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Bill Jelen

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Excel® 2013 Charts and Graphs

Bill Jelen

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Excel® 2013 Charts and Graphs

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Dedication

To Zeke Jelen

About the Author

Bill Jelen, Excel MVP and the host of MrExcel.com, has been using spreadsheets since 1985, and he launched the MrExcel.com website in 1998. Bill was a regular guest on *Call for Help* with Leo Laporte and has produced more than 1,500 episodes of his daily video podcast, Learn Excel from MrExcel. He is the author of 39 books about Microsoft Excel and writes the monthly Excel column for *Strategic Finance* magazine. His Excel tips appear regularly in *CFO Excel Pro Newsletter* and *CFO Magazine*. Before founding MrExcel.com, Bill Jelen spent 12 years in the trenches—working as a financial analyst for finance, marketing, accounting, and operations departments of a $500 million public company. He lives near Akron, Ohio, with his wife, Mary Ellen.

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I enjoy the visual delight of every Edward Tufte book. I apologize in advance to E.T. for documenting all the chartjunk that Microsoft lets us add to Excel charts.

Dick DeBartolo is the Daily GizWiz and has been writing for *Mad* magazine for more than 40 years, since he was 15. The pages of *Mad* were not where I expected to find inspiration for a charting book, but why not? Thanks to Bob D'Amico for illustrating the charts à la *Mad*. The pie chart in Chapter 4 is a Dick DeBartolo original, created especially for this book. Many thanks to Dick for being a contributor.

I was visiting Keith Bradbury's office in Toronto. Keith makes the completely awesome PDF-to-Excel utility at InvestInTech.com. Between parking the car and entering Keith's office, I saw the most amazing store, managed by David Michaelides. SWIPE is a bookstore dedicated to art and design. This is a beautiful store to browse, and if you go in and reveal that you work in Excel all day, they will sympathetically be very nice to you. In a clash of worlds, David has the original 1984 Mac way up above his cash register because it was the start of desktop publishing. I pointed out that the Mac was where Excel 1.0 got its start in 1985, so we had a common thread in our respective backgrounds. Stop by 401 Richmond Street West (two blocks west of Spadina) to take a look the next time you are in Toronto.

Thanks to Jane Liles at Microsoft for guiding the Excel team through Excel 2013. Thanks to Steve Tullis, Dan Battagin, and Melissa MacBeth for making the Excel Web App render charts better every year. Scott Ruble heads up the charting team and was always generous with his time when I ran into a charting quandary. Robin Wakefield provided help with some charting VBA that was eluding me.

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The great team at Pearson of Loretta Yates, Charlotte Kughen, Barbara Hacha, and Seth Kerney were a pleasure to work with.

Finally, thanks to Zeke Jelen, Dom Grossi, and Mary Ellen Jelen.

We Want to Hear from You!

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Introduction: Using Excel 2013 to Create Charts

Good charts should both explain data and arouse curiosity. A chart can summarize thousands of data points into a single picture. The arrangement of a chart should explain the underlying data but also enable the reader to isolate trouble spots worthy of further analysis.

Excel makes it easy to create charts. Even though the improvements in Excel 2013 enable you to create a chart with only a few mouse clicks, it still takes thought to find the best way to present your data.

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Choosing the Right Chart Type

Suppose you are an analyst for a chain of restaurants, and you are studying the lunch-hour sales for a restaurant in a location at a distant mall. Corporations surrounding the mall provide a steady lunchtime clientele during the week. The mall does well on weekends during the holiday shopping months but lacks weekend crowds during the rest of the year.

From the data contained in the chart in Figure I.1, you can spot a periodicity in sales throughout the year. An estimated 50 spikes indicate that the periodicity might be based on the day of the week. You can also spot that a general improvement in sales occurs at the end of the year, which you attribute to the holiday shopping season. However, there is an anomaly in the pattern during the summer months that needs further study.

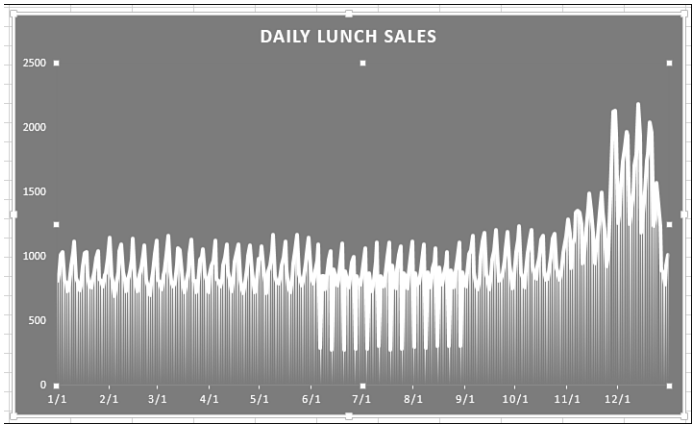

Figure I.1
This chart shows the sales trend for 365 data points.

After studying the data in Figure I.1, you might decide to plot the sales by weekday to understand the sales better. Figure I.2 shows the same data presented as seven line charts. Each line represents the sales for a particular day of the week. Friday is the dashed line. At the beginning of the year, Friday was the best sales day for this particular restaurant. For some reason, around week 23, Friday sales plummeted.

The chart in Figure I.2 prompts you to make some calls to see what was happening on Fridays at this location. You might discover that the city was hosting free Friday lunchtime concerts from June through August. The restaurant manager was offered a concession at the concert location but thought it would be too much trouble. Using this pair of charts enabled you to isolate a problem and equipped you to make better decisions in the future.

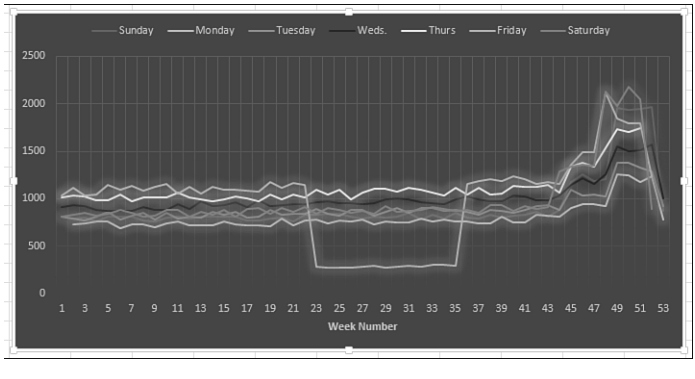

Figure I.2
When you isolate sales by weekday, you can see a definite problem with Friday sales in the summer.

Using Excel as Your Charting Canvas

Excel 2007 offered a complete rewrite of the 15-year-old charting engine from legacy versions of Excel. Unfortunately, Excel 2007 introduced too many new bugs to the charting engine. Much of the effort of the charting team in Excel 2010 went to cleaning up the bugs left over from Excel 2007. Now, in Excel 2013, some amazing leaps have been made with

Recommended Charts and a new set of 153 Chart Styles. Single-series charts no longer get a redundant legend. Chart labels pick up formatting from the source data. Three new helper icons appear to the right of a selected chart, enabling you to add elements, remove totals, and format a chart. A new interface simplifies combo chart creation. Also, data labels can appears as callouts and get their values from cell formulas.

If you have Excel 2013 Pro Plus or Office 365, you also have access to add-ins such as Power View and GeoFlow. Both enable you to use animated charts and maps.

Topics Covered in This Book

This book covers the Excel 2013 charting engine and three types of word-sized charts called *sparklines*. It also covers the Data Visualization and SmartArt Business diagramming tools that were introduced in Excel 2007. If you have Excel 2013 Pro Plus, the new Power View add-in came with your version of Excel and provides animated charts and dashboards.

Besides charts, Excel 2013 offers many other ways to display quantitative data visually. This book explains how to use the new conditional formatting features such as data bars, color scales, and icon sets to add visual elements to regular tables of numbers. In Figure I.3, conditional formatting features make it easy to see that Ontario has the largest population and that Nunavut has the largest land area. You can also add in-cell data bars such as these with a couple of mouse clicks, as described in Chapter 9, "Using Sparklines, Data Visualizations, and Other Nonchart Methods."

The three types of word-sized charts in Excel 2013 called sparklines enable you to create tiny line charts, tiny column charts, and win/loss charts. As shown in Figure I.4, these tiny charts can show win/loss events that paint a better picture than a simple 7–3 record.

Figure I.3
In-cell data bars draw the eye to the largest values in each column.

27	Province	Population	Area
28	Alberta	2974805	639987
29	British Columbia	3907740	926493
30	Manitoba	1119580	551938
31	New Brunswick	729495	71356
32	Newfound and Labrador	512930	370502
33	Northwest Territories	37360	1141108
34	Nova Scotia	908005	52917
35	Nunavut	26745	1925460
36	Ontario	11410045	907656
37	Prince Edward Island	135295	5684
38	Quebec	7237480	1357743
39	Saskatchewan	978930	586561
40	Yukon Territory	28670	474707

Figure I.4
The Twins baseball team made the post-season in 2009 because they won 8 of their last 10 games while the Tigers struggled.

