

Graphing (Read 593-594)

Step 1: Decide which variable will go on which axis.

The "X" axis is the horizontal axis.

Usually the independent or controlled variable in the experiment goes on this axis.

The "Y" axis is the vertical axis.

Usually the dependent or measured variable in the experiment goes on this axis.

2) Label each axis with the name of the variable and the unit for the variable

3) Determine the range of values for each axis:

$$\text{range} = \text{largest number used} - \text{smallest number used}$$

4) Determine the scale of the axis; how much each square on the graph is worth.

$$\text{scale} = \text{range} / \text{number of squares}$$

round UP the scale to the nearest reasonable whole number

Number the axes on the graph.

Don't crowd the axis, label every second, fifth, or tenth line as reasonable.

5) Plot each point onto the graph.

Draw a line up from X-axis value and across from the Y-axis value.

Where these two lines cross, plot the point.

With a good graph paper, this can be eye-balled, without actually drawing lines.

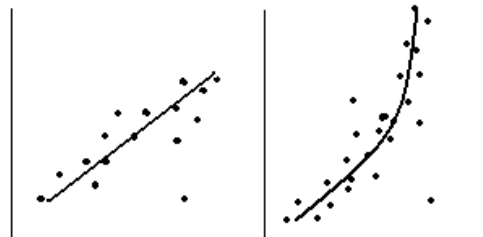
6) If the points are scattered and you suspect that there is a relationship between the two axes, draw a "best-fit line" through the points.

The line should pass between the points so that an equal number of points are above and below the line in any part of the graph. If the points seem to follow a straight line, draw a straight best-fit line with a ruler. If the points seem to follow a curve, draw a smooth simple curved best-fit line.

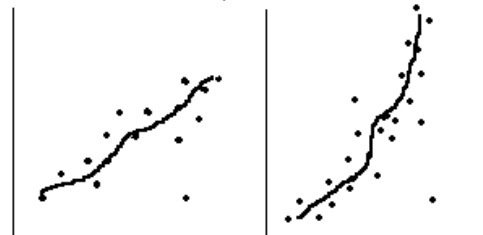
Do not try to follow every little bend in the points.

7) Write a suitable title for the graph across the top of the graph paper.

Good Best-fit Lines



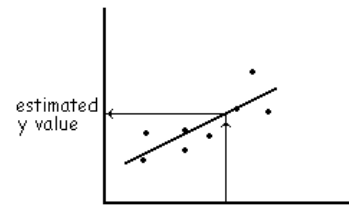
Bad Best-fit Lines



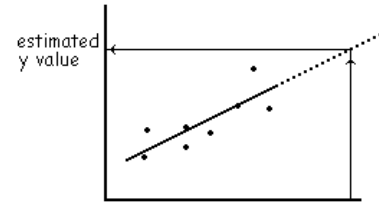
8) If there are more than one set of points, use different style of points and colours of lines for each set of points. Include a legend that describes colour and point styles.

9) Lines of best fit are useful for several reasons.

a) **Interpolation:** an estimate the value for the "y" value for an "x" value that was not sampled but is in the range of data that you sampled.



b) **Extrapolation:** like interpolation, but you are estimating a "y" value for an "x" value that is outside of the range of data. This is a less certain process, because we really do not know if our relationship between "x" and "y" hold true outside of the range in our data.



c) **Making a Line Equation:** a mathematical relationship between "x" and "y" can be generated from a straight line of best fit by calculating the slope of the line.

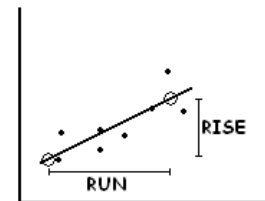
$$\text{slope} = \text{rise/run} = (y_2 - y_1) / (x_2 - x_1)$$

From the slope we can generate an equation for the line:

$$y = mx + b$$

$$m = \text{slope,}$$

$$b = \text{point where line crosses the y axis}$$



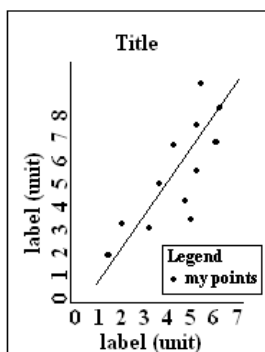
A line equation, provided it holds true in all situations, allows you to calculate a value for "y" for any value of "x" without needing to use the graph.

Advantages of Graphing

i) Relationships between properties are easier to see and describe using a graph than with words.

ii) The line of best fit is a better average than a simple mathematical average. Points that seem to be in error (outliers) are easier to spot and ignore.

iii) A mathematical relationship is easy to generate from the graph.



How a good graph should end up looking:

It has a title, axis labels with units, points, a line of best fit, and a legend, if there is more than one set of points.

The numbers on the axes should not be crowded.

The graph should fill as much of the page as possible.

The axes should be scaled so that the points fill as much of the graph as possible.