line vertical.
13. While the line is selected, on the Format ribbon, choose Shape Outline, Dashes and then select the fourth dash option to make the vertical line a dashed line. Note that this line is less prominent than the series line because the weight of the line is only 1.25 point.

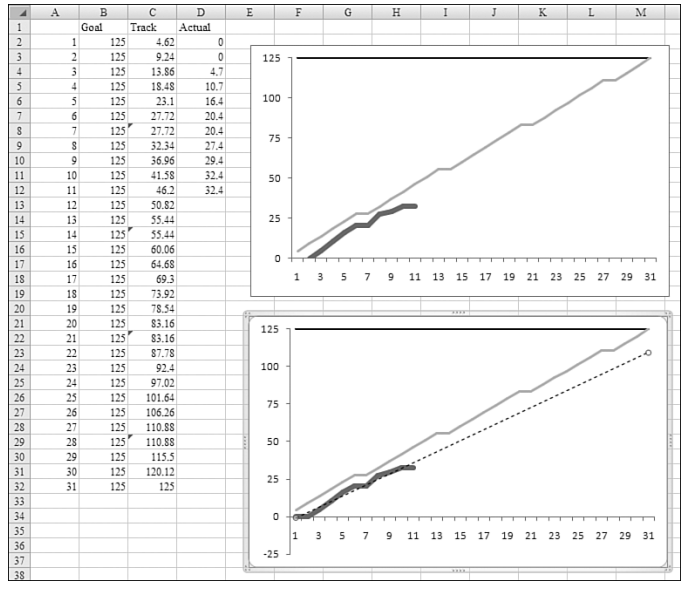
The final chart is shown at the bottom of Figure 3.34.

Adding an Automatic Trendline to a Chart

In the previous example, an analyst had created a forecast for the next two quarters. Sometimes, however, you might want to allow Excel to make a prediction based on past results. For just such situations, Excel offers a trendline feature. Excel can draw a straight line that fits the existing data points. You can either ask Excel to extrapolate the trendline into the future, or, if your data series contains blank points that represent the future, Excel can automatically add the trendline. I regularly use these charts to track my progress toward a goal or trendline.

The easiest way to add a trendline is to build a data series that includes all the days that the project is scheduled to run. In Figure 3.35, column A contains the days of the month. Column B contains 125 for each data point; Excel therefore draws a straight line across the chart, showing the goal at the end of the project. Column C shows the writing progress I should make each day. In this particular month, I am assuming that I would write an equal number of pages six days per week. Column D is labeled Actual; this is where I record the daily progress toward the goal.

The chart is created as a line chart. Gridlines are removed. The legend is removed. The trendline is formatted as a lighter gray. The actual line is formatted as a thick line. The top chart in Figure 3.35 shows the chart before the trendline is complete. You can see that the thick line is not quite above the progress line.



	Goal	Track	Actual
1	125	4.62	0
2	125	9.24	0
3	125	13.86	4.7
4	125	18.48	10.7
5	125	23.1	16.4
6	125	27.72	20.4
7	125	27.72	20.4
8	125	32.34	27.4
9	125	36.96	29.4
10	125	41.58	32.4
11	125	46.2	32.4
12	125	50.82	
13	125	55.44	
14	125	55.44	
15	125	60.06	
16	125	64.68	
17	125	69.3	
18	125	73.92	
19	125	78.54	
20	125	83.16	
21	125	83.16	
22	125	87.78	
23	125	92.4	
24	125	97.02	
25	125	101.64	
26	125	106.26	
27	125	110.88	
28	125	110.88	
29	125	115.5	
30	125	120.12	
31	125	125	

Figure 3.35
In the top chart, the actual line is running behind the trendline, but it seems close.