	A	B
1		Last 10
2	Indians	
3	Twins	
4	Tigers	
5	Astros	
6	Cardinals	

This Book's Objectives

The goal of this book is to make you more efficient and effective in creating visual displays of information using Excel 2013.

In the early chapters of this book, you find out how to use the new Excel 2013 charting interface. Chapters 3 through 6 walk you through all the built-in chart types and talk about when to use each one. Chapter 7 discusses creating unusual charts. Chapter 8 covers pivot charts, and Chapter 9 covers creating visual displays of information right in the worksheet. Chapter 10 covers mapping, and Chapter 11 covers the new SmartArt business graphics and Excel 2013's shape tools. Chapter 12 covers exporting charts for use outside of Excel. Chapter 13 presents macro tools you can use to automate the production of charts using Excel VBA. Chapter14 includes several techniques that people can use to stretch the truth with charts. Finally, Appendix A provides a list of resources that will give you additional help with creating charts and graphs.

Versions of Excel

Excel charting was largely unchanged for the dozen years leading up to Excel 2003. This book refers to Excel 2003 and earlier collectively as "legacy" versions of Excel.

This book covers new features in Excel 2013. Many of the concepts were possible in Excel 2010 and earlier, but required more steps.

Conventions Used in This Book

This book follows certain conventions:

- `Monospace`—Text message you see onscreen or code appears in `monospace` font.
- **`Bold Monospace`**—Text you type appears in **`bold, monospace`** font.
- *Italic*—New and important terms appear in *italics*.
- Initial Caps—Tab names, dialog box names, and dialog box elements are present with initial capital letters so you can identify them easily.

Special Elements in This Book

This book contains the following special elements:

NOTE

Notes provide additional information outside the main thread of the chapter discussion that might be useful for you to know.

TIP

Tips provide you with quick workarounds and time-saving techniques to help you do your work more efficiently.

CAUTION

Cautions warn you about potential pitfalls you might encounter. It is important to pay attention to Cautions because they alert you to problems that could cause hours of frustration.

CASE STUDY

Case studies provide a real-world look at topics previously introduced in the chapter.

Next Steps

Chapter 1, "Introducing Charts in Excel 2013," presents the new Excel 2013 interface for creating charts. You discover how to create your first chart and read about the various elements available in a chart.

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Creating Charts That Show Trends

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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 is a column chart, line chart, or area chart.

> **NOTE** The new Sparklines feature is another way to show trends with tiny charts. See Chapter 9, "Using Sparklines, Data Visualizations, and Other Nonchart Methods."

Column Charts for Up to 12 Time Periods

If you have only a few data points, you can use a column chart because they work well for 4 quarters or 12 months. If your data set contains 12 or fewer data points that represent a time period, choose a column chart to illustrate the trend over time.

Line Charts for Time Series Beyond 12 Periods

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

Figure 3.1 shows a chart with only nine data points, where a column chart is appropriate. Figure 3.2 shows a chart of 100+ data points. With this detail, you should switch to a line chart 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 middle chart in this figure shows the same data set as a line chart.

Area Charts to Highlight One Portion of the Line

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.

High-Low-Close Charts for Stock Market Data

If you are plotting stock market data, 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, such as when you need to track a range of quality rankings for each day.

Bar Charts for Series with Long Category Labels

Even though bar charts can be used to show time trends, they can be confusing because readers expect time to be represented from left to right. In rare cases, you might use a bar chart to show a time trend. For example, if you have 40 or 50 points that have long category labels that you need to print legibly to show detail for each point, consider using a bar chart. Another example is shown in Figure 3.3, which includes sales for 45 daily dates. This bar chart would not work as a PowerPoint slide. However, if it is printed as a full page on letter-size paper, the reader could analyze sales by weekday. In the chart in Figure 3.3, weekend days are plotted in a different color than weekdays to help delineate the weekly periods.

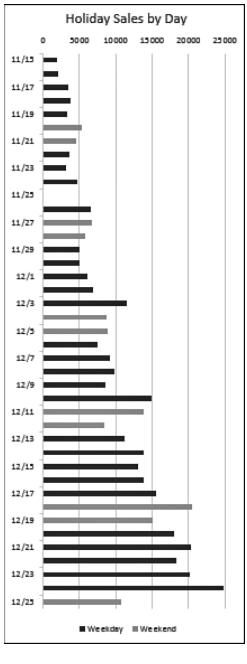
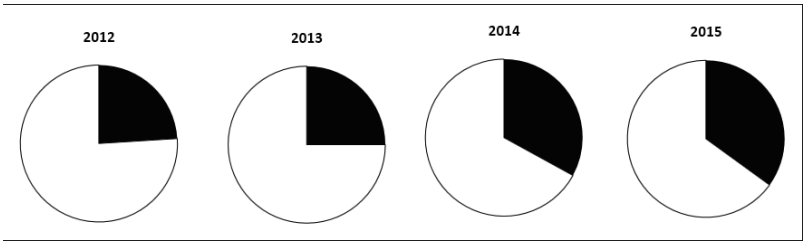


Figure 3.3
Although time series typically should run across the horizontal axis, this chart allows 45 points to be compared easily.

Pie Charts Make Horrible Time Comparisons

A pie chart is ideal for showing how components that add up to 100% are broken out. It is difficult to compare a series of pie charts to detect changes from one pie to the next. As you can see in 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 2013? Rather than using a series of pie charts to show changes over time, use a 100 percent stacked column chart.

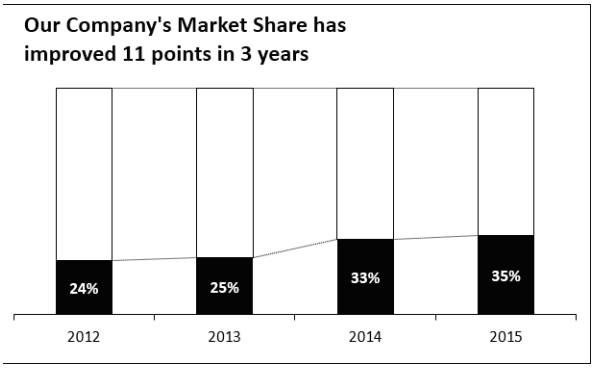
Figure 3.4
It is difficult to compare one pie chart to the next.



100 Percent Stacked Bar Chart Instead of Pie Charts

In Figure 3.5, the same data from Figure 3.4 is plotted as a 100 percent 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
The same data presented in Figure 3.4 is easier to read in a 100 percent stacked bar chart.



Understanding Date-Based Axis Versus Category-Based Axis in Trend Charts

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 because the results will be the same. When this occurs, it is fine to allow Excel to choose the type of axis automatically.

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

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 data set. In the middle of the data set, a strike closed one of the vendors, spiking the prices from the other vendors. Your purchasing department had stocked up before the strike, which allowed your company to slow its purchasing dramatically during the strike.

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 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 2013.

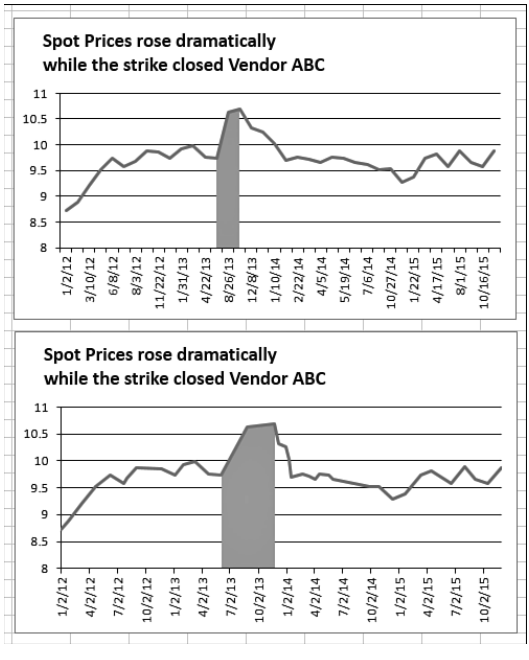


Figure 3.6
The top chart uses a text-based horizontal axis: Every event is plotted an equal distance from the next event. This leads to the shaded period being underreported.

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 always check to make sure 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. For example, Excel chooses a text-based axis when dates are stored as text in a spreadsheet and when dates are represented by numeric years. The list following Figure 3.7 summarizes other potential problems.

To explicitly choose an axis type, follow these steps:

1. Right-click the horizontal axis and select Format Axis.
2. In the Format Axis task pane that appears, select the Axis Options at the top, then the chart icon, and then expand the Axis Options category.
3. As appropriate, choose either Text Axis or Date Axis from the Axis Type section (see Figure 3.7).

