This module looks at ways in which data can be deceptively displayed with graphs. Such deception can be defined as "the deliberate or inadvertent manipulation or distortion of the form or content of a graphic display of statistical information." Return to Table of Contents

Few things sabotage the credibility of a report more than manipulated or distorted graphs. Errors in data interpretation are fairly easily addressed. They can be righted and generally do not undermine an entire report. However, whether deliberate or not, deceptive graphs are extremely difficult to explain away and can make the reader suspect both the content and intent of all other information contained in a report. Thus, graphs must be designed, assessed, and presented with great care.

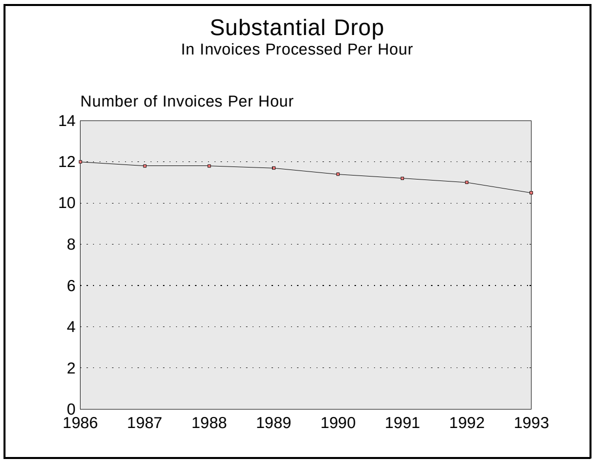
Graphs merely create a visual impression, and it is easy to create a false one. Unfortunately, using a computer to generate a graph does not guarantee accuracy and integrity. Such graphs must still be checked to avoid the following common ways in which graphic information can be misrepresented.

IS THE GRAPH NEEDED?

This is the first issue to resolve. As a rule, the more a graph requires explanation, the less it is needed. Graphs, like all other descriptive statistics, are intended to summarize, not introduce unnecessary confusion. Since graphs and text are processed differently by the reader, if the graph must be supported with a lot of text, consider omitting it.

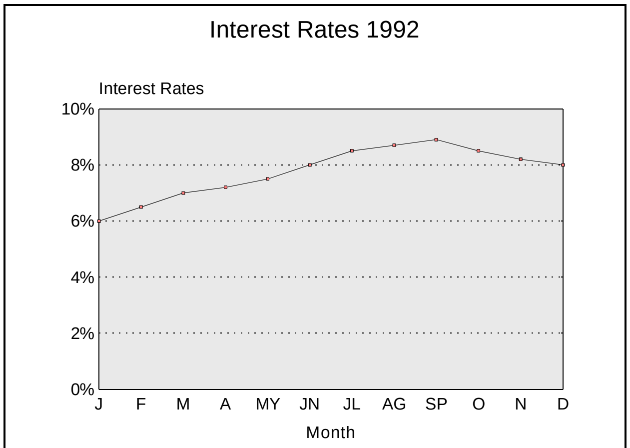
MANIPULATING TITLES

Each graph must be clearly and appropriately titled. The simplest approach is the "Y by X" method -- "Average Income by Ethnicity" or "Housing Starts by Year." Variations are both numerous and obvious, as in "Sales Per Day" or "Tax Collections, 1985-1990." The point is that the title should simply and clearly express the relationship between variables in which there is an interest. Try to avoid interpretive language in titles. For example, the use of the word "substantial" below is an inappropriate attempt to influence the reader. In the absence of further information, who is to say what is or is not "substantial"?:

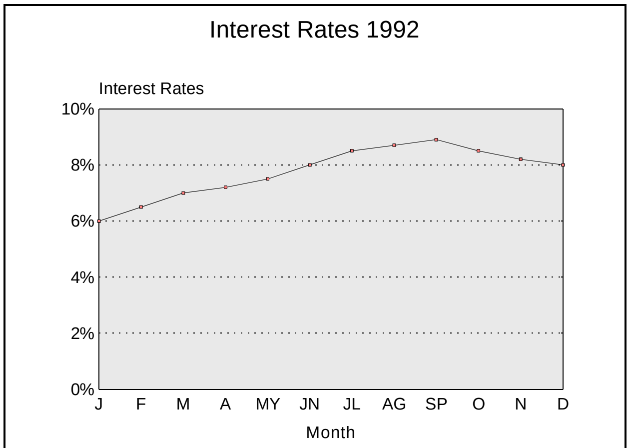


MANIPULATING CAPTIONS

Use captions with discretion. Unless they really add meaning or clarity, it is best to avoid them since they may yield unwanted results. Note how the captions used below influence the impression rendered. One caption creates the idea that interest rates have a downward trend, while the other caption suggests that interest rates are generally moving upward:



