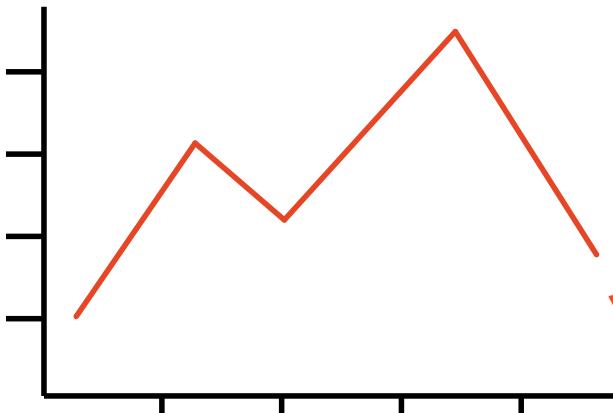


Data Visualisation
CIVL3704
2 September 2024

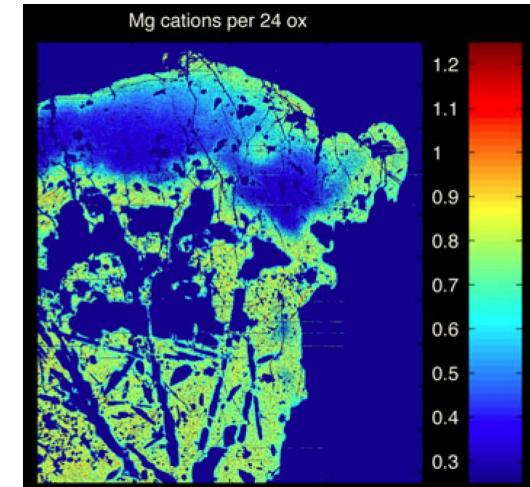
Presented by Nathaniel Butterworth
Slides courtesy of Kayla Maloney

<https://www.sydney.edu.au/research/facilities/sydney-informatics-hub.html>

What is data visualisation?

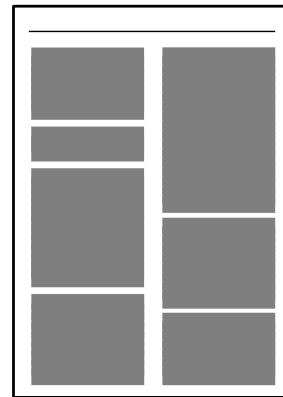


ID	X	Y
tl_001	3.7	0.42
tl_002	2.2	0.45
tl_003	6.5	0.48
tl_004	3.9	0.51



Maloney et al. (2011)

[doi:10.1111/j.1525-1314.2011.00934.x](https://doi.org/10.1111/j.1525-1314.2011.00934.x)



Give away

```
graph TD; alligator[alligator] -- stew. --> my1[my]; alligator -- soup. --> my2[my]; alligator -- pie. --> the[the]; my1 -- shoe. --> shoe_lyrics["shoe, But don't give away my alligator stew."]; my1 -- hockey_stick. --> hockey_stick_lyrics["hockey stick, give away my hoop, But don't give away my alligator soup."]; the -- green_grass. --> green_grass_lyrics["green grass, give away the sky, But don't give away my alligator pie."];
```

alligator

stew.
soup.
pie.

shoe, But don't give away my alligator stew.
hockey stick, give away my hoop, But don't give away my alligator soup.
green grass, give away the sky, But don't give away my alligator pie.

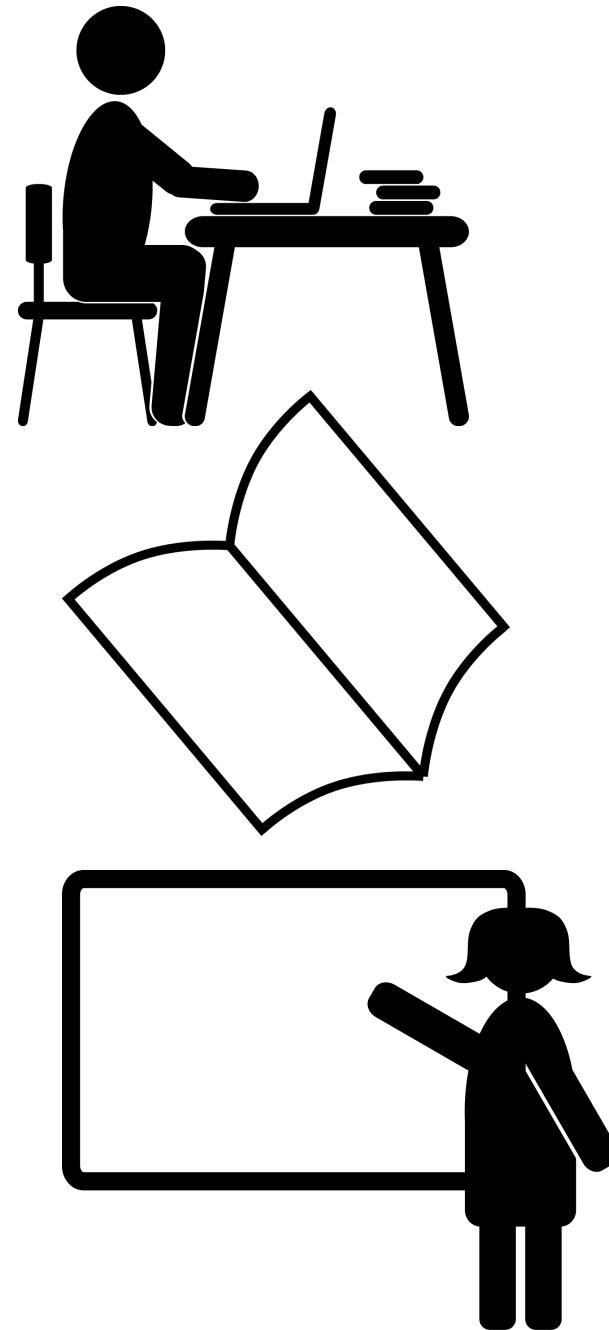
my

shoe.
hockey stick.

the

Who is it for?

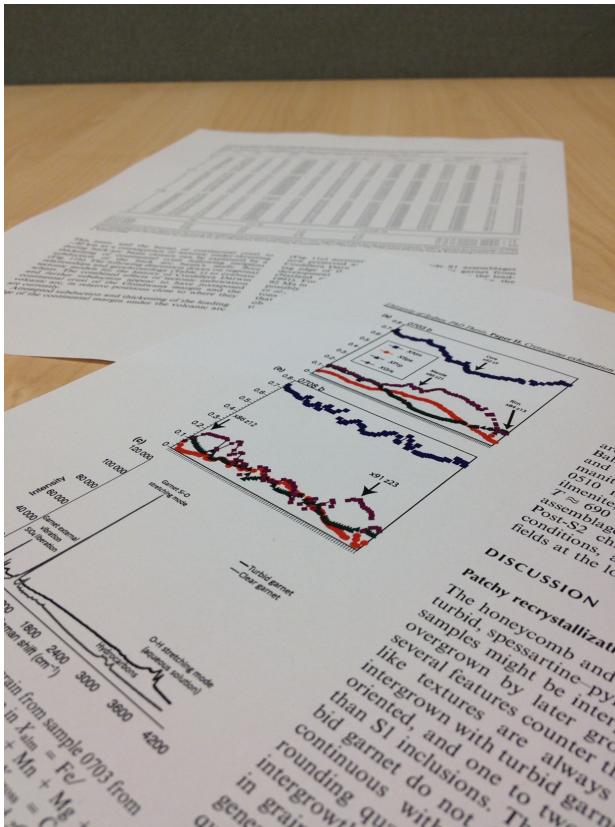
- Yourself
 - As part of the analysis of your data
- Others in your field
 - At conferences or as figures in papers
- Non-specialists
 - As part of public outreach
 - As part of reporting requirements



Presentation medium

How are you going to present your visualisation?

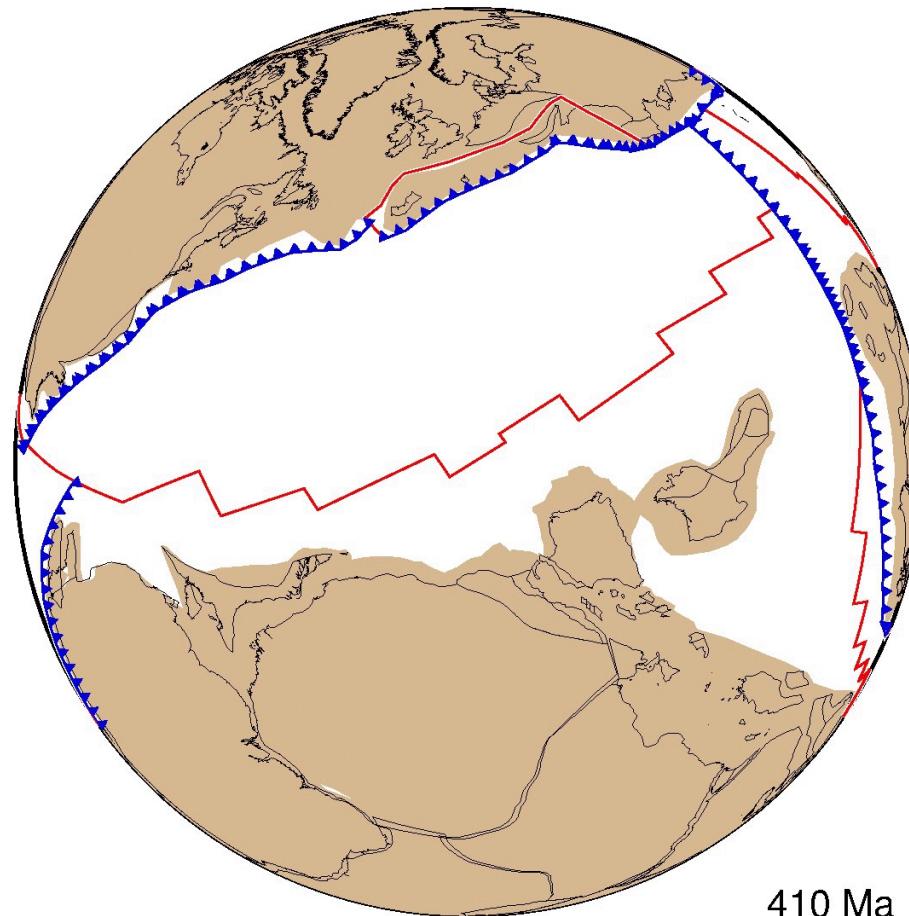
- Figure or table in a paper or poster



Presentation medium

How are you going to present your visualisation?

