perceptual edge

Introduction to Cycle Plots

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Line charts are often used to show a day-of-the-week or a month-of-the-year effect by displaying a separate line for each week or month. An analyst might want to know, for example, if sales differ by the day-of-the-week or by the month-of-the-year. Figure 1 shows an example of the sales of a hypothetical company over an eight week period. It shows clearly that sales were highest on Wednesdays and lowest over the weekend. We also notice that some days are more variable than others. However, it is difficult to determine a trend over the eight week period from beginning to end with this plot.

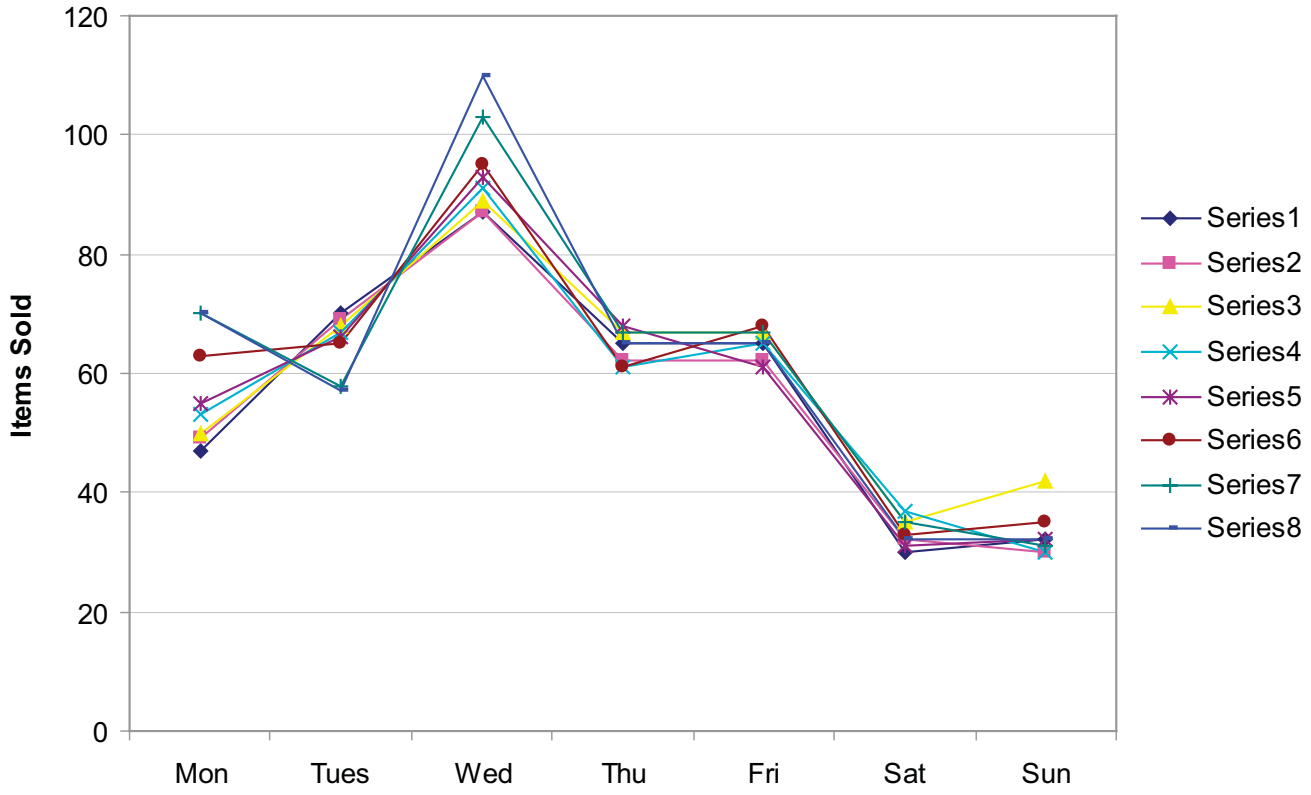

Figure 1: This line chart uses one line per week to display the sales of a hypothetical company by the day-of-the-week over an eight week period.

