

“A picture is worth a thousand words” *Anonymous*

## Why do we use graphs?

Graphs or charts are used for:

- making a point (in the same way that we use text).
- condensing information (usually numerical) that would otherwise be explained in text or in tables.
- revealing relationships or ideas not evident from text.

Before creating a graph first ask 'Is it necessary?' – a table (or maybe even text) may be sufficient for the point being made. Graphs must be constructed to *illuminate*, not just to illustrate. Effective graphs are **easily understood**, **independent** and **concise**.

## Graphs that are easily understood are...not easily misunderstood

As with text, the aim is to make it easy for the reader: avoid confusing them.

- Each graph should be uniquely numbered, e.g. 'Figure 1...', enabling easy identification in the textual discussion. (Note that all other images such as diagrams, pictures, photos and maps are also included in this numbering series.)
- Position the graph as close as possible after the paragraph in which the first text reference to it occurs.
- The title should be clear and contain all the 'what, where and when' information in sufficient detail, e.g. units of measurement. You may go further by using the title to highlight the main conclusion that you want the reader to draw, however, this 'journalistic' style may meet with less acceptance in some fields.
- Ideally, axis titles should be removed if they simply repeat the information in the title. However, convention is still to include them, so try to reduce the redundancy.
- Orient the Y-axis title(s) horizontally for easier reading.
- Avoid using too many symbols, line types or bar fills on a single graph. As a rule-of-thumb, aim for less than 4 per graph.

## Independent graphs should be able to stand alone...but they don't

Provide enough information in your graph through the graph title, axis titles and other notation so that the graph can be understood independently of the text (and of other figures and tables). However, ensure that you *discuss the graph* in the text.

## Concise graphs minimise their 'ink to data' ratio

In writing, being concise means using a minimal number of words, sentences and paragraphs to make a point.

Likewise, concise graphs use a minimal amount of ink.

- Fill up the graph area with the data as much as possible, like 'filling the frame' before taking a photograph. Do this by adjusting the minimum and maximum values of the axes (ensuring these numbers are still meaningful).
- Reduce the number of data labels on your axis scales. If there are more data labels on the scale than data points, why not label the data points with their values instead?
- Place the legend within or below the graph area to maximise the area for the data.
- Avoid 3-D effects. Even data that are truly 3-D are often best visualised on a 2-D scale.
- In general avoid 'chart junk', i.e. ink that is superfluous to (and confuses) your main point. Be aware that default graphs in software such as Microsoft Excel often come with chart junk, e.g. borders, backgrounds and gridlines (see example below).

For the best examples of efficient data display, see Tufte (2001).

## TIPS FOR SPECIFIC TYPES OF GRAPHS

*Scatterplots/Line graphs* (see Figure 4 for an example of a scatterplot)

- Ensure lines/symbols are large enough to distinguish clearly, and different lines/symbols can be distinguished from one another. For example, dotted and dashed lines are easily confused.
- Consider using one or more letters or numbers to identify series, to eliminate the need for a legend.

*Bar graphs* (see Figure 2 for an example)

- For sequences of data over time, use vertical bar graphs without spaces between bars; otherwise use horizontal bar graphs with spaces.
- Use bars of equal width.
- Order categories in a way that is meaningful to the reader, i.e. to support the point you are making (in most cases this does *not* mean order alphabetically). For horizontal bar graphs, the convention is descending order from top to bottom.

*Pie charts*

- Avoid using pie charts. The relative size of the 'pieces' is difficult to discern, especially for comparisons across charts. Use a table instead.

