

Data Visualization for Teaching and Learning Projects: Tips and Tricks



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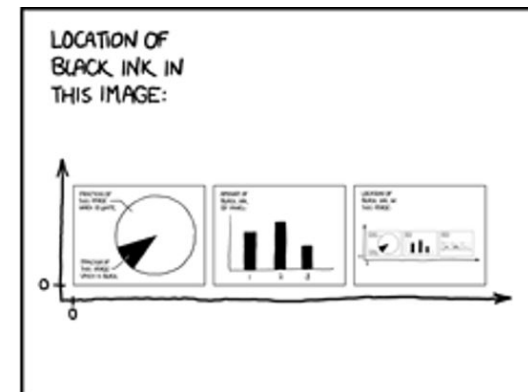
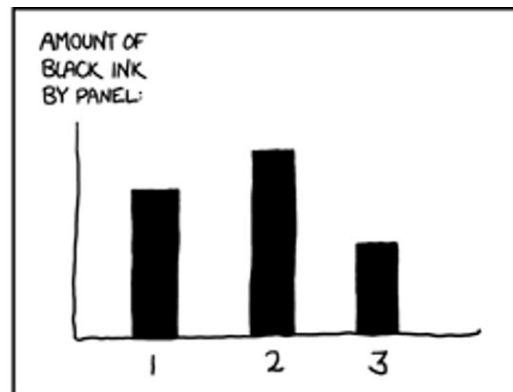
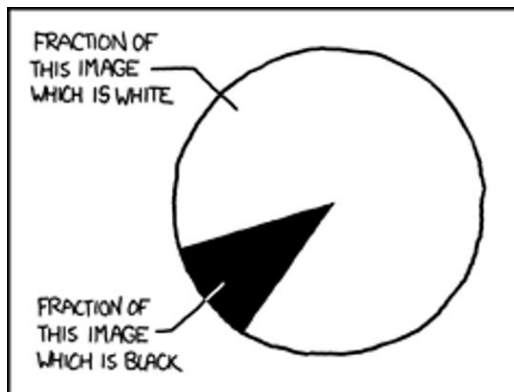


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Source: https://commons.wikimedia.org/wiki/File:UBC_aerial_view.jpg

Workshop outline



- Principles of data visualization
- What is the purpose of your visualization?
- Basic do's and don'ts for data visualization
 - Bar/column charts
 - Line plots and scatter plots
 - Other formats
 - Qualitative data
- Best practices and accessibility considerations
- Q&A and resources



What brought you to today's session?



Thank you for taking time to fill out your responses in Jamboard!



Why are you visualizing this data?



Who is the audience?



Expert vs. novice
Accessibility needs

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What are they trying to learn from the figure/image?



Exploratory: To learn about the data
Explanatory: To tell a story

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Principles of data visualization



“Graphical excellence is that which gives the viewer the **greatest number of ideas in the shortest time** with the least ink in the smallest space.”

- Edward Tufte

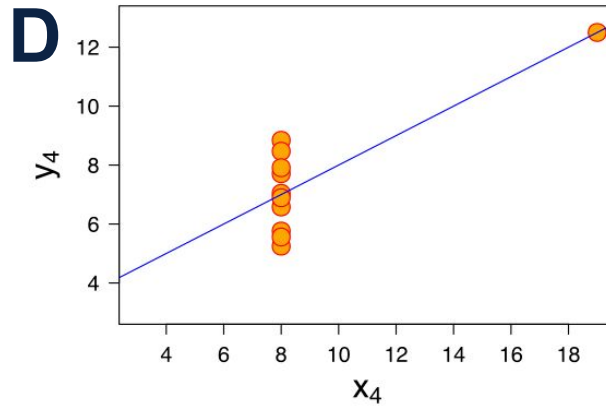
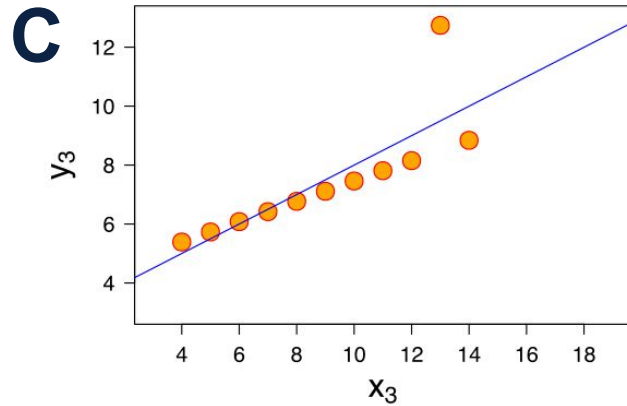
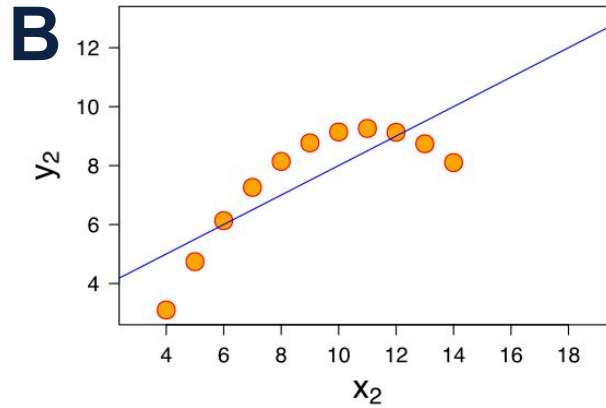
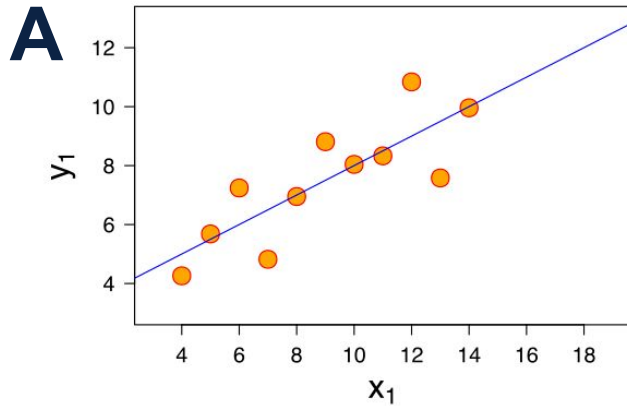


Principles of data visualization

A good visualization:

- 1) Represents quantities accurately
- 2) Clearly indicates how the values relate to one another
- 3) Makes obvious how people should use the information

Which graph has the highest mean?



Anscombe's Quartet

All have the same:

- Mean
- Variance
- Correlation

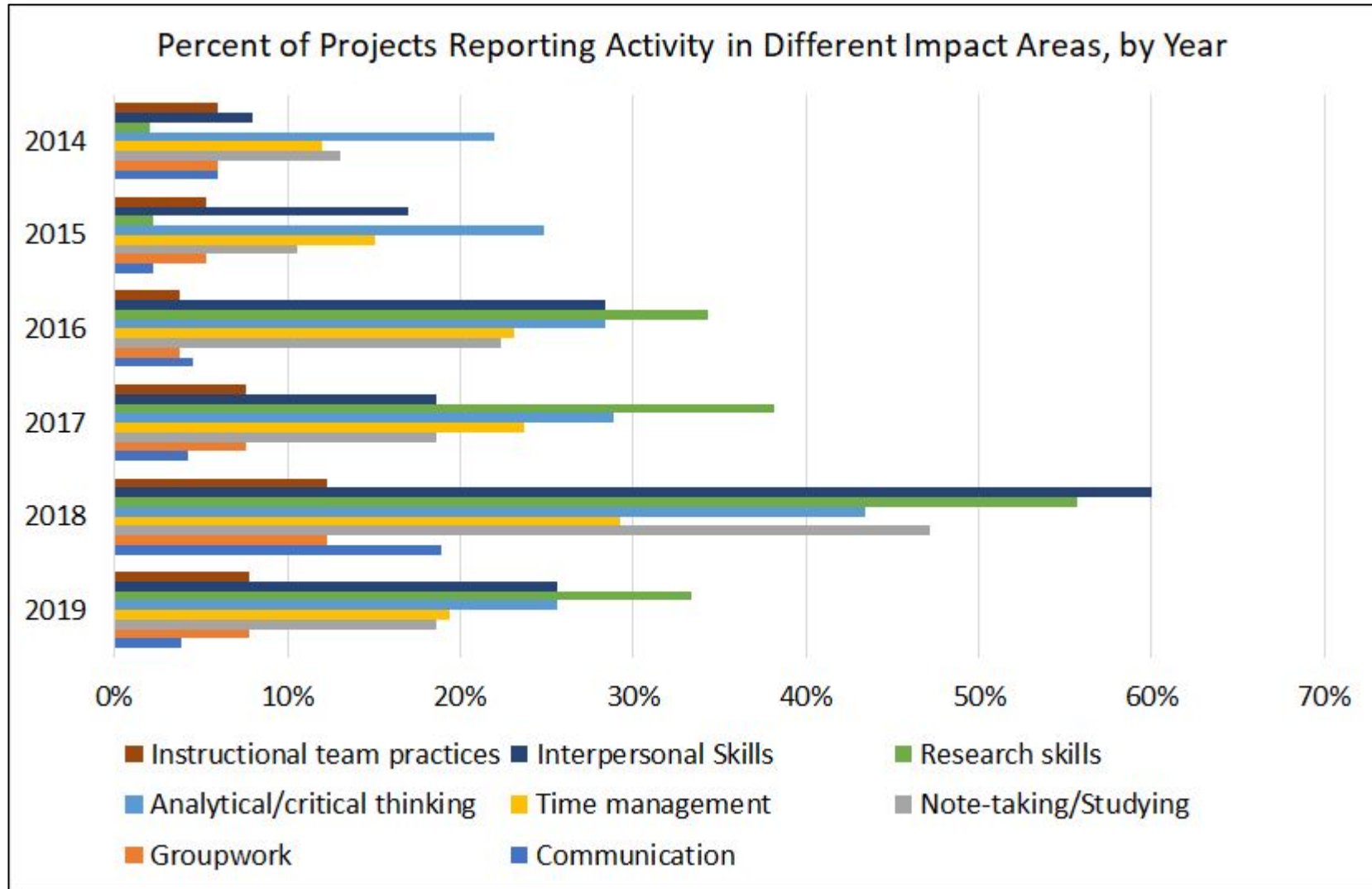
Common figure types: Bar/column charts



Useful for:

- comparing categories
- plotting means (e.g., grades, motivation scale means) or ranges of values (e.g., likert scale responses)

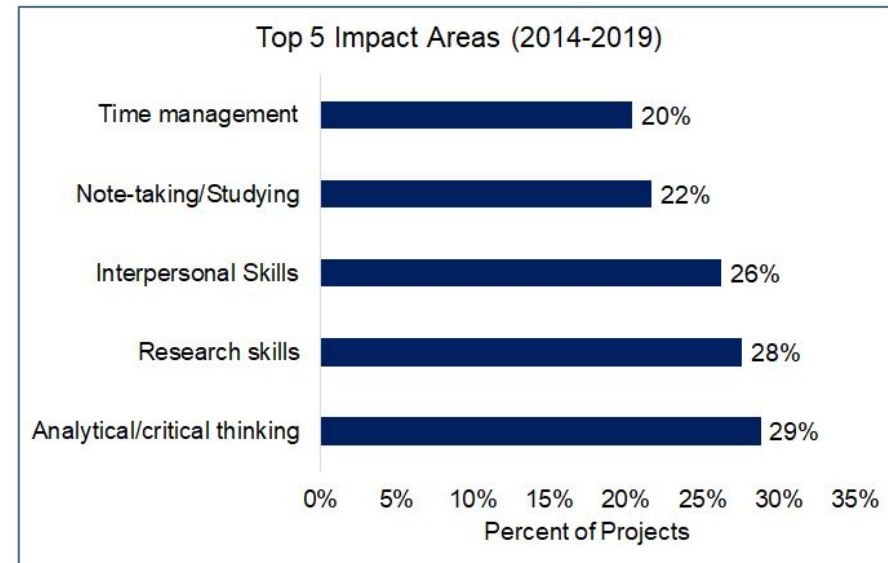
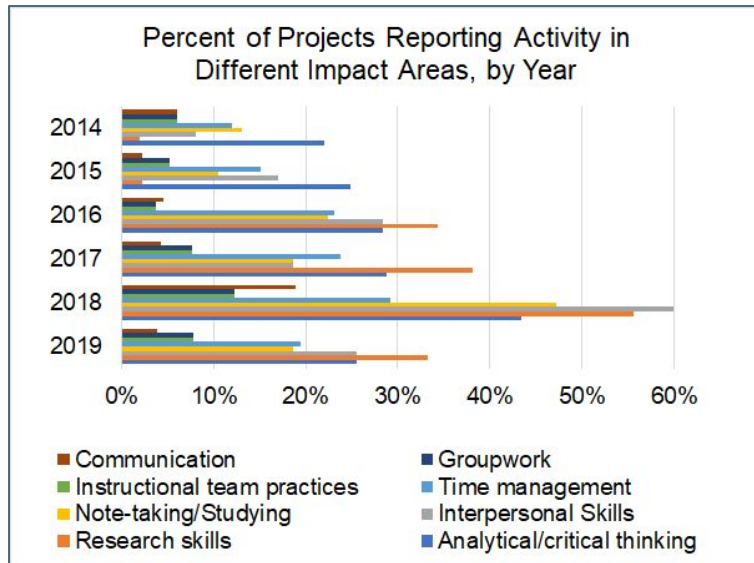
A problematic bar chart: What are the issues?



Easy ways to make your data clearer



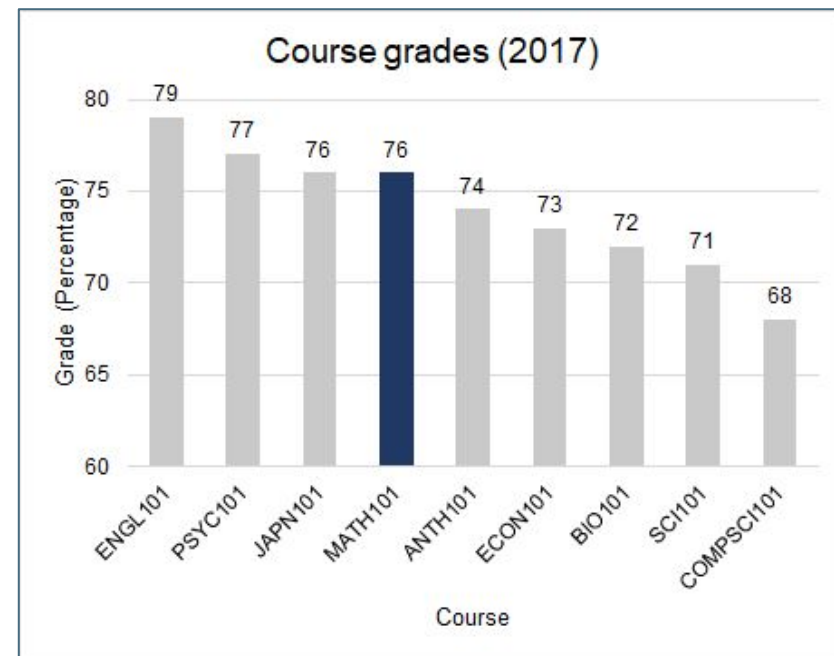
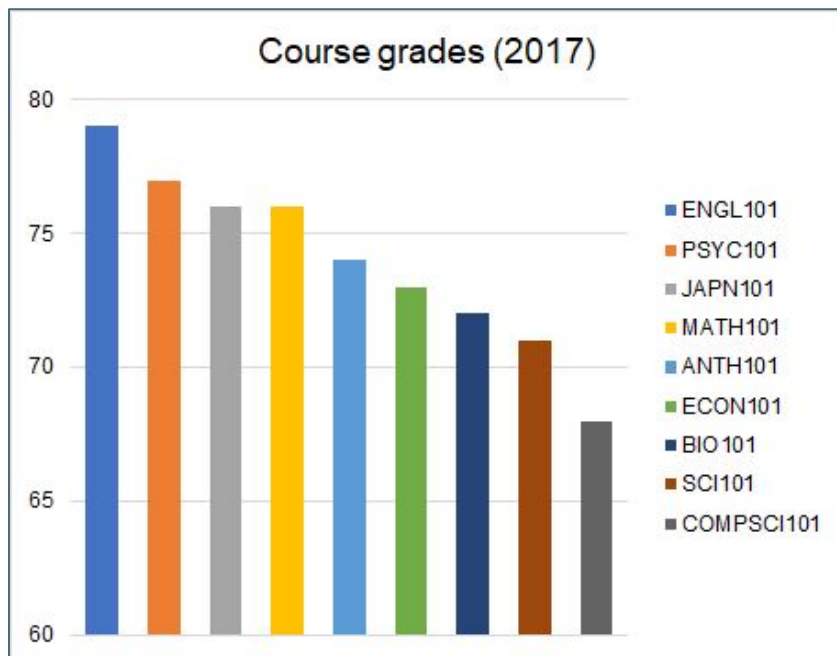
1) **Rank items** in a helpful way. With a small #, rank by count/percentage. With a large #, rank alphabetically and highlight key points.