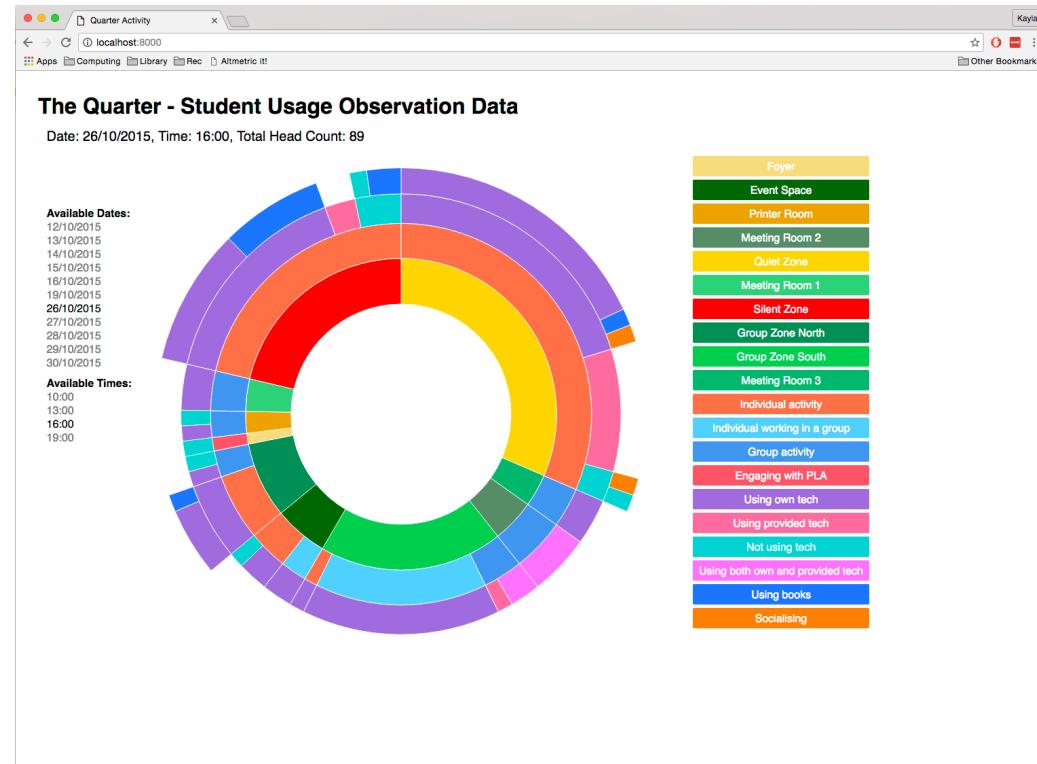
- Figure or table in a paper or poster
- On a slide in a talk



Presentation medium

How are you going to present your visualisation?

- Figure or table in a paper or poster
- On a slide in a talk
- On a website



Principles of Data Visualisation

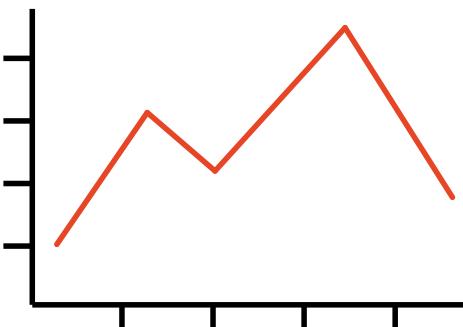
- Focus on the primary message of the visualisation
- Keep it as simple and uncluttered as possible
- Provide all information necessary to understand the visualisation
- Make comparisons easy
- Avoid any misleading presentation



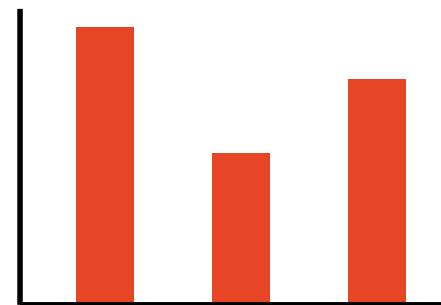
Focus on the primary message

Pick a figure type appropriate to your data and your message

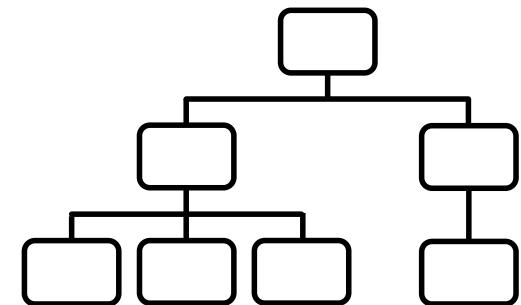
Numerical



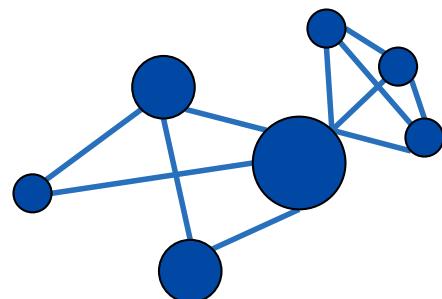
Categorical



Hierarchical



Network



Geographic/geospatial



Textual

Focus on the primary message

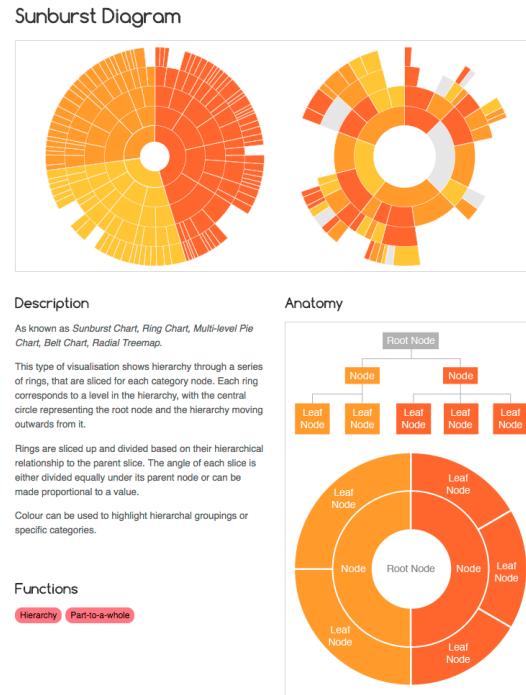
The Data Visualisation Catalogue

About • Suggest • Shop • Resources

Search by Function View by List

Arc Diagram Area Graph Bar Chart Box & Whisker Plot Brainstorm Bubble Chart

Bubble Map Bullet Graph Calendar Chord Diagram Choropleth Map Circle Packing



The Data Visualisation Catalogue can
be found at:

