

Good and bad graphs.

Good graphs clearly show the important features of the data. They should always have:

- a title
- labelled axes
- a key.

In general they should **tell a story** and be **memorable** but also have a '**low information to ink ratio**' (junk kept to a minimum and no distracting features) and **not** mislead the viewer. Some of the following examples of bad graphs also give a corrected good graph. Choice of colour when designing charts and graphs is also important to allow for colour blindness and black and white printing.

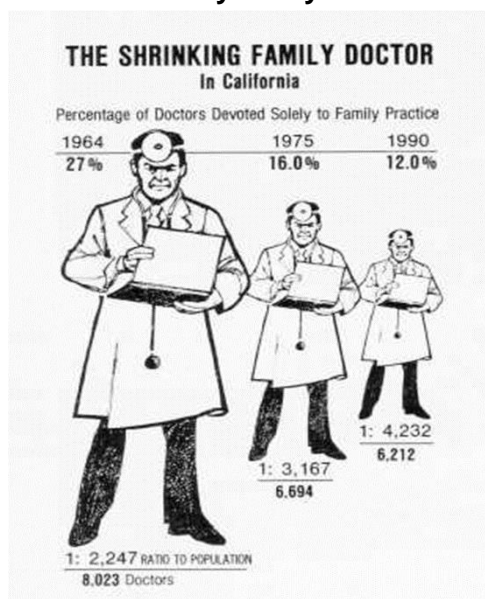
Graphs are often made misleading for advertising or other purposes, or even just by accident, by:

- Leaving gaps/changing the scale in vertical axes
- Uneven shading/colours
- Unfair emphasis on some sections
- Distorting areas in histograms (bar widths should always be equal - if you have different widths then the bar height must be adjusted so AREAS reflect counts)
- Use of 3-dimensions instead of two
- Misleading use of pictograms

In particular, watch out for missing zero points on axes, spurious colouring and annotation, and unjustifiable extrapolation. Pictograms are often misleading as in the case of the following graph as areas or volumes (instead of heights) are used to represent numbers exaggerating differences visually.

Example (from the Los Angeles Times, August 5 1979, p3)

The **data** show a reduction in the ratio from 27% to 12%. this is represented by a change in the **height** of the doctor but **your eye sees a change in the area**.