Easy ways to make your data clearer



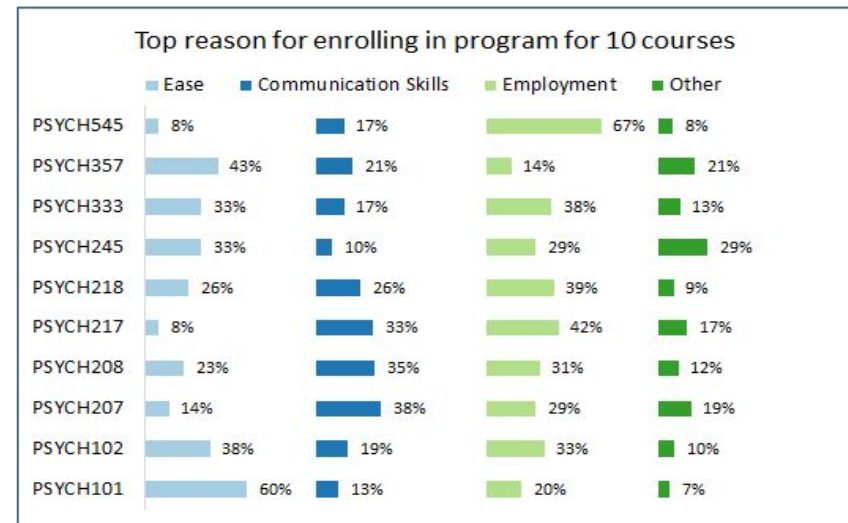
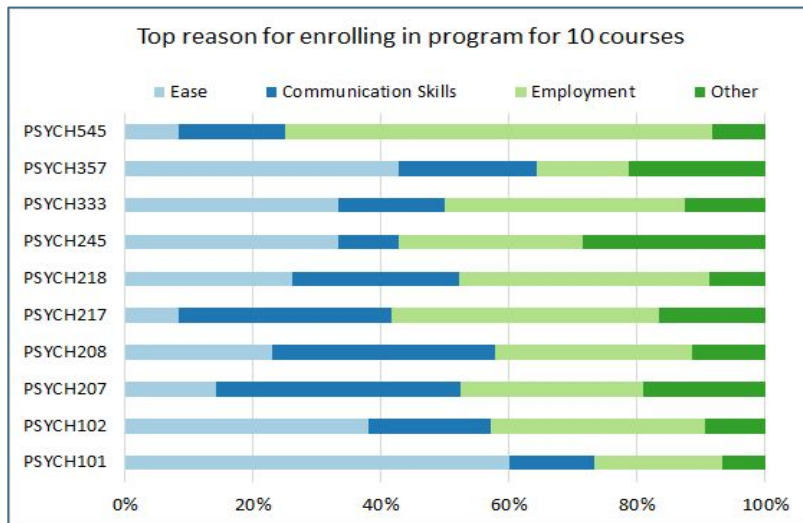
2) Use perceptual features (e.g., shape, colour, etc) to **highlight what is important** for the viewer to focus on.



Easy ways to make your data clearer



3) **Split the data** when you want to **compare values** within each category more easily (best when there are multiple factors being examined).

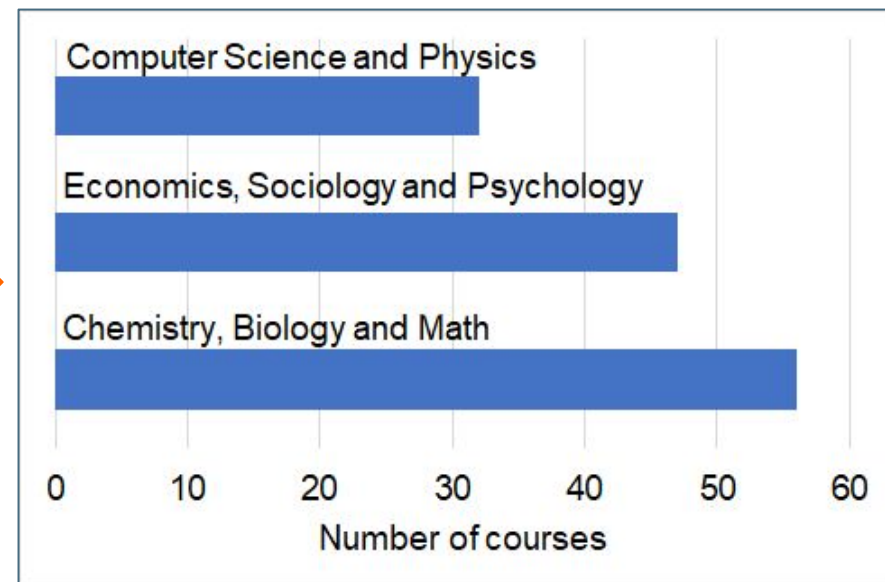
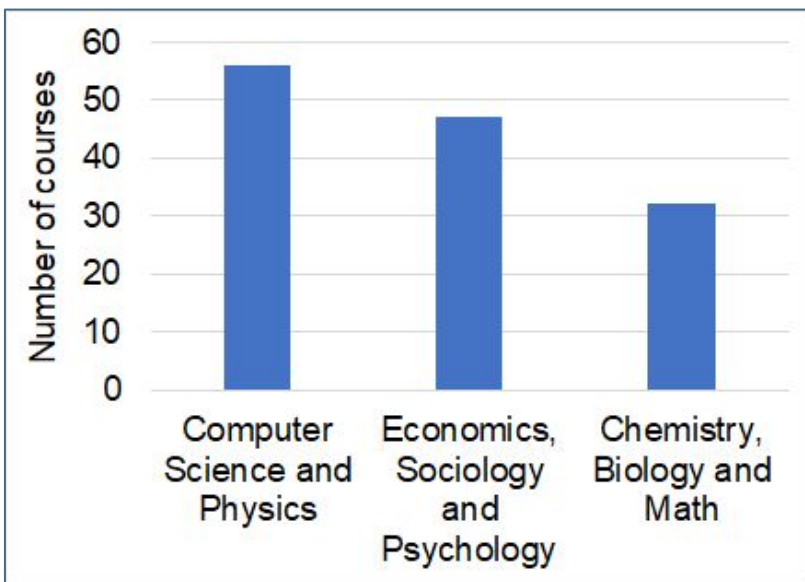


