Government Statistical Service

Effective tables and graphs in official statistics

Guidance for producers

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There are more resources on this topic on the GSS website: http://bit.ly/goodpracticeresources

Acknowledgements

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We also draw on material developed by Adam Little, Greg Wye and colleagues from the Health and Social Care Information Centre in their document "Presenting information visually" and Full Fact's internal "Charts in brief" guide. Other source material (including web content written by other authors) is cited in the text and described in the references section at the end of the document. The guidance on tables was devised originally by Nicole Choong during her Fast Stream summer internship with the Good Practice Team.

Contents

Introduction

Who is this guidance for?

This guidance is primarily for producers of official statistics who, in line with their professional obligations, need to design graphs and tables that are clear, consistent, informative and easy to use.

What is its aim?

The aim of the guidance is to ensure that the graphs and tables we produce convey key messages quickly and effectively.

The guidance is not a set of standards. Instead, it sets out some principles to think about when visualising and presenting statistical data and illustrates them with examples.

Why do we need it?

It is our responsibility to ensure that important patterns and trends in the data are clearly described and easy to see. This allows informed decision making.

Statistical tools provide all sorts of techniques for graphing and tabulation. Some are useful, but many of these features encourage bad practice. Default settings can include 3D effects and shadows which reduce clarity and obscure the message. It is vital that we get the basics right.

What does it cover?

The guidance explores principles and approaches for the effective presentation of statistical data in tables and graphs. It also discusses principles around the effective use of colour.

It brings together good practice from a range of existing sources and provides references for further reading.

While the guidance does not cover dynamic or web-based visualisation directly, the principles outlined here are also generally applicable in that context.

Don't forget...

Think clearly and carefully about the information you are trying to convey when creating tables and graphs. Also consider the requirements of your audience. Choose and tailor your visualisation method accordingly.

"The use of tables and graphs to communicate quantitative information is common practice, yet few of us have learned the design practices that make them effective."

Stephen Few
Show Me the Numbers [1]

The big picture

The UK Statistics Authority requires that producers of official statistics ensure that charts, tables and maps conform to good practice standards. Graphs and tables must be presented impartially, so that they avoid favouring a particular viewpoint.

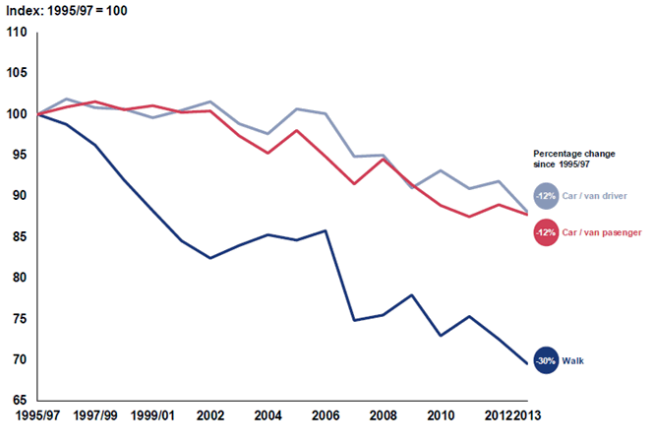
We must also follow good practice in meeting requirements for accessibility. This ensures that the information we produce is helpful to the widest possible audience.

As members of the Government Statistical Service, it is our role to show people what the numbers mean – clearly and consistently. We must also think carefully about choosing appropriate visualisations to convey the messages in the numbers. Table and graph design underpin and support this role.

Figure 3: GDP (£millions) and quarter on quarter growth, Q1 2014
United Kingdom 2003-2014

Source: Office for National Statistics

Chart 6: Average number of trips by selected private transport modes - index: England, 1995/97 to 2013 [NTS0103]



Principle 8 of the Code of Practice for Official Statistics requires that official statistics are readily accessible to all users. [13]

Designing graphs, tables and maps that enhance clarity, interpretability and consistency is essential to meeting this requirement.

Tables

Tables should be used to present numbers in a clear and systematic way.

Reference and demonstration tables

When we want to make statistics available for future reference, we supply them in a *reference table*. These typically have a large number of entries covering a wide variety of different statistics broken down into different categories. They are usually supplied away from the main commentary in an appendix or an accompanying spreadsheet. Because of this volume of information, it is important that the design of the tables allows the user to identify the right statistics with minimum effort.

If we are using a table to demonstrate a point that we are making in the text, we create a *demonstration table.* These use data extracted from reference tables, laid out so as to quickly reinforce the point. The design should ensure that "the patterns, and exceptions should be obvious at a glance, at least once one knows what they are." [2], [3]

When to use a demonstration table

Points may be illustrated using demonstration tables or graphs.

Use a graph when you want to show patterns, trends and relationships in the data, where the actual values are not required to make the point and all values share the same units.

Use a demonstration table:

- If you are asking the reader to compare individual values.
- If you want to include both the values and derived measures such as percentages or indices.
- If you want to include totals.

"Nation sizes will look different in the future

Any differences in growth rate accumulate into significant changes. Note how the United States and the Soviet Union grow relative to Western Europe.

(Source: United Nations.)" [2]

Table: Predicted future population sizes of different countries

Table 2.4 from Samuelson's Economics

Percentages and millions

	Annual Growth (% per year)	1970	1980	1985
United States	*1.3*	205.0	226.0	240.0
United Kingdom	*0.6*	55.1	59.5	61.8
France	*0.8*	50.8	55.3	57.6
Soviet Union	*1.0*	243.0	271.0	287.0
Sweden	*0.7*	8.0	8.6	8.8
Italy	*0.8*	53.7	57.9	60.0
Japan	*1.2*	103.0	116.0	121.0

Adapted from Ehrenberg (1977) *Source: United Nations*

Tables

Presenting numbers for comparison

If you are inviting the reader to compare numbers, try to ensure that those numbers are physically close together.

If this is a series of numbers, it is simpler to make the comparison and discern patterns if the numbers are arranged in a column.

To help the reader make comparisons:

- use the same level of precision,
- use commas to separate thousands,
- right align the figures.

Decimal fractions less than one should always begin with a zero.

Rounding

Simplifying by rounding assists comparisons by making numbers easier to read and remember [4] [5]. In making decisions, we usually focus on the most significant digits. By presenting too much detail we can make things harder.

The extent of rounding will depend on the intended use: a commentator may be content to report that the population of the UK is 64m, or that this has changed from 63.7m to 64.1m. An analyst performing further calculations will want to work with more precise figures.

Rounding does reduce precision. This usually means that the reported totals no longer equal the sum of the component parts. While demonstration tables should present suitably rounded numbers to illustrate the point being made, reference tables usually retain most or all of the precision so that users can decide on their own rounding.

