SIO223, 2010
Set 1: Plotxy and Graphical Rhetoric

Earth sciences convey a great deal of information in graphical form—maps, contour diagrams, and plain old graphs of data and functions. A graph can provide a powerful argument and make a point far more convincingly than a paragraph, if it is well done. Most of you use MATLAB for this purpose but, in my opinion, it is an awkward tool if one needs to draw publication-quality figures of a precise size, with the axes and annotation exactly specified.

Download and compile *plotxy* from the link on the class website. Access to *plotxy* is through X11, via an xterm window. On a Mac you can use preview to view the PostScript files generated, but gv or ghostview with the -watch option is more convenient. Download ghostview if you don't have it already. *Plotxy* will provide the display engine for other software covered later.

1. On the website there is a table of observations of ρ_a, apparent resistivities in the Fond du Lac, Wisconsin area. There are six columns: electrode separation, apparent resistivity (Ωm), 1-σ uncertainty, model A, model B, model C. The three models are best-fitting layered systems with different layer thicknesses. Using *plotxy* graph this information. One should be able to see how well the models match the observation at every measured point. The graph should be clear, concise and not cluttered. Color may be useful. Provide a listing of the script used to generate the graph.

2. Most journals insist that published graphs fit into a single column and charge extra for color. So now convey the information in a plot with a width of 3 inches, and without color. Simply shrinking your first plot and removing the color is not acceptable. You may want to compute other quantities that are more informative, or draw more than one diagram.

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    1. Below is large-format plot of the data in a straight-forward log-log presentation. If linear x axes are used the data are too compressed at small separations, and the problem is worse then. Notice the theoretical lines are drawn as curves, not straight-line segments, since the model functions must be smooth. I used the *light* version of the colors; this helps to emphasize the measured values, and shows the mismatch of the models much better than darker colors do. The results are not totally satisfactory: things are still too compressed at the right.

The plotxy script for this picture can be downloaded from the website.
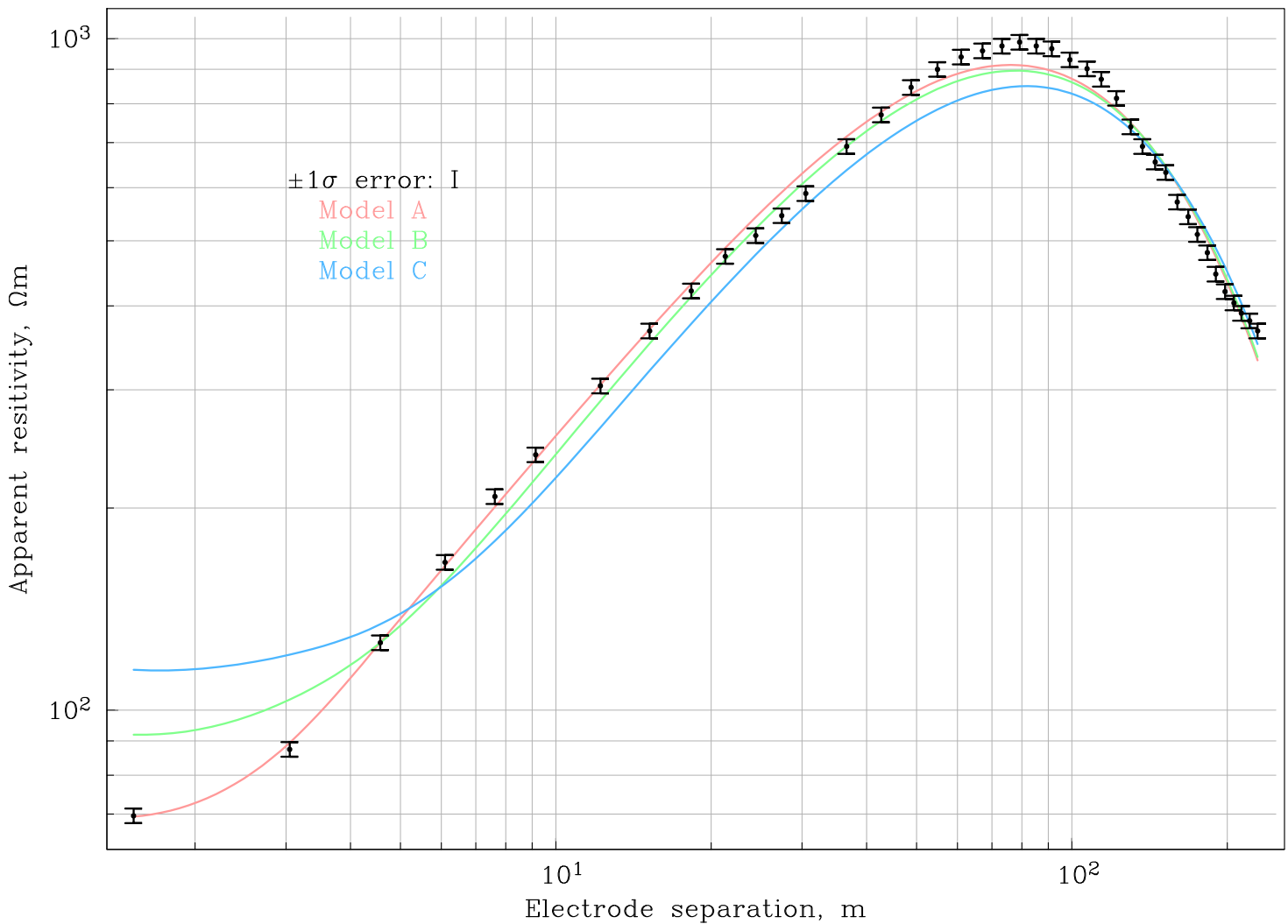
2. In a more compressed, colorless format the graph on the previous page would be impossible to interpret. One alternative is shown here: split the short range and long range data up, and plot as two 3-inch diagrams. The models are distinguished by different kinds of dashed lines, which works well. Even without color it is permitted to use grey, which is very effective in allowing the measurements to stand out against the model curves. There is no need to identify the models again in the left picture.