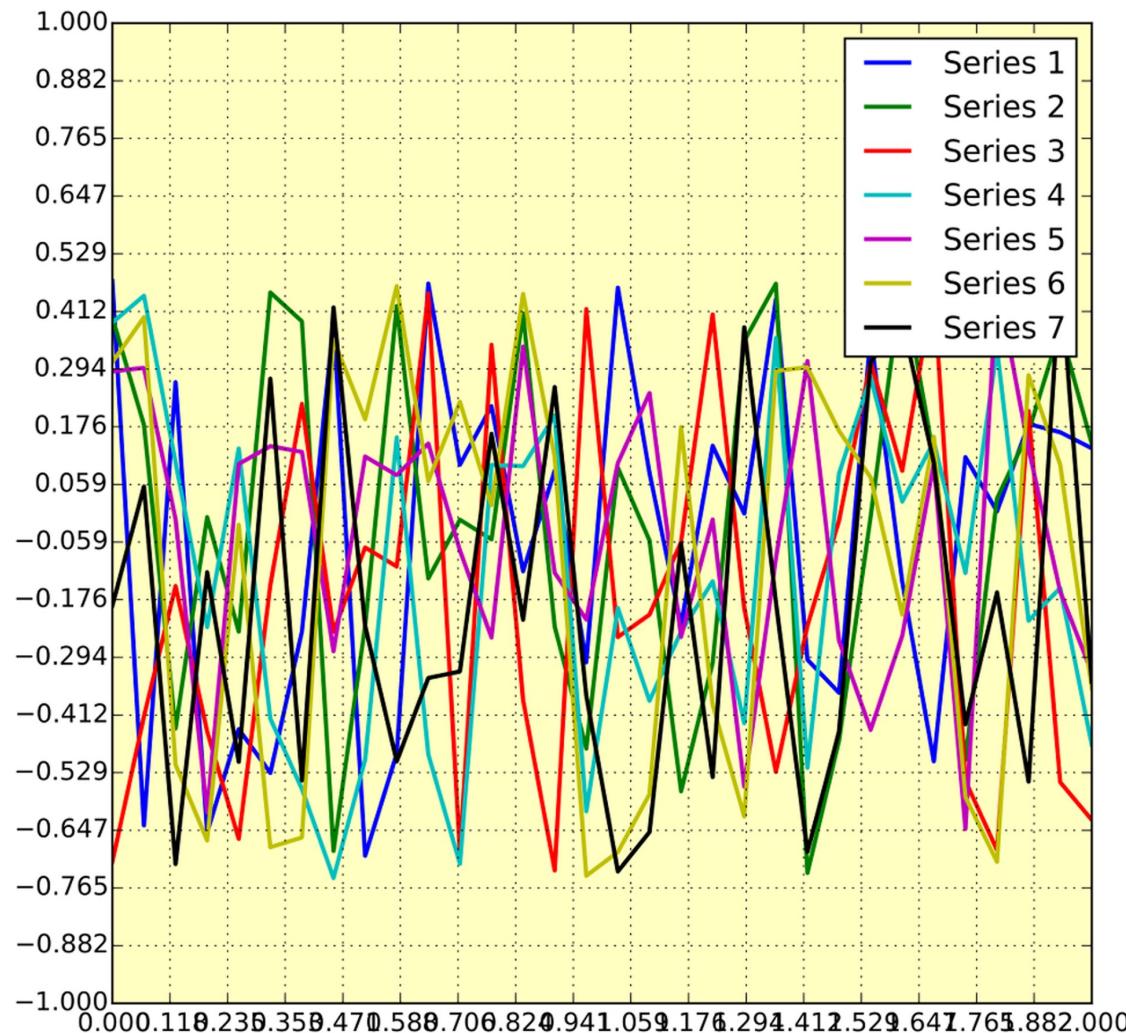
<http://www.datavizcatalogue.com/>

Or

<https://datavizproject.com/>

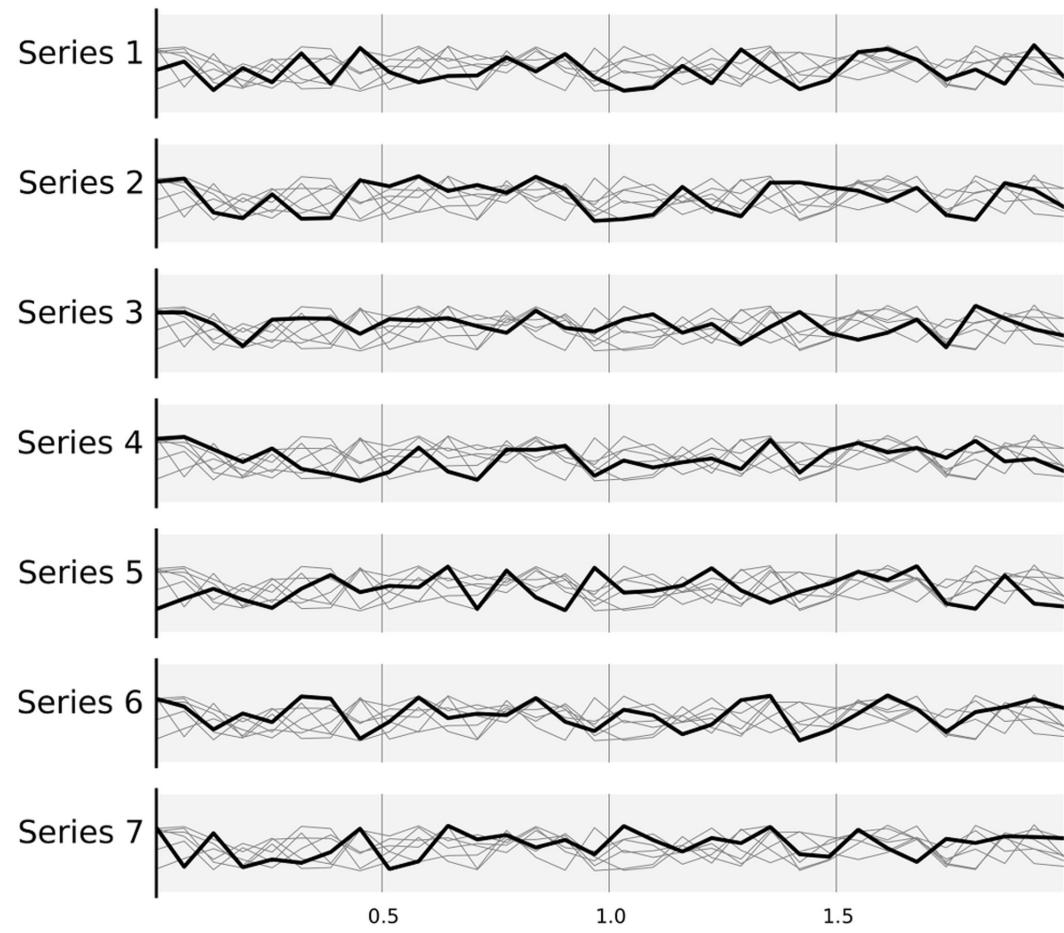
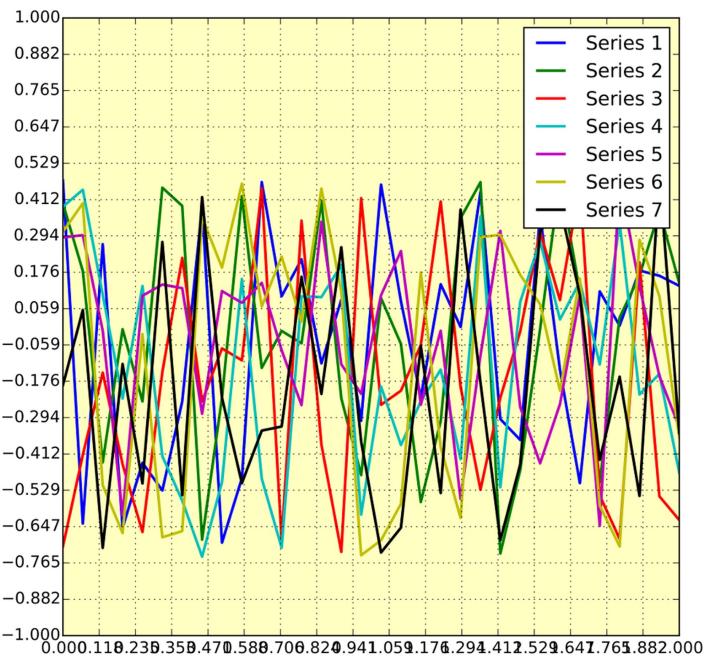
Keep it simple and uncluttered

What's wrong with this graph?



Keep it simple and uncluttered

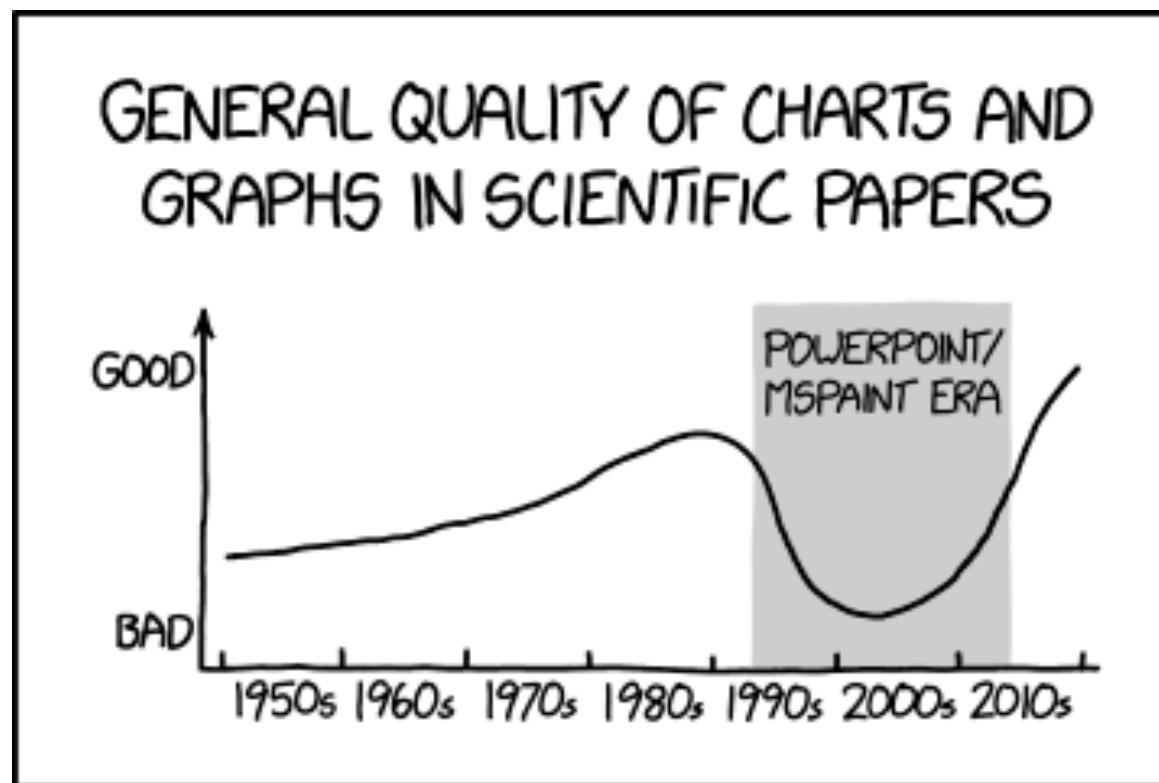
Consider your message when simplifying and tidying.



Rougier et al. (2014) [CC0 1.0]

Keep it simple and uncluttered

Plotting program defaults

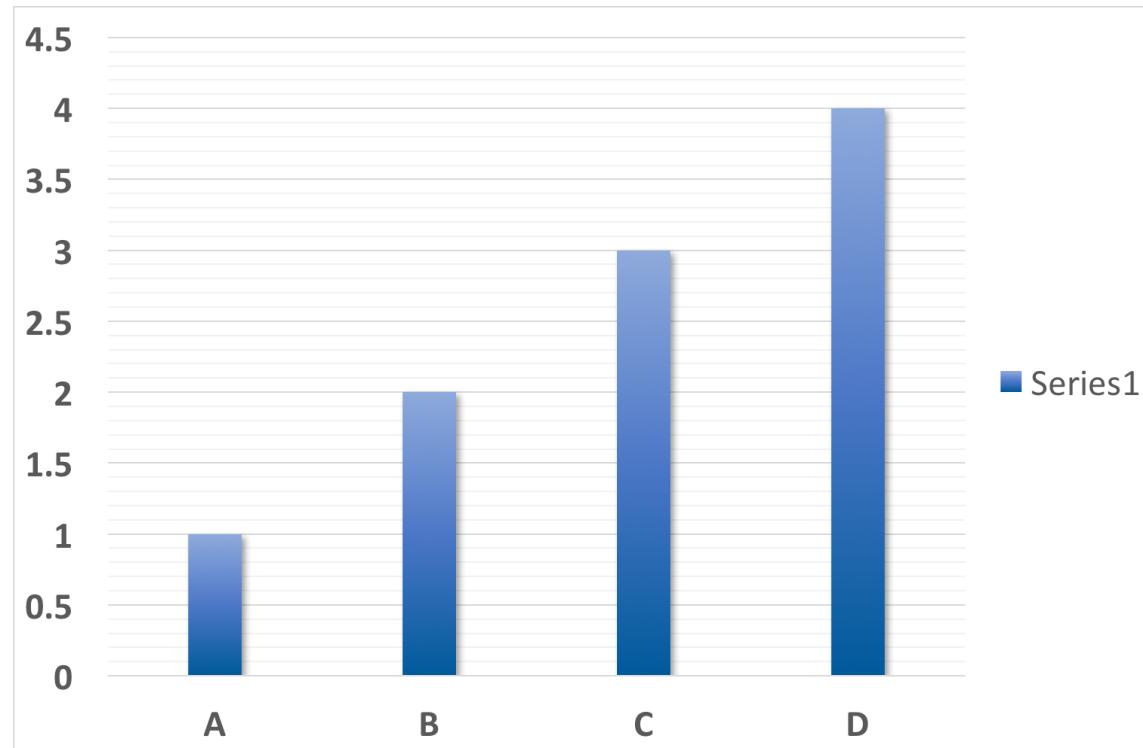


[Scientific Paper Graph Quality](#) by Randall Munroe xkcd.com [CC BY-NC 2.5]

Keep it simple and uncluttered

Plotting program defaults

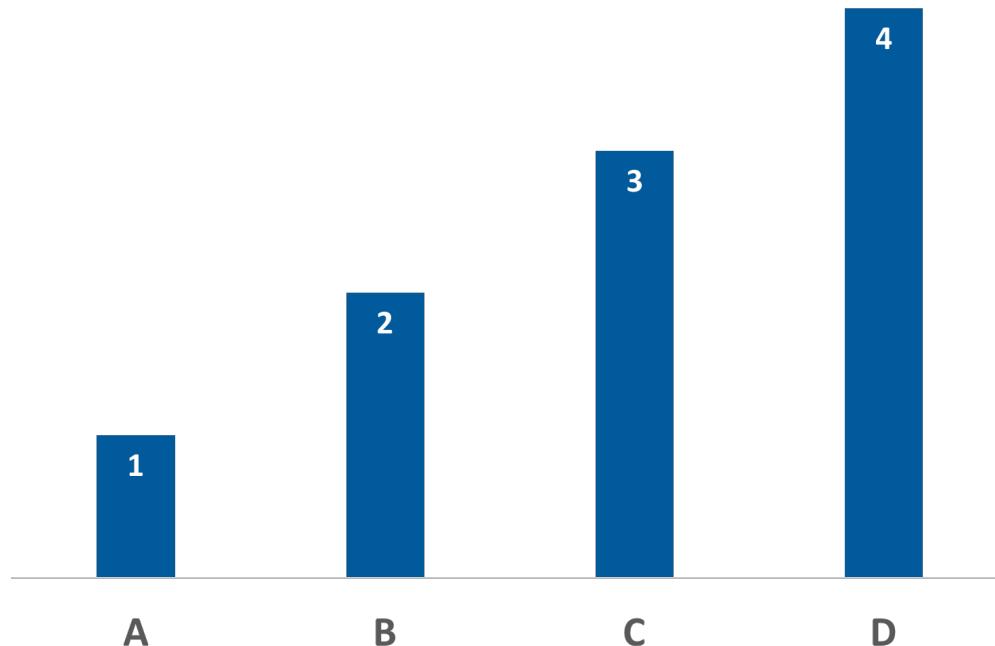
- Gridlines, gradients, shadows, excessive annotations add clutter