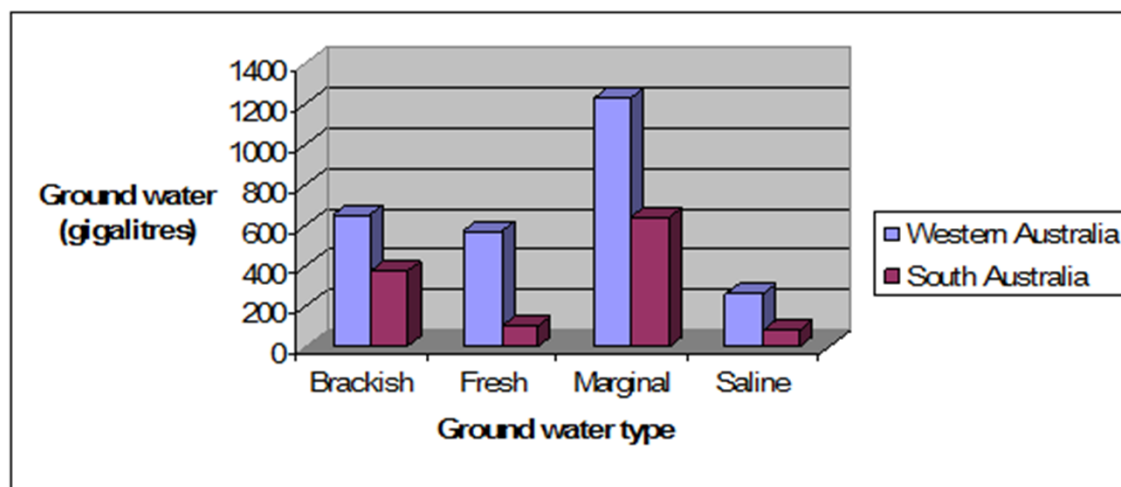
## REFERENCING YOUR SOURCE

Whether creating your own graph using another source's data, adapting their graph, or reproducing their graph in its entirety, you must cite the source. Place the citation (in identical format to a citation for text) below the graph, and precede by either 'Source: ' (for an exact reproduction) or 'Data Source: ' (where you have modified the original).

## EXAMPLES

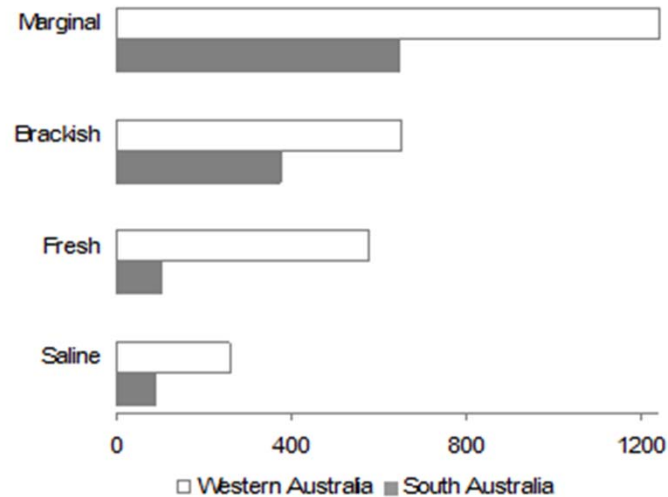
The two bar graphs below (Figures 1 and 2) display the same data. Figure 1 was constructed using default options in Microsoft Excel and Figure 2 has been revised according to the guidelines in this leaflet. Can you identify the changes that have been made?

Figure 1. Major ground water resources of Western Australia and South Australia, 1987.



Source: ABS (1994a cited in Hay, Bochner & Dungey 2002, p. 221)

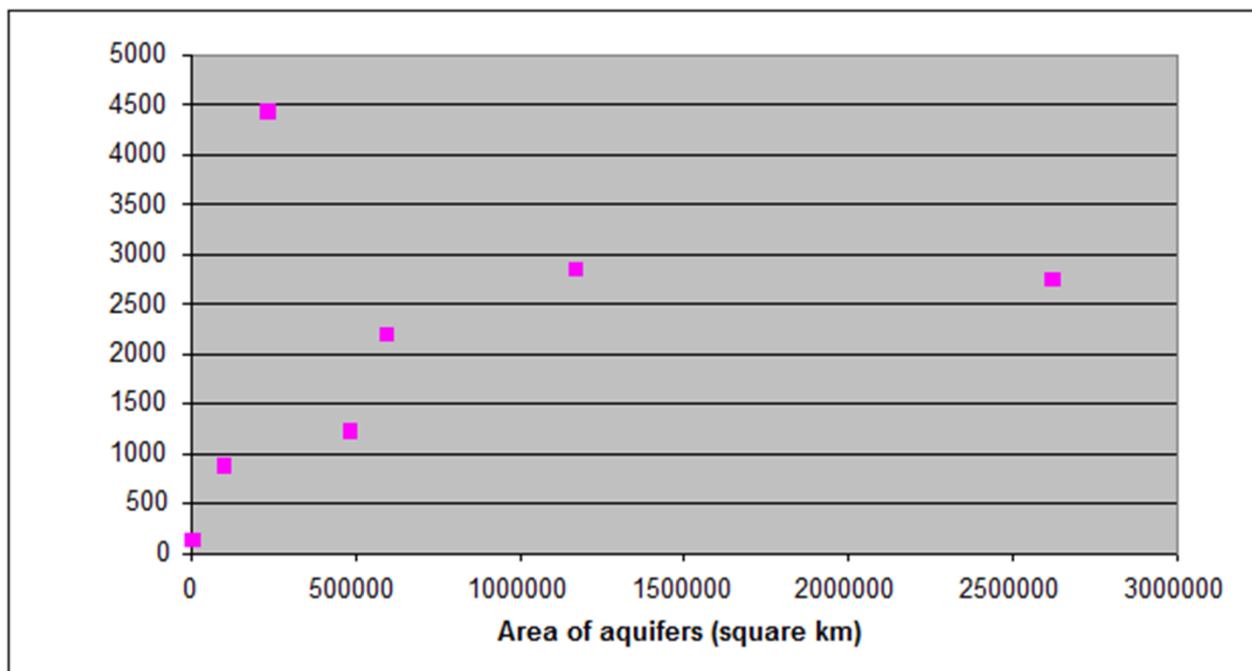
Figure 2. Waters of marginal and brackish salinity dominate the ground water resources (in gigalitres) of Western Australia and South Australia, 1987.