The same data are plotted as a standard end-to-end time series using a single line in Figure 2, which shows the presence or absence of cycles or trends but loses the information on the day-of-the-week or the month-of-the-year effect. It is difficult to follow a specific day of the week with this plot.

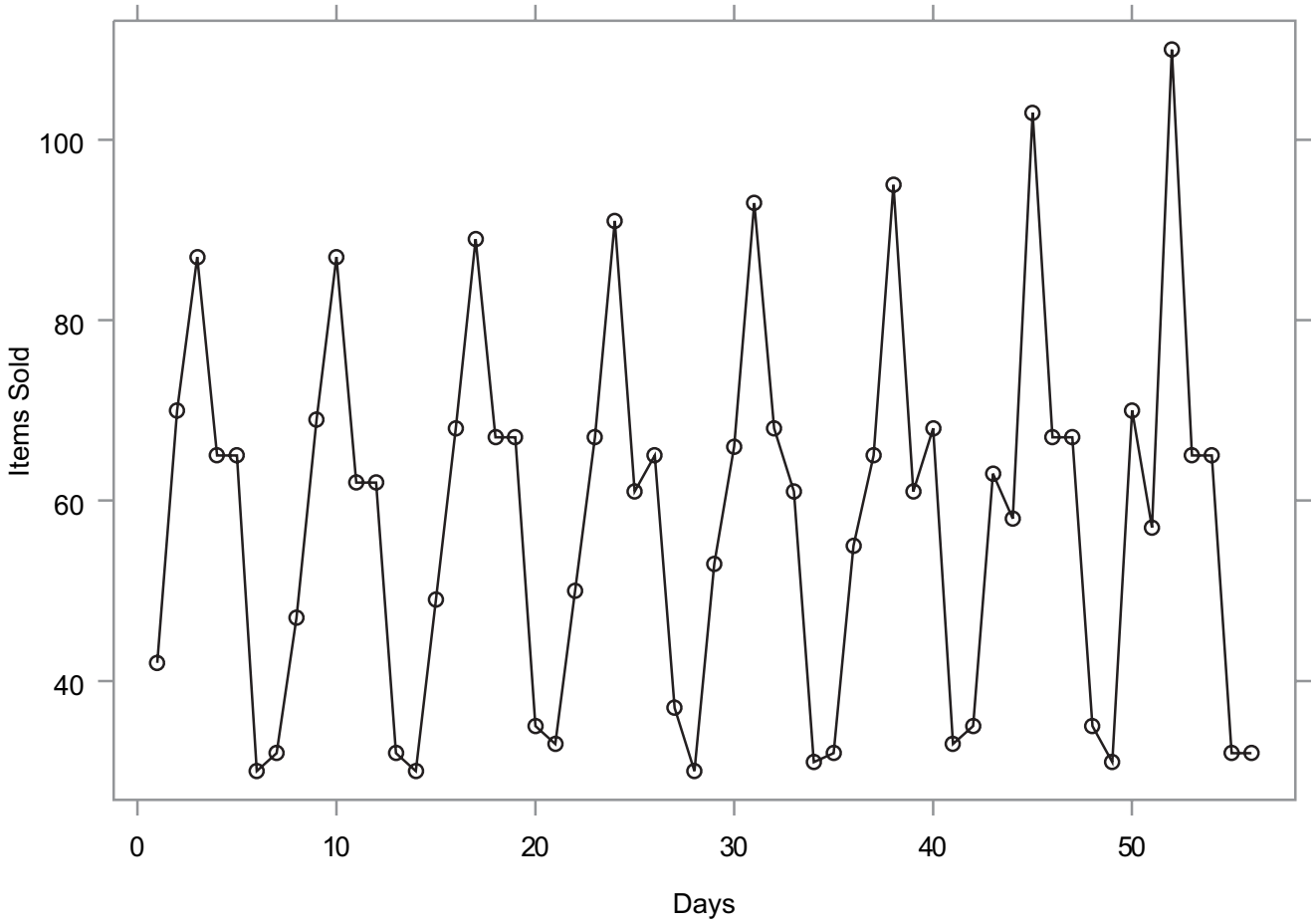

Figure 2: This time series chart shows the data of Figure 1 over the eight week period. Note that it is much more difficult to determine sales for a particular day, for example for Tuesdays.