Keep it simple and uncluttered

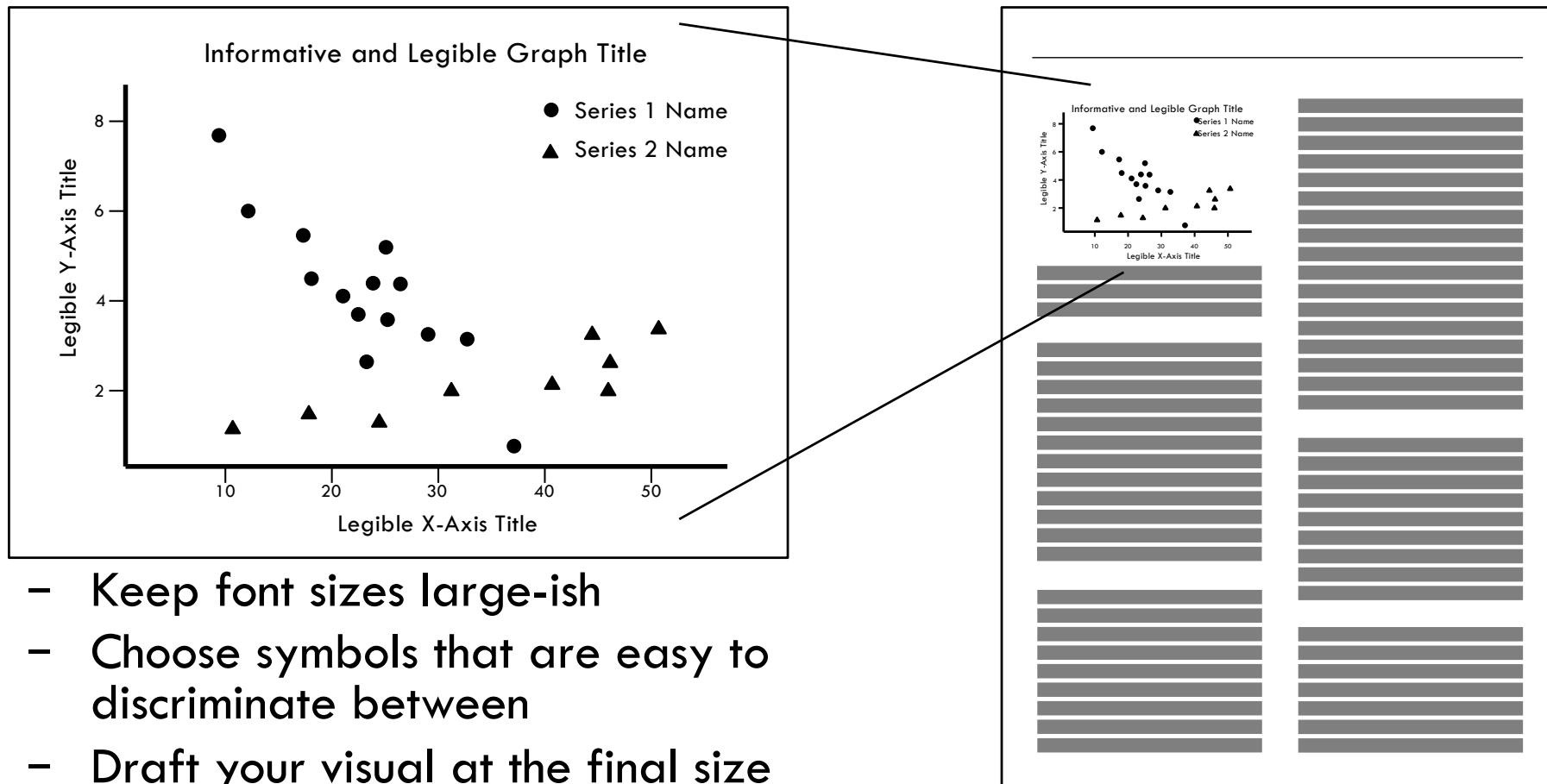
Plotting program defaults

- Gridlines, gradients, shadows, excessive annotations add clutter
- Direct labelling useful for simple plots
- Custom chart templates