To add a trendline, you follow these steps:

1. Right-click the series line for the Actual column. Choose Add Trendline.
2. The Format Trendline dialog offers to add exponential, linear, logarithmic, polynomial, power, or moving average trendlines. Choose a linear trendline.
3. In the Trendline Name section, either leave the name as Linear (Actual) or enter a custom name, such as Forecast.
4. For the settings where you can forecast forward or backward a certain number of periods, because this chart already has data points for the entire month, leave both of those settings at `0`. There are also settings where Excel shows the regression equation on the chart. Add this if you desire.
5. Right-click the trendline to select it. On the Format ribbon, choose Shape Outline, Dashes and then select the fourth dash option. Also choose Shape Outline, Weight, ¾ point.

The trendline is shown in the bottom of Figure 3.35. In this particular case, the trendline extrapolates that if I continue writing at the normal pace, I will miss the deadline by 15 pages or so.

CAUTION

Excel's trendline is not an intelligent forecasting system. It merely fits past points to a straight line and extrapolates that data. It works great as a motivational tool. The current example shows, for example, that it would take a few days of above-average production before the trendline would project that the goal would be met.

Showing a Trend of Monthly Sales and Year-to-Date Sales

In accounting, you generally track sales every month. But in the big picture, you are interested in how 12 months add up to produce annual sales.

The top chart in Figure 3.36 is a poor attempt to show both monthly sales and the accumulated year-to-date (YTD) sales. The darker bars are the monthly results. The lighter bars are the accumulated YTD numbers through the current month. In order to show the large YTD number for November, the scale of the axis needs to extend to $400,000. This makes the individual monthly bars far too small for the reader to be able to discern any differences.

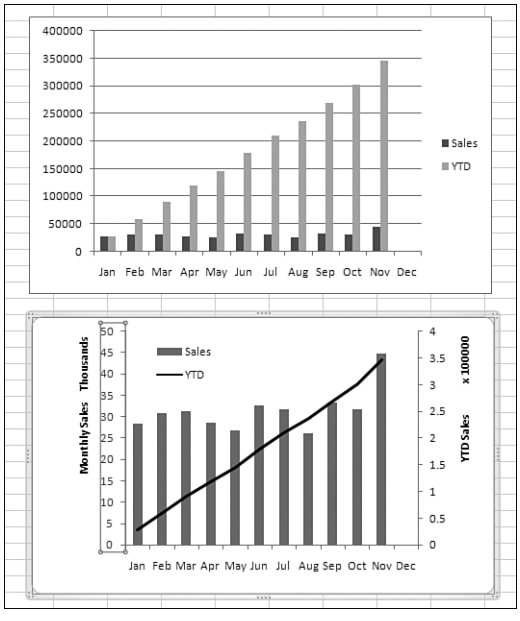


Figure 3.36
The size of the YTD bars obscures the detail of the monthly bars.

The solution is to plot the YTD numbers against a secondary vertical axis. My preference is that after you change the axis for one series, you should also change the chart type for that series. You follow these steps to create the bottom chart in Figure 3.36:

1. Left-click one of the YTD bars to select the YTD series. Right-click the selected series and choose Format Data Series. Excel displays the Format Data Series dialog.
2. In the Format Data Series dialog, choose Secondary Axis in the Plot Series On section of the Series Options page. Click Close. Excel creates a confusing chart, where the YTD numbers appear directly on top of the monthly numbers, obscuring any monthly numbers beyond August.
3. Excel deselects the series when you change the chart type. Reselect the YTD series by clicking the YTD line.
4. On the Format dialog, choose Shape Outline, Black to change the YTD line to black.

5. Turn off the gridlines by selecting Gridlines, None from the Layout ribbon.
6. Select Axes, Primary Vertical Axis, Show Axis in Thousands from the Layout ribbon.
7. Select Axis Titles, Primary Vertical Axis Title, Rotated Title from the Layout ribbon. Type `Monthly Sales` and press Enter.
8. Select Axis Titles, Secondary Vertical Axis Title, Rotated Title from the Layout ribbon. Type `YTD` and press Enter.
9. Right-click the numbers on the secondary vertical axis. Choose Format Axis. In the Scaling section, choose 100,000.
10. Click the legend and drag it to appear in the upper-left corner of the plot area.
11. Click the plot area to select it. Drag one of the resizing handles on the right side of the plot area to drag it right to fill the space that used to be occupied by the title.
12. If you want to present your charts in color, change the color of text in the primary vertical axis to match the color of the monthly bars. To do so, click the numbers to select them. Use the Font Color drop-down on the Home ribbon to select this color (for example, blue). This color cue helps the reader realize that the blue left axis corresponds to the blue bars.

