Misleading Graphs: Figures Not Drawn to Scale

Source: http://www.forbes.com/sites/naomirobbins/2012/02/16/misleading-graphs-figures-not-drawn-to-scale/2/

Graphs are pictorial representations of numbers. Therefore, at the least, we should expect that the representation of the numbers be proportional to the numbers themselves. Unfortunately, this is not always the case. In some cases this occurs because the graph designer wants to give the impression of better performance than is actually the case. In other cases, the designer might not have any numerical sense.

Figure 1. Source: Erickson Times

Figure 1, which appeared in Erickson Times, shows the number of Olympic medals won by country. For Germany, the picture of two medals corresponds to almost 500 medals. Therefore, we would expect the picture of four medals to correspond to almost 1000 medals and the picture of six medals to correspond to almost 1500 medals. However, the label for the four-medal picture is 615 and for the 6 medal picture is 1975. Although there is the correct rank ordering, there is little relationship between the pictures of the medals and the labels of the number of medals.

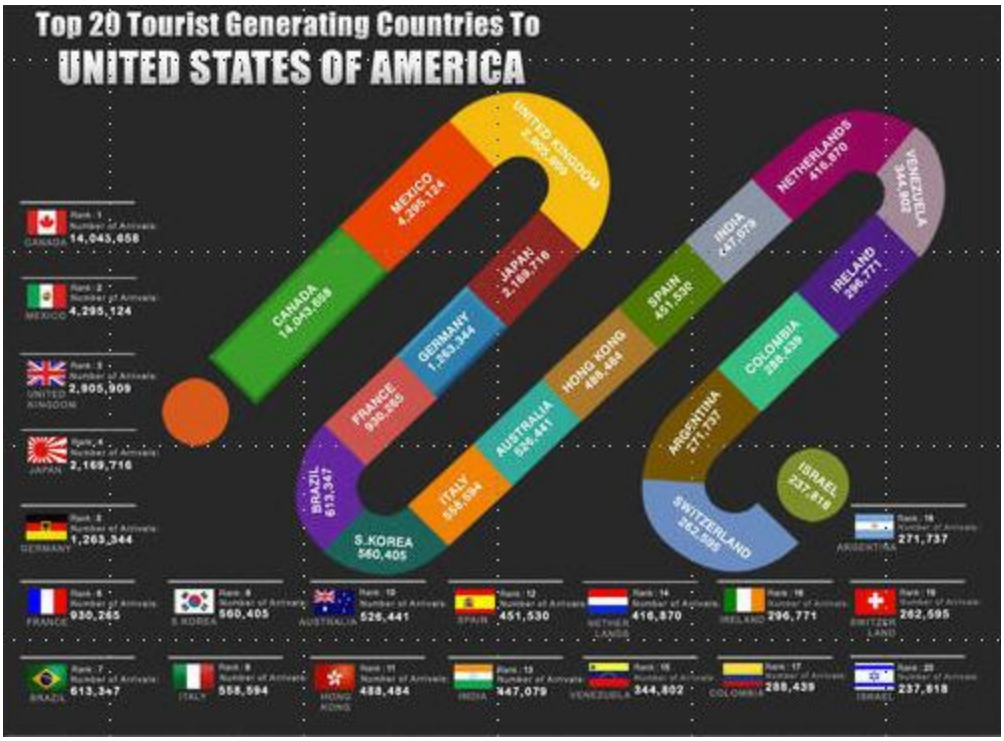

Figure 2. Source: http://jacklucky.posterous.com/top-20-countries-generating-visitors-to-the-u#

Figure 2 shows the top 20 tourist generating countries to the US. The reader is asked to compare straight lines with curved ones. There is little relationship between the length of the line segments and the number of tourists that they represent. Notice that Mexico and Canada are approximately the same length but Mexico represents between 4 and 5 million tourists while Canada represents over 14 million tourists.

Although both figures above are eye-catching, they distort the data and thus hinder rather than help with understanding the data. The reader must carefully examine the figure to determine the values of interest. The distortion in these figures is blatant. In other examples, the distortion may be more subtle. For example, some graph designers label the bars in bar graphs with data labels rather than including a scale. When I see a graph without a scale I take out my ruler and measure the heights of the bars. Too often, the labels don't agree with the heights of the bars. It is more difficult to deceive in this manner when there is a scale with tick marks at round numbers, since our eyes can judge if the scale is drawn evenly.