Table: Formatting numbers for comparison and rounding to one decimal place or two significant figures

Quarter	Original	Rounded to one decimal place	Rounded to two significant figures
2013 Q1	5617.87	5,617.9	5,600.00
2013 Q2	.304	0.3	0.30
2013 Q3	12.292	12.3	12.00
2013 Q4	844	844.0	840.00
2014 Q1	5515.99	5,516.0	5,500.00
2014 Q2	.272	0.3	0.27
2014 Q3	10.867	10.9	11.00
2014 Q4	769	769.0	770.00

Making a decision on rounding can be difficult when the values show a variety of magnitudes (as in the table above). If so, consider rounding to a fixed number of (for example two) significant figures, as in the third column of the table, to enable rapid comparison.

Tables

Grid lines

Grid lines can help to separate different parts of a table and group together related items. In this example, lines are used:

- to indicate where the body of the table starts and finishes;
- to separate the headings and bring together the columns for the two sets of statistics;
- to show that two of the columns refer to change rather than level.

Excessive use of grid lines clutters the page, confusing foreground and background objects and interrupting numerical comparisons.

Summary of latest Labour Market Statistics

Thousands and percentages

United Kingdom, May-July 2014 *Seasonally adjusted*

	Total people (thousands)			Rate (%)		
		Change on:			Change on:	
	May-Jul 2014	Feb-Apr 2014	May-Jul 2013	May-Jul 2014	Feb-Apr 2014	May-Jul 2013
Employed	30,609	74	774			
Aged 16-64	29,507	69	677	*73.0*	*0.1*	*1.4*
Aged 65+	1,103	4	97			
Unemployed	2,019	-146	-468	*6.2*	*-0.4*	*-1.5*
Aged 16-64	1,998	-138	-465			
Aged 65+	21	-8	-3			
Inactive	18,714	183	136			
Aged 16-64	8,930	114	-31	*22.1*	*0.3*	*-0.2*
Aged 65+	9,784	69	167			

Footnotes omitted *Source: UK Labour Force Survey*

Grouping

Objects grouped together are assumed to be associated. Here the different measures are grouped in rows and the different types of estimate in columns.

Fonts

Different fonts can signal related items through similarity. Here, they indicate main headings and differentiate between estimated totals and rates.

White space

As well as separating groups, white space can be used to associate items together through continuity.

Here the age group-specific statistics are grouped with the headline statistics, but shown to be together at the lower-level through indentation.

Alignment

The rates on the right of the table are associated with particular age groups through alignment. To achieve this association, it is important that the columns are not too far apart. This ensures that there is no break in the implied continuity when reading across.

Tables

Ordering categories

Ordering the categories in a table is a very effective way of aiding rapid interpretation. In the example on the right, the table from page 6 is re-ordered to emphasise annual growth levels. The accompanying commentary draws attention to the fact that Japan's growth rate was not previously discussed.

For some categorical variables, like time or age group, there is a natural order for presentation. Others may have standard or harmonised orderings. Use these whenever possible. An appropriate order may also be obvious from knowledge of the subject matter.

Alternatively, consider ordering categories according to the statistics in one of the columns. In our example, the data are ordered using the summary column on the left with the largest value at the top. This shows the rankings of the categories on that statistic, and may also show where some of the statistics depart from the overall pattern.

It's interesting to note that Samuelson didn't include Japan in his comparison of growth rates

Table: Predicted future population sizes of different countries

Ranked according to growth rate *Percentages and millions*

	Annual Growth (% per year)	1970	1980	1985
United States	*1.3*	205.0	226.0	240.0
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Sweden	*0.7*	8.0	8.6	8.8
United Kingdom	*0.6*	55.1	59.5	61.8

Adapted from Ehrenberg (1977) *Source: United Nations*

Positioning summary rows and columns

Summary rows and columns, particularly for totals, were traditionally placed at the bottom or right of the table. To help set the context for the subsequent statistics, it may be more helpful to place the totals at the top or left.

Shading

In reference tables, shading is sometimes used to indicate the degree of uncertainty in an estimate.

For demonstration tables, shading can be used to highlight the point being made in the commentary. We return to this point in the section on colour.

Tables

Titles and labelling

When designing a table, bear in mind that the reader may not read the commentary or that the table could be copied and used in another context.

We cannot be completely prescriptive about what should be included, but you should consider including the following information in the titles, labels, headings and footnotes accompanying the tables:

- Analysis units (people, households, enterprises)
- Types of statistics (totals, rates, means, etc)
- Units (thousands, km, £, etc)
- Classifications used to categorise
- Geographical or sector coverage
- Time periods
- Source of data
- Information about where statistics are not comparable, e.g. over time
- Where to find further guidance

Department for Transport statistics

Traffic (www.gov.uk/government/organisations/department-for-transport/series/road-traffic-statistics)

Table TRA0101

Road traffic (vehicle miles) by vehicle type in Great Britain, annual from 1949

Billion vehicle miles

				Other Vehicles			
	Cars and taxis	Light vans [1]	Goods vehicles [2]	Motorcycles	Buses & Coaches	Total [3]	All motor vehicles
1949	12.6	4.1	7.8	1.9	2.5	4.4	**28.9**
1950	15.9	4.8	6.9	2.7	2.5	5.2	**33.0**
1951	18.2	5.1	7.3	3.4	2.6	6.0	**36.6**
[rows omitted]							
1990	208.7	24.8	15.5	3.5	2.8	6.3	**255.3**
1991	208.3	25.9	15.2	3.4	3.0	6.4	**255.7**
1992	210.0	25.6	14.8	2.8	2.9	5.7	**256.1**
1993	210.1	25.8	15.1	2.3	2.9	5.2	**256.2**
1994	214.4	26.9	15.4	2.3	2.9	5.2	**261.9**
1995	218.2	27.7	15.8	2.3	3.0	5.4	**267.0**
[rows omitted]							
2011	240.7	41.4	15.9	2.9	2.9	5.8	**303.8**
2012	240.3	41.3	15.5	2.8	2.7	5.6	**302.6**
2013	240.0	42.6	15.7	2.7	2.8	5.5	**303.7**

1 Not exceeding 3,500 kgs gross vehicle weight, post 1982

2 Over 3,500 kgs gross vehicle weight, post 1982

3 Total of all other vehicles (i.e. motorcycles, buses, and coaches)

4 Data for 1993 onwards are not directly comparable with the figures for 1992 and earlier

Source: DfT National Road Traffic Survey

Last updated: June 2014

Next update: February 2015

Telephone: 020 7944 3095

Email: roadtraff.stats@dft.gsi.gov.uk

Notes & definitions (www.gov.uk/transport-statistics-notes-and-guidance-road-traffic)

The figures in this table are National Statistics.

Graphs

When to use a graph

Graphs are an excellent way to tell a memorable story or summarise something complex. They can also reveal insight that would otherwise be hidden if the statistics were only presented in a table.

Use a graph when you want to show patterns, trends and relationships in the data, where the actual values are not required to make the point.

Principle 1: Choose the right graph for the job

What is the statistical story that you want to tell with your graph and what type of relationships does that involve? Once you've decided on your statistical story, choose the graphing strategy that works best using the matrix on this page.

We can graph seven types of relationship. Different graphing strategies work better for different relationship types.