The resulting chart is shown at the bottom of Figure 3.36. The chart illustrates both the monthly trend of each month's sales and the progress toward a final YTD revenue number.

Understanding the Shortcomings of Stacked Column Charts

In a stacked column chart, Series 2 is plotted directly on top of Series 1. Series 3 is plotted on top of Series 2, and so on. The problem with this type of chart is that the reader can tell if the total is increasing or decreasing. The reader might also be able to tell if Series 1 is increasing or decreasing. Because all the other series have differing start periods, it is nearly impossible to tell whether sales in Series 2, 3, or 4 are increasing or decreasing. In the top chart in Figure 3.37, which regions are responsible for the increase from 2001 to 2006? It is nearly impossible to tell.

Stacked column charts are appropriate when the message of the chart is about the first series. In the lower chart in Figure 3.36, the message is that the acquisition of a new product line saved the company. If this new product line hadn't grown quickly, the company would have had to rely on aging product lines that were losing. Because the message here is about the sales of the new product line, you can plot this as the first series, and the reader of the chart will be able to see the impact from that series.

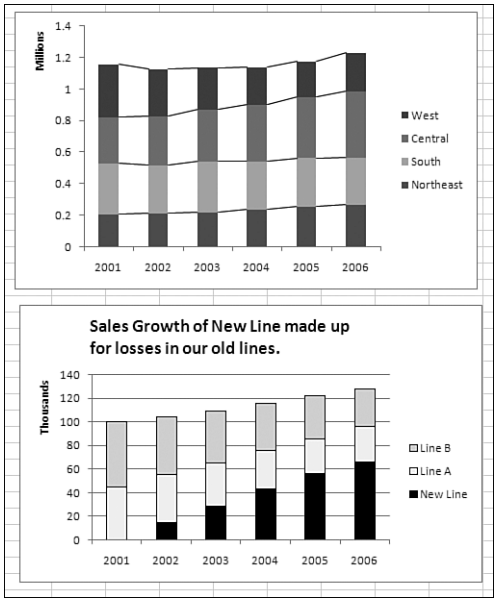
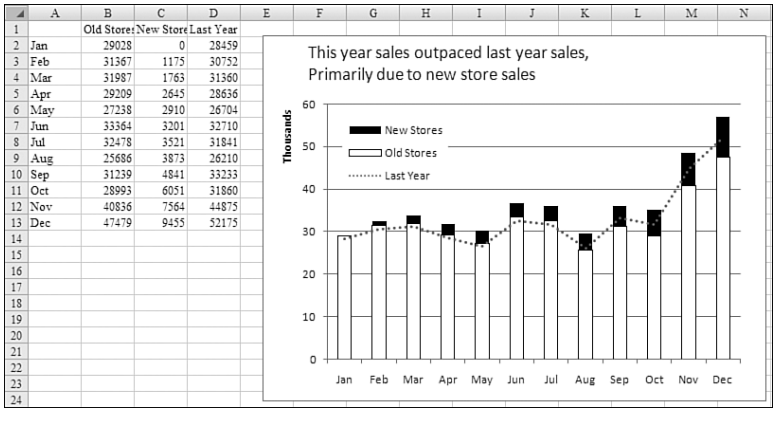


Figure 3.37
In the top chart, no one will draw any conclusions about the West, Central, or South regions.