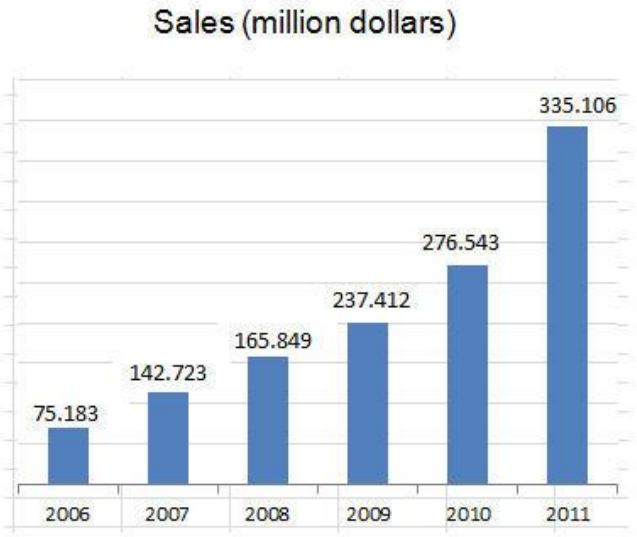

Figure 3. A deceptive graph where the values of the labels are not proportional to the lengths of the bars

Although the number of decimal places might suggest precision in the data labels of Figure 3; in fact, the values of the labels are not proportional to the lengths of the bars. The bars were drawn using one set of values and the labels were inserted with another set of values using text boxes to give the impression of rapidly increasing sales. How many of you noticed the deception before it was pointed out to you?

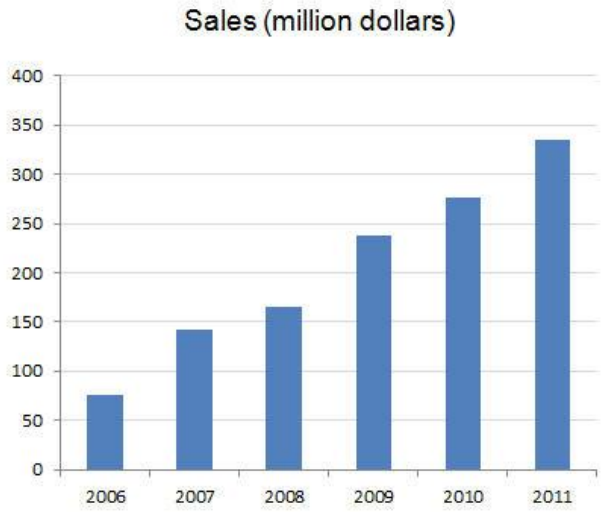

Figure 4. An honest graph corresponding to the labels in Figure 3.

We now show a bar graph plotted with the data from the labels of Figure 3. Notice that the sales growth now appears to be fairly linear, while Figure 3 suggests rapid growth in recent years. The scale on the vertical axis prevents the type of trickery shown in Figure 3.

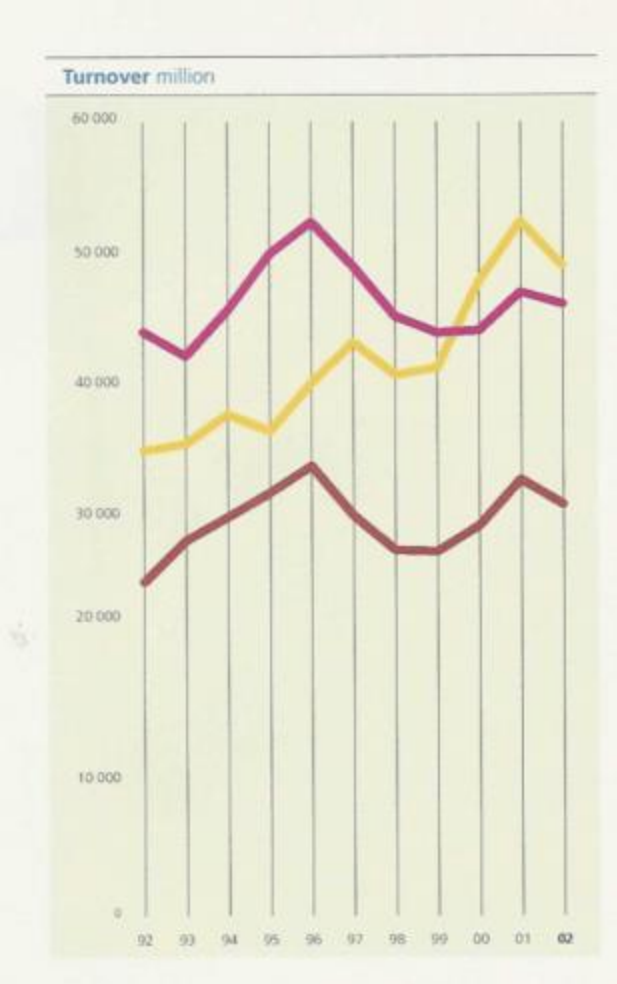

Figure 5. Source: Anonymous corporate annual report.

Figure 5 shows a line graph where the tick marks are not spaced evenly and do not appear to be an easily recognizable non-linear scale. It shows how easily our eyes can pick up this kind of distortion.

Drawing the data to scale is a basic requirement of an accurate graph. Some of the examples we just saw were designed to attract the readers' attention. Others were clearly meant to deceive. In either case, the power of graphs to aid understanding of data is undermined.