Both types of charts—those with multiple lines and standard time series plots—are in common use. But we just saw that each has a strength as well as a weakness in displaying day-of-the-week data.

A *cycle plot* (Cleveland, Dunn, and Terpenning, 1978) shows both the cycle or trend and the day-of-the-week or the month-of-the-year effect. Thus the cycle plot retains the strengths of both more common plots illustrated above without either of their weaknesses. This article introduces the cycle plot and offers *before* and *after* examples to compare presentations using line charts with separate lines for each period and cycle plots.

Figure 3 shows the same data in a cycle plot, also called a month plot or subseries plot. In the Monday series, the sales for the eight Mondays are plotted in time order with a horizontal line showing the mean for Mondays. Next the sales for the eight Tuesdays are shown, again with the horizontal line showing the mean for Tuesdays. This is continued for each day of the week.

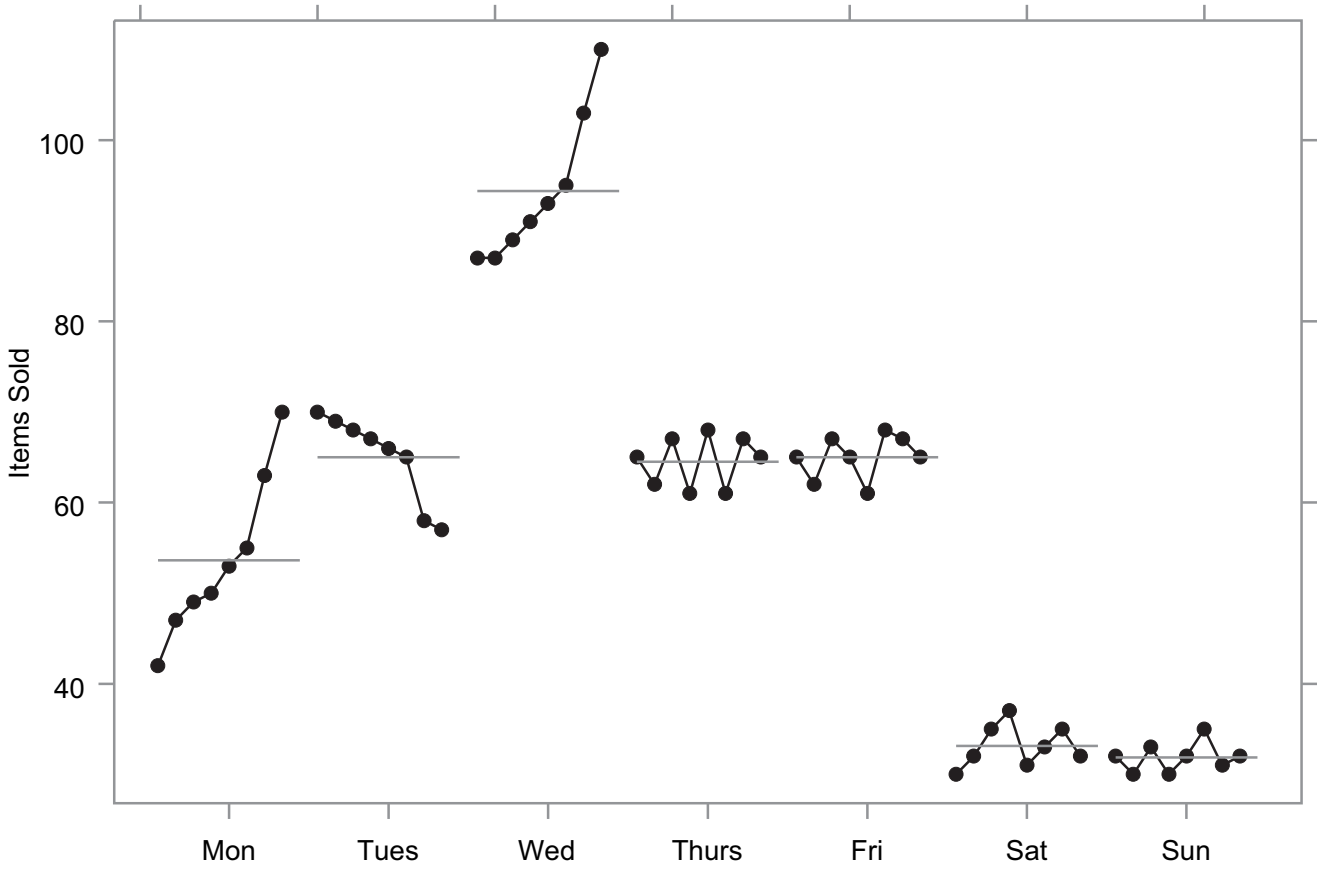

Figure 3: This cycle plot first plots the first Monday, the second Monday, and on through the eighth Monday. Then it plots the first Tuesday, second Tuesday, and so on. The horizontal lines show the means for each day of the week. Trends that were much more difficult to see in Figures 1 and 2 show up clearly in this figure.

The features we noticed in Figure 1, such as sales are highest on Wednesdays, are still clear. However, so much more is clear in Figure 3 that went unnoticed in the previous ones. We now see that sales for Mondays and Wednesdays have increased during the eight week period while sales for Tuesdays have decreased. Sales for the other four days were less variable and fluctuated around their means. This is information that any sales manager would want to know. This cycle plot immediately raises questions that the manager must address, such as “What makes Tuesdays different from Mondays...from Wednesdays, and so on?” Perhaps advertisements were placed on Mondays and Wednesdays. Perhaps there was a different staff. As you can see from this example, cycle plots allow us to see important characteristics of the data that do not show up in standard line charts. Another advantage of Figure 3 is that it does not depend on color, so it can be used in black and white publications with no loss of clarity.

The next example uses real data and shows a month of the year effect rather than a day of the week one. The figure shows the number of visitors to the St. Louis Science Center from January 1998 to December 2004.