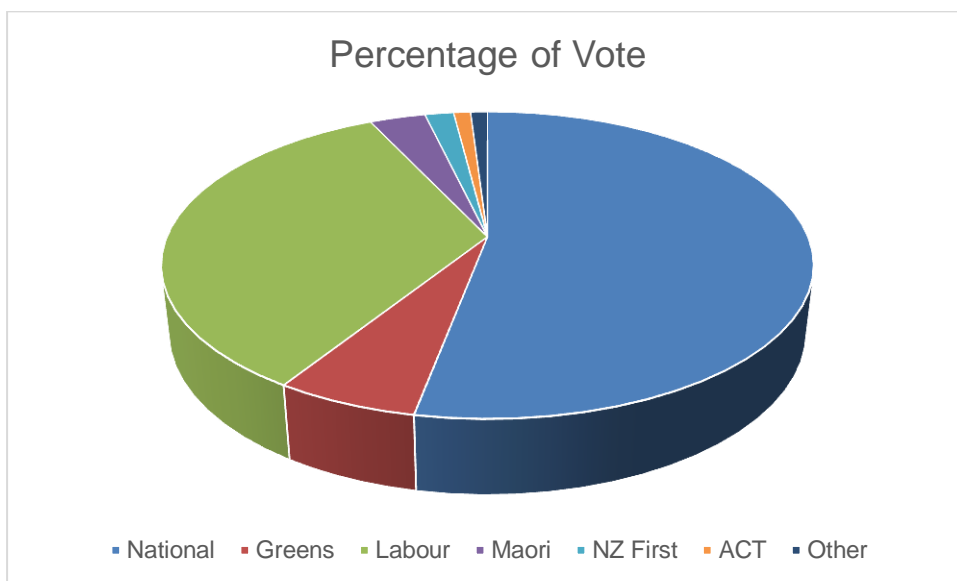


Examples of bad graphs that could have been drawn in Excel

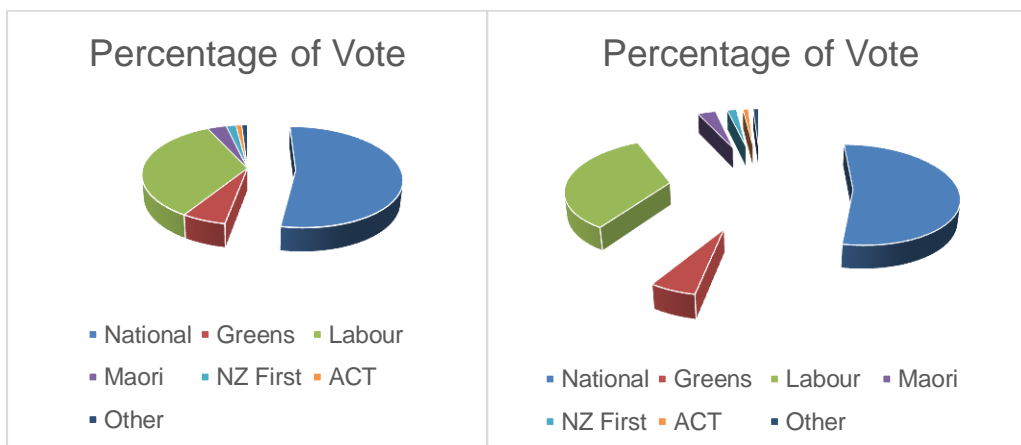
Pie charts

It is debatable whether pie charts ever need to be used as bar charts are almost always a better representation of proportions in a data set. Unless properly constructed pie charts can be very misleading.

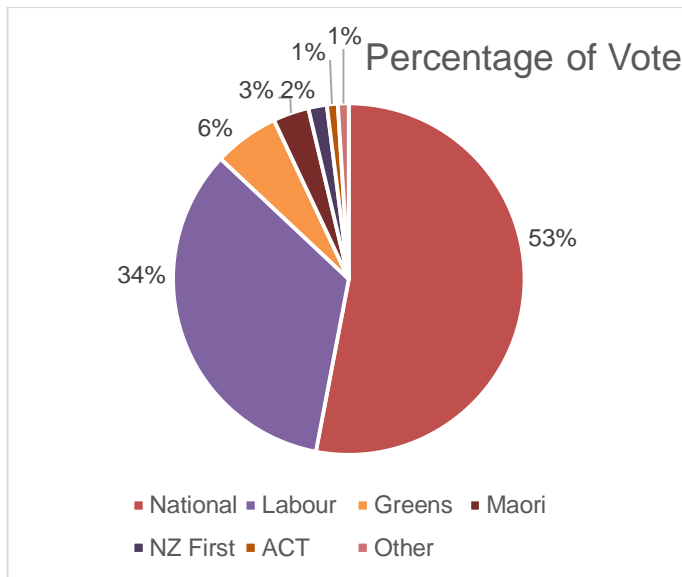
For example, the two dimensional pie chart below has been constructed so the party with the highest vote is in the front (and therefore inflated) but the second highest is at the back (and looks less than it should). Also no proportions are given on the graph.



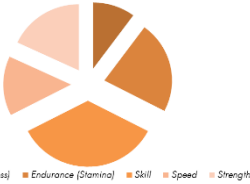
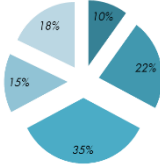
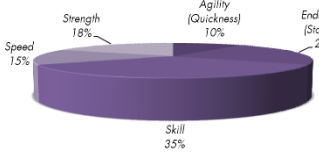
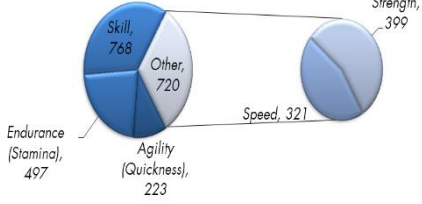
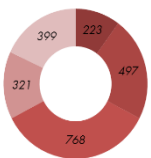
Pie charts like the one below (of the same data) that 'explode' by having the sectors move apart from each other further exaggerate these misleading features and should never be used.



A correct pie chart for this data is:

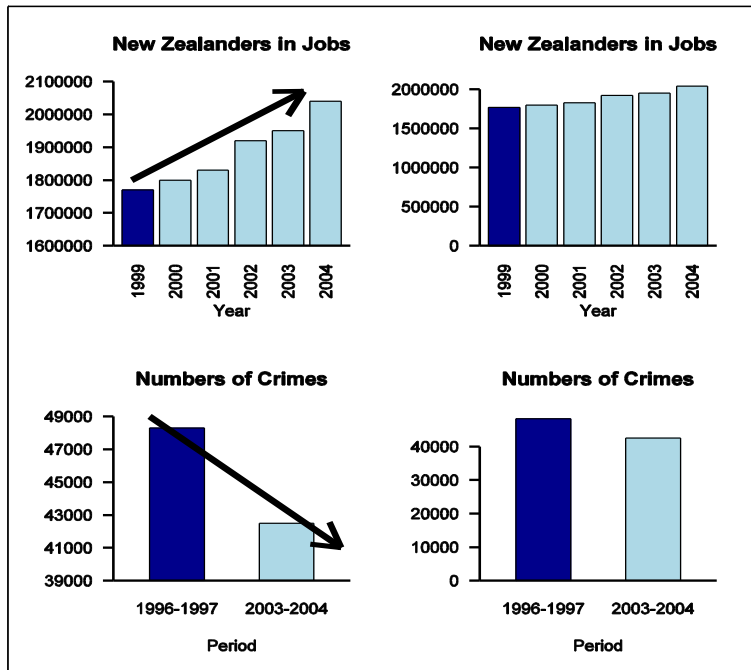


Bad pie charts created using UK *CENSUSATSCHOOL* data (problems with each graph are listed below it)

