Charts

DATA 201: Thinking With Data
Winter 2021

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What and Why?

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Tables
(are not charts)

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Tables

A type of visualization

Mostly values

Colours and formatting

Most accurate way to indicate and compare data

Don’t scale well, and can be hard to draw conclusions from

	A	B	C	D	E	F	G	H	I	J	K	L
1	0	0	0.6931	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0.6931	0	1.3459	0	0	0	0	0	0	0.6931	0	0
4	0.6931	0	0	0	0	0	0	0	0	0	0	0
5	1.0986	0	0	0	1.0986	0	0	0	0	0	0	0.6931
6	0	1.3459	1.7918	0	0.6931	0	0.6931	0	0	0	0	0
7	1.0986	2.1972	2.0794	0	2.4849	1.0986	1.0986	1.0986	0	0.6931	0	0
8	3.5553	4.0254	4.7875	2.0794	3.1781	2.0794	2.4849	2.9444	0	1.3863	1.0986	1.0986
9	4.7362	5.0562	5.1818	2.4849	3.4965	2.7081	3.0445	3.912	1.6094	2.5649	2.4849	0
10	5.7366	5.2832	5.9428	2.5649	4.1431	3.989	3.8712	3.5553	2.4849	3.2958	1.3863	1.0986
11	5.7004	5.0173	6.2126	2.3979	4.4773	2.5649	3.8067	2.7726	2.8332	1.6094	1.0986	0.6931
12	4.1589	2.6391	4.2047	0.6931	2.3026	1.7918	2.1972	0	0.6931	0.6931	0	0
13	0	0.6931	2.0794	0	0	0.6931	1.0986	0	0	0	0	0
14	0	0	1.0986	0	0	0	0	0	0	0	0	0
15	0.6931	0	0.6931	0	0	0	0	0	0	0	0	0
16	0.6931	0	0	0	0	0	0	0	0	0	0	0
17	1.0986	0.6931	1.3863	0	0	0.6931	0	0	0	0.6931	0	0
18	0	1.3863	1.0986	1.6094	0	0.6931	0.6931	0	0	1.3863	0	0.6931
19	0	1.0986	1.3863	1.0986	0	0	0	0	0	0	0	0.6931
20	2.0794	0	1.6094	0	0.6931	0	0	0	0	0.6931	0	0
21	2.1972	1.7918	2.3979	0	0	0	1.0986	1.3863	1.3863	0.6931	0	0.6931

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Tables

If numbers were all that matters it would be all we communicate in papers.

Good scientific papers have both, a table and a visualization like a chart.

	A	B	C	D	E	F	G	H	I	J	K	L
1	0	0	0.6931	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0.6931	0	1.3459	0	0	0	0	0	0	0.6931	0	0
4	0.6931	0	0	0	0	0	0	0	0	0	0	0
5	1.0986	0	0	0	1.0986	0	0	0	0	0	0	0.6931
6	0	1.3459	1.7918	0	0.6931	0	0.6931	0	0	0	0	0
7	1.0986	2.1972	2.0794	0	2.4849	1.0986	1.0986	1.0986	0	0.6931	0	0
8	3.5553	4.0254	4.7875	2.0794	3.1781	2.0794	2.4849	2.9444	0	1.3863	1.0986	1.0986
9	4.7362	5.0562	5.1818	2.4849	3.4965	2.7081	3.0445	3.912	1.6094	2.5649	2.4849	0
10	5.7366	5.2832	5.9428	2.5649	4.1431	3.989	3.8712	3.5553	2.4849	3.2958	1.3863	1.0986
11	5.7004	5.0173	6.2126	2.3979	4.4773	2.5649	3.8067	2.7726	2.8332	1.6094	1.0986	0.6931
12	4.1589	2.6391	4.2047	0.6931	2.3026	1.7918	2.1972	0	0.6931	0.6931	0	0
13	0	0.6931	2.0794	0	0	0.6931	1.0986	0	0	0	0	0
14	0	0	1.0986	0	0	0	0	0	0	0	0	0
15	0.6931	0	0.6931	0	0	0	0	0	0	0	0	0
16	0.6931	0	0	0	0	0	0	0	0	0	0	0
17	1.0986	0.6931	1.3863	0	0	0.6931	0	0	0	0.6931	0	0
18	0	1.3863	1.0986	1.6094	0	0.6931	0.6931	0	0	1.3863	0	0.6931
19	0	1.0986	1.3863	1.0986	0	0	0	0	0	0	0	0.6931
20	2.0794	0	1.6094	0	0.6931	0	0	0	0	0.6931	0	0
21	2.1972	1.7918	2.3979	0	0	0	1.0986	1.3863	1.3863	0.6931	0	0.6931