- Size comparisons
  Comparisons of the size of different groups (e.g. teachers, nurses)
- Time series
  Quantities that change over time (weeks, months, years)
- Ranking
  Quantities ordered from highest to lowest (or vice versa)
- Part-to-whole
  Sub-divisions of a whole (e.g. regions)
- Deviation
  The difference between two sets of values (e.g. from a national average)
- Distribution
  How quantities are distributed from lowest to highest (e.g. by age group)
- Correlation
  Comparison of two sets of values to see if there is a relationship between them (e.g. income and obesity)

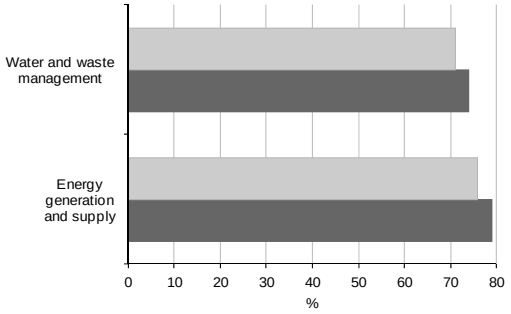
Which graph?	Size comparisons	Time series	Ranking	Part-to-whole	Deviation	Distribution	Correlation
Bars	✓	✓	✓	✓	✓	✓	×
Lines	×	✓	×	✓	✓	✓	×
Area	×	×	×	✓	×	×	×
Points	✓	✓	✓	×	✓	✓	✓
Boxes	×	✓	✓	×	×	✓	×

Adapted from Little, A. and Wye, G. (2013) [18]

Graphs

Bar graphs

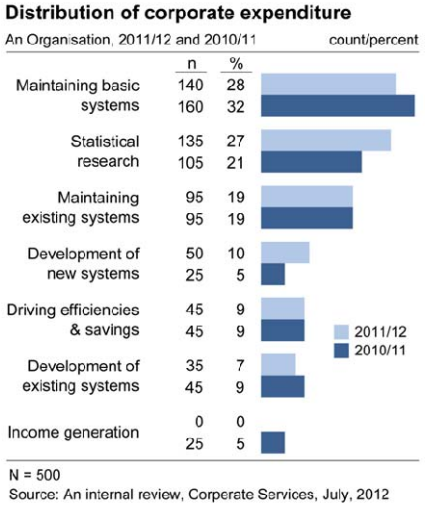
Bar graphs can be used either vertically or horizontally. Horizontal bar graphs are useful when you have long category labels that do not fit under vertical bars.



When you have clustered bars, as in the example above, the gap between the clusters should be slightly wider than a bar. For non-clustered graphs, the gap should be slightly narrower than a bar.

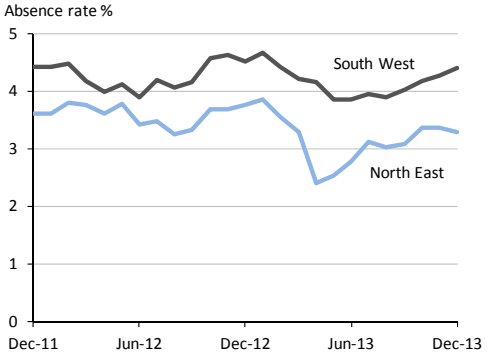
Avoid adding data labels to the bars. If you find yourself wanting to add labels, consider whether a table would be better.

You could also try using *spark lines* [6]. This approach combines both a table and a miniature graph, and can be very effective. Here is an example:



Line graphs

It's easy to clutter up a line graph with too many lines. As a general rule, graphs with more than four lines are difficult to follow, even if you vary the texture of the lines.



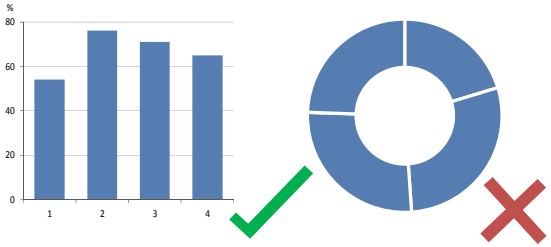
Wherever possible, label lines directly rather than using a legend. This reduces effort for the reader because they do not have to look across to a legend to see and remember what the lines represent.

Consider using a *small multiples* plot if you have a lot of different data series that you want to present in a line graph. See page 23 for an example.

Graphs

Pie charts

Pie charts (or donut charts) are often used for showing part-to-whole relationships, but in many cases a bar graph is a better option.



When to use a bar graph

- To accurately show small variations across categories which aren't obvious in a pie chart (as in the example above)
- When there are more than four or five categories

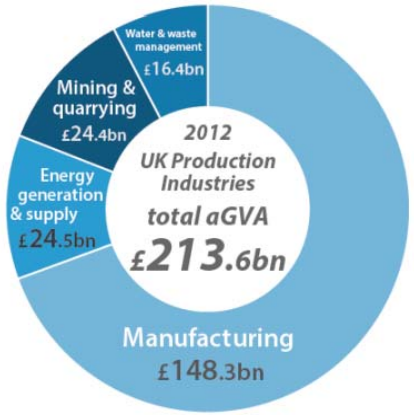
When to use a pie chart or donut chart

- If there is a dominant value in the statistics, which would dwarf the other categories in a bar graph
- To break up a page of bar graphs

Pies or donuts? Pie charts rely on our ability to decode angles, but the human brain finds it tricky to interpret these. We're much better at decoding information based on length.

With donut charts, we can use the length of the inner ring to help us understand how the sections differ.

You can also use the space in the centre of the donut chart to add extra, contextual information, as in this example from ONS.



One of the major differences between tables and charts is that a table says "here is your data, now go find the answers"... while a good chart says "here is your answer."

Jorge Camoes
excelcharts.com blog [14]

Graphs

Principle 2: Set the scene

A graph should always make sense when seen on its own as it could potentially be copied and re-used elsewhere.

Title and source. Give your graph a meaningful title, so readers know what it shows, even if removed from its original context. Include the source of the statistics underneath your graph.

Axes. Start the axes at zero unless you have a very good reason not to, such as for an index. Label the axes so it is clear what the graph is showing. Horizontal labels are much easier to read and interpret than vertical or diagonal ones.

Annotations. Consider adding annotations to the graph, if this helps to tell the story. Work Programme Statistics [6] by the Department for Work and Pensions includes good examples of annotation.

Principle 3: Focus on the story

It's tempting to put a lot of information in a graph or to stick with the graphing software default options. In many cases, this can distract from the story you're trying to tell. Aim to simplify your graph and clarify the story for your readers.