	Ease	Communication	Employment	Other
PSYCH101	60%	13%	20%	7%
PSYCH102	38%	19%	33%	10%
PSYCH207	14%	38%	29%	19%
PSYCH208	23%	35%	31%	12%
PSYCH217	8%	33%	42%	17%
PSYCH218	26%	26%	39%	9%
PSYCH245	33%	10%	29%	29%
PSYCH333	33%	17%	38%	13%
PSYCH357	43%	21%	14%	21%
PSYCH545	8%	17%	67%	8%

Easy ways to make your data clearer



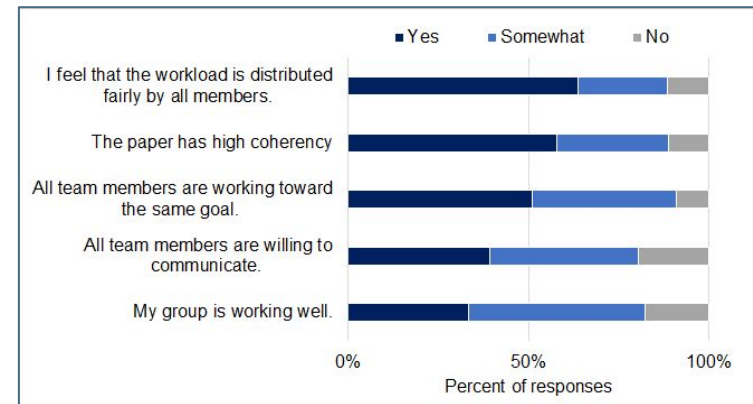
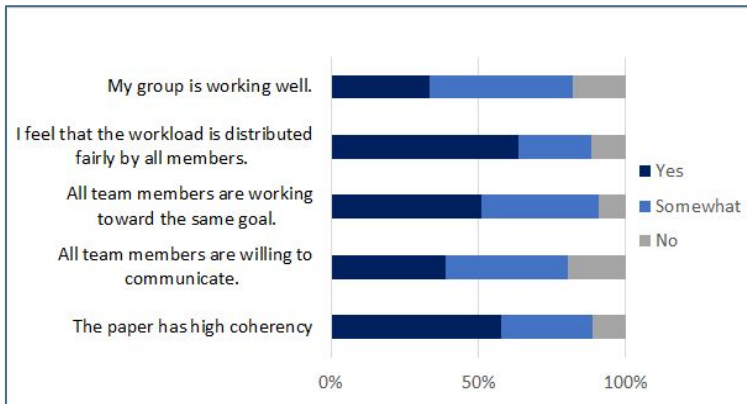
4) Use a column chart instead of bar chart if the labels are long. Move labels above the column.



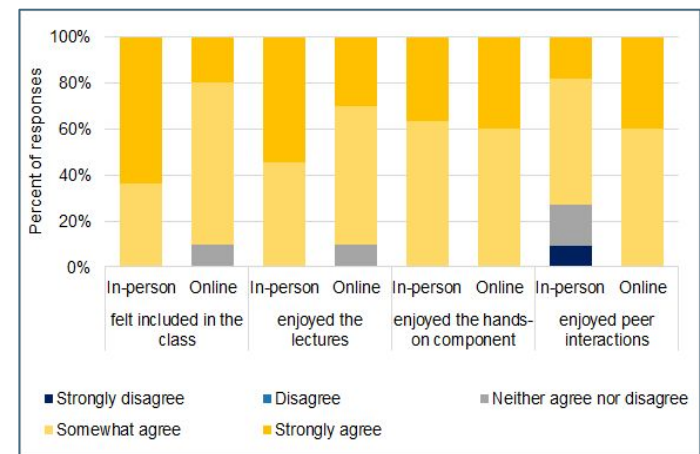
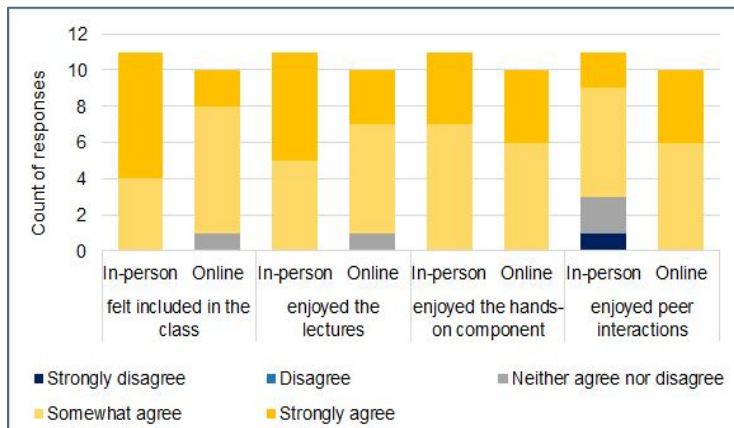
Tips for plotting Likert-type scale data



1) Sort “positive/strongly agree” data largest to smallest (or smallest to largest). Include the legend at the top in large font.



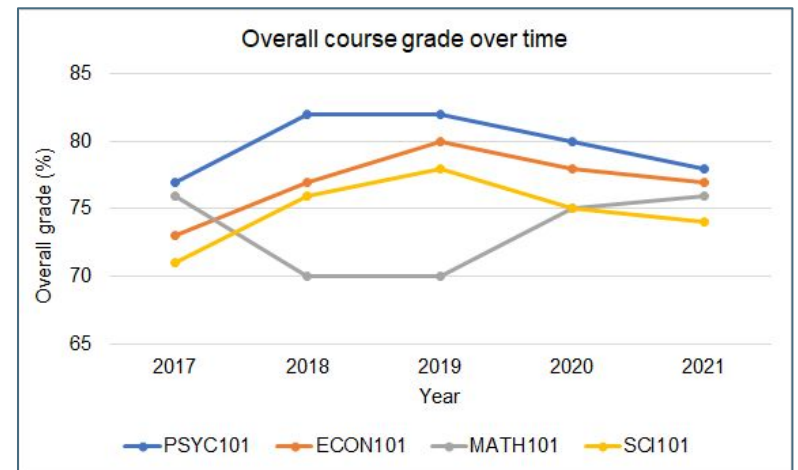
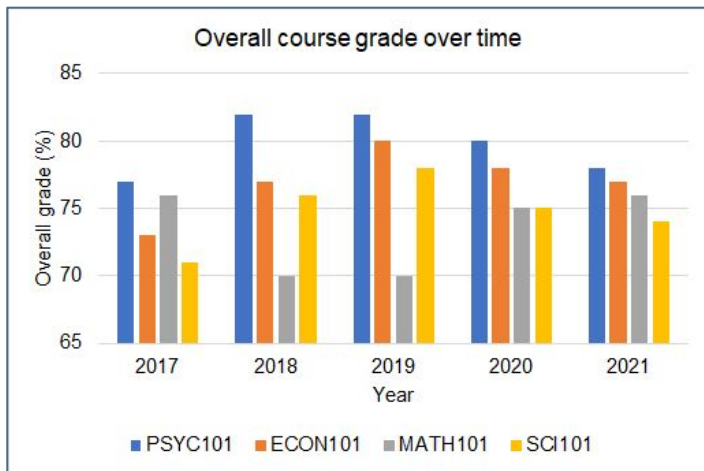
2) Use 100% stacked plots so that the data is on an equal “spread” and more easily comparable.



When a bar chart is too messy



A **slope chart** is typically better for showing changes over time compared to a bar chart.