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Bar/Column Charts

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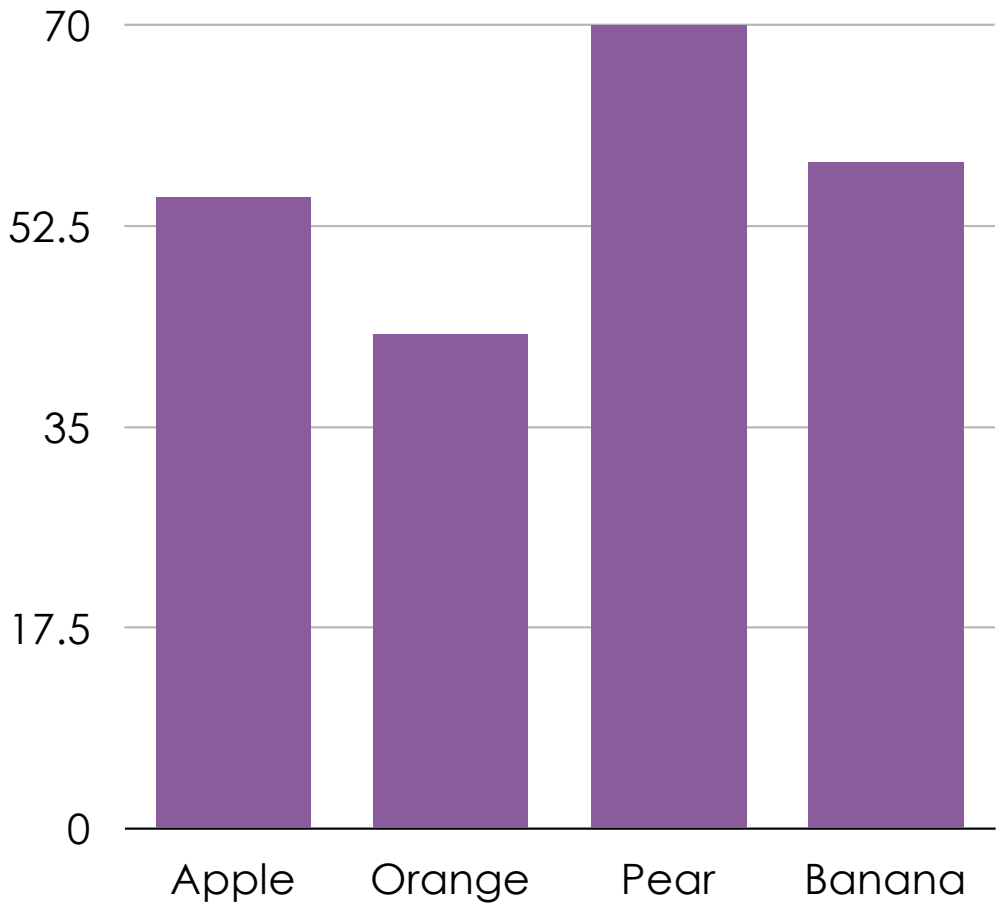
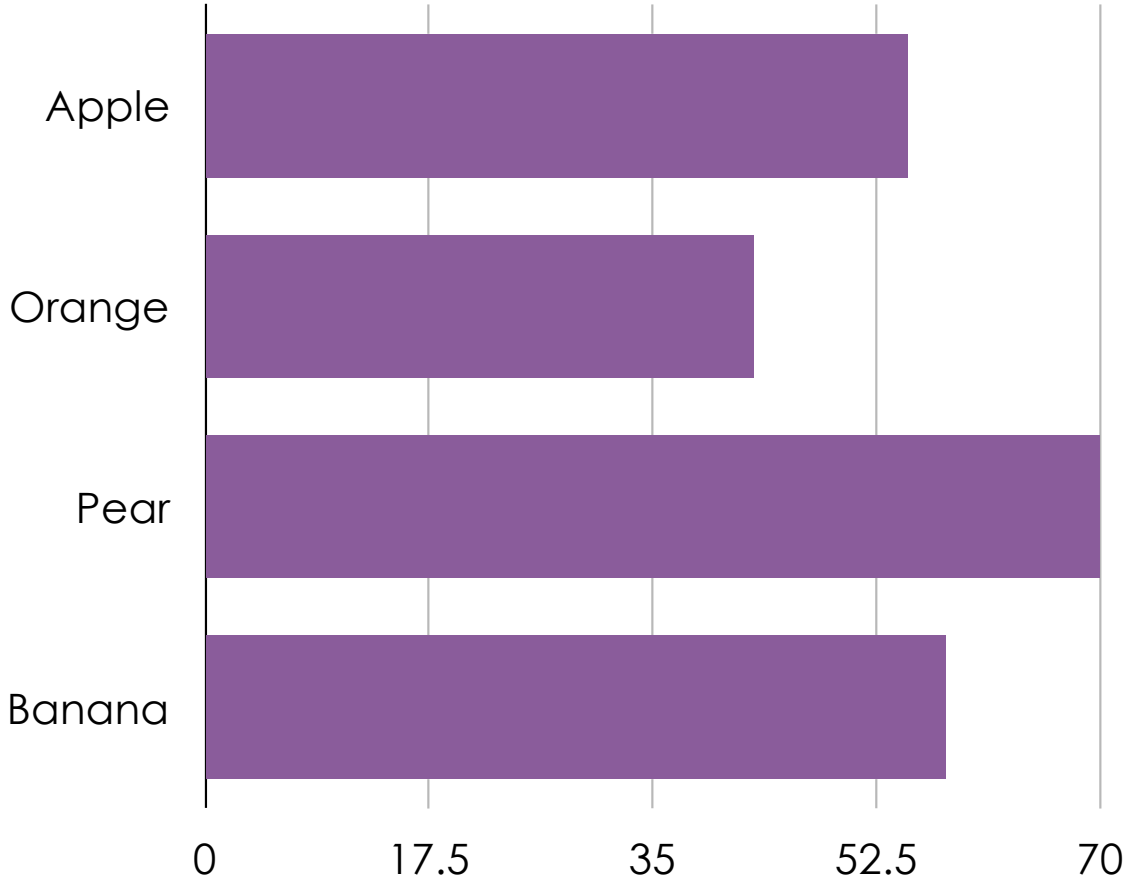
Column Chart / Vertical Bar Chart