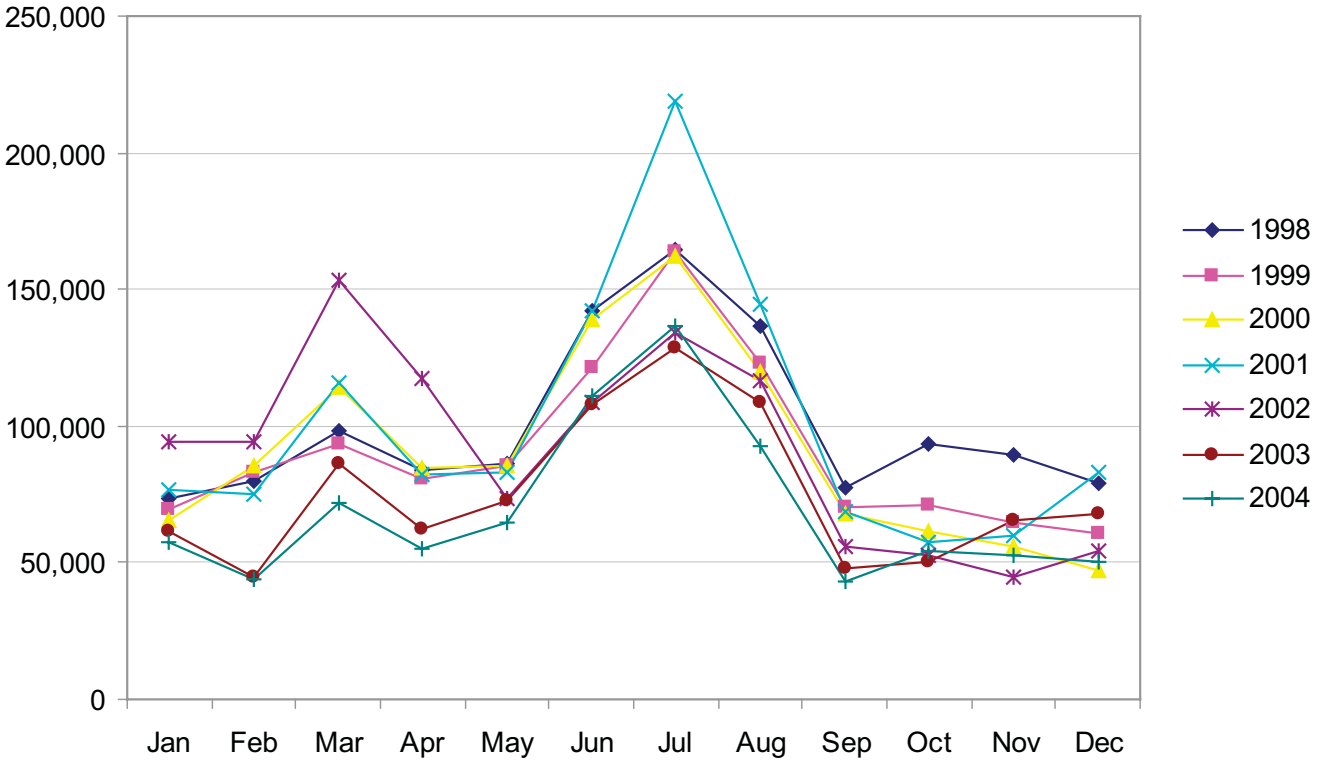

Figure 4: This chart uses one line per year to show the number of visitors at the St. Louis Science Center during the period from January 1998 to December 2004.

Figure 4 clearly shows that July has the largest attendance with March having a local peak. Attendance in June and August appears to be similar. However, it is difficult to follow the overall trend or the trend of the attendance in a given month over a several year period.

Again, because it is displayed as a cycle plot, Figure 5 clearly indicates the features of the data that we see in Figure 4, but shows much more as well. We see the trends and patterns for each month; for example, attendance in September has been declining over this period. It is also easier to compare the monthly attendance averages.