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Common figure types: Line & scatter plots



Useful for:

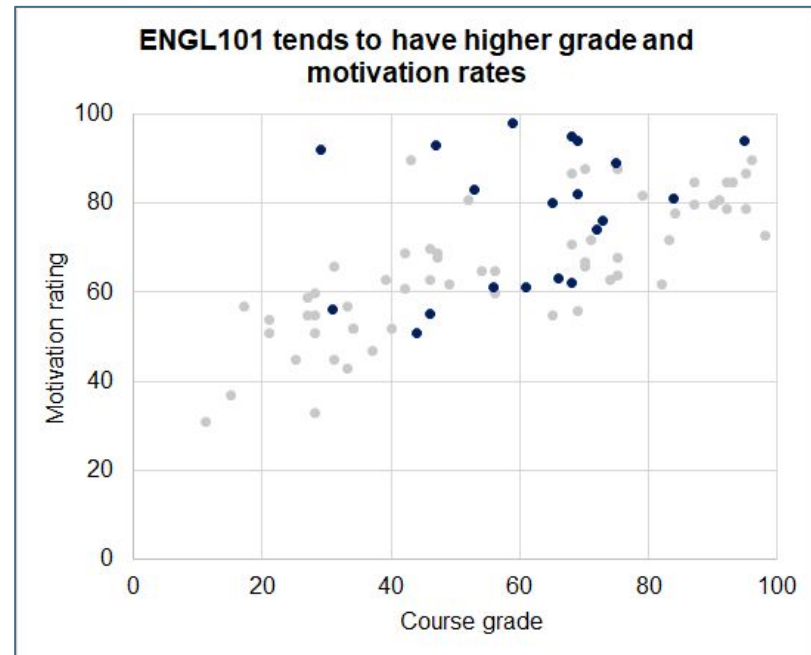
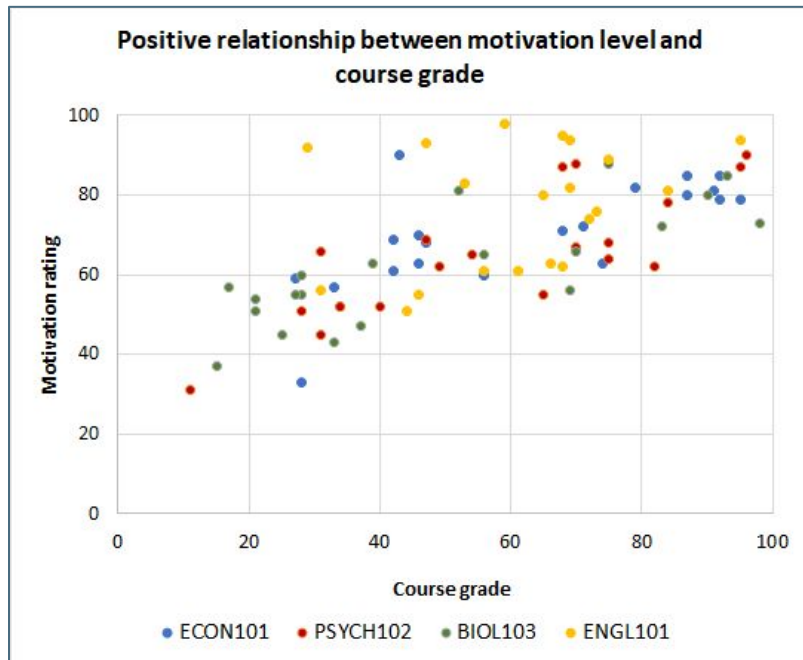
- Temporal data (e.g., changes over a term or years; pre/post data)
- Continuous data (e.g., student grades)

Easy ways to make your data clearer: Scatter plot example



Reduce clutter:

- **highlight the focus** by adding color to a subset of data points
- **change the title** to emphasize a point.

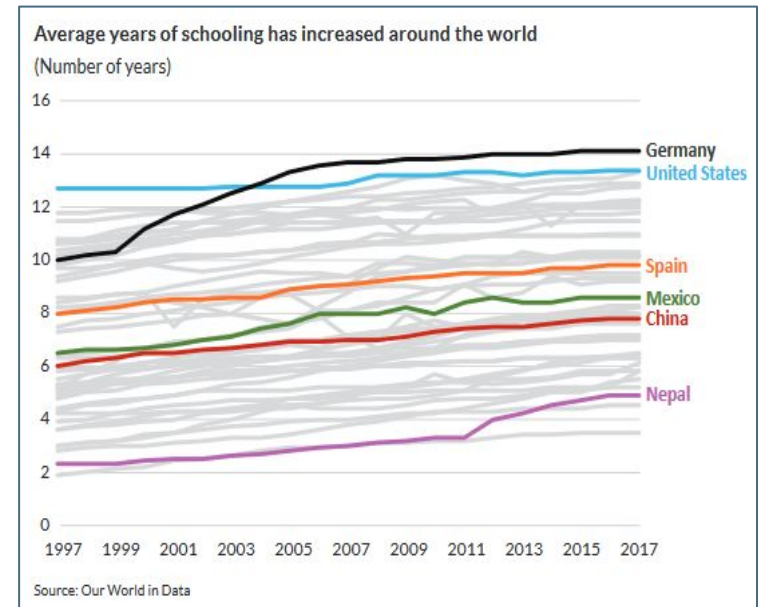
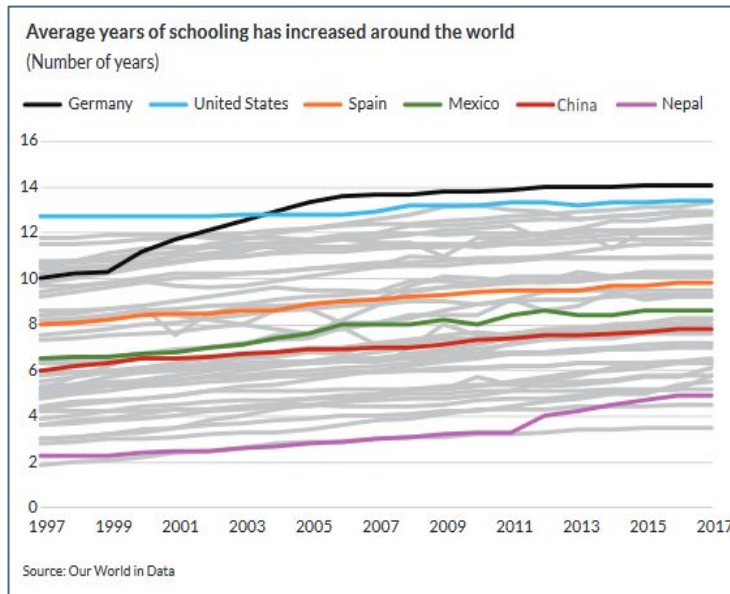


