basic ideas of plotting

With box-and-whisker plots we are beginning our plotting education. The first thing we need to do is separate, in our mind, what it takes to make plotting easy from what it takes to make plotting effective. The lines ruled on graph paper help to make plotting easy, but they do not make plotting effective for seeing what is going on--instead they get in the way of seeing what we ought to see. (If we are using a graph as a substitute for a table--as a way to look up values of a function--things are likely to be different. This, however, is something we almost never need to do in exploratory data analysis.)

tracing paper

If we want to see what our plots ought to tell us, there is no substitute for the use of tracing paper (or acetate). If we slip a well-printed sheet of graph paper just below the top sheet of a pad of tracing paper, we can plot on that top sheet of tracing paper almost as easily as if it were itself ruled. Then, when we have the points plotted, some boundary or reference lines drawn, and a few scale points ticked, we can take away the graph sheet and look at the points undisturbed by a grid. We often gain noticeably in insight by doing this. (And we have had to pay for a sheet of tracing paper rather than for a sheet of graph paper.) Alternatively, we can plot on a sheet of graph paper and then trace the result.

In doing either of these we gain very much by having:

◇well-printed graph paper, which means (a) good quality lines, (b) every 10th line heavy, (c) every 5th line medium heavy. ("Five and dime" graph paper or quadrille-ruled paper will make our work much harder. For more detailed discussion, see section 5A, below.)

◇tracing paper that erases cleanly and easily (quality equal to that of the Clearprint Paper Co. of San Francisco is worth the difference).

◇a transparent plastic rule or triangle.

An alternative that:

◇can be even more effective,

◇is no more expensive,

◇takes a little more trouble to prepare for,

replaces the tracing paper by the thin sheets of transparent plastic (acetate) made for use in overhead projectors. Two cautions are important:

1. You can only use markers specially made for the purpose. (A number of manufacturers make satisfactory products, but it may not be easy to find any of them. The writer prefers the temporary--wash-off--styles to those that cannot be erased.)
2. It is important to keep one's fingers off the plastic until the picture is completed. (A piece of thin graph paper, placed upside down, works very well as a hand shield.)

scale values

We ought to put as many scale values on the graph paper preliminary as will help us make the plot easily. On the tracing paper final, however, we ought not show more than three or four numbers along a scale. More clutters up the picture and distracts the eye from what it ought to see. (Scales for dates are sometimes an exception. It can matter whether an appearance came in 1929 or 1928, in 1776 or 1775.)

People are used to scales on the left and below. So be it--for the picture, perhaps. When one is plotting the points, however, it is much more convenient to put the horizontal scale ABOVE the plot, where you do not have to move your hand to see it. (It would be rational to plot from detailed scales above and left, and to produce a final picture with a few scale points shown below and right; but such rationality is usually not worth the possibility of occasional confusion.)

plotting without graph paper

We almost always want to look at numbers. We do not always have graph paper at hand. **There is no excuse for failing to plot and look.**

We usually have ruled paper at hand. For emergency graph paper, take out one sheet of ruled paper, turn it on its side, and place it beneath another sheet of ruled paper. If these two sheets have a light-colored backing--often provided by the rest of the pad or notebook--the vertical lines on the lower sheet are almost certain to show through well enough, combining with the horizontal lines on the top sheet to form a grid on which plotting is reasonably easy. (The first step in this sort of plotting is to mark--by ticks or unobtrusive dots--enough information on the top sheet to make it easy to get the lower sheet back to its original position after it slips.)

With this technique, one can make useful, if not decorative, plots almost anywhere.

review questions

What is a box-and-whisker plot? What do its parts show forth? What rules does it obey about showing values individually? About identifying values? What must we separate in our minds about plotting? What are the essentials of convenient, effective plotting? How can we, in an emergency, plot without graph paper?

2D. Fences, and outside values

Hinges are for our convenience. They can--and will--serve various purposes for us. Their role in 5-number summaries is only the beginning.

When we look at some batches of values, we see certain values as apparently straying out far beyond the others. In other batches straying is not so obvious, but our suspicions are alerted. It is convenient to have a rule of