Using a Stacked Column Chart to Compare Current Sales to Prior-Year Sales

The chart in Figure 3.38 uses a combination of a stacked column chart and a line chart. The stacked column chart shows this year's sales, broken out into same-store sales and new-store sales. In this case, the same-store sales are plotted as the first series in white. The new-store sales are the focus and are plotted in black.

The third series, which is plotted as a dotted line chart, shows the prior-year sales. While the total height of the column is greater than last year's sales, there is some underlying problem in the old stores. In many cases, the height of the white column does not exceed the height of the dotted line, indicating that sales at same store are down.



	A	B	C	D
1		Old Store	New Store	Last Year
2	Jan	29028	0	28459
3	Feb	31367	1175	30752
4	Mar	31987	1763	31360
5	Apr	29209	2645	28636
6	May	27238	2910	26704
7	Jun	33364	3201	32710
8	Jul	32478	3521	31841
9	Aug	25686	3873	26210
10	Sep	31239	4841	33233
11	Oct	28993	6051	31860
12	Nov	40836	7564	44875
13	Dec	47479	9455	52175

Figure 3.38
The current-year sales are shown as a stacked column chart, with last year's sales as a dotted line.

The process of creating this combination chart involves a few steps during which the chart looks completely wrong. You need to overlook the chart in those steps and keep progressing through the steps, as follows:

1. Set up your data with months in column A, old-store sales for this year in column B, new-store sales for this year in column C, and last year's sales in column D.
2. Select cells A1:D13 and create a stacked column chart. Initially, Excel stacks prior-year sales on top of the other sales, and you have a chart that is not remotely close to the expected outcome.
3. Click the top bar to select the third series. Choose Design, Change Chart Type, Line Chart. An important distinction here is that the first two series are plotted as stacked charts. The third series is plotted as a regular line, not as a stacked line.
4. Use the Format ribbon to format the third series as a dotted line. Format the colors of the first two series as shown in Figure 3.38.

Shortcomings of Showing Many Trends on a Single Chart

Instead of using a stacked column chart, you might try to show many trendlines on a single line chart. This approach often leads to confusion. In the top chart in Figure 3.39, for example, the sales trends of five companies create a very confusing chart.

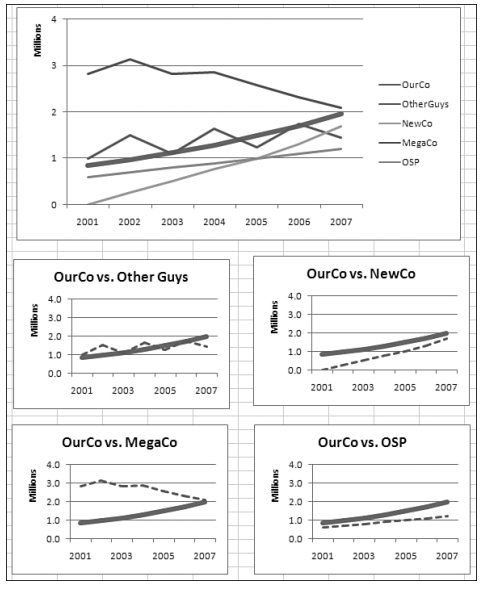


Figure 3.39 Instead of using a single chart with five confusing lines, you can compare your company to each other competitor in smaller charts.

If the goal is to compare the sales results of your company against those of each major competitor, why not show four individual charts, as is done at the bottom of Figure 3.39?

In these charts, the reader can easily see that your company is about to overtake the long-time industry leader MegaCo, but that quick growth from NewCo might still cause you to stay in the second position next year.

Using a Scatter Plot to Show a Trend

Typically, trends are shown with line or column charts. One popular chart from the blogosphere is bucking this trend. This chart, which shows a trend using a combination of two scatter plots, has been published in the blog of professor Charles H. Franklin from the University of Wisconsin (see http://politicalarithmetik.blogspot.com/2005/11/approval-of-president-bush-2001.html).

The advantage of this chart is that the solid line in the chart shows the trend of an average score from month to month. The individual dots in the scatter chart show the individual scores. The degree of scatter in the gray dots gives you an idea of the variation in the individual scores.