Bar Chart / Horizontal Bar Chart



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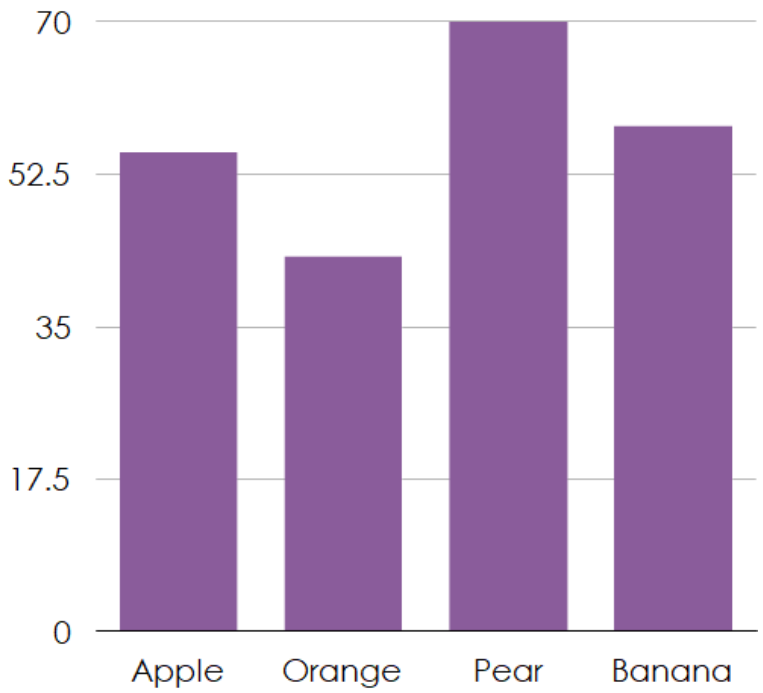
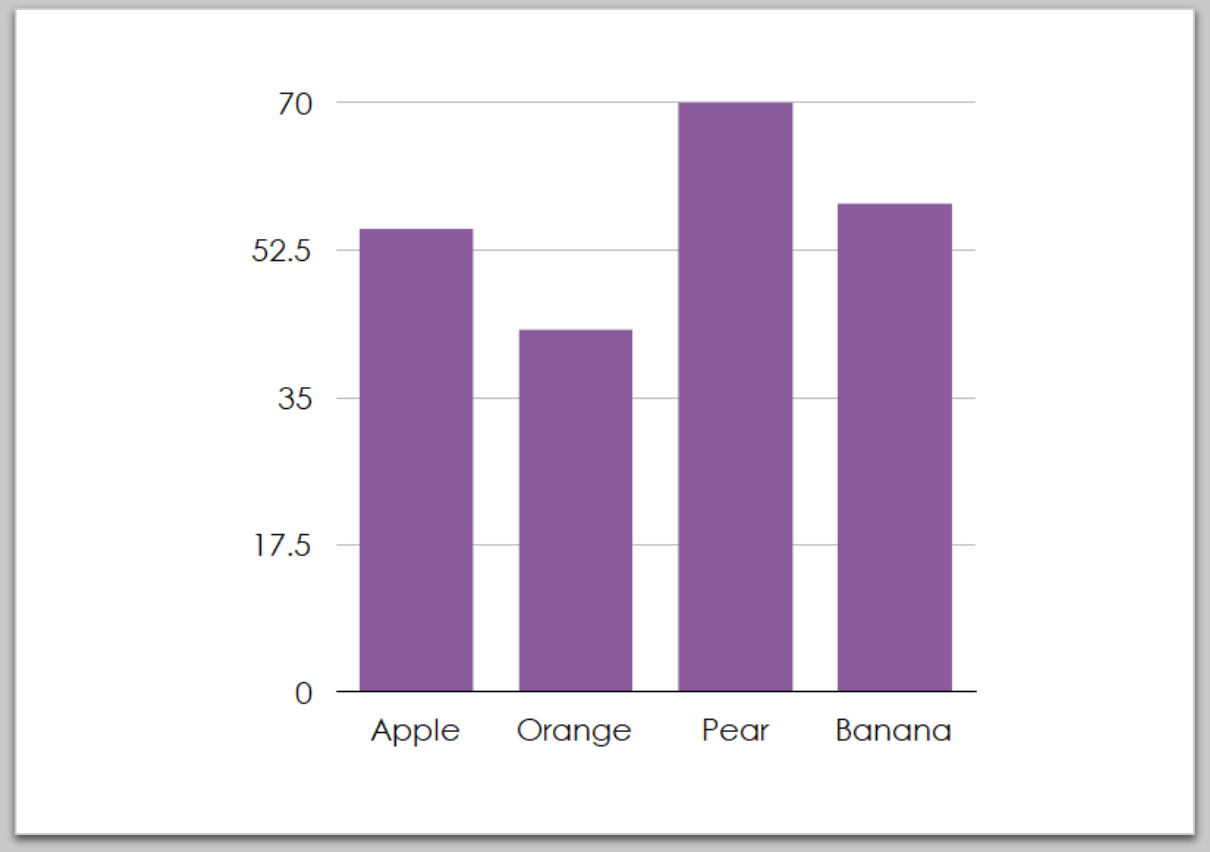