Easy ways to make your data clearer: Line plot example

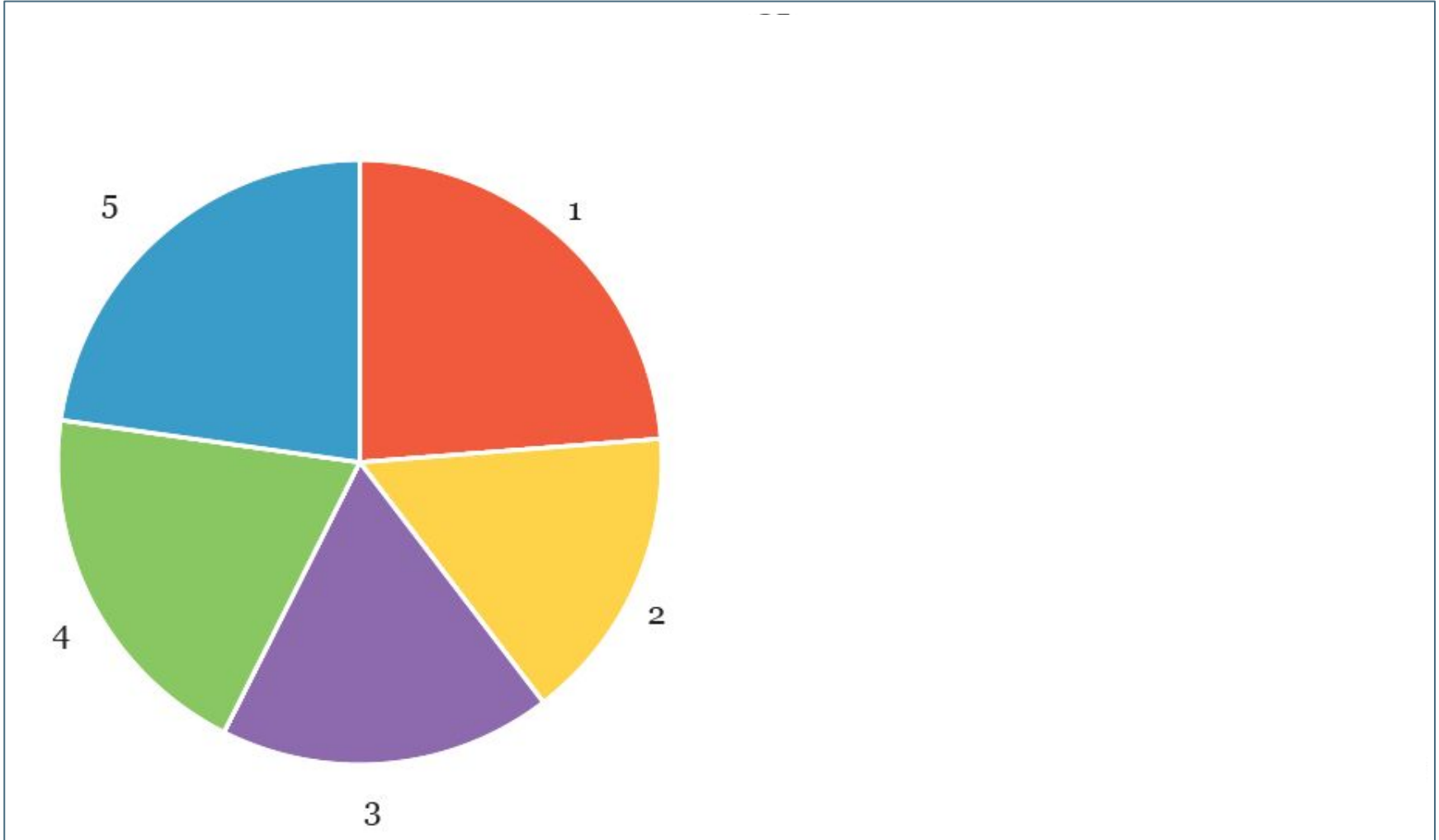


Reduce clutter:

- Move labels to appear next to lines
- **Highlight meaningful data** or **reduce plotting** to fewer lines per chart



Other visualizations: Pie charts

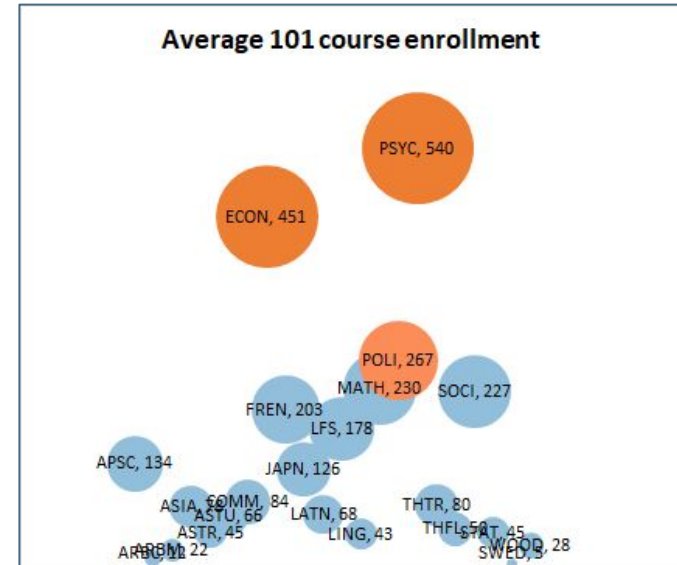


Other visualizations: Bubble plots, pie & donut charts



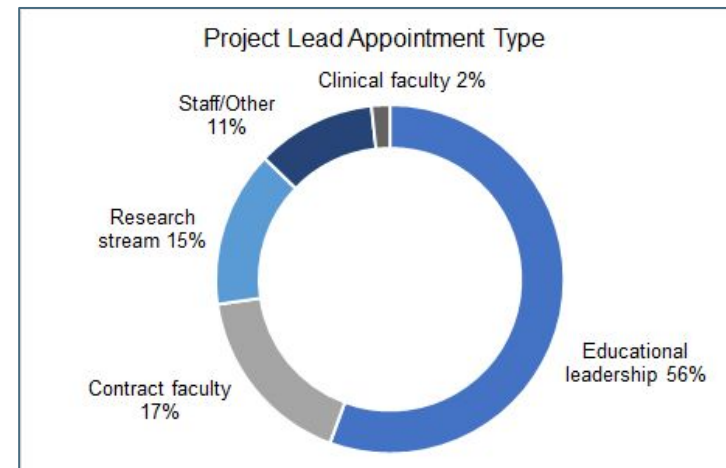
Pie charts and bubble plots:

- Very hard to compare areas
- Rarely the best option for presenting data



Donut charts:

- Help to reduce the issue of confusing area comparisons

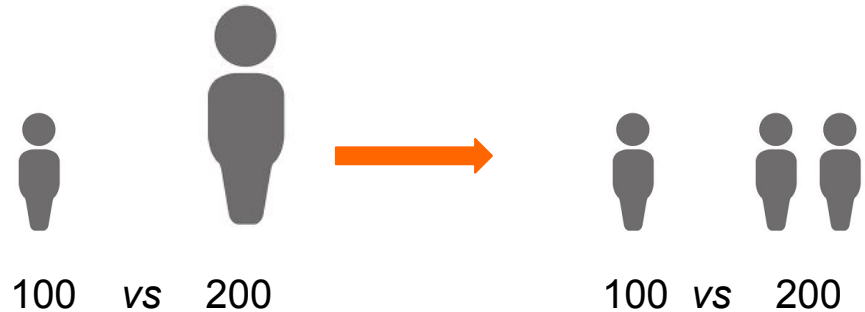


Other visualisations: Pictographs

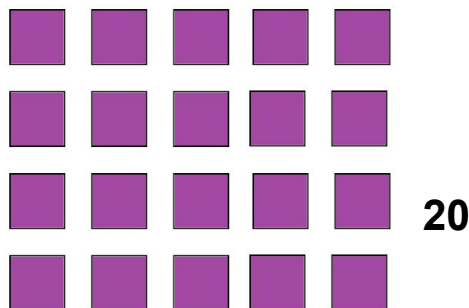


Best practices:

- **Don't** truncate, use full images
- **Don't** distort images to demonstrate increase/ decrease, instead use duplicates of the same image



- **Do** provide a numeric visual for # of items (don't make people count!)
- **Do** group in a way that is easy to tally



Visualizing qualitative data: Word clouds and word trees



Word clouds/trees:

- Can be helpful to get a quick snapshot of themes
- Difficult to compare specific frequencies
- Words may appear larger/more significant simply due to orientation or colour



Visualizing qualitative data: Word clouds and word trees



Visualizing qualitative data: Heat maps



	Helpfulness of peer feedback	Giving feedback improves own work	User experience	Anonymity of feedback	Workload
P1	Green	Yellow	Red	Green	Red
P2	Yellow	Green	Yellow	Red	Yellow
P3	Orange	Green	Yellow	Green	Red
P4	Yellow	Yellow	Green	Green	Red
P5	Green	Yellow	Green	Red	Orange
P6	Green	Yellow	Yellow	Red	Red
P7	Yellow	Green	Orange	Green	Orange
P8	Green	Orange	Yellow	Red	Orange
P9	Orange	Orange	Red	Red	Red
P10	Green	Yellow	Green	Green	Yellow

Example quotes:

“The feedback system was slow and very frustrating to use.”