The script for these plots is bit longer because of the need to switch between the external file `tabl1.txt` and terminal input. We need to define the interval on the axes of each picture exactly, since self-scaling in *plotxy* uses the whole series, not just the part in the frame.

The results are completely satisfactory.
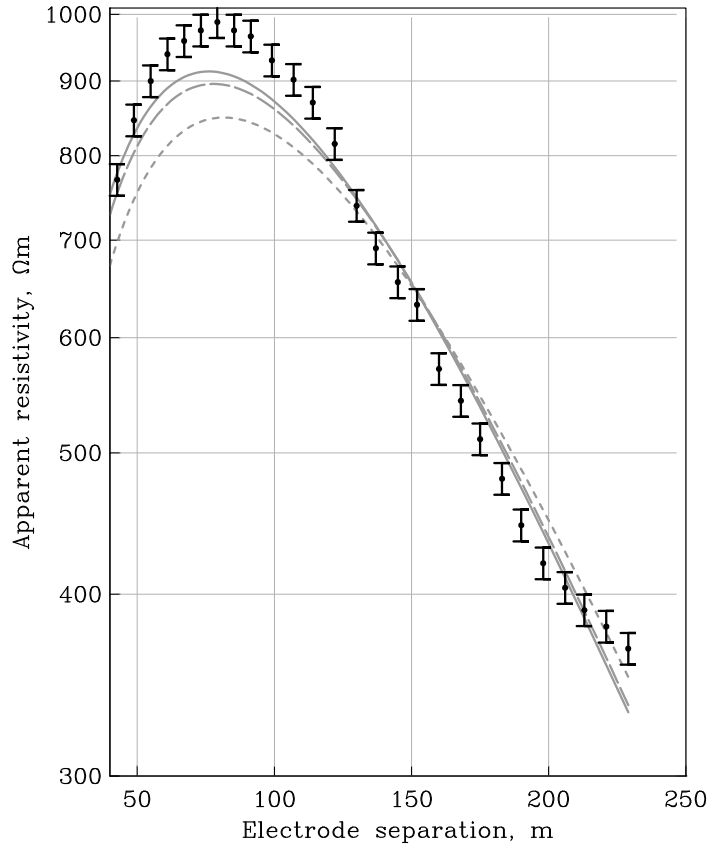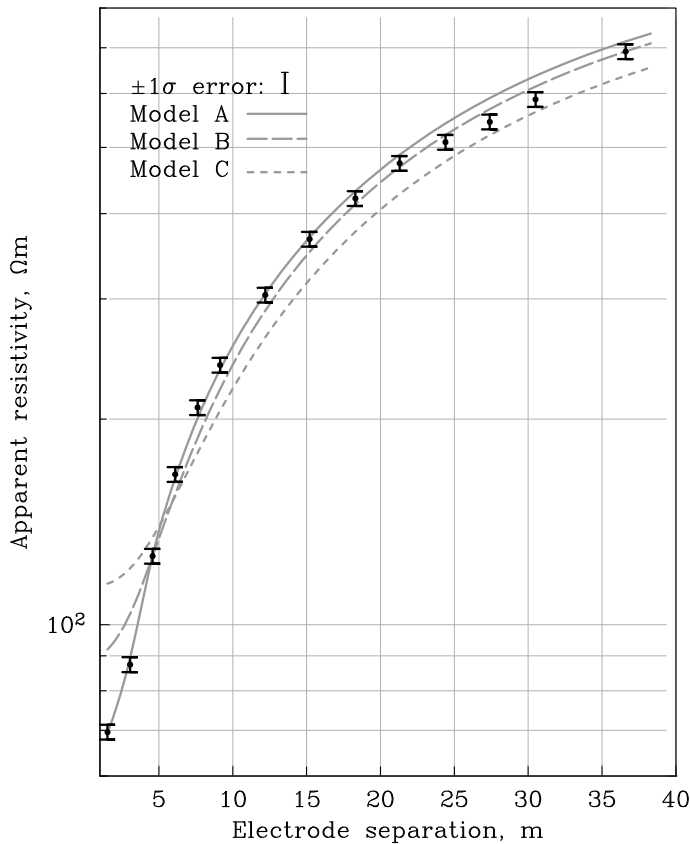
Finally, below is a more radical approach. Now the best-fitting model is used as a base, while the data and the other models are normalized with respect to it, that is, divided by it. The electrode separation, which covers too large a range is eliminated as the x variable and replaced by the ordinal numbers thus avoiding crowding at low x with a linear scale, and at large x with a logarithmic one. We see very clearly how well the models fit the measurements, although the overall impression is a bit cluttered. But of course this clarity comes at the expense of not knowing how the apparent resistivity actually varies with range: this is fixed by plotting the data more naturally in another plot. The right picture would benefit from grey curves too, but I wanted to see how well I could do without that device. You can see how poorly the data are distinguished when they are drawn black and lie on top of black model lines, particularly when compared with graphs on the previous page.

On the whole, I prefer my first solution to the small-format question.