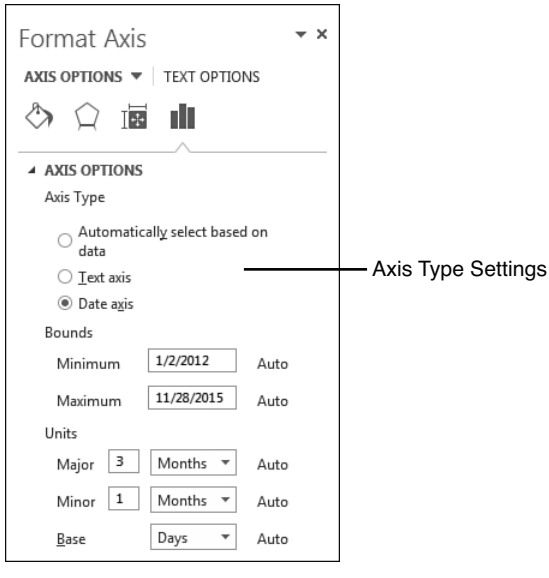


Figure 3.7
You can explicitly choose an axis type rather than letting Excel choose the default.

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

- **Dates stored as text—**If 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—**Trend charts can have category values of 2008, 2009, 2010, and so on. Excel does not naturally recognize these as dates, but you can trick it into doing so. Read "Plotting Data by Numeric Year" near Figure 3.15 in this chapter.
- **Dates before 1900—**If your company is old enough to chart historical trends before January 1, 1900, you will have a problem. In Excel's world, there are no dates before 1900. For a workaround, read "Using Dates Before 1900" near Figure 3.16.
- **Dates that are really time—**It is not difficult to imagine charts in which the horizontal axis contains periodic times throughout a day. For example, you might use a chart like this to show the number of people entering a bank. For such a chart, you need a time-based axis, but Excel will group all the times from a single day into a single point. See "Using a Workaround to Display a Time-Scale Axis" near Figure 3.19 for the rather complex steps needed to plot data by periods smaller than a day.

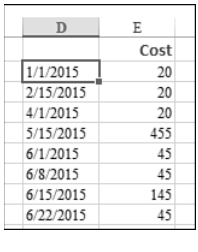
Each of these problem situations is discussed in the following sections.

Converting Text Dates to Dates

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

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 to see whether there is an apostrophe before the date. If so, you know you have text dates (see 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. Or, if the number format drop-down on the Home tab indicates that the cell is formatted as text, then you might have text dates.



D	E
	Cost
1/1/2015	20
2/15/2015	20
4/1/2015	20
5/15/2015	455
6/1/2015	45
6/8/2015	45
6/15/2015	145
6/22/2015	45

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

CAUTION

Selecting a new format from the Format Cells dialog does not fix this problem, but it might prevent you from fixing the problem! If you import 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, number, or date in the range. People try to select the range, to change the format from text to numeric or date, hoping this will fix the problem, but it doesn't. After you change the format, you still have to use a method described in the "Converting Text Dates to Real Dates" section, 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 General, Date, or anything else. If you do not change the format, and 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. Therefore, 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 tab, and change the format from Text to General. Figure 3.9 shows the Dialog Launcher icon.

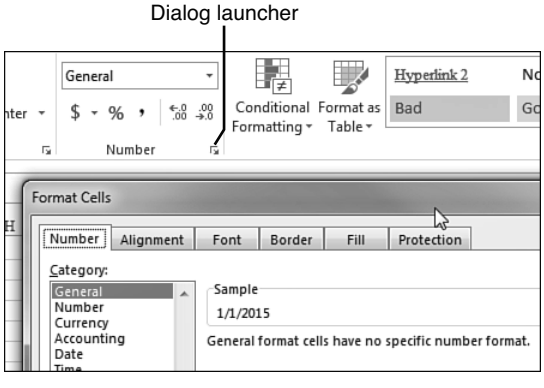


Figure 3.9
Many groups on the ribbon have this tiny Dialog Launcher icon in the lower-right corner. Clicking this icon leads to the legacy dialog box.

CASE STUDY: COMPARING DATE SYSTEMS

Complete the following case study to see firsthand how important date systems information really is.

1. Enter the number 1 in cell A1.
2. Select cell A1 and then press Ctrl+1 to access the Format Cells dialog.
3. 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.
4. Type 2 in cell A1. The date changes to January 2, 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.
3. Change the number format from a date to a number. Your date changes to a number in the 40,000 to 42,000 range, assuming you are reading this in the 2013–2015 time period.

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

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 the same mistake to make sure that the billions of spreadsheets using dates produced the same results. Although the 1900 date system works fine and reports the right day of the week for the 40,300 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.

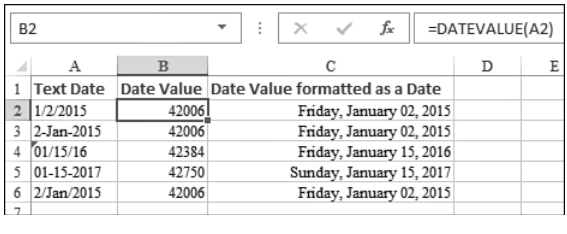
Excel provides a complete complement of functions to deal with dates, including functions that convert data from text to dates and back. Excel stores times as decimal fractions of days. For example, you can enter noon today as `=TODAY()+0.5` and 9:00 a.m. as `=TODAY()+0.375`. Again, the number format 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. For example, your international date settings might 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 A.



	A	B	C	D	E
1	Text Date	Date Value	Date Value formatted as a Date		
2	1/2/2015	42006	Friday, January 02, 2015		
3	2-Jan-2015	42006	Friday, January 02, 2015		
4	01/15/16	42384	Friday, January 15, 2016		
5	01-15-2017	42750	Sunday, January 15, 2017		
6	2/Jan/2015	42006	Friday, January 02, 2015		

Figure 3.11 shows a column of text dates. Follow these steps to convert the text dates to real dates:

1. Insert a blank column B by selecting cell B1. Select Home, Insert, Insert Sheet Columns. Alternatively, you can use the legacy shortcut Alt+I+C.
2. In cell B2, enter the formula `=DATEVALUE(A2)`. Excel displays a number in the 40,000 range in cell B2. You are halfway to the result. You still have to format the result as a date.
3. 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.
4. Select Column B2. On the Home tab, select the drop-down at the top of the Number group and choose either Short Date or Long Date. Excel displays the numbers in Column B as a date (see Figure 3.12). Alternatively, you can press Ctrl+1 and select any date format from the Number tab. 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.
5. To convert the live formulas in column B to static values, while the range of dates in Column B is selected, press Ctrl+C to copy. Press Ctrl+V to paste. Press Ctrl to open the Paste Options dialog. Press V to paste as values.
6. Delete the original column A.

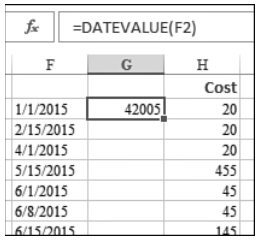


Figure 3.11
The result of the DATEVALUE function is a serial number.

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

- **Method 1—**Select any empty cell. Press Ctrl+C to copy. Select your dates. On the Home tab, select Paste, Paste Special. In the Paste Special dialog, choose Values in the Paste section and Add in the Operation section. Click OK. The text dates convert to dates.
- **Method 2—**Select the text dates, select Text to Columns on the Data tab, and then click Finish.

After converting the text dates to real dates, insert a line chart with markers. Excel automatically formats the chart with a date-based axis. In Figure 3.13, 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 3.12
Choose a date format from the Number drop-down on the Home tab.

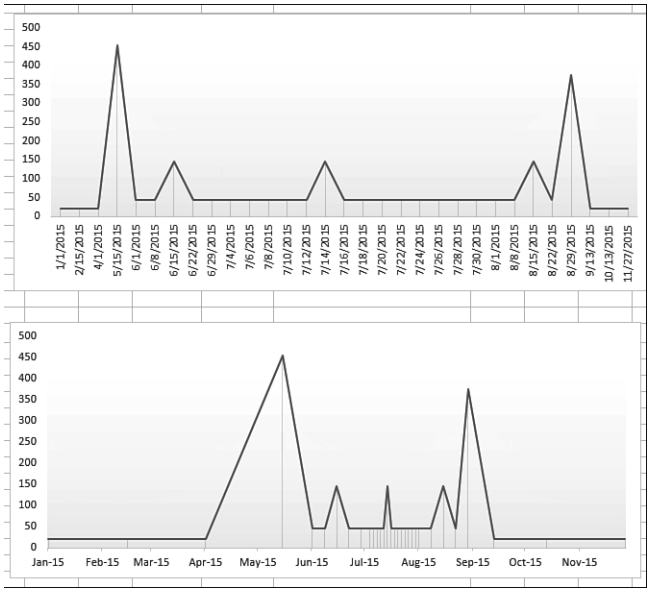


Figure 3.13
When your original data contains real dates, Excel automatically chooses a more accurate date-based axis. The bottom chart reflects a date-based axis.