Include all necessary information

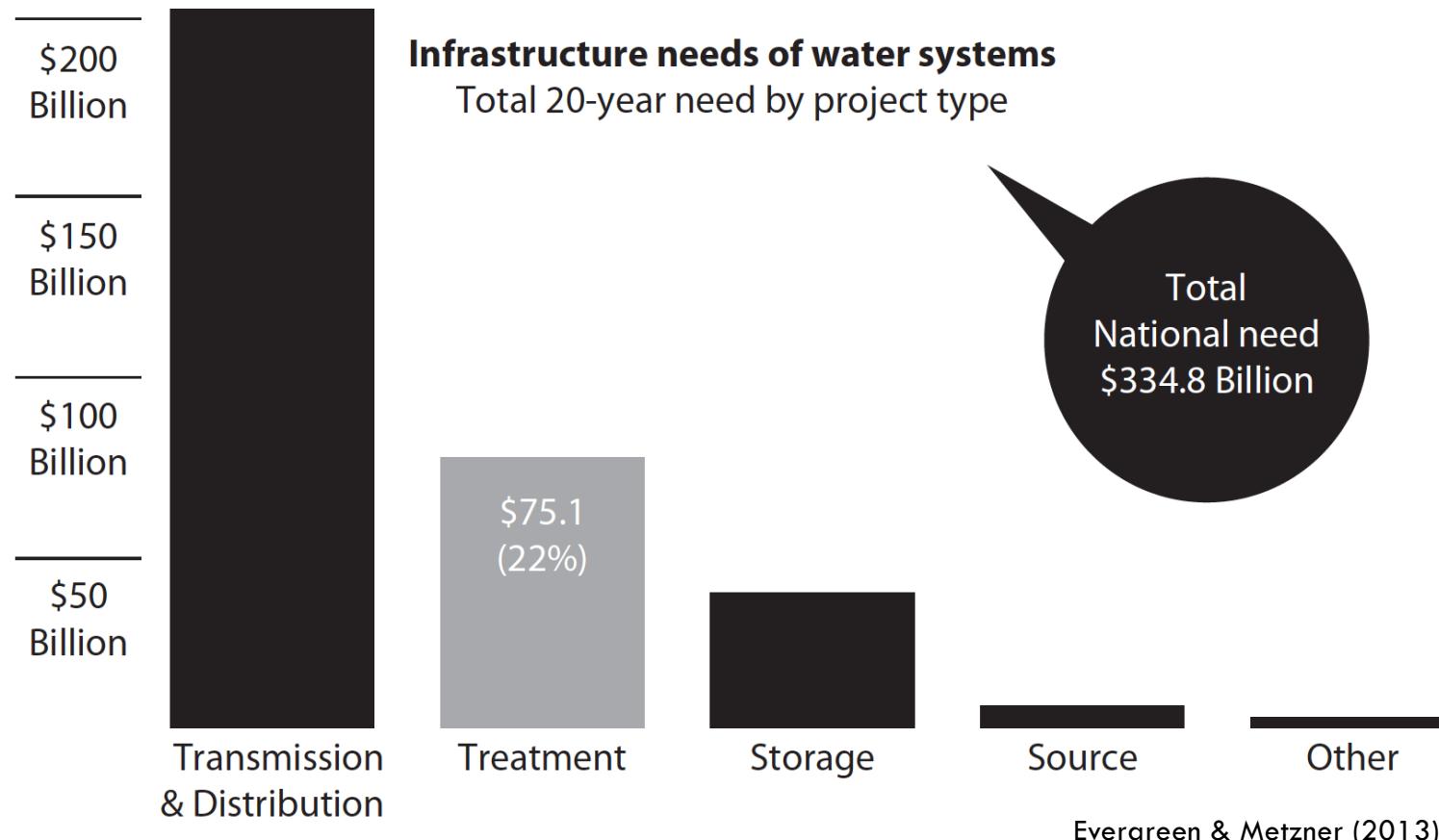
Ensure all parts are easily legible



Include all necessary information

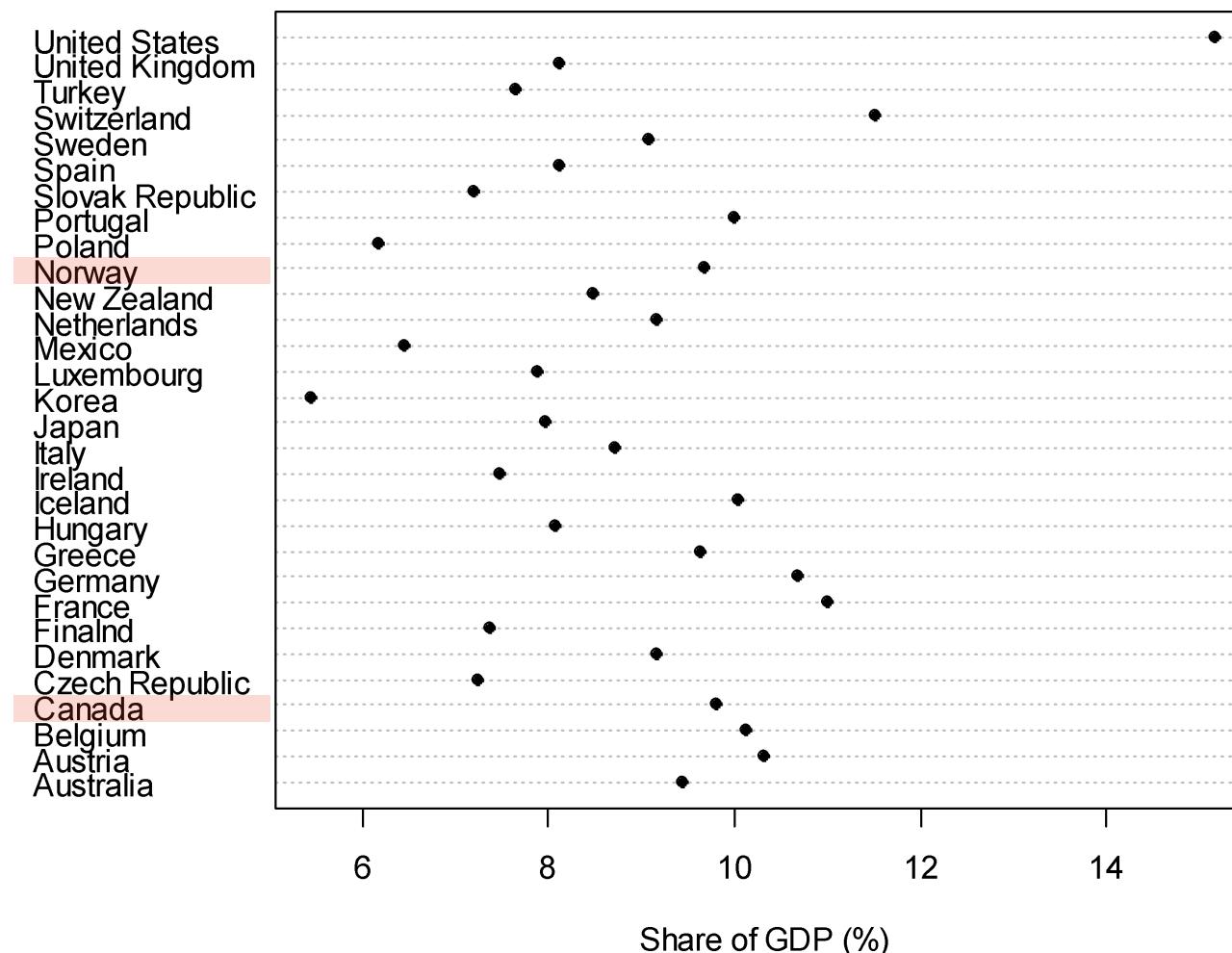
Emphasise important details

- Use sparingly! You don't want to re-clutter your visual



Make comparisons easy

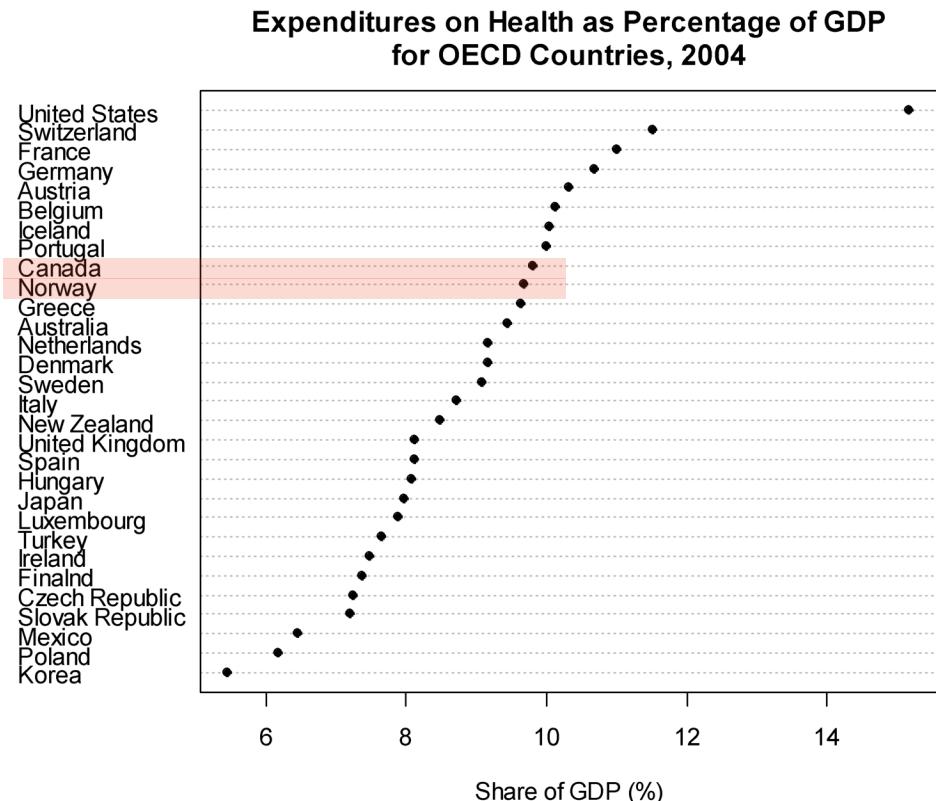
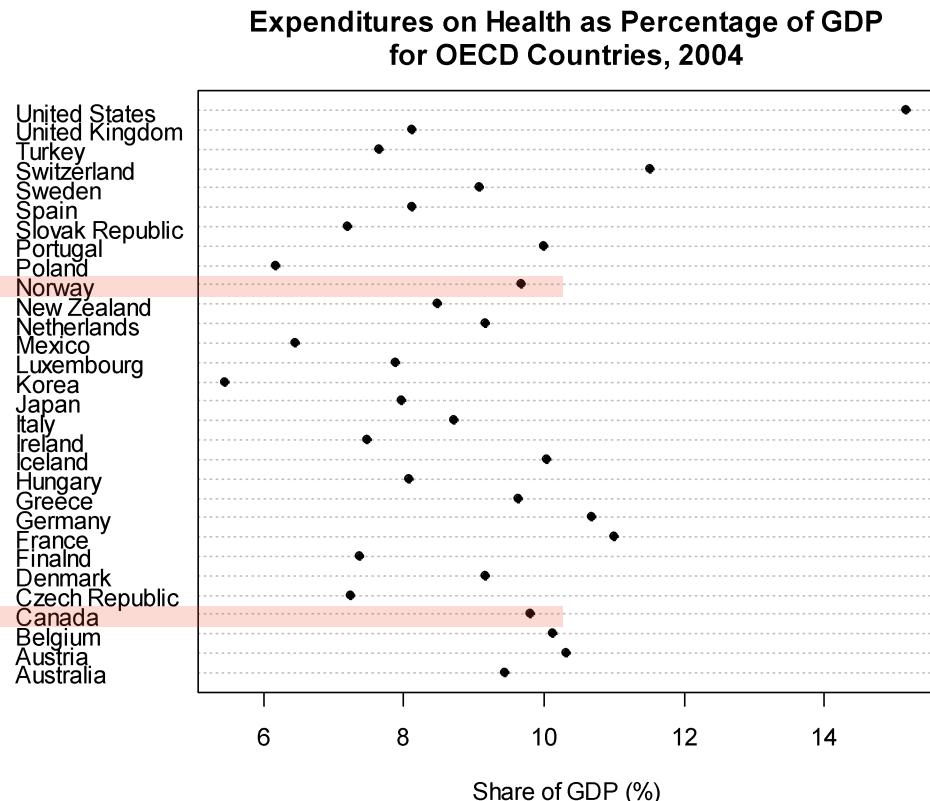
Expenditures on Health as Percentage of GDP
for OECD Countries, 2004



Michael Friendly (2001)
[\[CC-BY-NC 3.0\]](#)

Make comparisons easy

Order data in a meaningful way



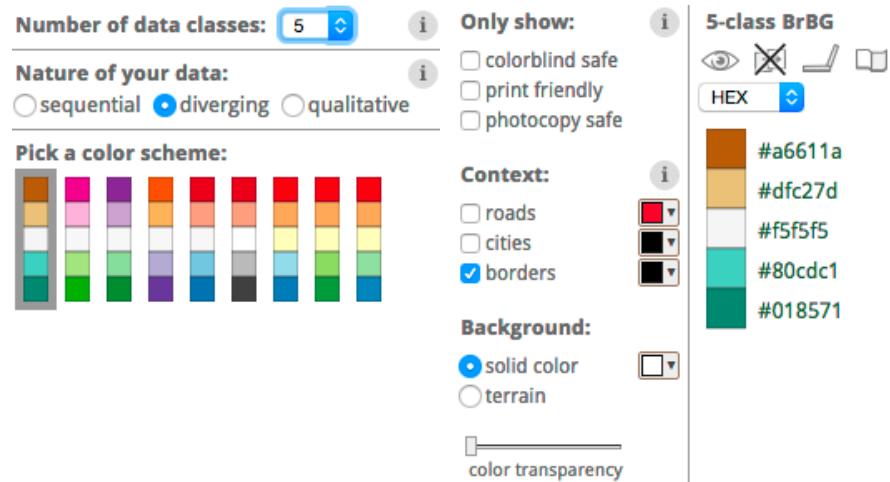
Michael Friendly (2001)
[CC-BY-NC 3.0]

Make comparisons easy

Colour resources

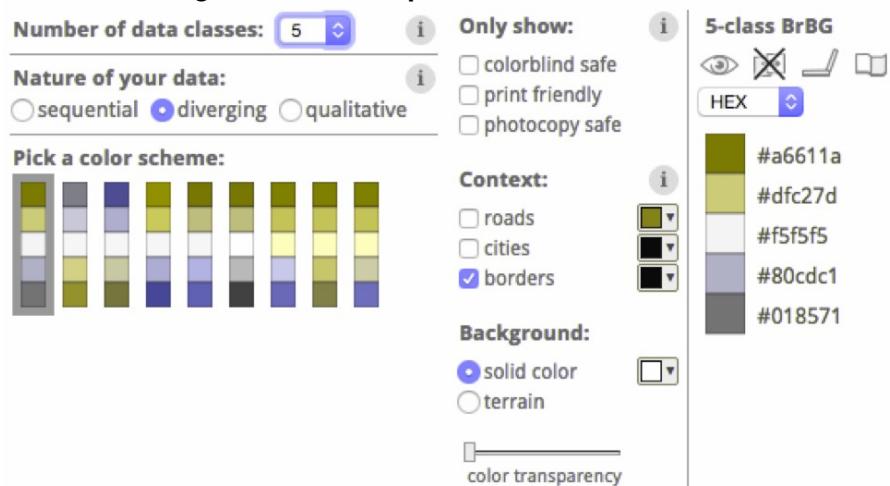
- ColorBrewer 2.0 – helps you create colour palettes and notes whether they are colour-blind, print and photocopy friendly
colorbrewer2.org
- Color Oracle – a colour-blindness simulator that applies a filter to your screen to demonstrate how it would be perceived by people with several types of colour impaired vision
colororacle.org

Picking a colour scale using ColorBrewer 2.0



The screenshot shows the ColorBrewer 2.0 interface for picking a color scale. The 'Number of data classes' is set to 5. Under 'Nature of your data', 'diverging' is selected. A preview of the '5-class BrBG' color scheme is shown, consisting of five colors: #a6611a (orange), #dfc27d (yellow-orange), #f5f5f5 (light grey), #80cdc1 (teal), and #018571 (dark teal). The 'Only show' section includes checkboxes for 'colorblind safe', 'print friendly', and 'photocopy safe'. The 'Context' section has a checked 'borders' option. The 'Background' section shows 'solid color' is selected. A 'color transparency' slider is at the bottom.