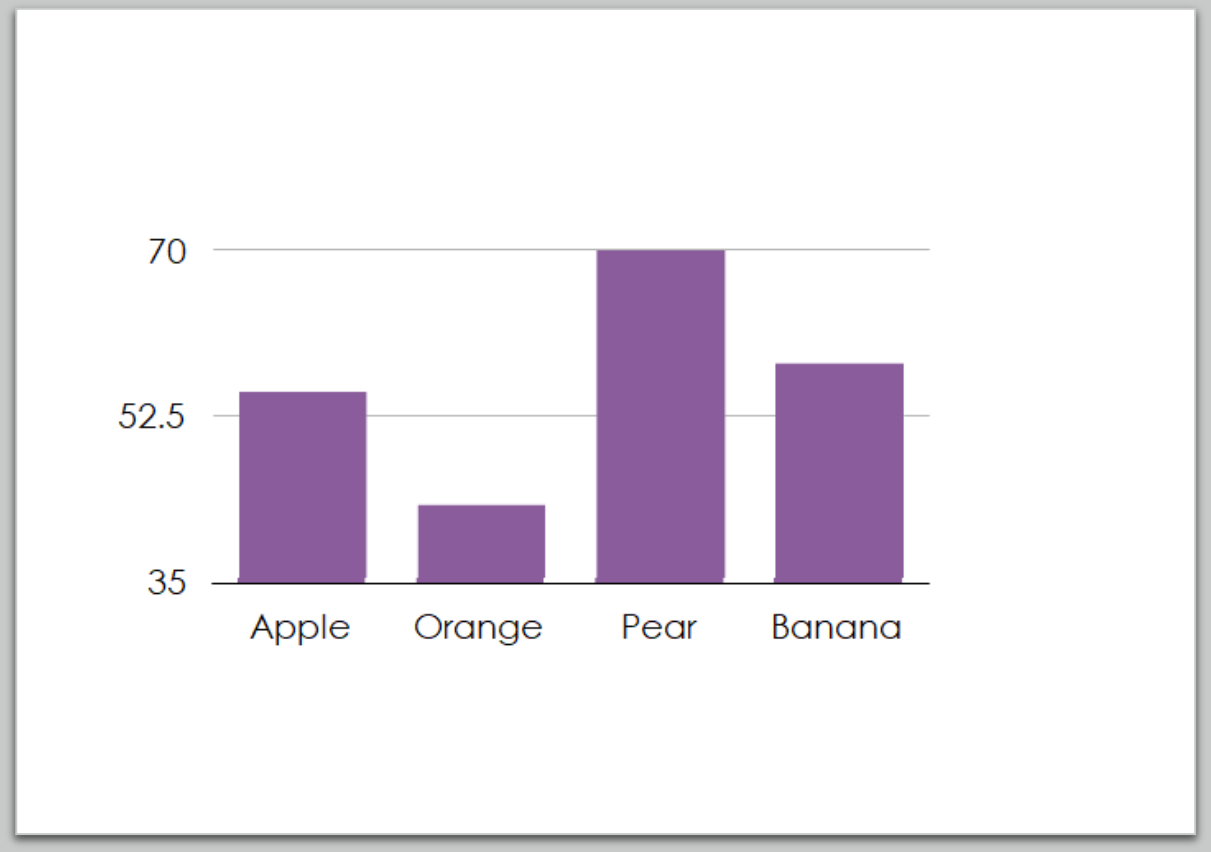
Column Charts

- Compare across categories
- Ex. What percentage of people like each type of fruit?
- Y is response (or count)
- X is category
- Column charts are best in terms of Y as a response variable
- Bar charts work well when labels are long or data is more of a natural horizontal idea (length!)

Column Charts

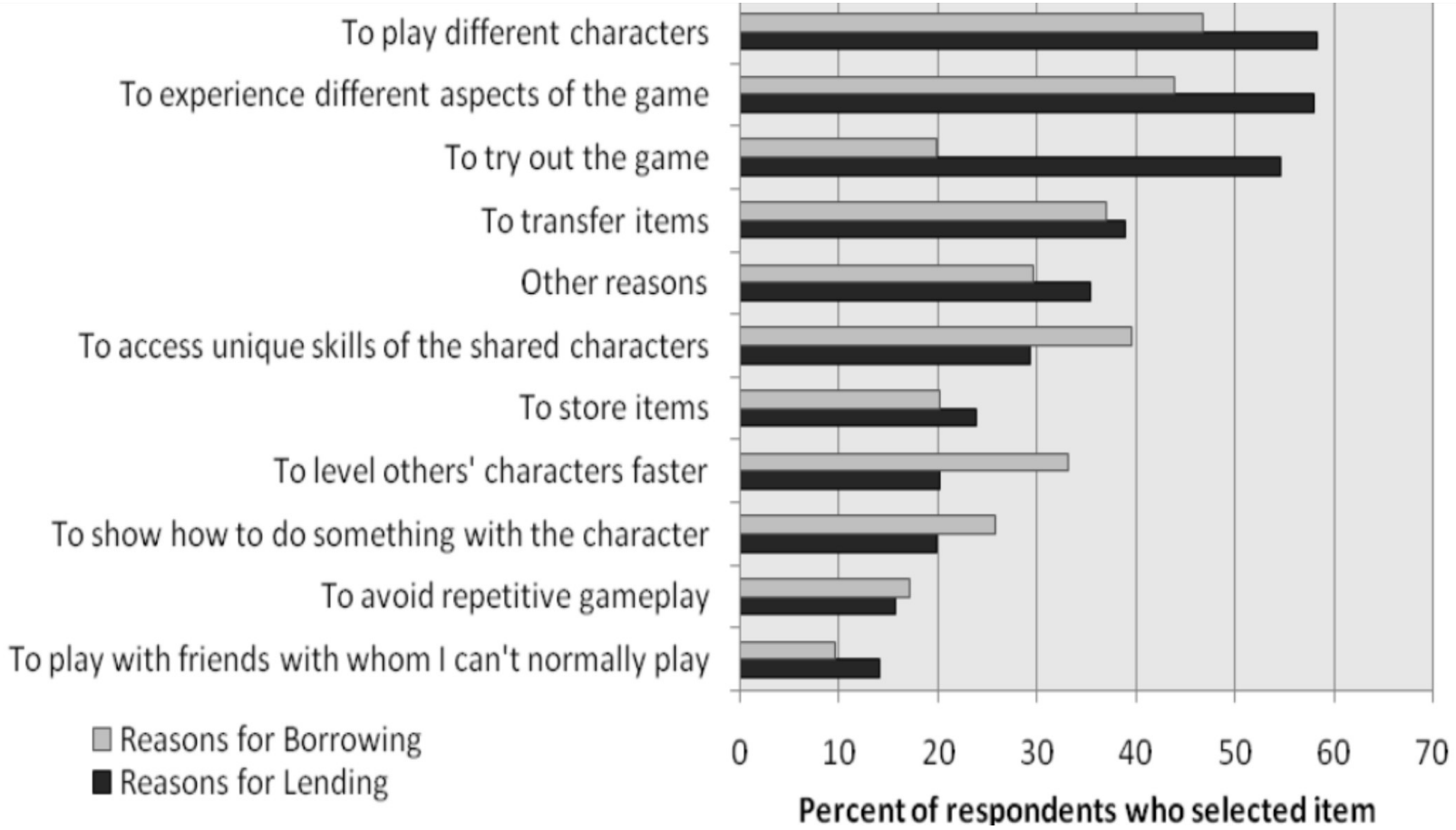
- Start your Y axis at 0!
- Alternate Y axis origins can be acceptable but when they are used it is because those reading chart understand context of non-zero origin.
- Many non-zero origin choices are deceptive.