Converting Bizarre Text Dates to Real Dates

When you rely on others for source data, you are likely to encounter dates in all sorts of bizarre formats. For example, while gathering data for this book, I found a data set where each date was listed as a range of dates. Each date was in the format 2/4-6/15. I had to check with the author of the data to find out if that meant February 4th through 6th of 2015 or February 4th through June 15th. It was the former.

Used in combination, the functions in the following list can be useful when you are converting strange text dates to real dates:

- `=DATE(2015,12,31)`—Returns the serial number for December 31, 2015.
- `=LEFT(A1,2)`—Returns the two leftmost characters from cell A1.

- `=RIGHT(A1,2)`—Returns the two rightmost characters from cell A1.
- `=MID(A1,3,2)`—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)`—Finds the position number of the first slash within A1.

Follow these steps to convert the text date ranges shown in Figure 3.14 to real dates:

Figure 3.14
A mix of `LEFT`, `RIGHT`, `MID`, and `FIND` functions parse this text to be used in the `DATE` function.

	A	B	C	D	E
1	**Date**	**Year**	**Month**	**Day**	**Date**
2	2/1-4/15	2015	2	1	2/1/2015
3	2/9-11/15	2015	2	9	2/9/2015
4	2/15-12/15	2015	2	15	2/15/2015
5	12/19-21/15	2015	12	19	12/19/2015
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)*				

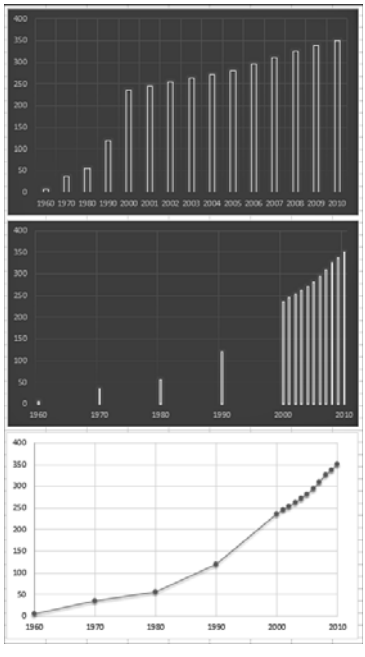
1. Because the year is always the two rightmost characters in column A, enter the formula `=RIGHT(A2,2)+2000` in cell B2.
2. Because the month is the leftmost one or two characters in column A, ask Excel to find the first slash and then return the characters to the left of the slash. Enter `=FIND("/",A2)` to indicate that the slash is in second character position. Use `=LEFT(A2,FIND("/",A2)-1)` to get the proper month number.
3. For the day, 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 whether you need one or two characters is a bit more complicated. Find the position of the dash, subtract the position of the slash, and then subtract 1. To see the formula in action, select the cell and choose Formulas, Evaluate Formula, and click Evaluate 10 times. 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)`

Plotting Data by Numeric Year

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

For example, in Figure 3.15 data are plotted once a decade for the past 50 years and then yearly for the past decade. Column A contains four-digit years, such as 1960, 1970, 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 1960 to 1970 is the same as the distance from 2000 to 2001.

Figure 3.15
Excel does not recognize years as dates.



Listed here are two solutions to this problem:

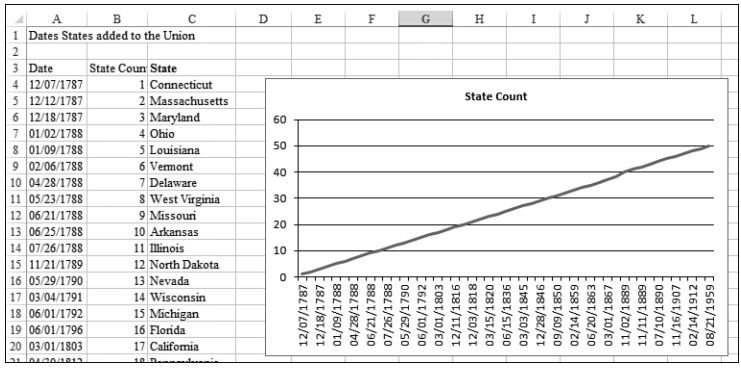
- Convert the years in column A to dates by using `=DATE (A2,12,31)`. Format the resulting value with a yyyy custom number format. Excel displays 2015 but actually stores the serial number for December 31, 2015.
- Convert the horizontal axis to a date-based axis. Excel thinks your chart is plotting daily dates from May 13, 1905, through July 2, 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.

Using Dates Before 1900

In Excel 2013, dates from January 1, 1900 through December 31, 9999 are recognized as valid dates. However, if your company was founded more than a demisesquicentennial before Microsoft was founded, you will potentially have company history going back before 1900.

Figure 3.16 shows a data set 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. This inaccurate statement would cause Mr. Kessel, my eighth-grade geography teacher, to give me an F for this book.

Figure 3.16
Dates from before 1900 are not valid Excel dates. A date-based axis is not possible in this case.

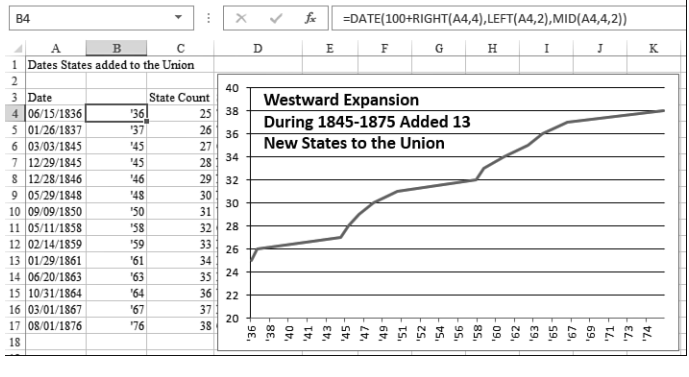


As mentioned previously, formatting the chart to have a date-based axis will not work because Excel does not recognize dates before 1900 as valid dates. Possible workarounds are discussed in the next two subsections.

Using Date-Based Axis with Dates Before 1900

In Figure 3.17, 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.

Figure 3.17
Transforming the 1800s dates to 1900s dates and clever formatting allows Excel to plot this data with a date axis.



One solution is to transform the dates to 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. However, keep in mind that this solution fails when you are trying to display more than 100 years of data points.

To create the chart in Figure 3.17, 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. Select the date format 3/14/01 from the Date category on the Number tab. This formats the 1936 date as 6/15/36. Later, you will add a title to indicate that the dates in this column are from 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 tab, open the Line Chart drop-down and choose the first line chart icon.
7. Double-click the vertical axis along the left side of the chart to display the Format Axis task pane.
8. In the task pane, click the Chart icon.
9. For the Minimum value, type a value of 20.
10. Click the dates in the horizontal axis in the chart. Excel automatically switches to formatting the horizontal axis, and the settings in the Format task pane redraw to show the settings for the horizontal axis. In the Axis Type section, select Date Axis.
11. From the Plus icon to the right of the chart, hover over Chart Title and then click the arrowhead that appears. Select 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 tab, click the Decrease Font Size button. Click the Left Align button.
14. Carefully click the border of the title. Drag it so the title 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 3.17. The reader might believe that the chart is showing dates in the 1800s, but Excel is actually showing dates in the 1900s.

Rolling Daily Dates to Months Using a Pivot Chart

Suppose that you have daily data that you would like to summarize by month. You might think that you can use the Units drop-downs in the Format Axis task pane, under the Chart icon, Axis Options to solve the problem. Here you'll see three settings:

- Major Units: *N* Days/Months/Years
- Minor Units: *N* Days/Months/Years
- Base: Days/Months/Years

In the first two bullet points, *N* is the number entered in the text box.

The Major Units setting is useful for controlling the labels along the date axis. The top-left chart in Figure 3.18 is plotting one point per day, but the labels are readable because the Major unit is set to 1 month instead of 1 day.

The lower-left chart is also using a Base of Days, but the Major Unit is 2 Months. Using the Number category at the bottom of the task pane, adjust the date format to mmm and you get month abbreviations instead of individual dates.

If you attempt to change the Base field from Days to Months, the result is not a summary by month, as you might have expected. The-top right chart is a Line with Markers chart where the Line is set to No Line so you can see the points. By rolling the Base field to Months, Excel plots all the points that occurred in January in a single column. This might be interesting for showing the range of daily sales, even perhaps the distribution of daily sales. But it is not a method for summarizing the daily dates.