Maximise the data to ink ratio

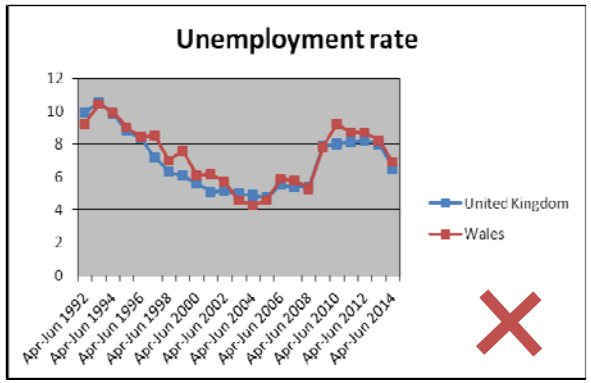
Remove anything from your graph which detracts from the story. Some common "chart junk" includes:

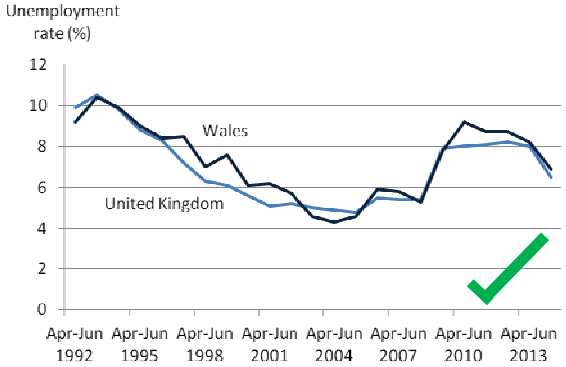
- legends
- shaded backgrounds
- borders
- patterns, textures and shadows
- 3D shapes
- data markers on line charts

Grid lines. Keep them to a minimum, so they don't clutter the graph. Multiples of two, five and ten work well for grid line increments. Make the grid lines pale grey.

Unemployment rate

Wales and the UK, 1992-2014





Source: Labour Force Survey

Graphs

Principle 4: Graphs should be the same size as a paragraph of text

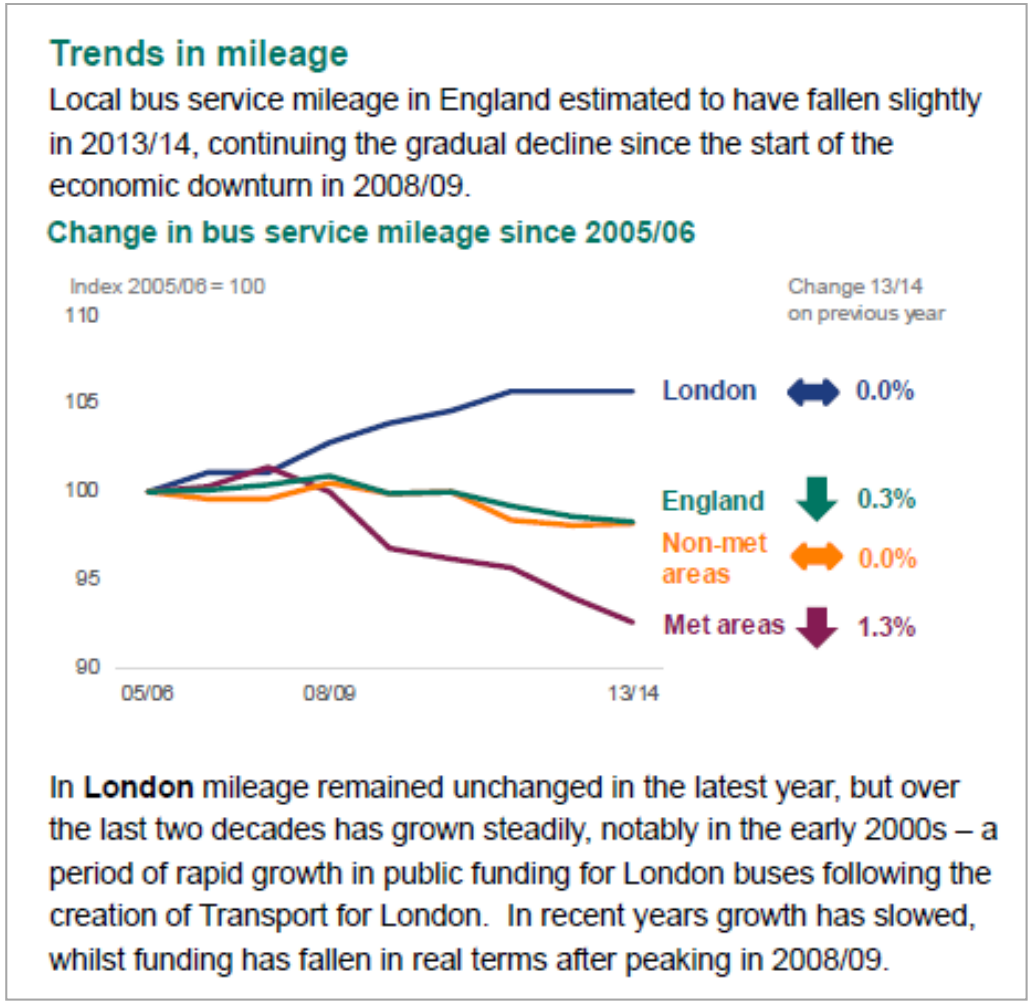
A graph that is about the same size as a paragraph of text becomes part of the natural flow of content.

When a graph is too big, it interrupts the eye's journey through the page. Over-sized graphs are perceived as being unprofessional and lack authority.

If a graph is too small the change to a smaller font disrupts the flow of text and it is hard to see what the graph is showing.

Graph text should be about the same size as the body text in the document, with the title a little larger, as in the example on the right.

The reader should be able to take in a graph at a glance. They should not need to click, scroll or enlarge a graph to view it.



Source: Department for Transport [17]

Colour

Colour can fundamentally change how we understand the information in graphs and tables. Colour used well can enhance and clarify statistical content. Colour used poorly will obscure, muddle and confuse [7].

This section sets out some key principles for working with colour in graphs and tables. It also provides examples of their application in practice.

Using colour: what users need

We add colour to make graphs and tables more effective. Users need to be able to tell which colour is which (*identification)* and to tell the difference between distinct colours (*discrimination*). The way the brain perceives colour can affect the ability to do this, as can the context in which the colours are used.

Colours are usually chosen because of a combination of three factors:

Graphic design. Illustrators may prefer particular colour combinations. House styles might use specific palettes.

Cultural context. Colours can have cultural associations. We react to these consciously and unconsciously and they vary across countries and groups. Recent research [8] shows that using colours that people would expect to see when representing familiar concepts (like blue for water) can improve quality and speed of information processing. Counter-intuitive colours (red for grass) do the opposite.

Science. Biological and psychological knowledge can help us to design colour schemes that take account of how the human brain and visual system process information. This can really improve the usability of graphs and tables.

"Avoiding catastrophe becomes the first principle in bringing colour to information.

Above all, do no harm."

Edward Tufte
Envisioning Information [16]

Colour

Principle 1:

Use colour sparingly and with restraint

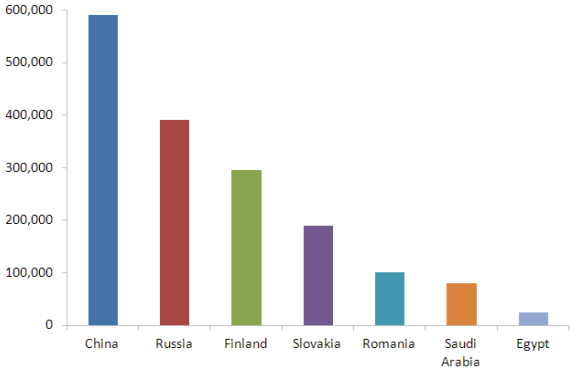
Never use colour to specify something on its own. People often print documents in black and white.