Wong et al., 2009 (Multi-set Bar Chart)
Example of primary/secondary categories

- Colour of bar (or texture, etc.) indicates another category for comparison



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Histograms

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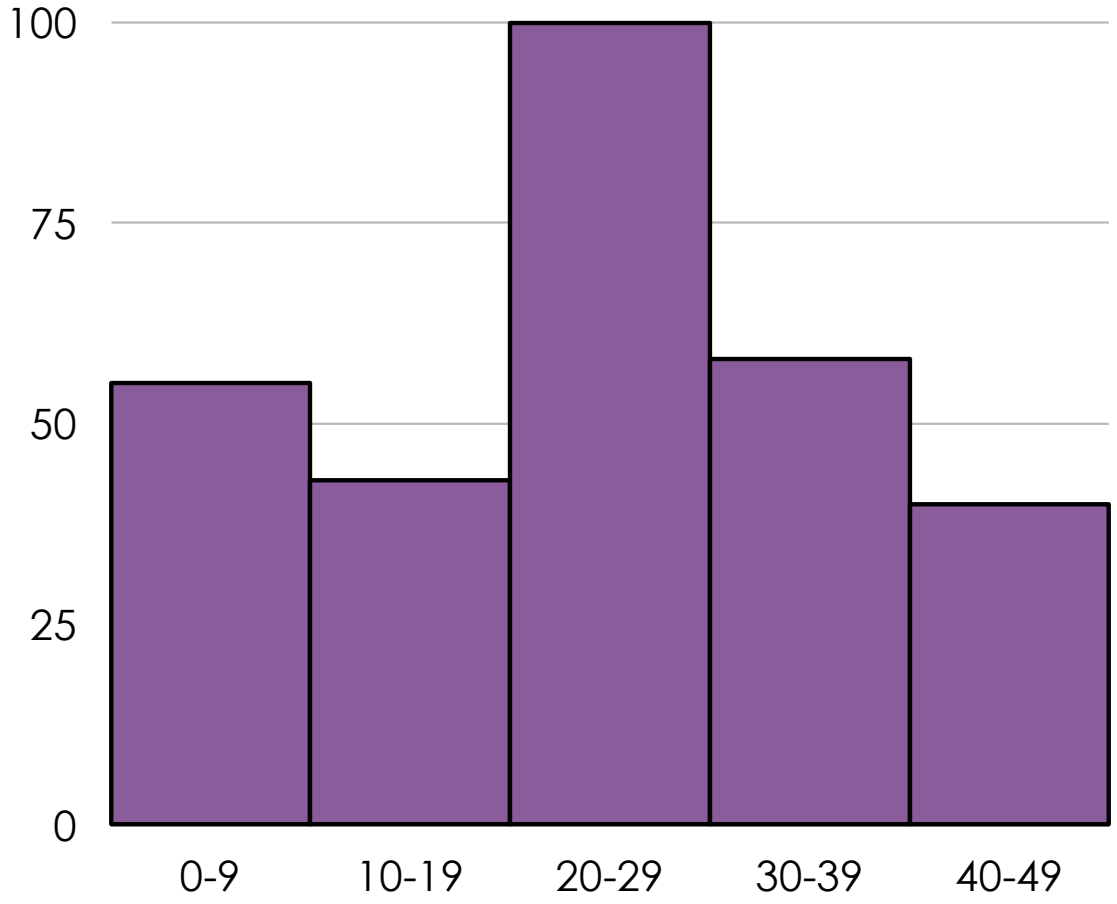
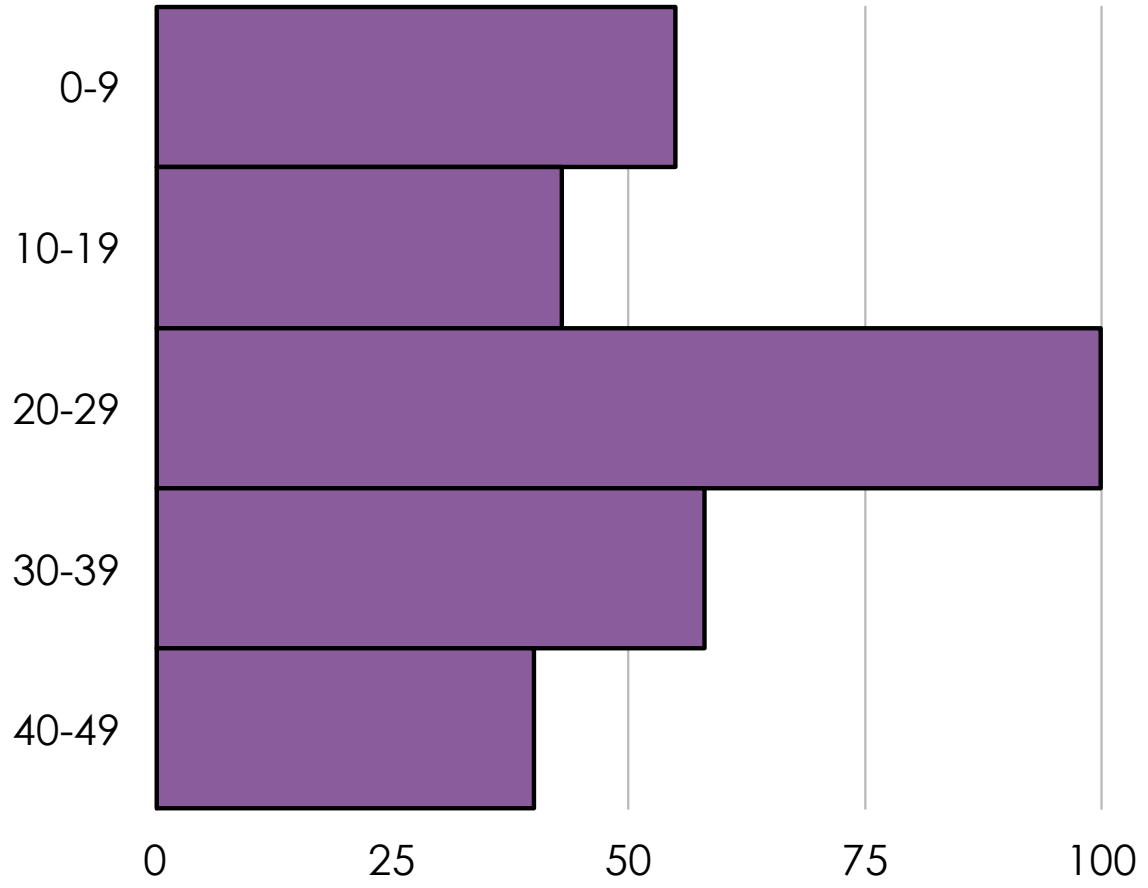
Histograms