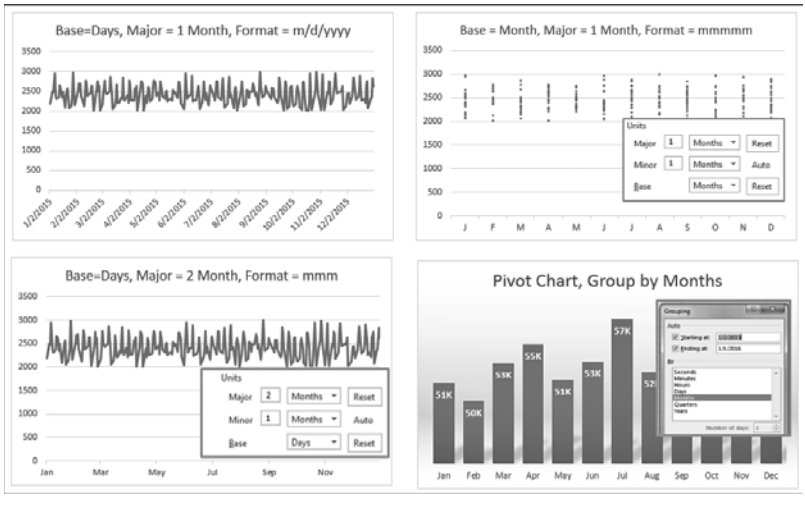


Figure 3.18
The settings in the Format Axis task pane control the axis labels, but cannot summarize by months.

Excel can roll the daily dates up and summarize by month, but you need to start with a pivot chart instead of a regular chart. Pivot charts are covered in detail in Chapter 8, "Creating PivotCharts and Power View Dashboards." Here are the steps to create the bottom-right chart in Figure 3.18.

1. Select the range of sales by date.
2. Choose Insert, PivotChart.

3. The Create PivotChart dialog will offer to create the chart on a New Worksheet. Because a pivot chart includes an associated summary pivot table, it is best to build the chart on a new worksheet and then move the chart when it is done. Accept the default settings in the Create PivotChart dialog and click OK.
4. A new worksheet is inserted to the left of the old worksheet. A PivotTable Fields task pane appears with a list of field. Check both the Date and Sales field. You end with a table of daily dates, identical to what you started with.
5. In the Excel worksheet, choose a cell in the new table that contains a date. The ribbon changes to show a tab called PivotTable Tools Analyze. The third group in this ribbon tab is called Group. Choices there include Group Selection and Group Field. Be sure that you have a date cell selected and choose Group Field. Excel displays the Grouping dialog box. You can see this dialog in the inset of the bottom-right chart of Figure 3.18.
6. Select Months (or Quarters) from the Grouping dialog. If your data spans more than one year, be sure to include years. To group by Week, choose only Days and then use the Number of Days spin button to go to seven-day periods. Click OK.

The pivot table and pivot chart changes to show one column per month instead of daily dates. You can use normal chart formatting to customize the chart. After the chart is formatted, right-click the chart and choose Move Chart to move to the desired worksheet.

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. However, 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.

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

Based on the staffing level and the number of customers in the bank, further calculations determine when the customer will move from the queue to an open teller window and when the customer will leave the window, based on an average of three minutes per transaction.

A summary range records 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, whereas many customers enter the bank during the lunch hour.

The top chart in Figure 3.19 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 1:00 p.m. takes up 41 percent of the horizontal width of the chart. In reality, this one-hour period merits only 16% of the chart. This sounds like a perfect use for a time-series axis, right? Read on for the answer.

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.

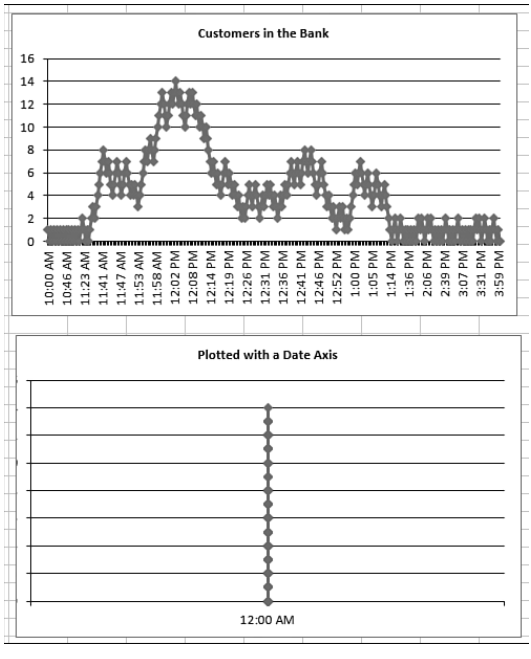


Figure 3.19
Excel cannot show a time-series axis that contains times.

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

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.