Simulating deutanopia with Color Oracle



The screenshot shows the Color Oracle interface simulating deutanopia. The 'Number of data classes' is set to 5. Under 'Nature of your data', 'diverging' is selected. A preview of the '5-class BrBG' color scheme is shown, consisting of five colors: #a6611a (orange), #dfc27d (yellow-orange), #f5f5f5 (light grey), #80cdc1 (teal), and #018571 (dark teal). The 'Only show' section includes checkboxes for 'colorblind safe', 'print friendly', and 'photocopy safe'. The 'Context' section has a checked 'borders' option. The 'Background' section shows 'solid color' is selected. A 'color transparency' slider is at the bottom.

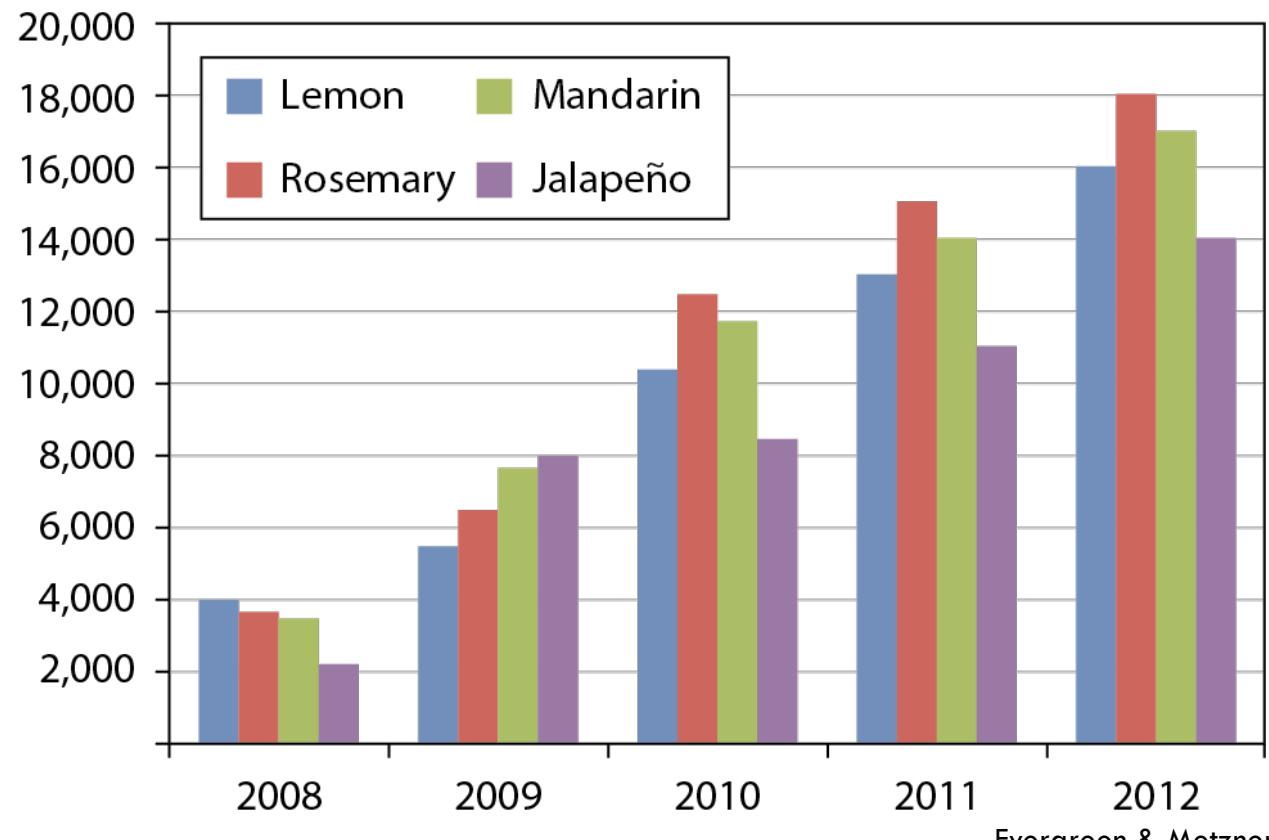
Avoid misleading presentation

Consider your use of colour:

- Pre-existing colour associations

Importing infusion scents

Quantities rise as programs help increase production



Evergreen & Metzner
(2013)

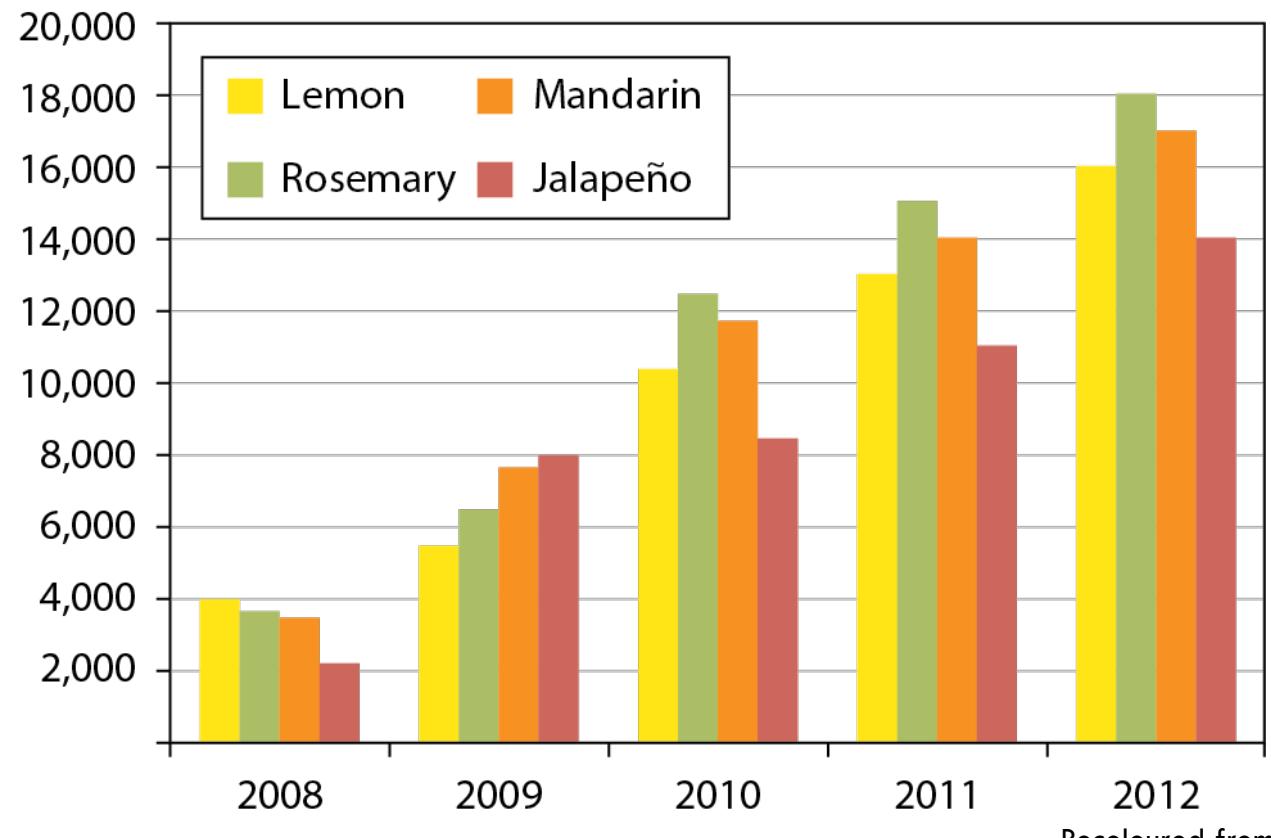
Avoid misleading presentation

Consider your use of colour:

- Pre-existing colour associations

Importing infusion scents

Quantities rise as programs help increase production

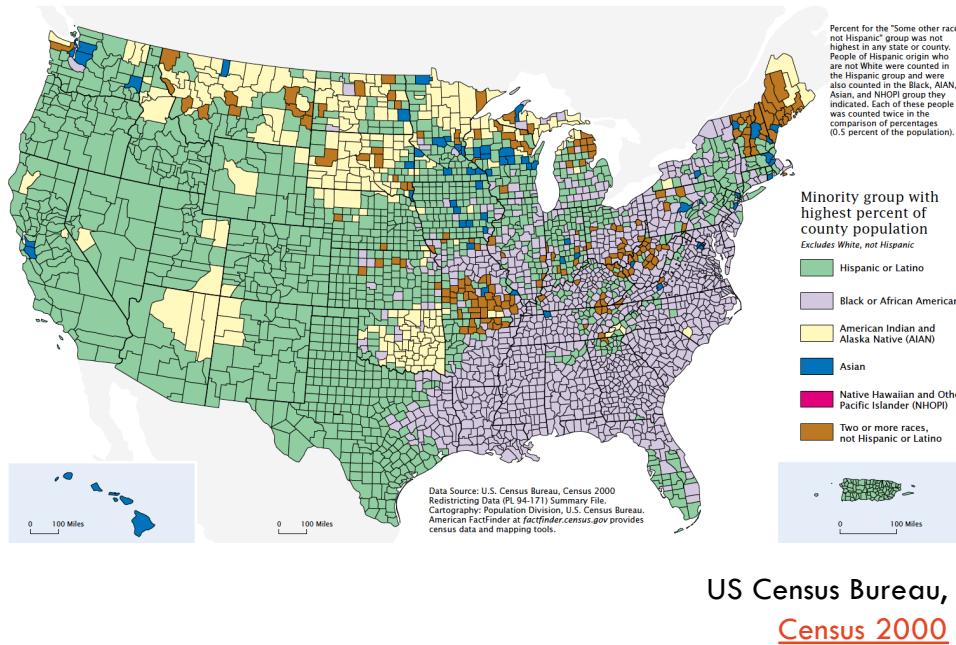


Recoloured from
Evergreen & Metzner (2013)

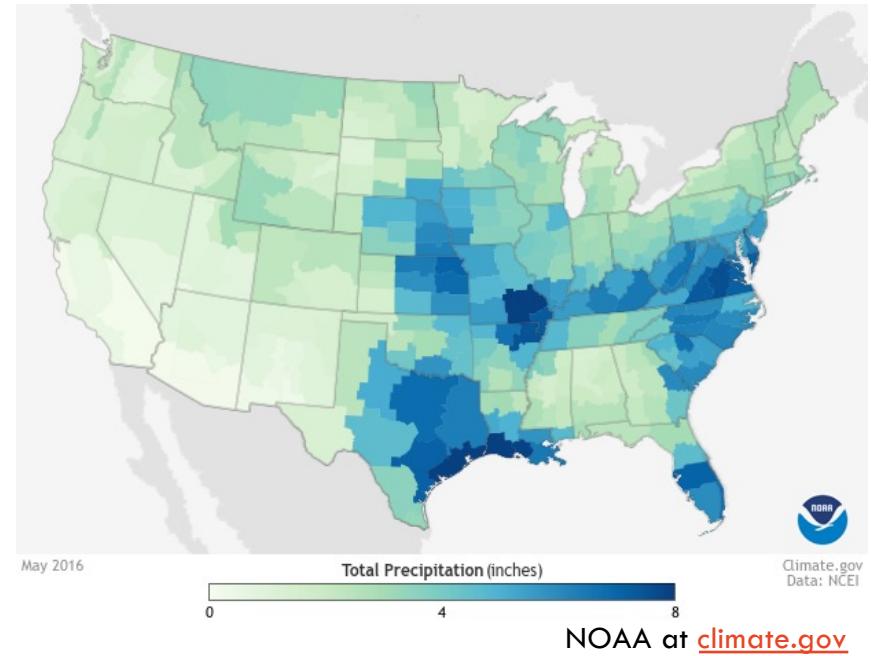
Avoid misleading presentation

Consider your use of colour:

- Does it imply nominal or sequential data?