“5 papers to review was a bit too many. 3 papers is good for next time.”

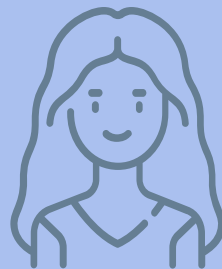
“The peer feedback mostly gave me good suggestions to improve.”

“I really appreciated that it was anonymous because I was able to be totally objective in my feedback.”

Visualizing qualitative data: Using participant quotes

- Ensure you have student permission to share quotes
- Helpful to provide context
- Consider how icons may help contextualize or strengthen the visualization

“The worksheet allowed me to organize my ideas, and figure out what I was confused about. It helped me start writing my report much earlier.”



“I would have appreciated a clearer build up to the worksheet in class and more specific instructions. Also, feedback on the first draft would have been nice.”



Mixed data presentation



New Peer Feedback System

“I would like to see [system] used for giving feedback on other assignments in this course as well.”



“Because what I’m saying is anonymous, it makes me give more objective feedback and makes it more fair.”



“Anonymity makes people give lower quality feedback.”

“More efficient and convenient than other forms of giving feedback, like on Canvas. It was fast and easy to operate.”



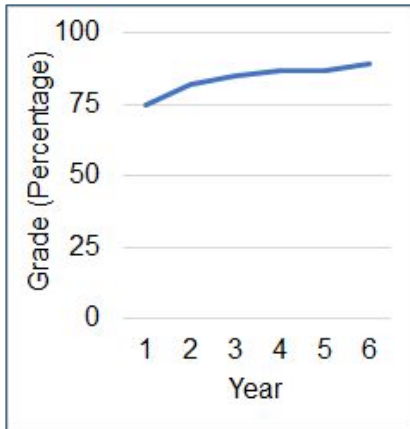
“The format of the text in the program was hard to read.”

Best practices: Scale considerations

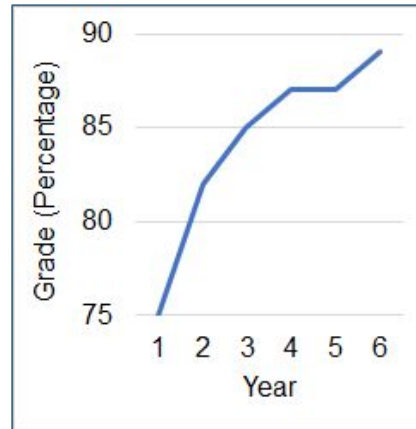


For the y-axis, use a scale that does not over/under exaggerate trends/differences.

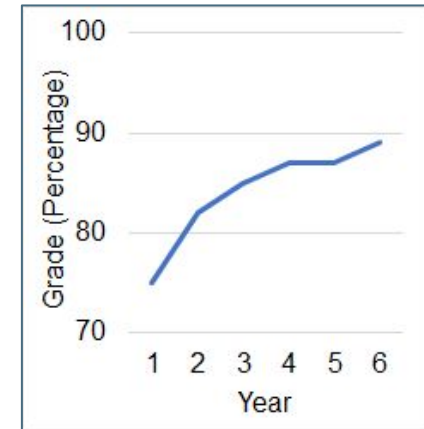
Grade Increase Over Time



Too flat,
minimizes difference



Too exaggerated,
maximizes difference



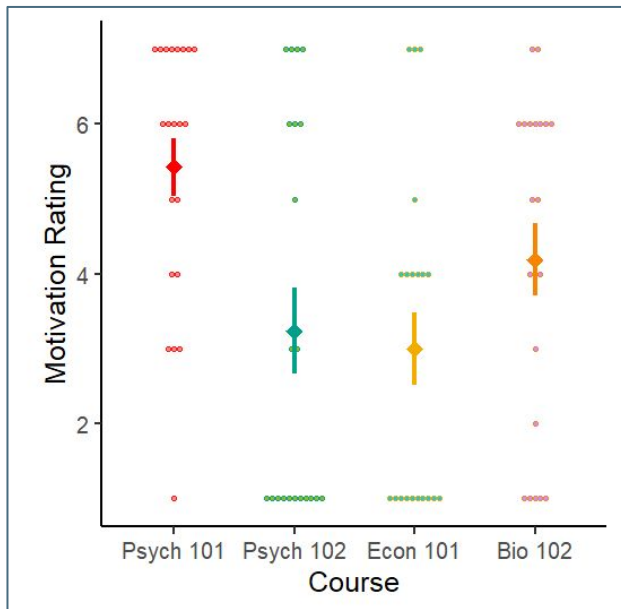
Best choice!

Best practices: Conveying uncertainty

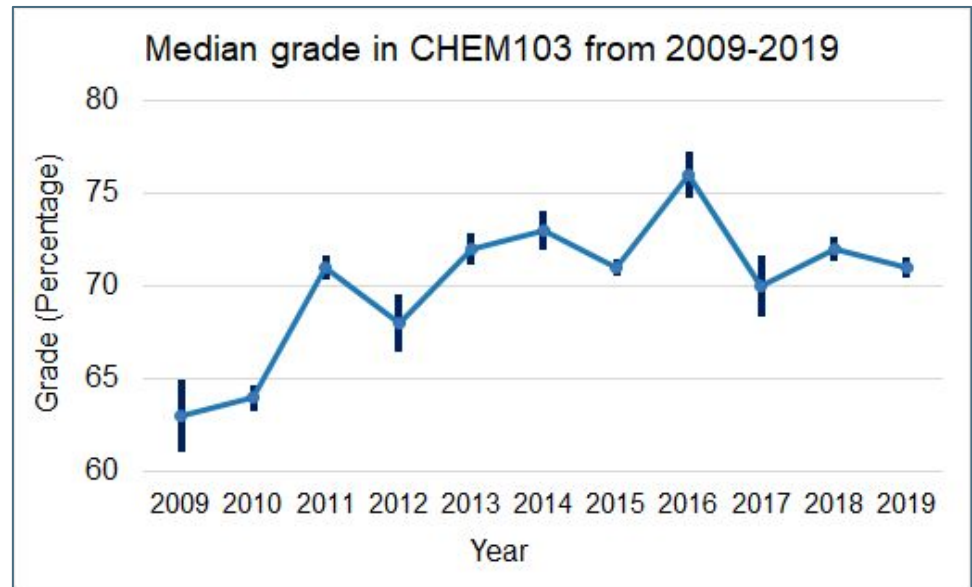


Data often contains (**unintentional**) uncertainty. Be clear about this uncertainty:

- Always note what percent of students completed the task/survey
- If possible, include error bars/confidence intervals to show variability
- If possible, display the entire distribution of the data for context



Distribution of ratings with data means and error bars.

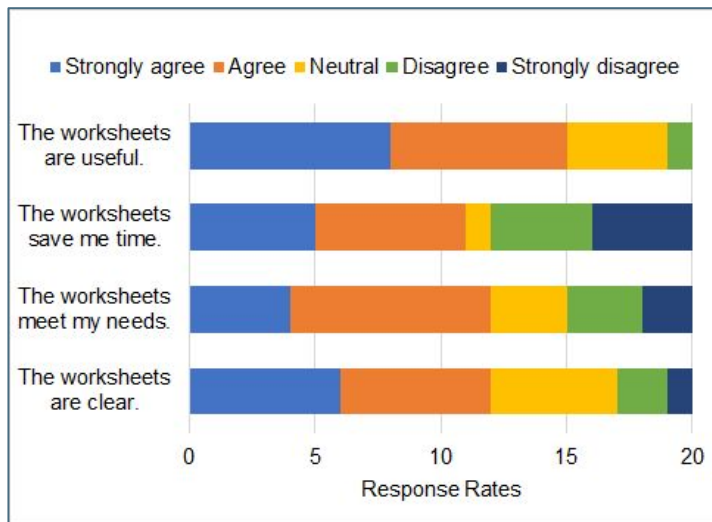


Linear line plot of data medians. Confidence intervals indicated by dark blue lines.