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

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*365,0)
   ```

   Because each hour represents a single year, the years argument of the `DATE` function is `=HOUR(I2)+2000`. This returns values from 2010 through 2015. The month and day 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*365`. The entire formula is rounded to the nearest integer because Excel would normally ignore any time values.

2. With cell L2 selected, press Ctrl+1 to display the Format Cells dialog. On the Number tab, choose the Custom category. In the Type box, enter yy":00". This format displays the year of the date with two digits. Hence, all dates in 2010 display as "10". Excel appends whatever is in quotes after the year. Because you've put :00 after the year, a date in 2010 displays as 10:00. A date in 2015 displays as 15:00. It is up to you to convince your manager that you have to use the 24-hour clock.
3. Select cell L2. Double-click the fill handle to copy this formula down to all the data points. The result of this formula ranges from January 1, 2010, which represents the customer who walked in at 10:00 a.m., to 12/25/2015, which represents the customer who walked in at 3:57 p.m. However, thanks to the formatting in step 2, you have a series of cells that all display 10:00, then more cells that display 11:00, and so on.
4. Select cells L1:M303.
5. From the Insert tab, select Recommended Charts, OK. The resulting chart is almost perfect. The only glitch: Each "hour" along the bottom axis appears three times.
6. Double-click the labels along the horizontal axis to display the Format Axis task pane. Choose the Chart icon and then expand the Axis Options category. You see the Major Unit is set to 4 Months. Change the Months to Years. Change the 4 to 1. The chart now displays one label per year, which on the chart looks like one label per hour.

As you see in Figure 3.20, 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 3.19. The additional chart in Figure 3.20 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.

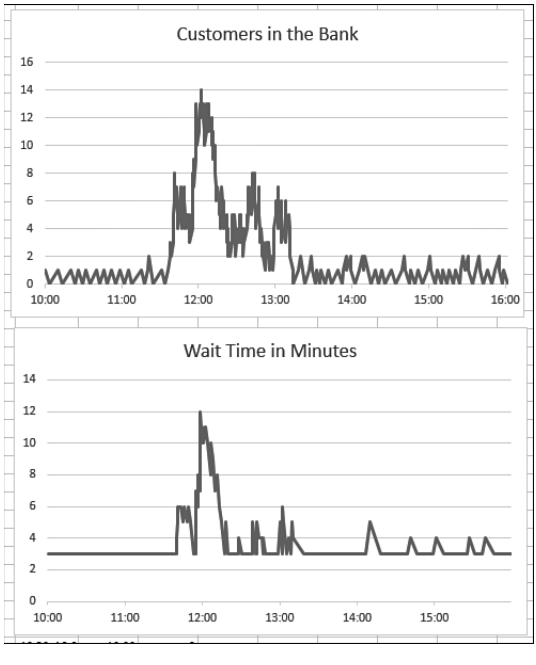


Figure 3.20
These charts show the number of customers in the bank and their expected wait times.

Communicate Effectively with Charts

A long time ago, 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 was turned sideways, and a pencil was used to create a landscape chart that was an awesome communication tool. After drawing the charts by hand, they sent off the charts to someone in the home office who generated the charts on a computer. This was a great technique. Long before touching Excel, someone figured out what the message should be.

You should do the same thing today. 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. Instead of using an Excel-generated title such as "Sales," you can 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 onscreen, use red for negative periods and blue or green for positive periods.

The following sections present some Excel trickery that enables you to highlight a certain section of a line chart or a portion of a column chart. In these examples, you spend 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* (McGraw-Hill, 2006, ISBN: 978-0-07-147470-2). Gene is the chart guru at McKinsey & Company who trained the consultants and taught me the simple charting rules. Although *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 the readers of your chart. Rather than hoping the reader discovers your message, why not add the message to the title of the chart?

Figure 3.21 shows a default chart in Excel. Because this chart contains a single series, the label "Share" from the original data becomes the title.

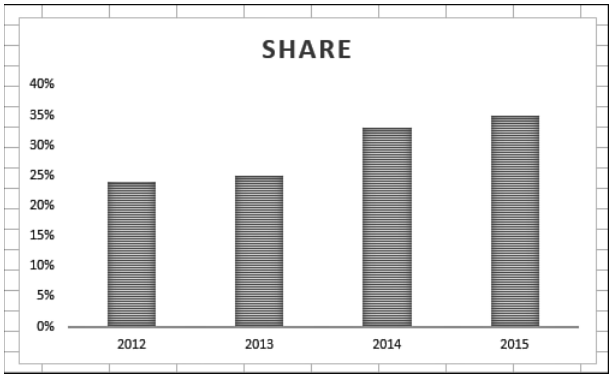


Figure 3.21
By default, Excel uses an unimaginative title taken from the heading of the data series.

Follow these steps to create the chart in Figure 3.22:

1. Select the data for the chart. Use Insert, Recommended Chart, Column Chart, OK.
2. Use the Paintbrush icon. Choose a Chart Style.
3. Click the Plus icon. Put a check next to Data Labels.
4. Click the title in the chart. Click again to put the title in Edit mode.
5. Backspace to remove the current title. Type **`Market share has improved`**, press Enter, and type **`13 points since 2012`**.
6. 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. When the border becomes solid, you can use the formatting icons on the Home tab to format the title. Alternatively, right-click the title box and use the Mini toolbar to format the title.
7. On the Home tab, select the icon for Align Text Left and then click the Decrease Font Size button until the title looks right.
8. 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 3.22, provides a message to assist the reader of the chart.

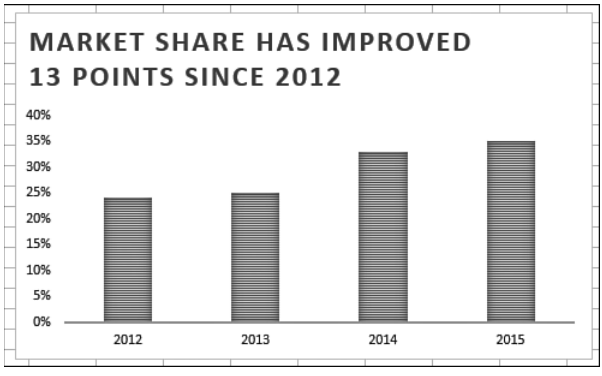


Figure 3.22
Use the title to tell the reader the point of the chart.

Resizing a Chart Title

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 tab to format the title. Click the Increase/Decrease Font Size buttons to change the font of all 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, carefully right-click the bounding box and select Edit Text. Alternatively, you can left-click a second time inside the bounding box to also put the title in Text Edit mode. Note that the dashed line in the bounding box indicates the title is in Text Edit mode. Using 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 available formatting commands. You can edit specific characters within the title to create a larger title and a smaller subtitle, as shown in Figure 3.23.

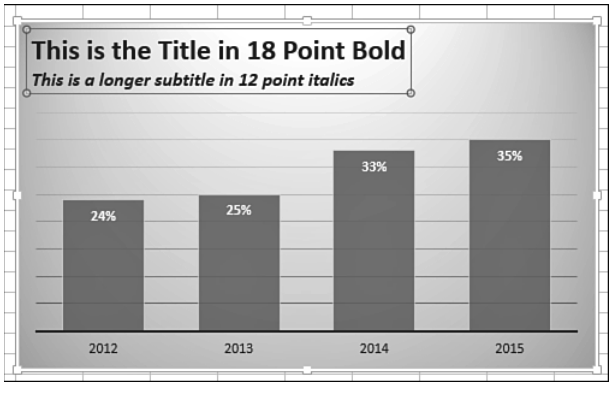


Figure 3.23
By selecting characters in Text Edit mode, you can create a title/subtitle effect.

You cannot move the title when you are in Text Edit mode. To exit Text Edit mode, right-click the title and select Exit Edit Text, or 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.

When you click a chart title to select it, a bounding box with four resizing handles appears. Actually, they are not resizing handles even though they look like it, which means that 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 were 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. Keep in mind that you can insert carriage returns only when you are in Text Edit mode.

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 3.24 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.

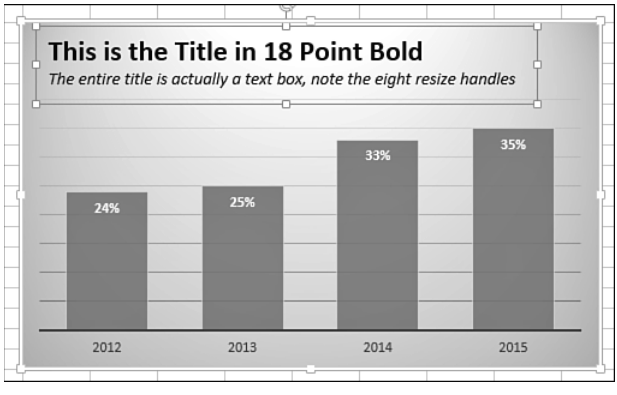


Figure 3.24
Instead of a title, this chart uses a text box for additional flexibility.

To create the text box shown in Figure 3.24, follow these steps:

1. Click the Plus (+) icon. Uncheck the box next to Chart Title to remove the title. Excel resizes the plot area to fill the space that the title formerly occupied.
2. Select the plot area by clicking some white space inside the plot area. Eight resizing handles now surround the plot area. Drag the top resizing handle down to make room for the title.