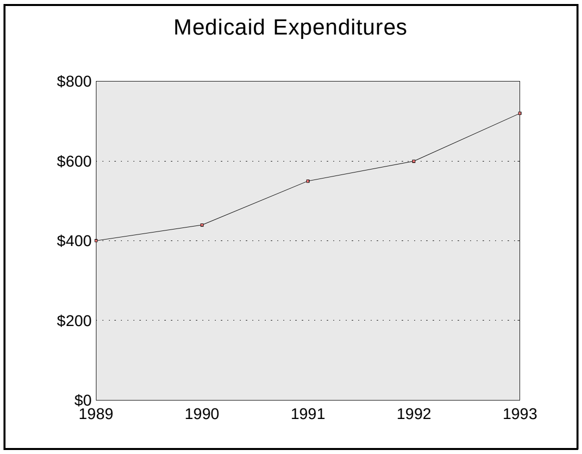
Rates finally began dropping in Fall 1992.



Fall 1992 gave consumers temporary relief from rising interest rates.

MANIPULATING UNITS OF MEASURE

The units in which all variables are measured must be clearly and concisely stated, either in the caption for each axis or in the title of the graph. In the example below, it is not clear whether the graph refers to thousands or millions of dollars. All that is needed is the word "millions" in parentheses under the title of the graph:

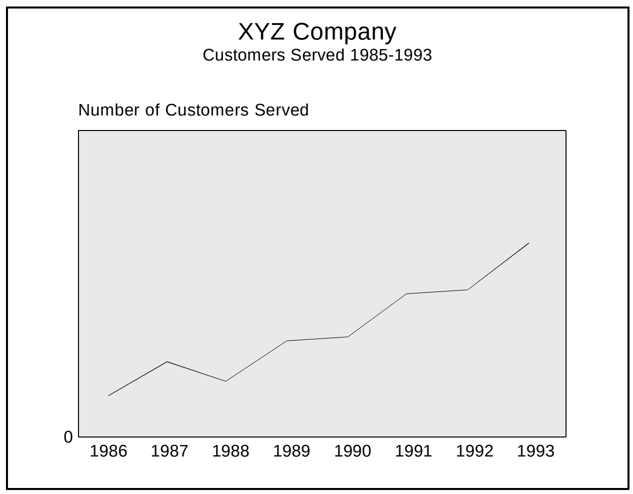


ABSOLUTE NUMBERS VERSUS RELATIVE PERCENTAGES

The media and business regularly distort graphs by reporting data in ways that sensationalize results. For example, consider a one-day drop of 300 points in the Dow Jones Industrial Average as compared to a one-day 300-point drop in the Japanese Nikkei Index. A fall of 300 points in the Dow Jones would be catastrophic, while an identical drop in the Nikkei would mean virtually nothing. A comparison based on percentages is more informative -- 10 percent (DJIA) versus about one-tenth of one percent (Nikkei). So, choose wisely between numbers and percentages.