As shown in Figure 3.40, my Excel replica of this chart is based on data that I scraped from www.pollingreport.com/BushJob1.htm.

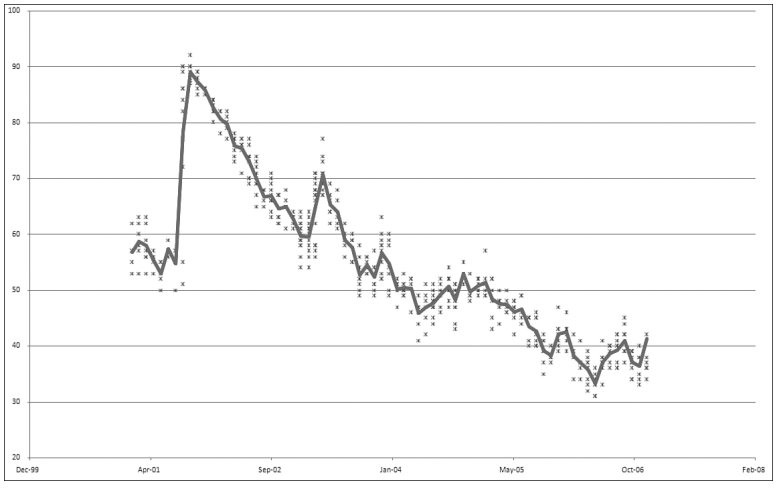


Figure 3.40
This trendline is backed by a scatter plot showing the degree of scatter of individual results.

The process of creating this chart involves these steps:

1. Collect all the individual results. Column A contains the month, stored as a real date. Column B contains the individual score that will be shown as the dots in the chart. If you have 60 months of data, this dataset might include hundreds of rows of data.
2. Build a pivot table to summarize the original dataset, by month. The pivot table should have month in the row area and average of score in the data area.

3. In column C, build a formula that gathers the average score for each month. The goal is to report the average month in the first row for each month and then use #N/A values for the remaining rows for that month. If the dates start in A2, the formula is `=IF(A2=A1,NA(),VLOOKUP(A2,$V$4:$W$74,2,FALSE))`. Figure 3.41 shows a few rows of the dataset. Dot scores appear in the second column, and line scores appear once per month in the third column. The results of the pivot table appear in the fourth and fifth columns.

Figure 3.41
The underlying detail used to create the chart in Figure 3.40.

Date	Score	Score2		
Jan-01	57	56.8	Average of Y	
Jan-01	57	#N/A	Date	Total
Jan-01	53	#N/A	Jan-01	56.8
Jan-01	62	#N/A	Feb-01	58.71428571
Jan-01	55	#N/A	Mar-01	58
Feb-01	57	58.71429	Apr-01	55.4
Feb-01	62	#N/A	May-01	53

4. Build a chart based on the first two columns. Select Scatter Chart with Only Markers.
5. Format the data series to use a light-colored marker of a small size.
6. Select the chart. A blue outline appears around the data in the second column. Grab the top-right handle on the blue outline and drag to the right to incorporate the data in the third column.
7. In the Layout ribbon, select the new series from the Current Selection drop-down.
8. In the Design ribbon, change the chart type to a scatter chart with straight lines. Format the line series as a thicker line.

Although Professor Franklin's innovative chart and blog feature mostly political charts, you can easily adapt this concept to your business.

My coauthor on *Excel for Marketing Managers*, Ivana Taylor of Third Force Marketing, is a huge proponent of asking your customers how you are doing. Ivana provides a service whereby she randomly calls 20 customers each month to get a feel for how your customers approve of your service. This data would be a perfect dataset to port to Professor Franklin's chart. Rather than showing only a "consensus" quality score, you could easily see the degree of scatter around the average score.

Next Steps

In Chapter 4, you will learn about charts used to make comparisons, including pie, radar, bar, donut, and waterfall charts.