<p>Attributes children would like to have</p>  <ul style="list-style-type: none"> • Sectors should be touching each other • No percentage labels • No indication of how many children participated 	<p>Attributes children would like to have</p>  <ul style="list-style-type: none"> • Sectors should be touching each other • No key to say what each sector represents • No indication as to how many children participated
<p>Attributes children would like to have</p>  <ul style="list-style-type: none"> • Pie charts should always be 2-dimensional, in 3-dimensions the visual representation of the sectors is distorted • A key should be used for the attributes 	 <ul style="list-style-type: none"> • All the sectors should be presented in the same pie • A key should be used for the attributes • No title
<p>Attributes children would like to have</p>  <ul style="list-style-type: none"> • Sectors don't touch in the middle, (so angles can't be compared easily) 	

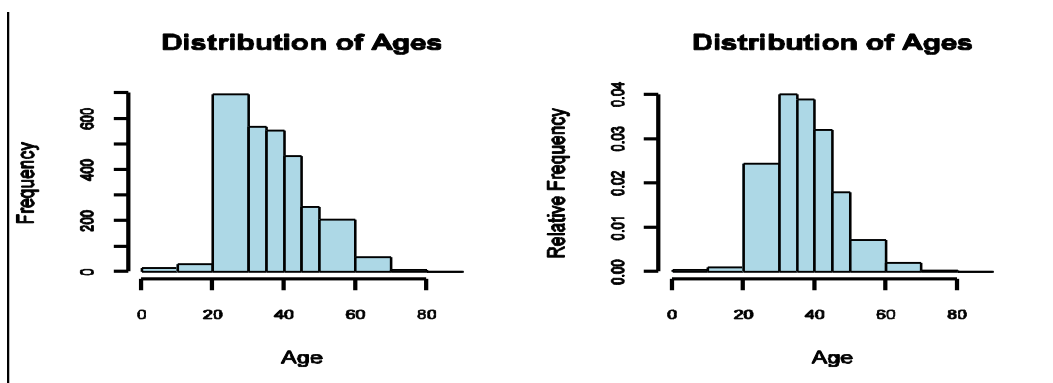
Bar charts

Both the (made up) graphs on the left mislead the reader by exaggerating the differences in the heights of the bars by not starting the vertical axis at zero. The correct graphs are given on the right.



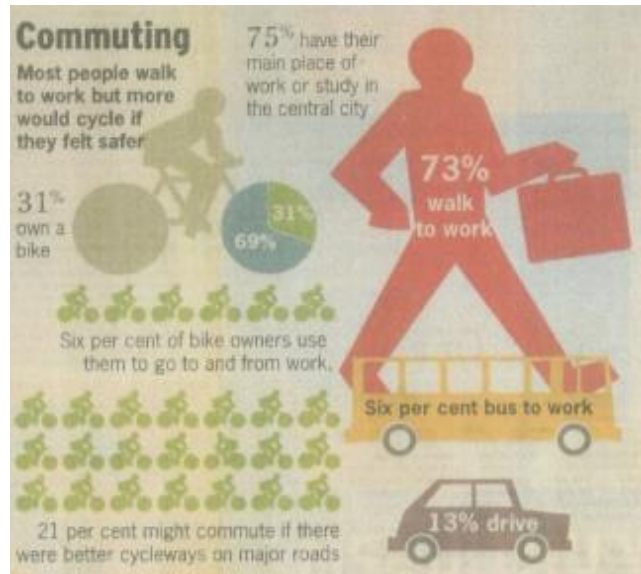
Histograms

The graph on the left misleads the reader by doubling the width of some of the bars. The correct graph on the right halves the heights of these bars so that the area still represents the frequency.



Real life examples of bad graphs

The following graph from a survey of inner city apartment dwellers in Wellington, New Zealand was published in the Dominion Post newspaper on Monday 13 April, 2009. Not only are the pictograms representing walking to work, going by bus or driving incorrectly sized (with the 6% going by bus being larger than the 13% driving) but also has two different sets of data muddled into the same graph (the data displayed on the left hand side of the graph is not just about the proportion of those cycling to work, 6%, but also about what cycle owners might do in certain situations). The larger picture of a bike is there merely to display the proportion that own a bike. It is not good practice to use a pie chart with just two values.



Many more examples of real life bad graphs can be seen on websites such as Junk Charts <http://junkcharts.typepad.com>, The Top Ten Worst Graphs www.biostat.wisc.edu/~kbroman/topten_worstgraphs and Eval Blog <http://evalblog.com/2012/01/23/tragic-graphic-the-wall-street-journal-lies-with-statistics>.