Only use different colours when they represent helpful differences of meaning in the data.

Colours are most effective when they are not overused. Limiting colour increases its impact by drawing on the brain's ability to highlight differences quickly.

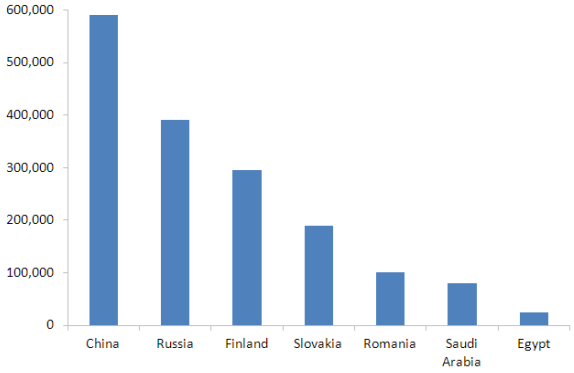
Think carefully before you introduce additional colours into a table or graph. Do you really need them? Do they enhance the clarity of the message that you want to get across?

This example, adapted from Stephen Few's Perceptual Edge website [9] illustrates the point. The two graphs show the same data on sales levels by country for a product. The labels along the x-axis tell us which countries the bars represent.



The colours in this first graph add no information value, but their presence suggests that they do. When people look at a data display like this one and see visual differences, they try to determine the meaning of those differences. Suggesting meanings which aren't there makes the reader waste time and effort trying to understand them.

The second version of the graph below is more effective. The reader is much more likely to compare the bars when they look alike than when they look different.



Colour

Defining colour digitally

Colours are represented digitally using several common schemes. For our purposes, the most useful of these is the HSL model [10]. HSL allows us to define colours uniquely using three properties which are fairly intuitive:

Hue

Hues are colours like red, blue or yellow. They are not generally perceived as having an agreed sequence, so readers may have difficulty in assigning a logical order to them. Small changes in hue are easy to detect – but colour blindness can have an impact here. This is discussed later.

Saturation (Chroma)

Saturation is the intensity of colour. It varies from grey or white (no saturation at all) to rich, glowing colour. Saturation is perceived on a continuous scale, but small changes are hard to detect.

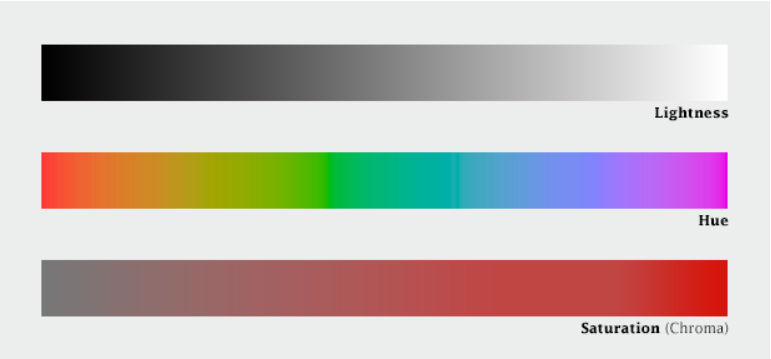
Luminance (Lightness)

Luminance is the brightness of colour. It is perceived as a continuous, ordered scale from dark to light. Changes in luminance are easy to detect, and humans can rank levels of lightness quite well unless the change is very subtle.

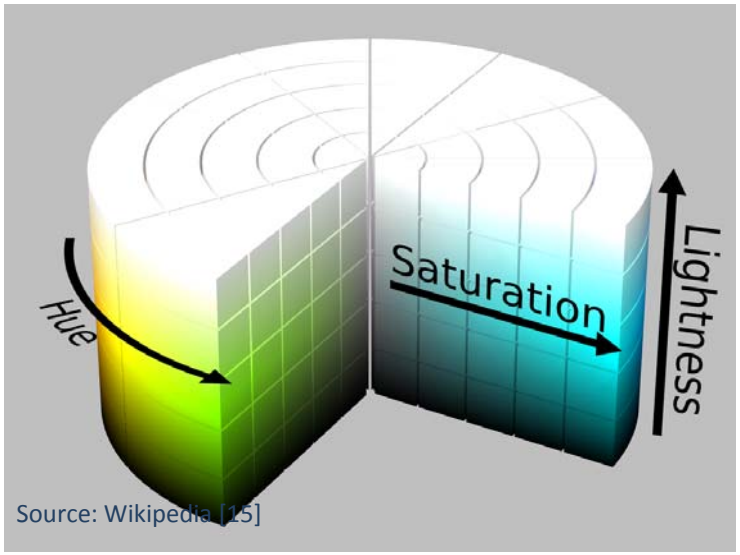
How we perceive luminance depends on hue. Consider these coloured squares:

Although they all have the same luminance and saturation, the yellow and green squares look lighter than the blue, red and purple ones. Colour palettes can be designed to adjust for this effect.

The diagrams on the right provide a visual representation of hue, saturation and luminance and how they are inter-related.



Source: Robert Simmon / NASA [10]

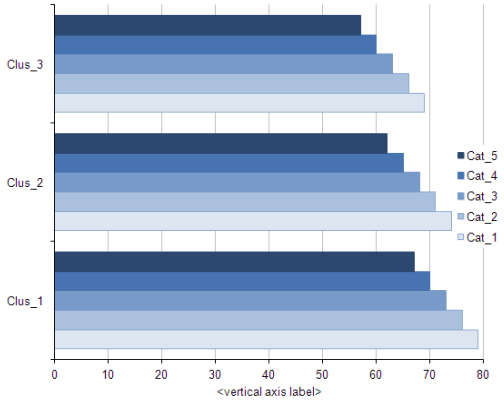


Source: Wikipedia [15]

Colour

Because luminance is perceived as having a natural order, it can help us to optimise colour schemes for maximum distinction and differentiation.

Consider this chart. It is easy to distinguish between the bars. The only changing colour parameter is luminance.

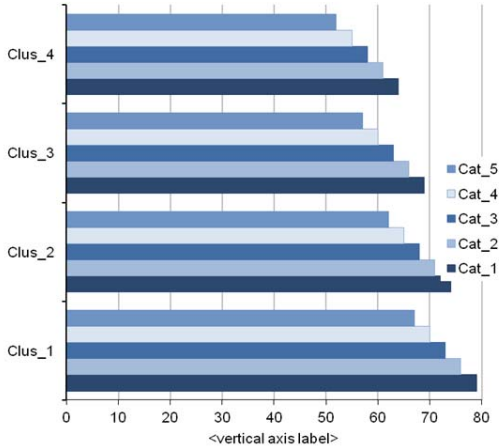


Here is the colour sequence from the bar chart above, with the percentage changes in luminance shown.