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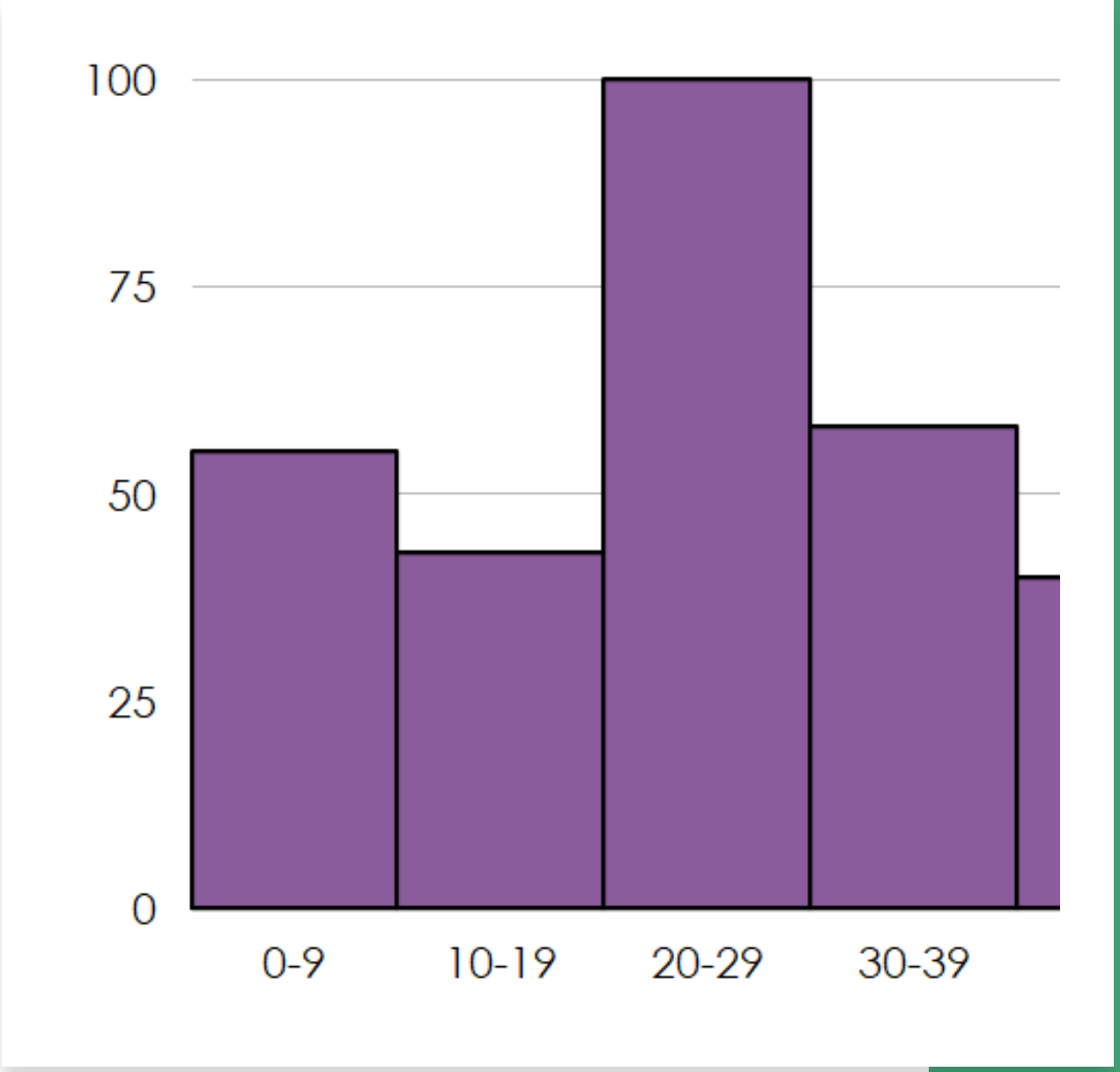
Histograms

- Distribution based data
- Ex. Student grades, data that might have categories or groupings
- Each x in X is a bucket (a smaller range portion of the total range)
- Y is response (count in category)
- Like bar chart but categories are related as being ranges which are part of a complete range
- Range choice can be used to manipulate data's appearance.