3. Make sure the chart is still selected. On the Insert tab, 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 do not press the Enter key, Excel wordwraps and begins a new line when the text reaches the right side 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 tab 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 tab to make the subtitle 12 point, italic, 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 tab. When you use the WordArt menus on a text box, however, all the Transform commands are available (see Figure 3.25).

A text box works perfectly because it is resizable, and you can use WordArt Transform commands. If you move or resize the chart, the text box moves with the chart and resizes appropriately.

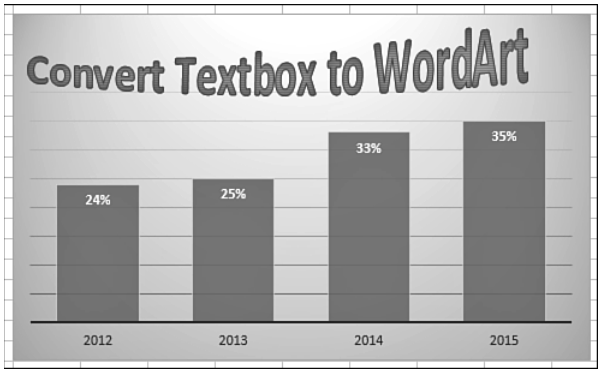


Figure 3.25
Using a text box instead of a title allows more formatting options.

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, as shown in Figure 3.26. Although the tools on the Design tab do not allow this, you can achieve the effect quickly by using the Format tab.

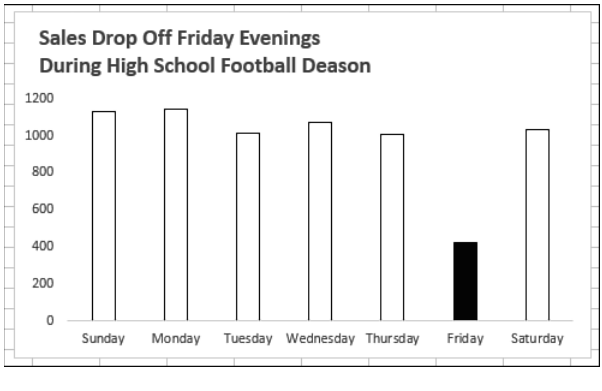


Figure 3.26
The column for Friday is highlighted in a contrasting color, and it is also identified in the title.

To create the chart in Figure 3.26, follow these steps:

1. Create a column chart by selecting Column, Clustered Column from the Insert tab.
2. Click any of the columns to select the entire series.
3. On the Format tab, select Shape Fill, White. At this point, the columns are invisible. Invisible bars are great for creating waterfall charts, which is discussed in Chapter 4, "Creating Charts That Show Differences." However, in this case, you want to outline the bars.
4. From the Format tab, select Shape Outline, Black. Select 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 all the columns have handles, click Friday again.
6. From the Format tab, select Shape Fill, Black.
7. Using the Plus icon, turn off Gridlines.
8. Type a title, as shown in Figure 3.26, pressing Enter after the first line of the title. On the Home tab, change the title font size to 14 point, left aligned.

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

Replacing Columns with Arrows

Columns shaped like arrows can be used 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 to further indicate the positive growth.

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 tab, select Shapes, Block 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, select Format Selection from the Format tab. Reduce the gap setting from 150 percent to 75 percent to make the arrows wider.

The new chart is shown in the bottom half of Figure 3.27. After creating the chart, you can delete the arrow created in step 2 by clicking the arrow and pressing the Delete key.

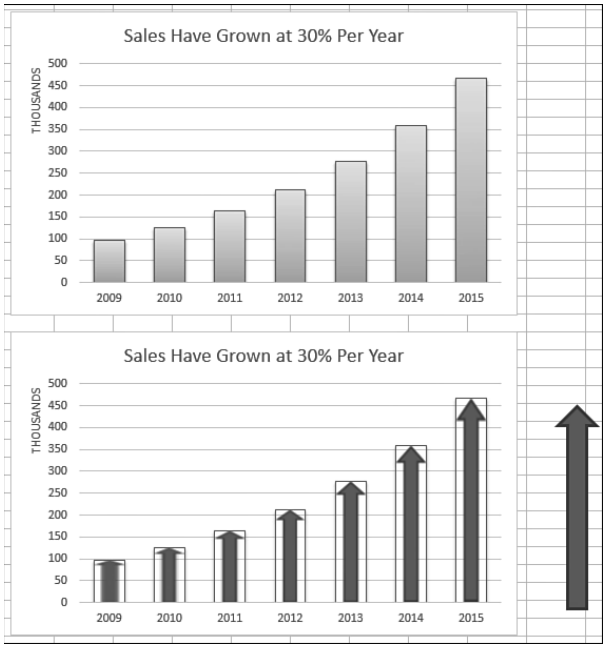


Figure 3.27
Arrows can be used to emphasize the upward growth of sales.

Highlighting a Section of a Chart by Adding a Second Series

The chart in Figure 3.28 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.

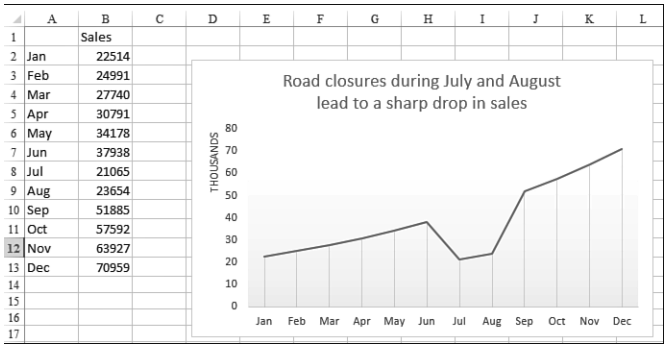


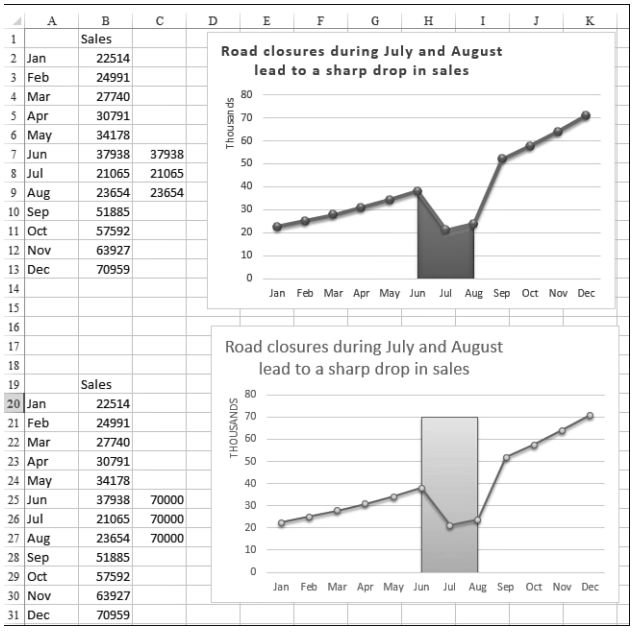
Figure 3.28
Highlight the road construction months in the chart to emphasize the title further.

The title calls out the July and August time period, but it would be helpful to highlight that section of the chart. 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 July and August.

2. Click a blank area inside 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 tab, use the Current Selection drop-down to select Series 2, which is the series you just added.
4. While Series 2 is selected, select 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 tab, use the Current Selection drop-down to reselect Series 2. Open the Shape Fill drop-down. Choose a fill color. The fourth row, first column offers a ToolTip of White, Background 1, Darker 25% and is suitable.

The top chart in Figure 3.29 shows the highlight extending from the horizontal axis up to the data line for the two line segments. Alternatively, you can replace the numbers in column C with 70,000 to draw a shaded rectangle behind the months, as shown in the bottom chart in Figure 3.29.



	A	B	C
1		Sales	
2	Jan	22514	
3	Feb	24991	
4	Mar	27740	
5	Apr	30791	
6	May	34178	
7	Jun	37938	37938
8	Jul	21065	21065
9	Aug	23654	23654
10	Sep	51885	
11	Oct	57592	
12	Nov	63927	
13	Dec	70959	
19		Sales	
20	Jan	22514	
21	Feb	24991	
22	Mar	27740	
23	Apr	30791	
24	May	34178	
25	Jun	37938	70000
26	Jul	21065	70000
27	Aug	23654	70000
28	Sep	51885	
29	Oct	57592	
30	Nov	63927	
31	Dec	70959	

Figure 3.29
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 3.30. 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.

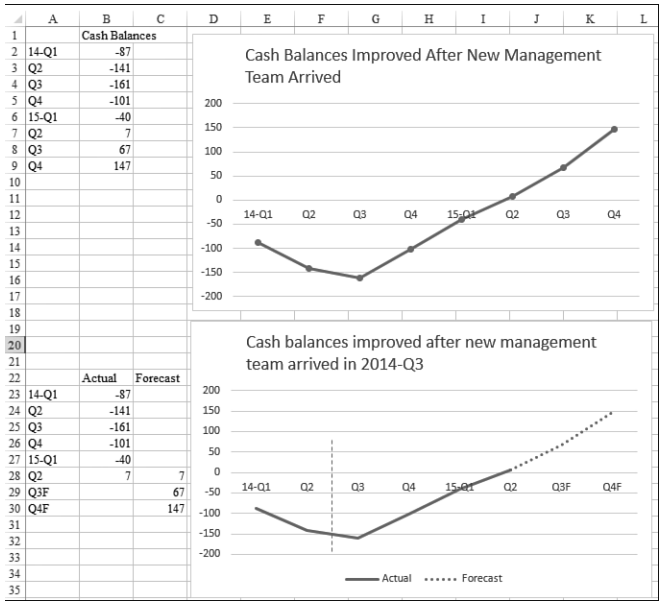


Figure 3.30
It is not clear in the top chart that the last two points are forecasts.

It is misleading to represent forecast numbers as part of the actual results line. It would be ideal if you change the line type at that point to indicate that the last two data points are forecasts. To do so, 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 2014, move the numbers for Q3 and Q4 of 2014 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 the data in column B. Grab the lower-right blue handle and drag outward to encompass B & C. A second series is added to the chart as a red line.
7. Click the red line. In the Format tab, you should see that the Current Selection drop-down indicates Series "Forecast."
8. Select Format, Shape Outline, Dashes and then select the second dash option. The red line changes to a dotted line.
9. While the forecast series is selected, select Design, Change Chart Type. Select a chart type that does not have markers.

10. The chart title indicates that a new management team arrived, but it does not indicate when the team arrived. To fix this, change the title to indicate that the team arrived in Q3 of 2014.
11. On the Insert tab, select Shapes, Line. Draw a vertical line between Q2 and Q3 of 2014, holding down the Shift key while drawing to keep the line vertical.
12. While the line is selected, on the Format tab, select 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 points.

The final chart is shown at the bottom of Figure 3.30.

Adding an Automatic Trendline to a Chart

In the previous example, an analyst had created a forecast for the next two quarters. However, sometimes you might want to allow Excel to make a prediction based on past results. In these situations, Excel offers a trendline feature in which Excel draws a straight line that fits the existing data points. You can ask Excel to extrapolate the trendline into the future. 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.

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 3.31, column A contains the days of the month and column B contains 125 for each data point. Therefore, Excel 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 will write an equal number of pages six days per week. Column D, which is labeled Actual, is where I record the daily progress toward the goal.