Changes in luminance of 10-20% are enough to distinguish shades in bar graphs, pie and donut charts. Changes of 30-40% are needed to achieve the same effect in line graphs.

Alternating colours

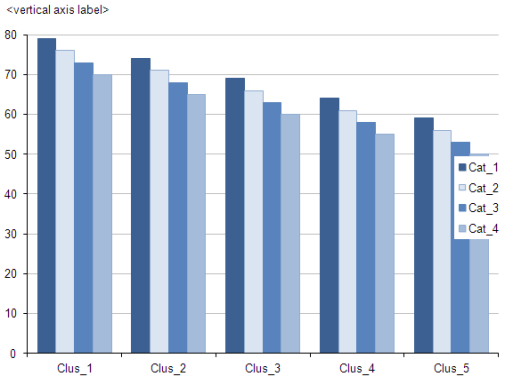
Consider alternating dark and light colours for categorical data to improve clarity. This graph uses the same palette as before, but alternates the dark and light colours to improve differentiation.



Shading edges to improve contrast

Edges can also enhance clarity. Using a dark tint for the edges of light bars makes them stand out more.

The dark bars below have the same outline and fill colour, while the light bars have darker outlines than the fill colour to improve contrast.



Colour

Principle 2:
Don’t overuse saturated colours

Use bold, saturated colours only when you want to draw attention to a specific piece of information, rather than for all of the colours in a graph.

Do not use saturated colours to highlight information in a table.

Bold, saturated colours have a powerful impact. This can include unsettling visual side-effects. They may appear to glow for many readers, can generate after-images and their presence can affect how colours viewed subsequently or nearby appear.

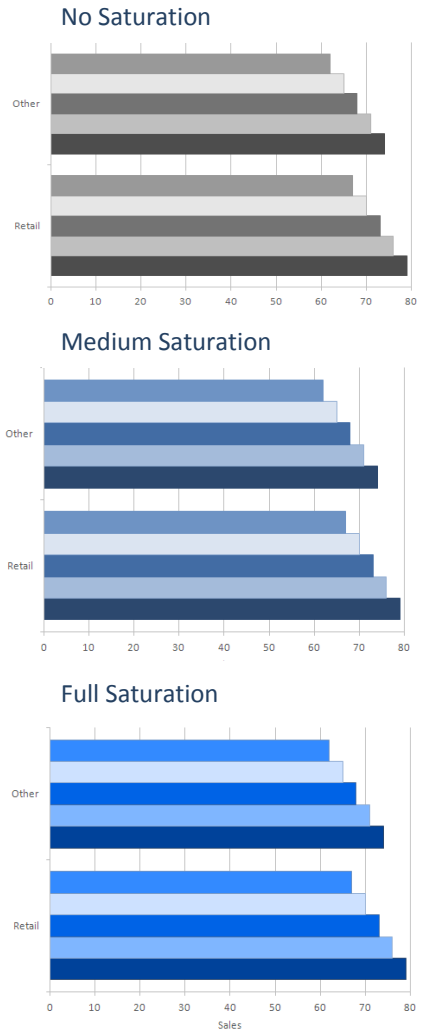
Lots of saturated colour actually reduces impact and clarity. If all the colours in a graph are bold, this can destroy any logical visual hierarchy in the data.

Mid to low levels of saturation are easy on the eye. High levels are bright and vibrant.

Consider the three graphs on the right. Hue and luminance are held constant as the colours move from no saturation through to full saturation.

The third graph is actually quite uncomfortable to look at on a screen. Saturated colours like this are best left for highlighting key messages or to draw attention to small, hard to see elements like points on a graph. Avoid using them to cover large expanses in a graph or table.

For point and line graphs, experiment with colours of medium saturation to see if you can achieve an effective result before resorting to bold, saturated ones.



Colour

Principle 3:
Be consistent in your use of colour

Use the same colour to mean the same thing in a series of graphs.

Make sure that your use of colour is consistent and logical. Where possible, use colours that users would expect to see to represent familiar concepts.

Changing what colours represent in a sequence of graphs or tables increases the reader's cognitive workload. It can also cause them to mistake one data series for another, especially if skim reading.

Using unexpected colours to represent familiar concepts (such as red for grass) slows down information processing [8] and forces the reader to work harder. These effects are small and subtle, but do accumulate.

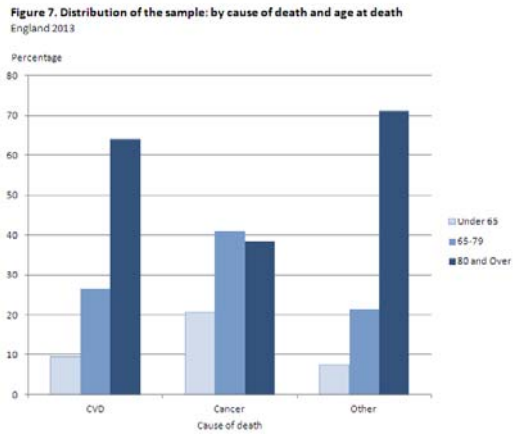
Principle 4:
Use colour logically in sequences

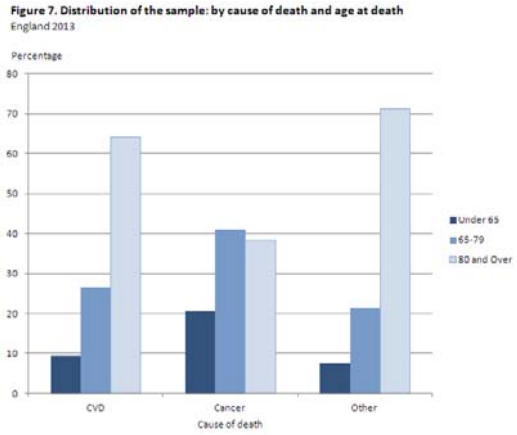
For sequences of colours, ensure that these progress in a way that the user would expect (e.g. in luminance order).

When representing a sequence, use a single hue (or small set of closely related hues) and vary lightness from pale colours to dark colours, rather than alternating.

This example uses a sequential blue palette to portray ascending age bands. The order of the colours is a matter of experimentation. A logical sequence here might be to go from light (young) to dark (old). However, the reverse means that the small bars are easier to pick out and the biggest are less overly dominant.

Use colours that are clearly distinct from one another given your choice of hue.