Stacked Charts / Histograms

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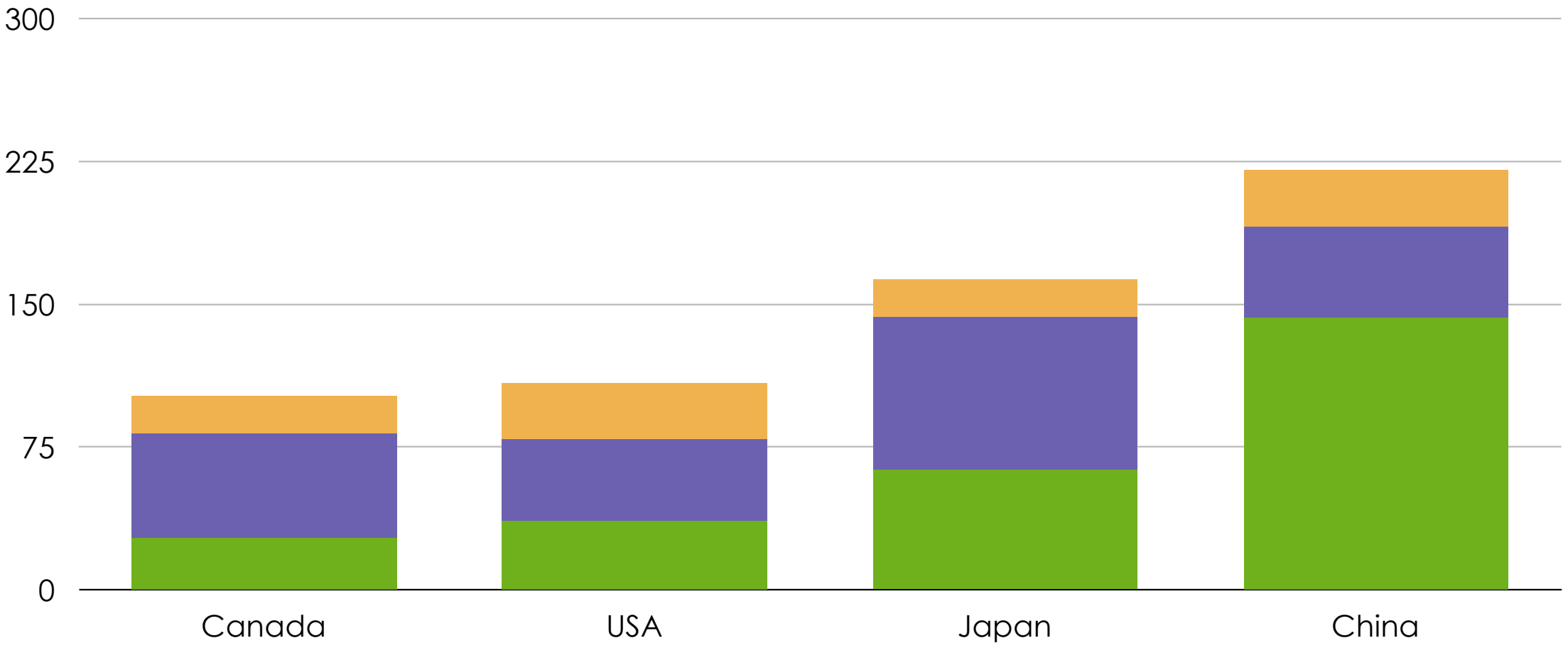
Stacked Charts



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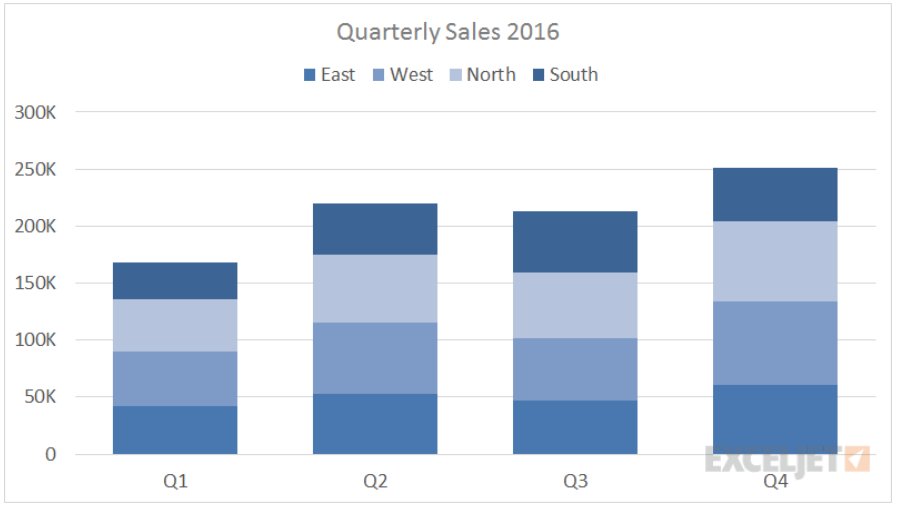
Stacked Charts

- Variant of bar type charts
- Part to whole comparisons
- Primary and secondary categories, but the secondary categories are all part of the whole for each primary category
- Ex. Sales per quarter for company, but also divided by area of country within that quarter.
- Note that secondary categories become hard to numerically compare.



Box-And-Whisper Charts

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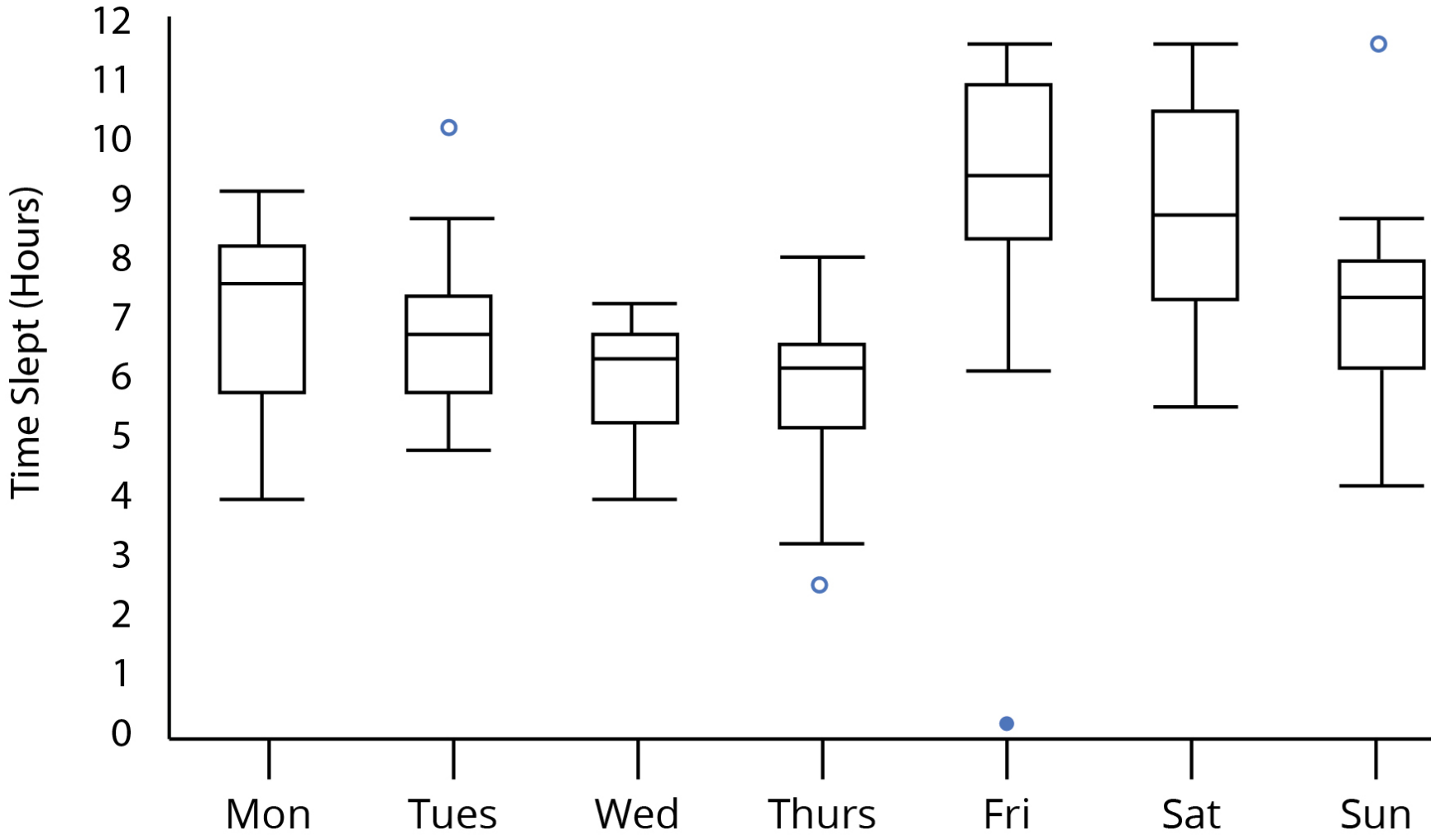
Box-And-Whisper