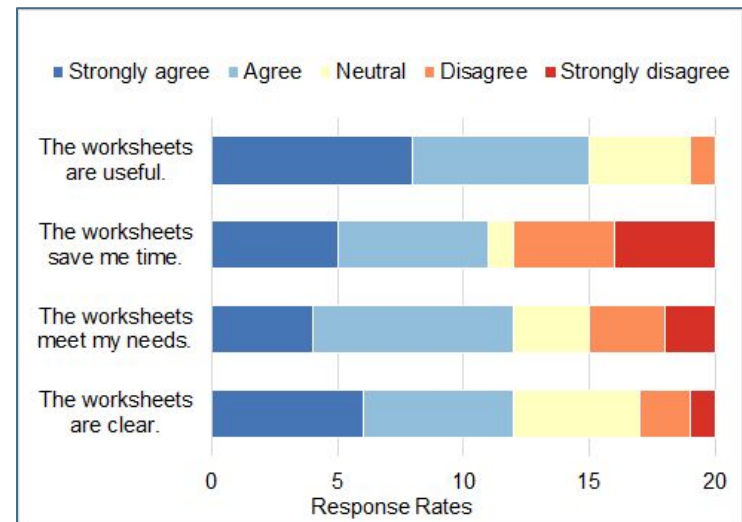
Best practices: Scale colours



Instead of using mixed colours:



Use **divergent colours**:

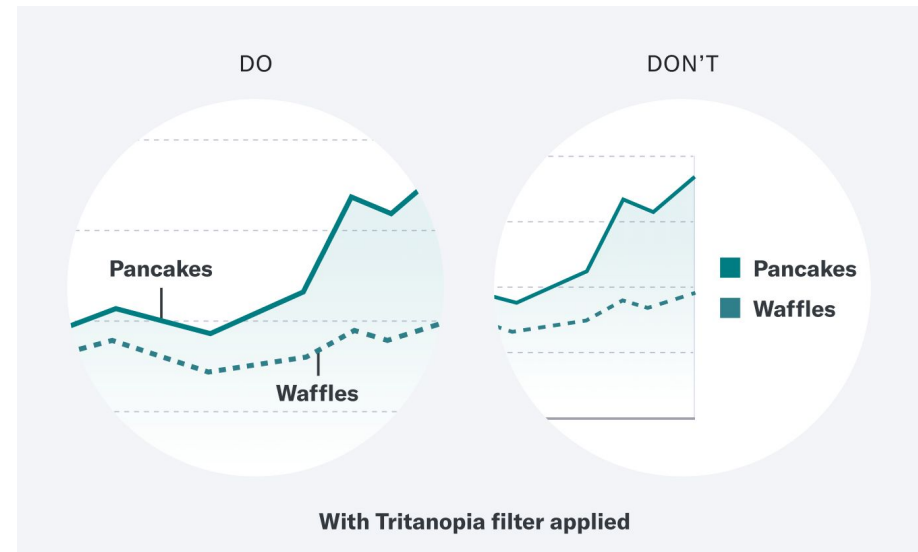


Use a **sequential colour** scale for continuous data, to show increase in numbers:



Use a **mix of colours** only for qualitative/categorical data (e.g., showcasing how different groups performed).

Accessibility: Colour blindness and contrast





Accessibility: Titles, captions and alt-text

Titles and captions should make clear the purpose of the visualization and important takeaways.

A good caption/text description:

- Contextualizes the visualization
- Clarifies or highlights important patterns/trends/relationships in the data
- Includes a link to a readable format of the data (e.g., CSV file)
 - *when needed!



Accessibility: Titles, captions and alt-text

Alt-text best practices:

- Be concise (1-2 sentences *in most cases)
- Consider context and importance
- Avoid extraneous words (i.e., “photo of,” “screenshot of”)
 - *might make these choices for particular reasons*
- Avoid redundancy

More information at: <https://it.wisc.edu/news/how-to-write-effective-alt-text-for-web-images/>

Guidelines on how to add alt text in Microsoft Office package software:

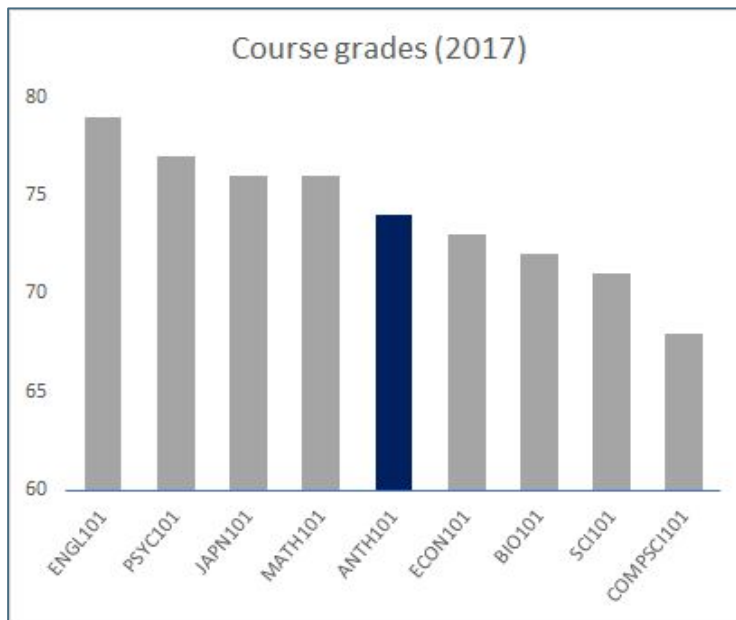
<https://support.microsoft.com/en-us/office/add-alternative-text-to-a-shape-picture-chart-smartart-graphic-or-other-object-44989b2a-903c-4d9a-b742-6a75b451c669>

Accessibility: Titles, captions and alt-text

alt= “**Chart type** of **type of data** where **reason for including chart**”

Include a **link to data source** somewhere in the text

Picture source: <https://medium.com/nightingale/writing-alt-text-for-data-visualization-2a218ef43f81>



“**Bar chart** ([link here](#)) of **2017** course grades, organized from highest to lowest. Highlights the **ANTH 101** average course grade of **74% in the middle.**”



Thank you for joining us!

Your facilitators:

Natasha Pestonji-Dixon: natasha.pestonji-dixon@ubc.ca

Trish Varao-Sousa: trish.varao-sousa@ubc.ca

Accessibility resources:

Resources on making accessible visualizations:

- Various colour blind friendly palettes and colour codes can be found here:
[http://www.cookbook-r.com/Graphs/Colors_\(ggplot2\)/#a-colorblind-friendly-palette](http://www.cookbook-r.com/Graphs/Colors_(ggplot2)/#a-colorblind-friendly-palette)
- Trish's favorite website for choosing color schemes:
<https://colorbrewer2.org/#type=sequential&scheme=BuGn&n=5>
- Interactive checklist for infographics and flyers/posters:
<https://www.csun.edu/universal-design-center/accessible-infographics-and-flyers-checklist>
- Accessible data visualization in general:
<https://it.wisc.edu/learn/accessible-content-tech/accessible-data-visualizations/>

Resources



Content and examples were adapted from:

- Evergreen (2018) Effective data visualization
- Schwabish (2020) Better Data Visualizations
- Wong (2010) Guide to Information Graphics

Advanced qualitative visualizations:

<https://stephanieevergreen.com/wp-content/uploads/2021/07/Qualitative-Chooser.pdf>