- Nominal**
- Unordered
 - Represented by different, distinct colours



- Sequential**
- Ordered
 - Represented by a gradient, generally in hue or intensity

So, to create an effective data visualisation...

Before you start, consider:

- Who is it for?
- How will it be presented?
- What do you need to say?

Remember the Principles while making your visualization:

- Focus on the primary message of the visualisation
- Keep it as simple and uncluttered as possible
- Provide all information necessary to understand the visualisation
- Make comparisons easy
- Avoid any misleading presentation

Then get a pal to look it over.

Python example!

- <https://github.com/natbutter/SydneyTolls>

Where next?

University training in specific tools, including Excel, MATLAB, R, Python

Training schedule available at:

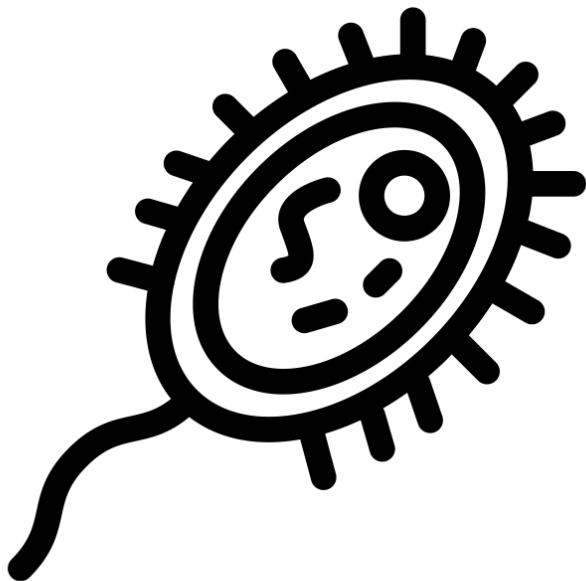
<https://informatics.sydney.edu.au/services/training/>

Hacky Hour – A regular drop-in meetup for any questions about data, coding, analyses, visualisation, modelling, and research problems.

Other Resources

The Noun Project and Flaticon

- Libraries of icons free to use under Creative Commons licences



[Bacteria](#) by [Adnen Kadri](#)
via the [Noun Project](#)
[CC-BY 3.0 US]

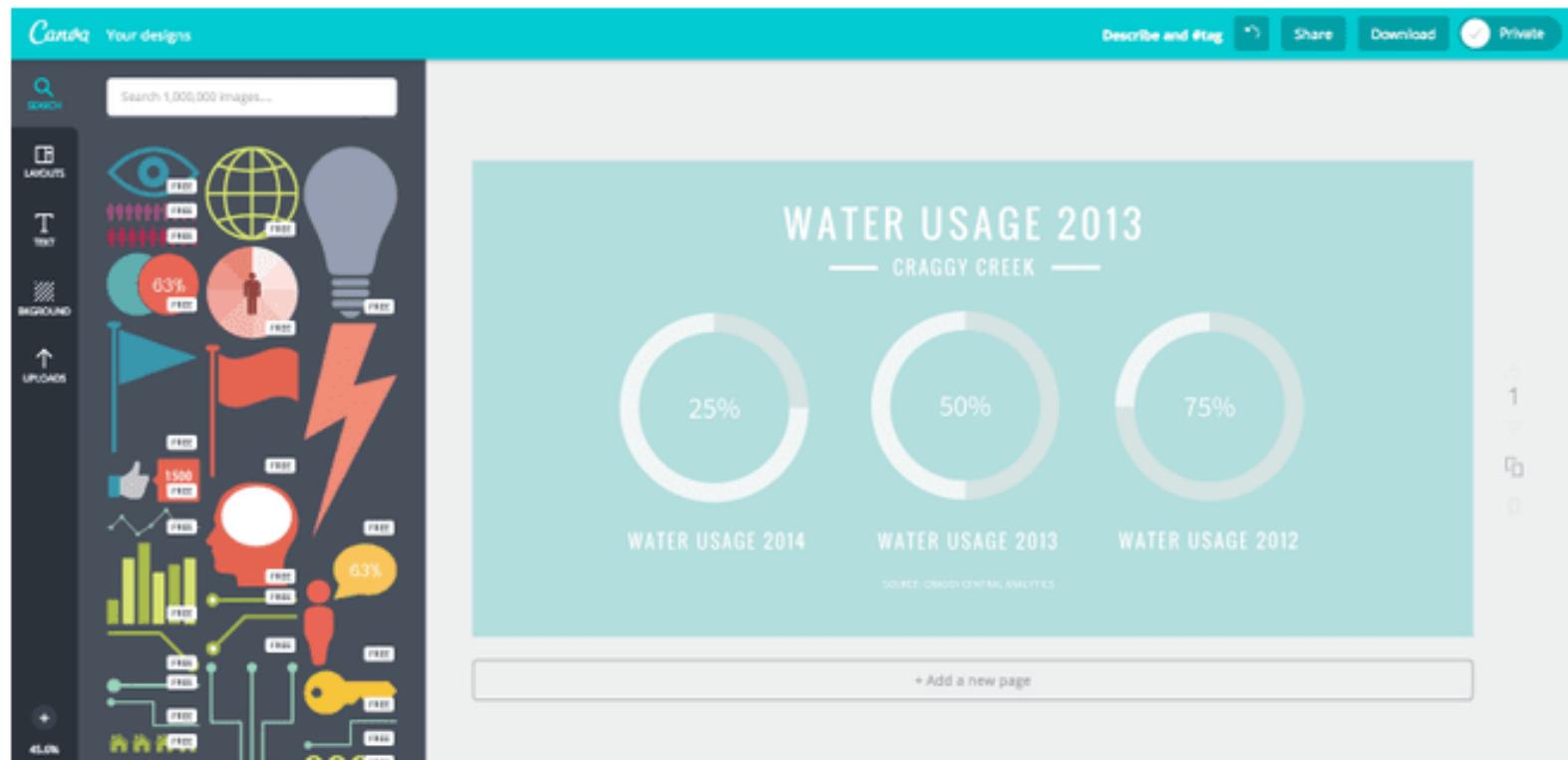


[family insurance](#) by [H Alberto Gongora](#)
via the [Noun Project](#)
[CC-BY 3.0]

Other Resources

Canva

- Browser-based graphic design tool
- Includes a drag-and-drop infographic maker

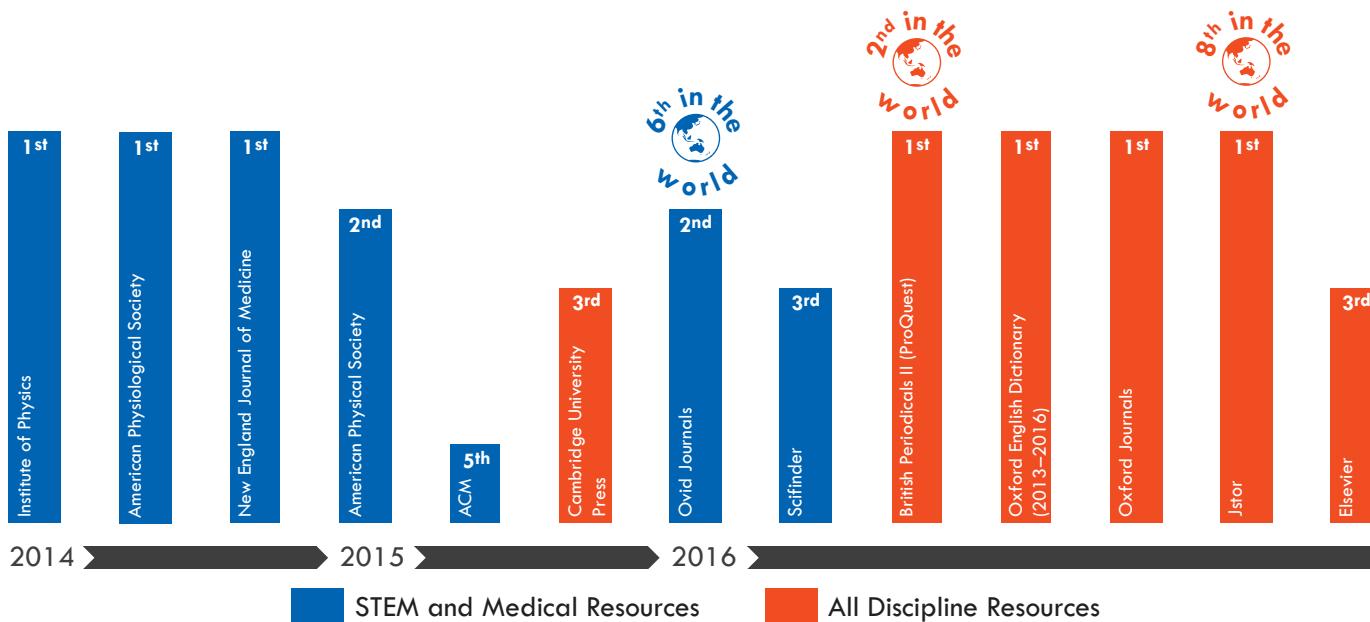


Other Resources

Adobe Illustrator

- Tidy up visualisations created with other tools
- Make icons, infographics from scratch

The University of Sydney's Usage Rank in Australia and New Zealand for Online Scholarly Resources



Over 11 million uses of the more than 1 million online scholarly resources in our collection in 2016

Other Resources

Online training videos across a wealth of topics and tools,
available to anyone with a UniKey

Access to LinkedIn Learning (formerly Lynda.com):

1. Go to <https://www.linkedin.com/learning>
2. Sign In with SSO
3. Login using your UniKey and password

References

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[doi:10.1371/journal.pcbi.1003833](https://doi.org/10.1371/journal.pcbi.1003833)
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- Tobacco and the Economy, Gale, Foreman, and Capehart, Agriculture Economic Report No. 789, September 2000.
- U.S. Census Bureau, Census 2000 Redistricting Data (PL 94-171) Summary File. Available at
<http://www.census.gov/population/www/cen2000/atlas/index.html>

Where next?

Data Analysis and Visualisation Guide

<http://libguides.library.usyd.edu.au/data-analysis-visualisation>

Data Analysis and Visualisation: Visualisation Tools

Search this Guide

Search

Home
Creating a Visualisation
Visualisation Tips
Analysis and Visualisation Toolkit

Visualisation tools available at the University of Sydney

The University of Sydney provides licences to some commercial software packages for staff and students. Please visit the [list of software](#) available through the university to see what software you are eligible to access, and for information on how to obtain access to the available packages.