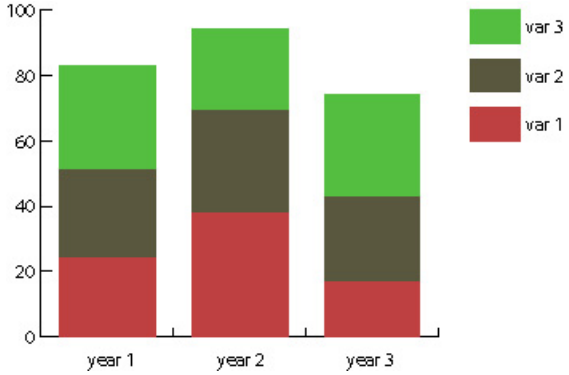


Colour

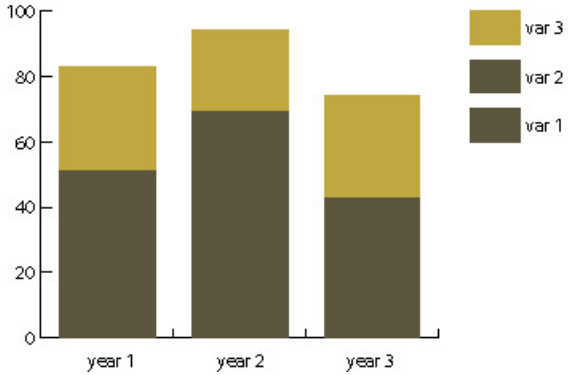
Consider accessibility

Colour blindness affects the ability to distinguish between some groups of colours, especially reds and greens. It affects about 1 in 12 men and 1 in 200 women – 4.5% of the UK population – with varying levels of severity [11].

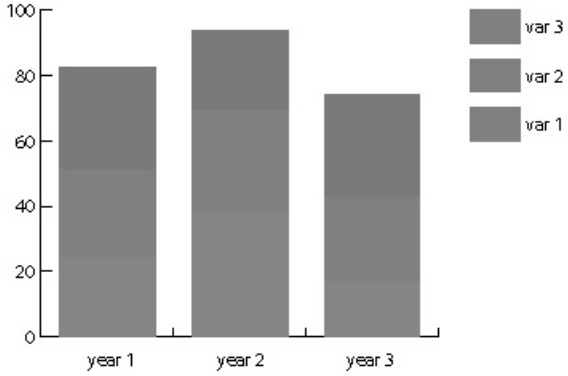
Consider this graph, which uses a red, green and grey colour scheme:



While the graph is reasonably clear for a reader with normal vision, it is much less effective for a reader with red-green colour blindness, as the next graph shows.

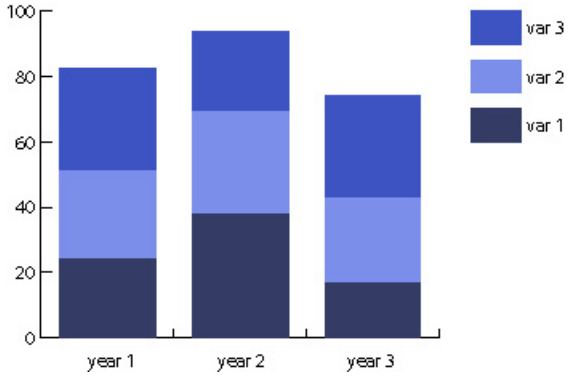


This scheme has the additional issue that it is not helpful to anybody in greyscale:

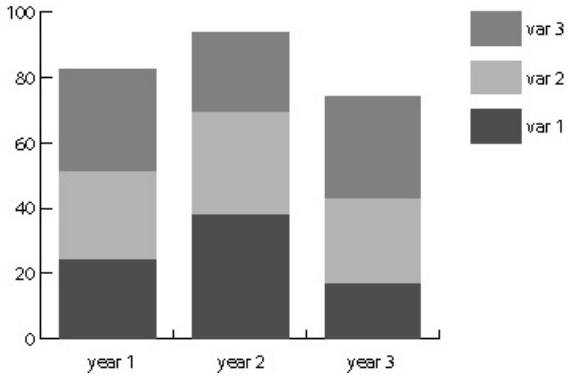


To minimise the impact on colour blind readers, avoid using greens and reds in the same display.

A safe starting point is a blue palette:



This one also works better in greyscale because the colours have been chosen to be optimally distinct from one another.



Colour

Colours on line graphs

We have already seen that graphs with more than four lines are hard to follow, even with variations in line texture and shading. Introducing additional colour is unlikely to solve the problem.

The example on this page includes seven lines. We have used Stephen Few's optimised, multi-colour, medium saturation palette from the book "Show Me The Numbers" [1]. A palette like this is sufficient for four lines (although printing it in greyscale may still be problematic), but with seven lines, the graph is hard to follow. Even this palette is not very successful for so many lines.

A better approach to visualise five or more lines is to use a "small multiples" plot [12], which picks out variations in the different series at a glance. In this example, the UK data series appears in all of the plots for easy comparison with other countries.

Figure 3: Quarterly international manufacturing output

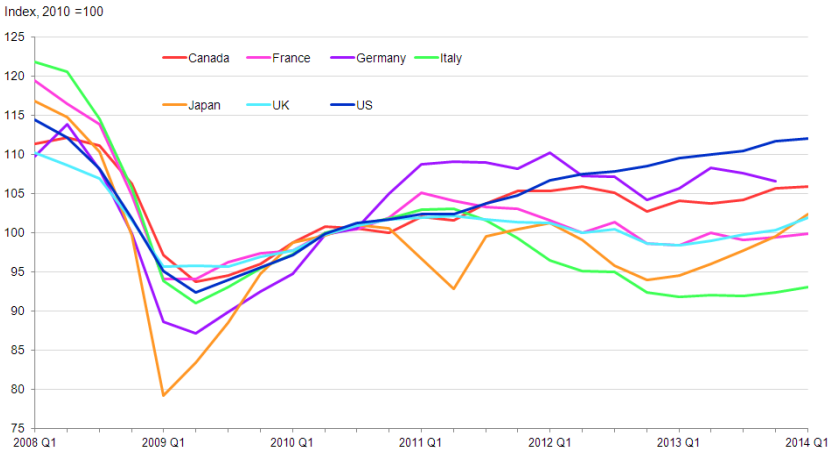
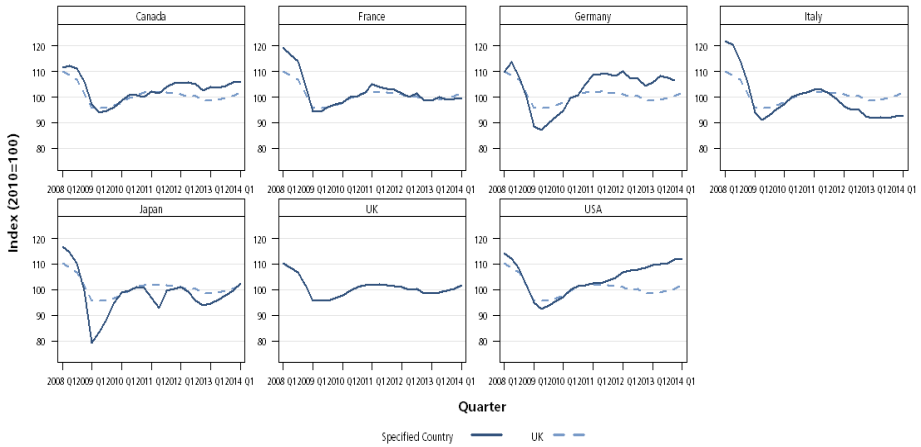


Figure 3: Quarterly international manufacturing output



Colour

Colour and highlighting

Colour can be used to highlight elements of graphs and tables to aid interpretation.