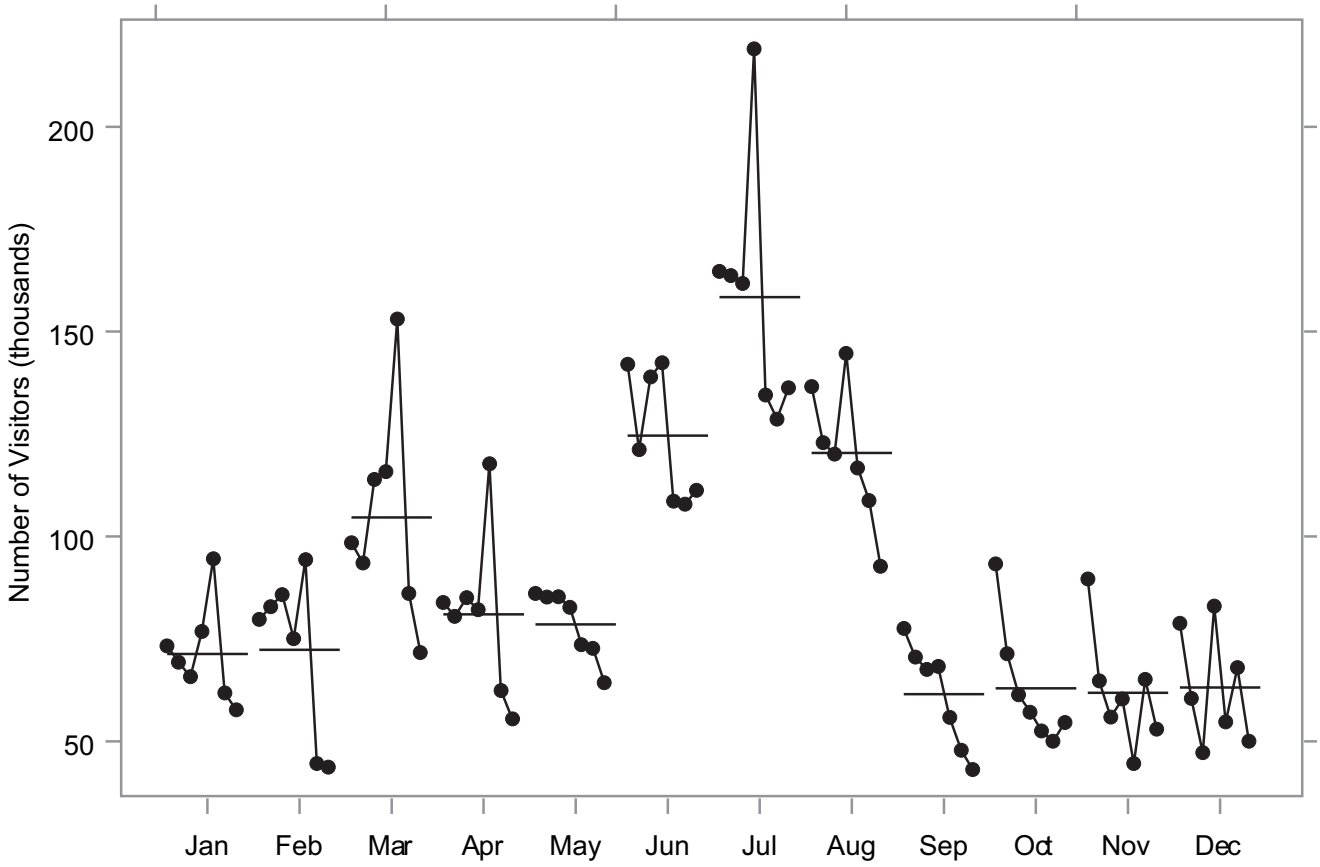

Figure 5: This cycle plot makes it much easier to visualize the trend of a given month over the seven years.

It is sometimes useful to rotate the subseries in a cycle plot; that is, to start the subseries at a value other than January for months or Monday for days. If your main interest is in peaks in the months December through February, then it would be better to begin around July so the months of interest appear together in the center of the figure.

Cleveland, Dunn, and Terpenning (1978) introduced cycle plots to study the behavior of seasonal time series. They first decomposed time series into frequency components: trend, seasonality, oscillation, and the remainder, and then examined the components individually, using different techniques. Cycle plots were used to study the seasonal component. The examples above show the usefulness of these plots for any time series without strong trend or oscillatory components.

Although this method was published 30 years ago, it is still little known and not many tools support cycle plots directly. However, they are easy to create with almost any software. Some software programs do include commands or functions for cycle plots, including R, S-Plus, and Stata. The cycle plots in this article were drawn using S-Plus. S-Plus and R are based on the S language. S-Plus is commercial software available from Insightful Corporation. R is open source software that is freely downloadable. Stata is commercial software available from StataCorp. Cycle plots, as well as some other useful plots, are not available on Excel menus, but Excel users have provided macros for their use or instructions for drawing these plot types.

In a previous article titled "Dot Plots: A Useful Alternative to Bar Charts", I described dot plots (Robbins, 2006). In my book *Creating More Effective Graphs* I describe dot plots, cycle plots, and other useful but little known graphs. Readers of this book have used their Web pages to provide instructions for Excel users to create these graphs which are not on Excel menus. Links to some of these resources can be found on my website—nbr-graphs.com—if you click on "How to Draw Some Useful Charts Not on Excel Menus". Figure 6 demonstrates what can be done by recreating Figure 3 using Excel.