Tools specific to data visualisation that are available at the University are listed and described below. Keep in mind that analysis and visualisation are often overlapping activities, so be sure to check both the analysis and visualisation sections to ensure that you don't miss the ideal tool for your data!

Adobe Illustrator – A vector graphics editor that can be extremely useful for creating figures or touching up those made in other programs, including adding annotations. Illustrator can also be useful in creating outreach visuals, such as infographics. Illustrator is part of the Adobe Creative Suite. [Get Illustrator from ICT](#).

Microsoft Visio – A diagramming and vector graphics application that can help you simplify complexity with dynamic, data-driven visuals. Visio shapes can be linked to multiple data sources including Microsoft Excel. [Get Visio from ICT](#).

Freely available visualisation tools

In addition to commercial software, a host of open-source and/or freely available tools exist for data visualisation. We have collected a short list of some of the more widely used, or easy to use tools that are available. Keep in mind that analysis and visualisation are often overlapping activities, so be sure to check both the analysis and visualisation sections to ensure that you don't miss the ideal tool for your data!

Interactive Visualisation

Tableau Public – A tool that allows you to create and share interactive charts and graphs, maps, live dashboards and applications. All work will be saved to your Tableau Public profile, visible online.

D3.js – A JavaScript library for manipulating documents based on data. D3 allows you to create interactive web-based visualisations of your data, and helps you bring data to life using HTML, SVG, and CSS.

Keep it simple and uncluttered

Plotting program defaults

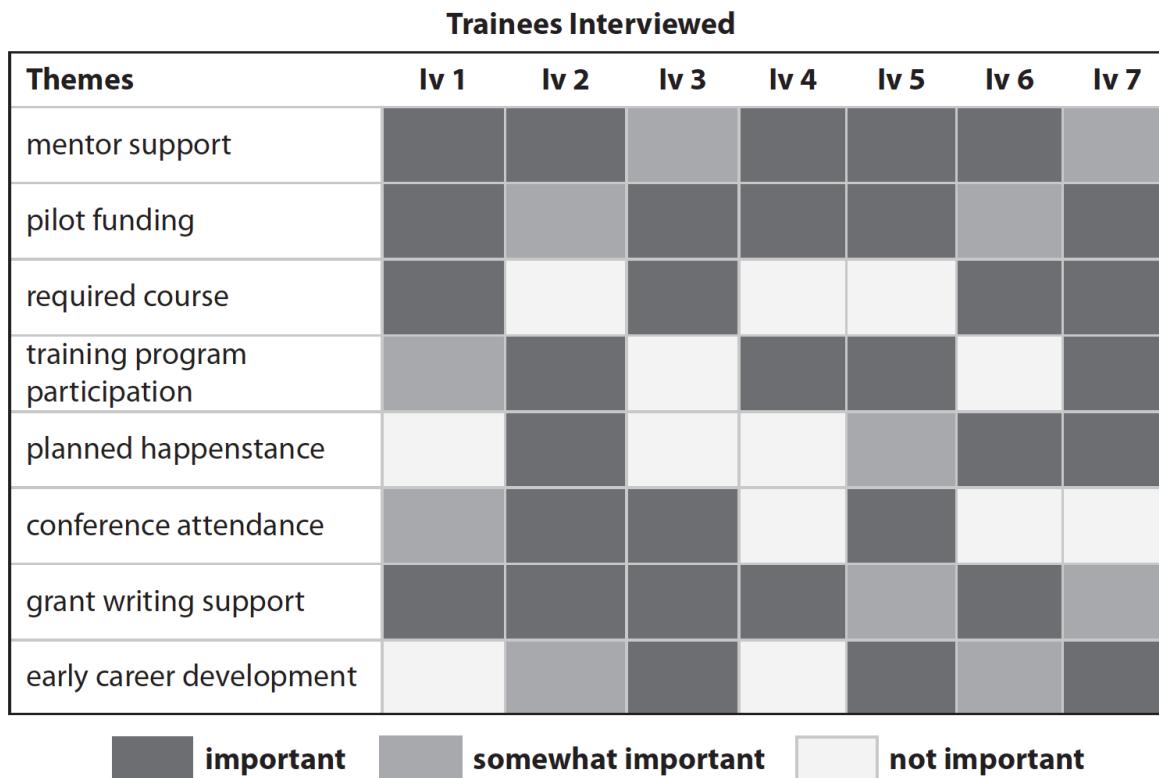
- Custom chart templates



Include all necessary information

Make visualisations self-contained

Figure 3.5. Matrix Displaying the Level of Importance of Themes Uncovered in Interviews With Training Program Participants



Note: Iv# is the number of each trainee. Darker shades indicate increased importance of theme.

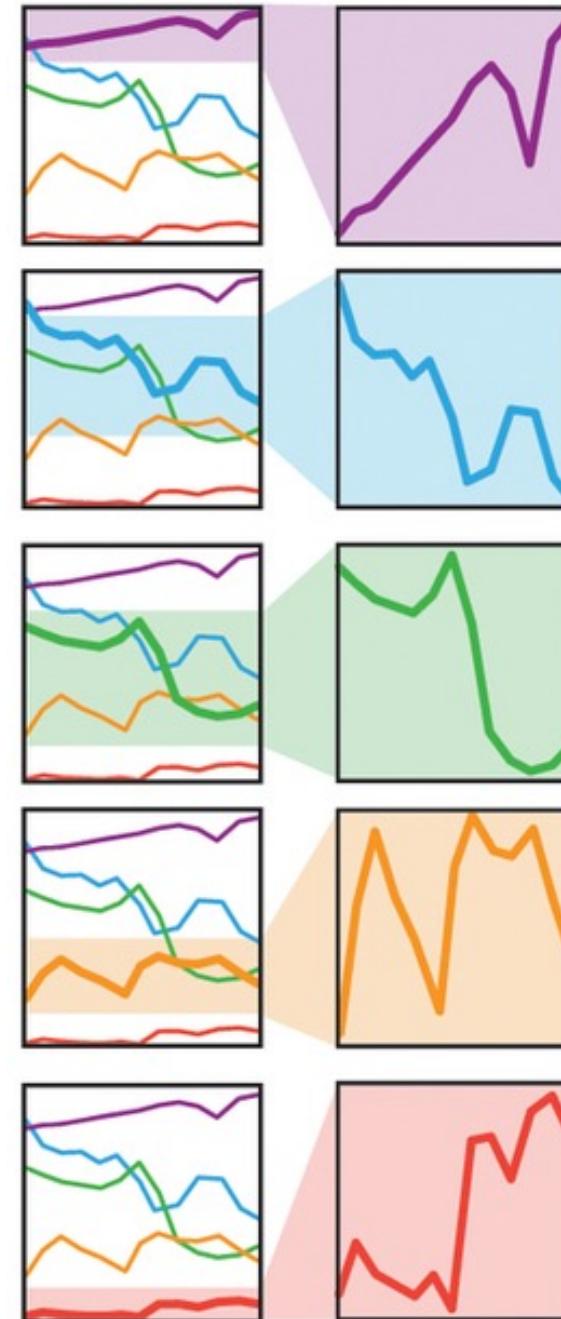
Henderson & Segal
(2013)

Avoid misleading presentation

Ensure your scale is appropriate

- Different scales can wildly change how your data is perceived
- Including zero shows the overall trend
- Clipping the y-scale around the data highlights the actual data values and the variation within your data

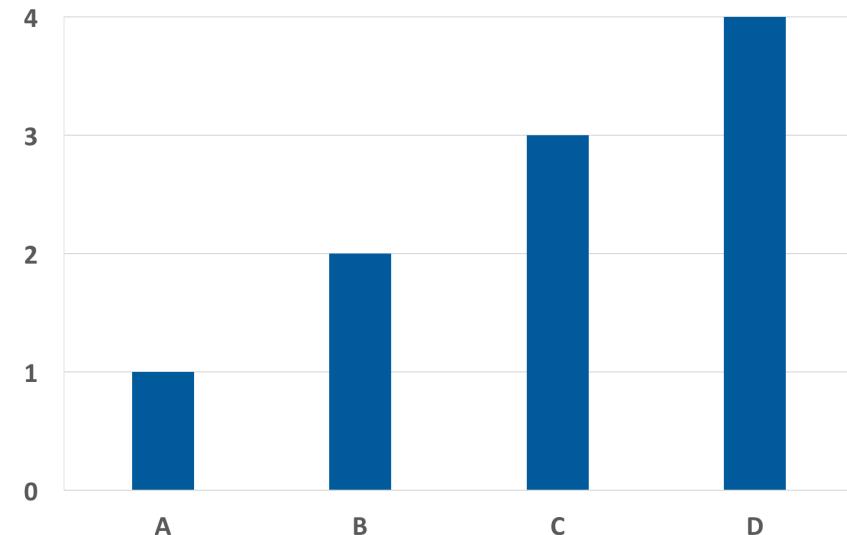
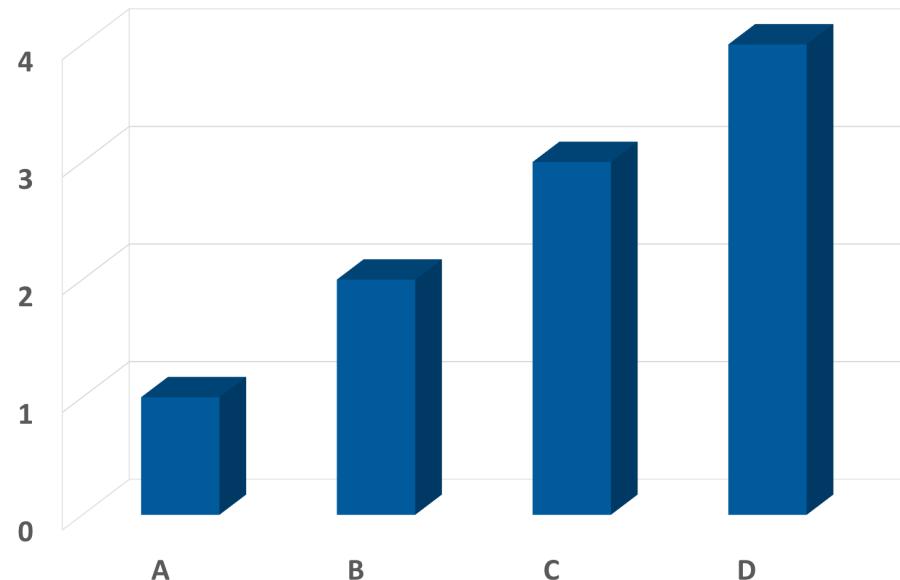
****Always include zero on bar or area plots****



McInerny &
Krzywinski
(2015)

Avoid misleading presentation

Do not use pseudo-3D effects



- 3D effects for non-3D data distort your data
- These bar plots were made using the exact same data!
- Could you tell that the data values are 1, 2, 3, 4 for the pseudo 3D version?