The chart is created as a line chart with the gridlines and legend removed. The trendline is formatted as a lighter gray. The actual line is formatted as a thick line. The top chart in Figure 3.31 shows the chart before the trendline is complete. Notice that the thick line is not quite above the progress line.

To add a trendline, follow these steps:

1. Right-click the series line for the Actual column. Select Add Trendline. A default linear trendline is added to the chart. The Format Trendline task pane appears. Your choices in the task pane are for trendlines that use Exponential, Linear, Logarithmic, Polynomial, Power, or Moving Average. Leave the choice at Linear for this example.
2. In the Trendline Name section, either leave the name as Linear (Actual) or enter a custom name such as Forecast.

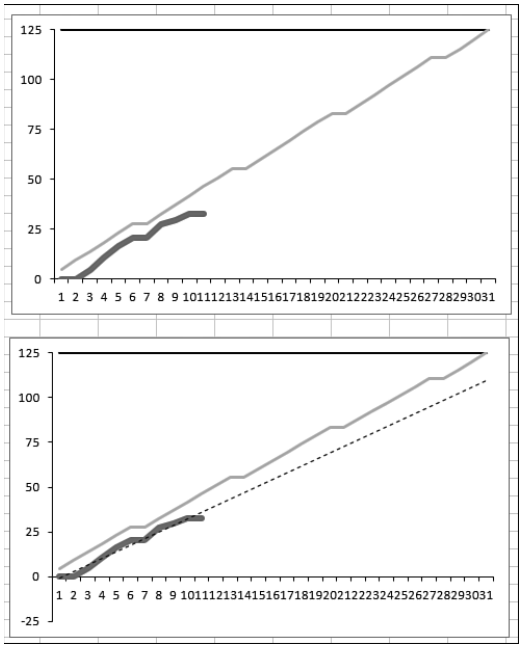


Figure 3.31
In the top chart, the actual line is running behind the target line, but it seems close.

3. When forecasting forward or backward for a certain number of periods, leave both of those settings at 0 because this chart already has data points for the entire month. There are also settings where Excel shows the regression equation on the chart. Add this if you desire.
4. Right-click the trendline to select it. On the Format tab, select Shape Outline, Dashes and then select the fourth dash option. Also, select Shape Outline, Weight, 3/4 point.

The trendline is shown at the bottom of Figure 3.31. 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.

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. For example, the current example shows 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, sales are generally tracked every month. However, in the big picture you are interested in how 12 months add up to produce annual sales.

The top chart in Figure 3.32 is a poor attempt to show both monthly sales and accumulated year-to-date (YTD) sales. The darker bars are the monthly results, whereas the lighter bars

are the accumulated YTD numbers through the current month. To show the large YTD number for November, the scale of the axis needs to extend to $400,000. However, this makes the individual monthly bars far too small for the reader to be able to discern any differences.

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. Follow these steps to create the bottom chart in Figure 3.32:

1. Select the chart. In the Design tab, choose Change Chart Type.
2. In the left panel of the Change Chart Type dialog, choose Combo. Change the YTD series to a Line chart. Choose the Secondary Axis box for YTD. Click OK. The YTD line is now plotted on the second axis, allowing the columns for months to fill most of the plot area.
3. From the plus icon, uncheck gridlines.
4. From the plus icon, choose Axis Titles. Excel adds the words "Axis Title" to the left, bottom, and right side of the chart.
5. Double-click the numbers along the left axis to display the Format Axis task pane. At the top of the task pane, leave Axis Options selected. From the row of icons, choose the Chart icon. Expand the Axis Options category. Open the Display Units drop-down and choose Thousands. Uncheck the box for Show Display Units Label on Chart, because you will note the units when you edit the axis title.
6. Without closing the task pane, single-click the numbers along the right axis. Open the Display Units drop-down and choose Thousands. Uncheck the box for Show Display Units Label on Chart.
7. Click the bottom Axis Title and press the Delete key to delete that axis title.
8. Double-click the left axis title. Type **`Monthly Sales ($000)`**.
9. Double-click the right axis title. Type **`YTD Sales ($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. 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 change the color, click the numbers to select them. Use the Font Color drop-down on the Home tab to select a color, such as 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 3.32. The chart illustrates both the monthly trend of each month's sales and the progress toward a final YTD revenue number.

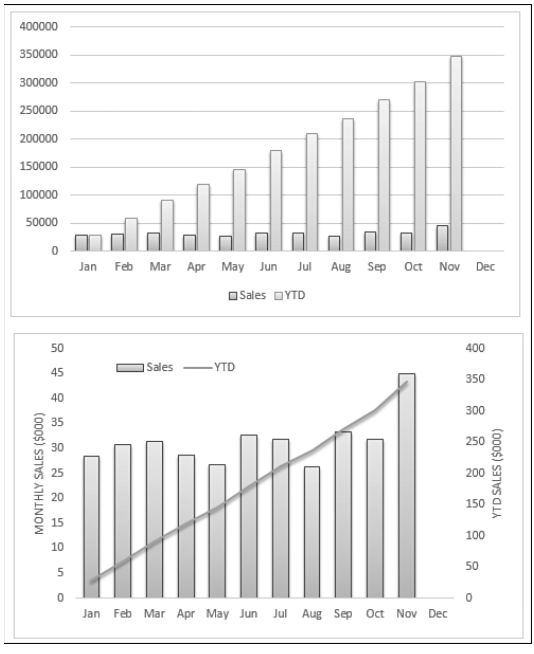


Figure 3.32
The size of the YTD bars obscures the detail of the monthly bars.

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't tell whether the values in the individual series is increasing or decreasing. The reader also might not be able to tell if Series 1 is increasing or decreasing. However, 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. For example, in the top chart in Figure 3.33, it is nearly impossible for the reader to tell which regions are responsible for the increase from 2010 to 2015.

Stacked column charts are appropriate when the message of the chart is about the first series. In the lower chart in Figure 3.33, the message is that the acquisition of a new product line saved the company. If this new product line had not grown quickly, the company would have had to rely on aging product lines that were losing money. Because this message is about the sales of the new product line, you can plot this as the first series so the reader of the chart can see the effect from that series.

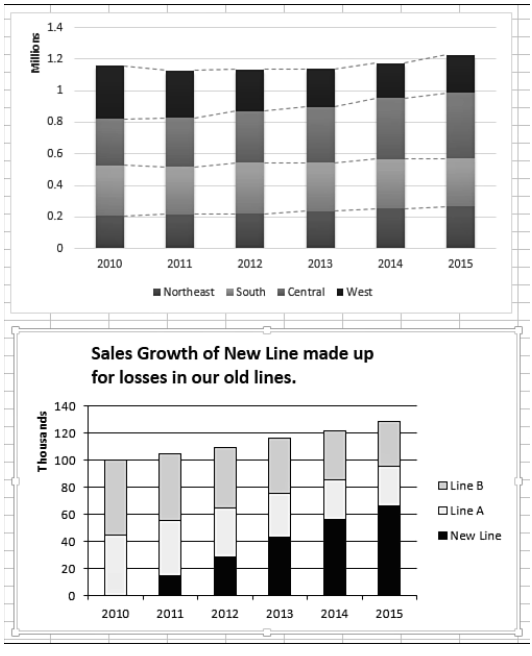


Figure 3.33
In the top chart, readers are not able to draw conclusions about the growth of the three regions located at the top of the chart.

CASE STUDY: USING A STACKED COLUMN CHART TO COMPARE CURRENT SALES TO PRIOR-YEAR SALES

The chart in Figure 3.34 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. Although the total height of the column is greater than last year's sales, some underlying problem exists 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. To create this chart, follow these steps:

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. Choose Insert, Recommended Charts. Click the All Charts tab in the Insert Chart dialog. Choose Combo chart from the left panel.
3. In the bottom of the Insert Chart dialog, change the Chart Type for Old Stores to Stacked Column. The Chart Type for New Stores will automatically change as well. Leave Last Year as a Line chart. Do not check Secondary Axis for any of the charts. Click OK.
4. Use the Format tab to format the third series as a dotted line. Format the colors of the first two series as shown in Figure 3.34.

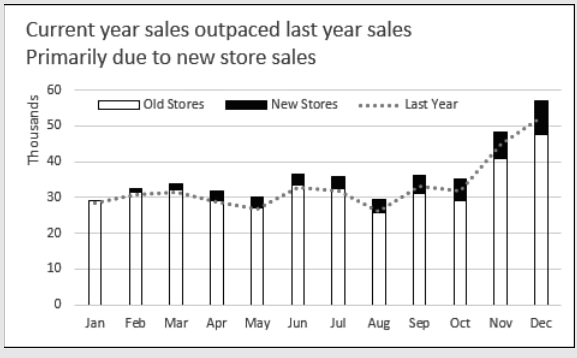


Figure 3.34
Current-year sales are shown as a stacked column chart, with last year's sales as a dotted line.

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, which can be confusing. For example, in the top chart in Figure 3.35, the sales trends of five companies create a very confusing chart.

If the goal is to compare the sales results of your company against those of each major competitor, consider using four individual charts instead, as shown at the bottom of Figure 3.35. 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.

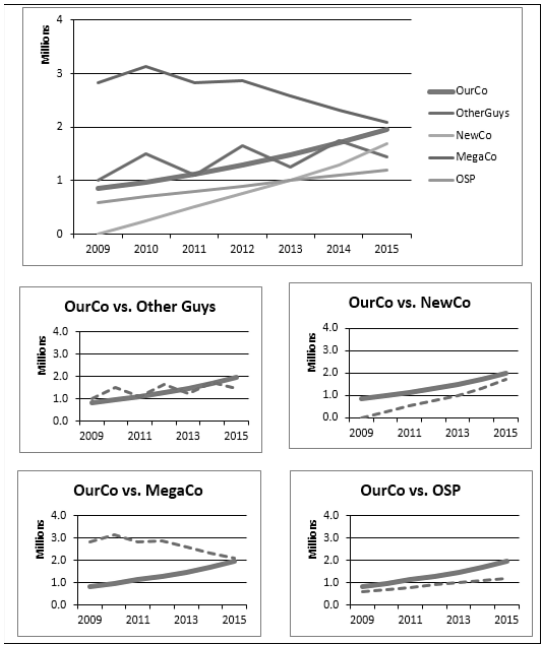


Figure 3.35
Instead of using a single chart with five confusing lines, compare your company to each other competitor in smaller charts.

Next Steps

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

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