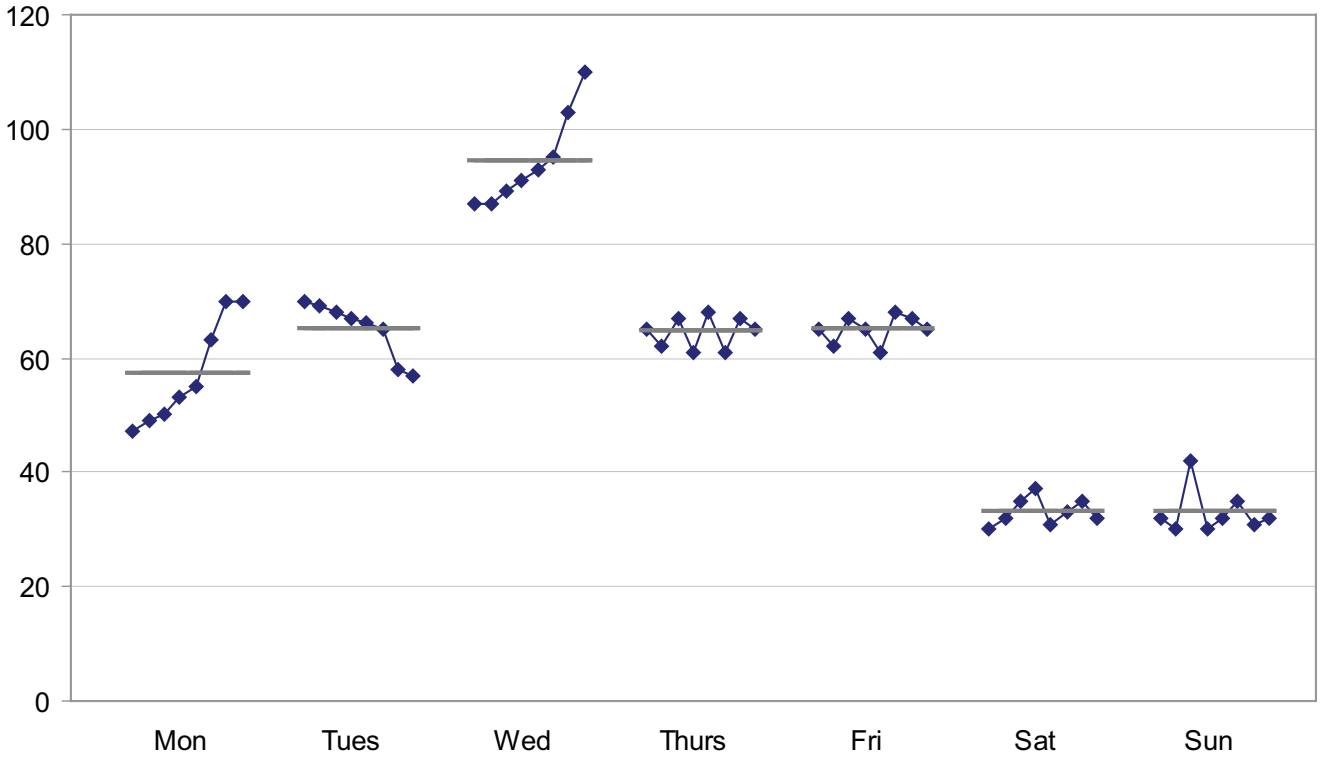

Figure 6: This figure, created using Excel, is similar to Figure 3.

For additional discussion and examples of cycle plots, see Cleveland (1993, 1994), Cox (2006), and Robbins (2005). I hope that cycle plots prove themselves to be a useful addition to your graphical toolbox.

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About the Author

Naomi B. Robbins is the author of *Creating More Effective Graphs*, published by John Wiley (2005). She is a consultant, keynote speaker, and seminar leader who specializes in the graphical display of data. She trains corporations and organizations on the effective presentation of data. She also reviews documents and presentations for clients, suggesting improvements or alternative presentations as appropriate.

This was published as a guest article in Stephen Few's monthly Visual Business Intelligence Newsletter. A complete library of Stephen Few's articles, as well as other guest articles, is available at www.perceptualedge.com.