In graphs, use a distinct foreground colour to draw attention to specific features. Muted pastel or grey shades can be used to reduce the impact of the other elements in the graphic.

The graphs on this page use a red highlight colour, with muted greys for the other elements. Note the use of a more saturated red on the line chart than on the bar chart. Even here, it is not usually necessary to use very high levels of saturation to achieve helpful results.

Carefully chosen background colours can also be used to improve the clarity of tables by highlighting particular rows or columns. Use subtle shades rather than bold, saturated ones for highlighting in tables.

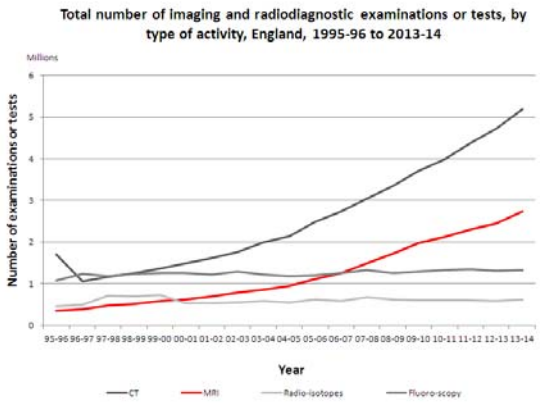
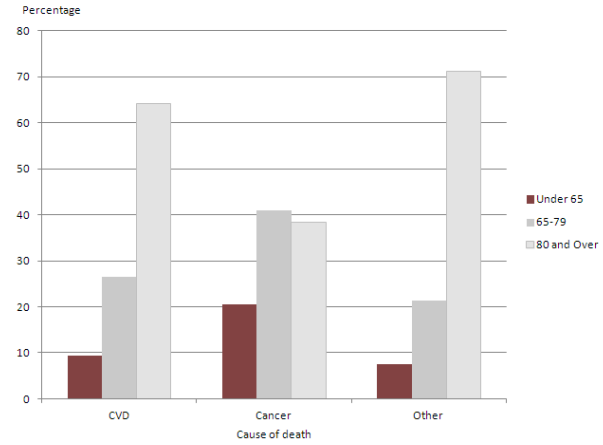


Figure 7. Distribution of the sample: by cause of death and age at death
England 2013



SomeData: By SomeCategory

SomePlace, 2011 SomeUnit

	Cat_1	Cat_2	Cat_3	Cat_4	Cat_5
Variable_1	22.7	56.3	98.5	33.6	87.4
Variable_2	19.6	65.2	78.2	78.9	65
Variable_3	23.7	23.9	12.7	55.2	44.2
Variable_4	12.9	98.5	32.6	25.1	23.9
Variable_5	67.9	73.1	78.3	12.8	17.4
Variable_6	23.9	45.2	93.2	83.8	45.1
Variable_7	45.8	21.8	77.3	87.2	98.9

1 Some footnote about something

Source: SomeSurvey from somew here

The following colours and mixtures of colours work well for this purpose:

- Grey
- Blue
- Grey with any one of blue, purple, red, pink or orange
- Blue with any one of purple, red, pink or orange

Unless you use very light shades green, cyan and yellow should be avoided. Remember not to mix greens and reds.

Don’t overdo highlighting in tables. It is best to restrict this to one or two columns.

Colour

Background colour

Effective use of colour applies as much to graph annotation and background as it does to data elements like bars and lines.

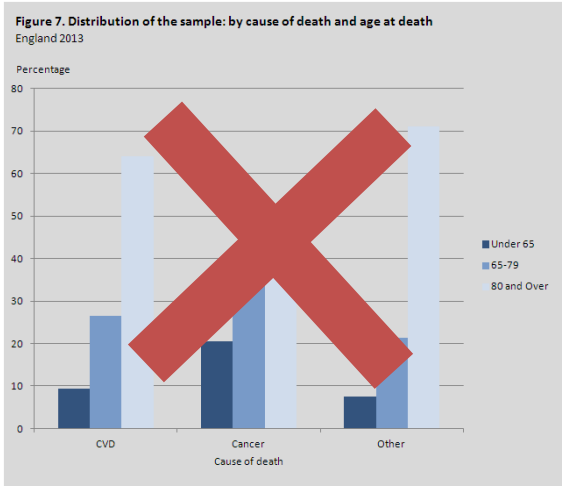
Principle 5:
Use a white background

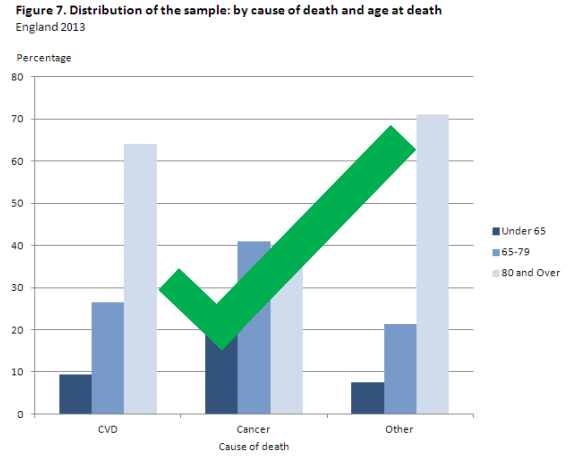
Most colour palettes are designed to appear on a white background.

Human vision adopts colour perception relative to the local definition of white. A white background provides a helpful reference “anchor” for the visual system.

The only functional reason to use a non-white background is for viewing the image in the dark. The use of modern digital projectors, which work well under normal lighting conditions [7], make this issue is largely irrelevant today.

- Confine use of colour to foreground items in graphs. Always use white for background. Use grey palettes for drawing and labelling axes and annotation.
- In general, background colour should be avoided in tables unless it is to provide subtle highlighting.
- Avoid using white as a foreground colour in graphs. It should also be avoided on maps unless it represents “no data”.
- Never, ever use images as backdrops in graphs or tables. These simply distract the reader.





References and resources

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Other useful material

General references

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Evergreen, Stephanie D., Presenting data effectively – communicating your findings for maximum impact, Sage Publications, 2014.

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Information Is Beautiful website: http://www.informationisbeautiful.net/

Perceptual Edge website: http://www.perceptualedge.com.

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United Nations Economic Commission for Europe, Making data meaningful Part 2: A guide to presenting statistics, available from http://www.unece.org/stats/documents/writing/ .

Visualising data website: http://www.visualisingdata.com/

Yau, N., 2011, Visualize this: The FlowingData guide to design, visualisation and statistics, Wiley.

On colour

Brewer palettes website: http://mkweb.bcgsc.ca/brewer/

Colorbrewer website: http://colorbrewer2.org

Colour usage guidance and tools at NASA Ames Research Laboratory: http://colorusage.arc.nasa.gov/guidelines.php

Colour FAQ: http://www.poynton.com/PDFs/ColorFAQ.pdf

I Want Hue website – colours for data visualisation: http://tools.medialab.sciences-po.fr/iwanthue/

Kosara, R., 2013, How the rainbow color map misleads, available at http://eagereyes.org/basics/rainbow-color-map