Source: ABS (1994a cited in Hay, Bochner & Dungey 2002, p. 221)

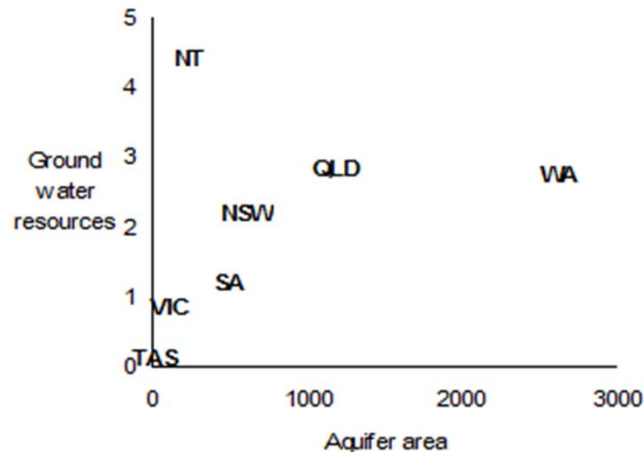
Two further graphs below (Figures 3 and 4) also display identical data. Figure 3 was constructed using default options in Microsoft Excel and Figure 4 was constructed as a scatterplot and revised according to the guidelines in this leaflet. Can you identify the changes that have been made?

Figure 3. Major ground water resources of Australian states/territories, 1987.



Source: ABS (1994a cited in Hay, Bochner & Dungey 2002, p. 221)

Figure 4. Ground water resources (thousands of gl) relative to aquifer area (thousands of km<sup>2</sup>) for Australian states and territories, 1987.



Source: ABS (1994a cited in Hay, Bochner & Dungey 2002, p. 221)

For more examples, look at recent issues of reputable journals in your field.

## REFERENCES & FURTHER READING

Hay, I, Bochner, D & Dungey, C 2002, *Making the grade: a guide to successful communication and study*, 2<sup>nd</sup> edn, Oxford University Press, Melbourne.

(Written by Flinders University lecturers, this book contains a chapter on graphs and tables, as well as much other useful information.)

Huff, D 1993, *How to lie with statistics*, WW Norton & Co., New York.  
(Highly readable, originally published in 1954.)

Klass, G 2006, *Constructing good charts and graphs*, viewed 10 August 2006,  
<<http://iilt.ilstu.edu/gmklass/pos138/datadisplay/sections/goodcharts.htm>>.  
(Solid overview with examples. Also provides tips for formatting Microsoft Excel charts.)

Peltier, J 2006, *Charting in Microsoft Excel*, viewed 10 August 2006, <<http://peltiertech.com/Excel/Charts/index.html>>.  
(Tips and tricks for creating graphs in Microsoft Excel.)

Tufte, ER 2001, *The visual display of quantitative information*, 2<sup>nd</sup> edn, Graphics Press, Connecticut.  
(A bona fide classic. The most relevant chapter (from the 1st edition) is reproduced in Tufte, ER 1990, 'Data graphics', *Oikos*, vol. 58, pp. 129-144.)

Other relevant Student Learning Centre leaflets:  
*Creating Effective Tables*

STUDENT LEARNING CENTRE  
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