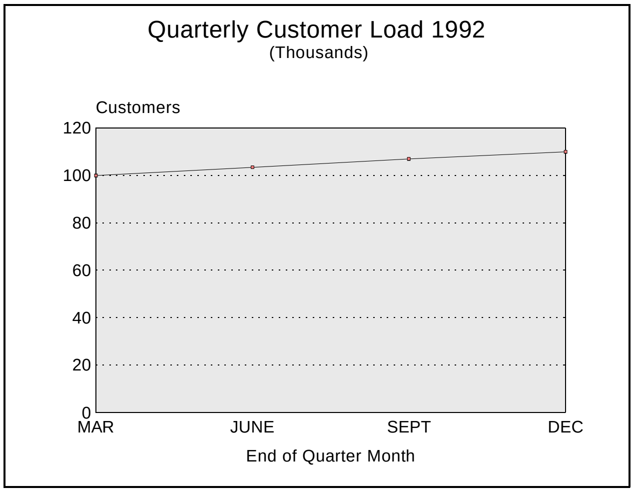
OMITTING A SCALE

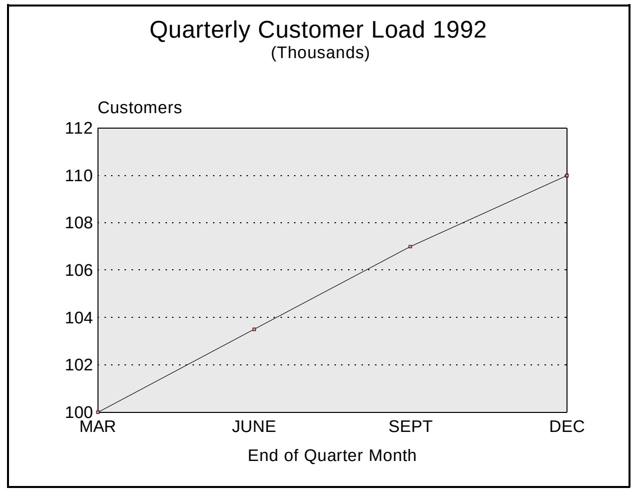
Never use a graph on which a scale is missing from one of the axes. Such methods destroy perspective. The example below purports to show the number of customers served by the XYZ Company between 1986 and 1993. However, without a scale on the Y-axis, we do not know if this graph represents a growth in demand of 10 percent or 1,000 percent. Graphs like these should be avoided:



MANIPULATING THE VERTICAL AXIS

This technique is extremely common as a way to make things look better (or worse) than they really are. Consider the following depictions of a 10 percent rise in quarterly customer load at the Department of Redundancy Department. Each graph on the next page shows a change from 100,000 customers to 110,000 customers:

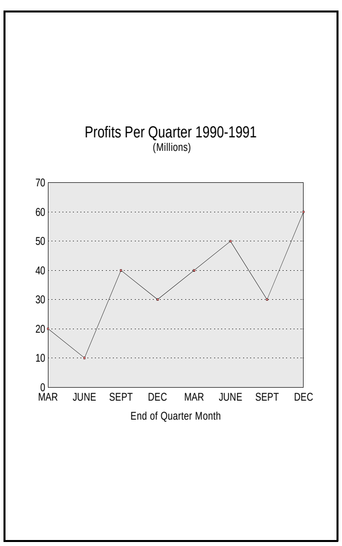


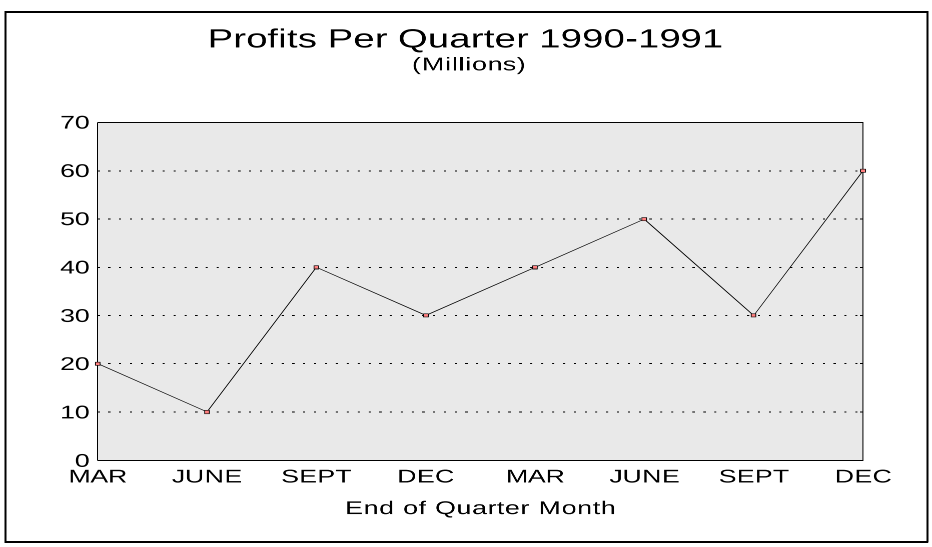


Note the growth trend indicated by the graph on the left. It appears relatively small. The graph on the right however paints a different picture. The reason for the difference is simple. The graphs use two different scales on the vertical axis. The scale on the left goes from 0 to 120,000 while the scale on the right graph ranges from 100,000 to 112,000. The appearance of the graph is strongly influenced by the scale used on the axis. Always be wary of a graph where the origin (intersection of the X and Y axes) is labeled as something other than "0."

MANIPULATING THE HORIZONTAL AXIS

Similar distortions can be created by stretching the X axis. This makes slopes and trends seem less steep, as in the following graphs of profits at Megabucks Consolidated International. The first graph shows big swings in profits, while the second one suggests more stable profit performance:



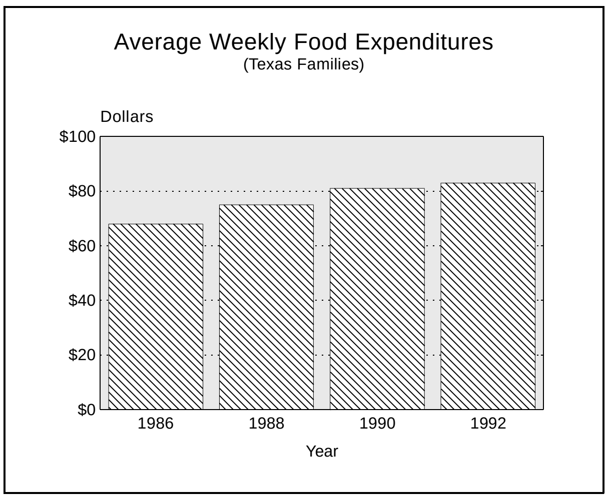


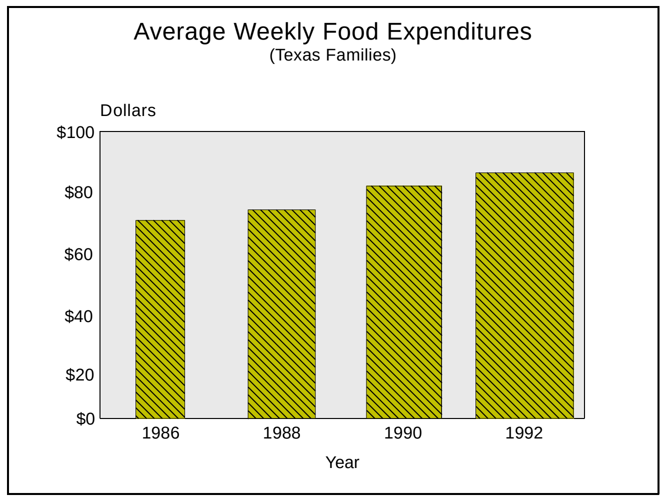
CLIPPING THE GRAPH

Another way to manipulate readers' impressions is to "clip" the graph. Here we simply withhold information by stopping the graph short of full display. Turning back to profits at Megabucks Consolidated International on the previous page, consider the different impression created by clipping off the last quarter of information (Sept. - Dec.). This approach conceals the fact that Megabucks had their best quarter of all at the end of 1991.

MANIPULATING BAR GRAPHS AND PICTOGRAMS

Another popular technique is to construct bar graphs in which the width of the bars is proportional to their height. The first graph below correctly shows the average weekly amount spent on food by Texas families between 1986 and 1990. The second graph exaggerates expenditure growth by widening the bars as they become higher. This could create the impression that expenditures actually rose more sharply over the period:





This sort of distortion is especially problematic in pictograms where bars are replaced by pictures of objects -- bags of money, people, etc. -- to enhance visual appeal. For this reason, use pictograms with caution.

SUMMARY

These methods of graphic manipulation and distortion reveal that graphs only create a visual impression, and this impression is easily distorted unless the graph is constructed and critiqued with care. The reader is less likely to be misled if attention is focused on the numerical (or proportional) values which the graph represents and leaves all else to explanatory text and the perception of the reader.

For a humorous but extremely enlightening discussion of these and other problems with statistics, see Darrell Huff, *How To Lie With Statistics*, New York: W. W. Norton & Company, 1954.