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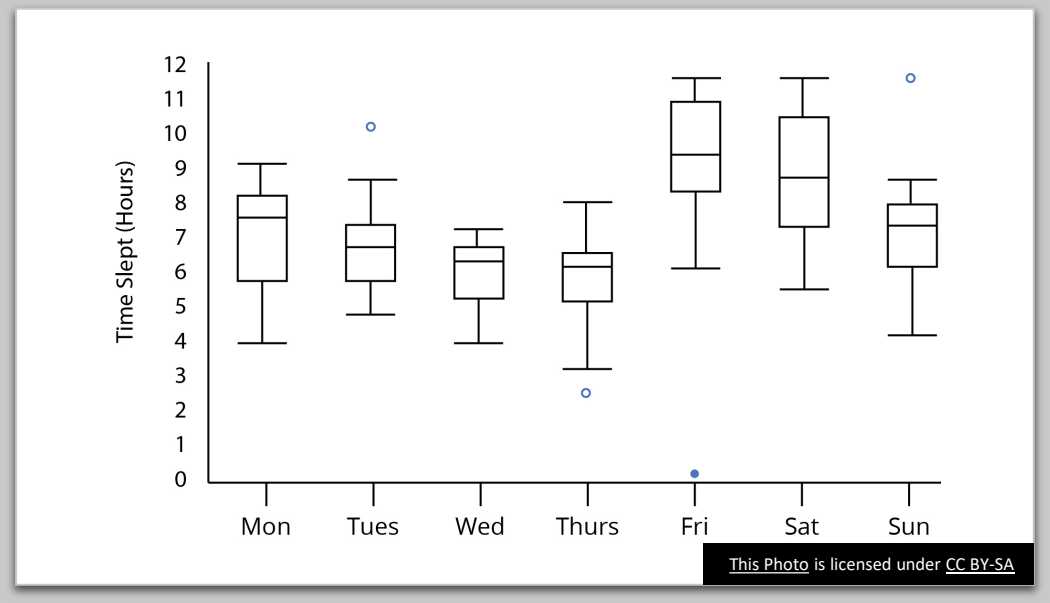
Box-And-Whisper

- Center line (sometimes an X) is the median of the collection of values in the category
- The top/bottom of box are 25% and 75% quartile values.
- The whiskers (top and bottom thin pieces) are the minimum and maximum values
- Dots are outliers that fall a certain extent away from the mean (technically they are the true mimima and maxima)
- Common in sciences to convey multiple data points in more statistical manner



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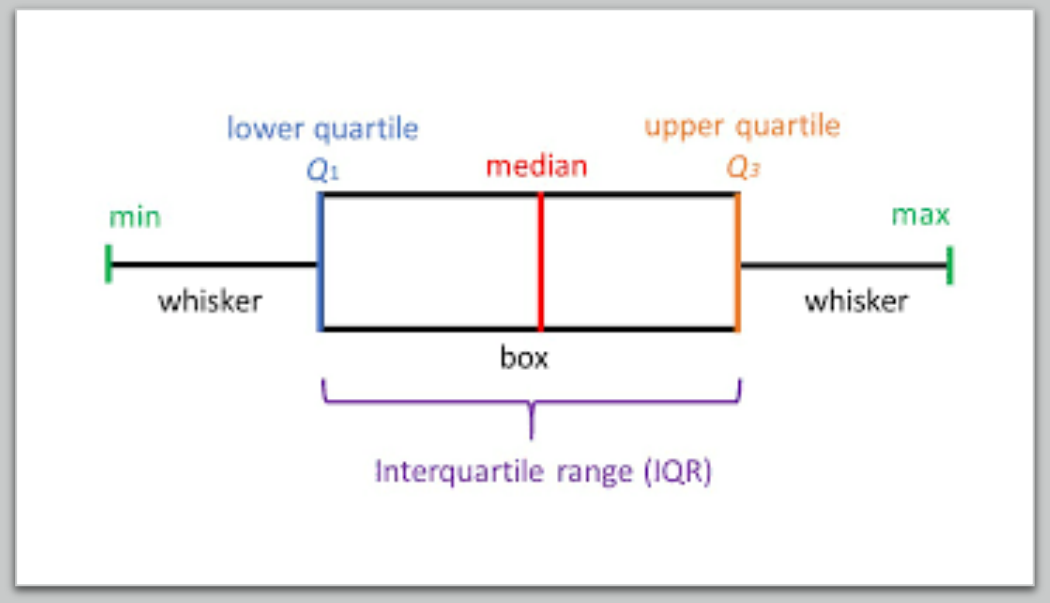
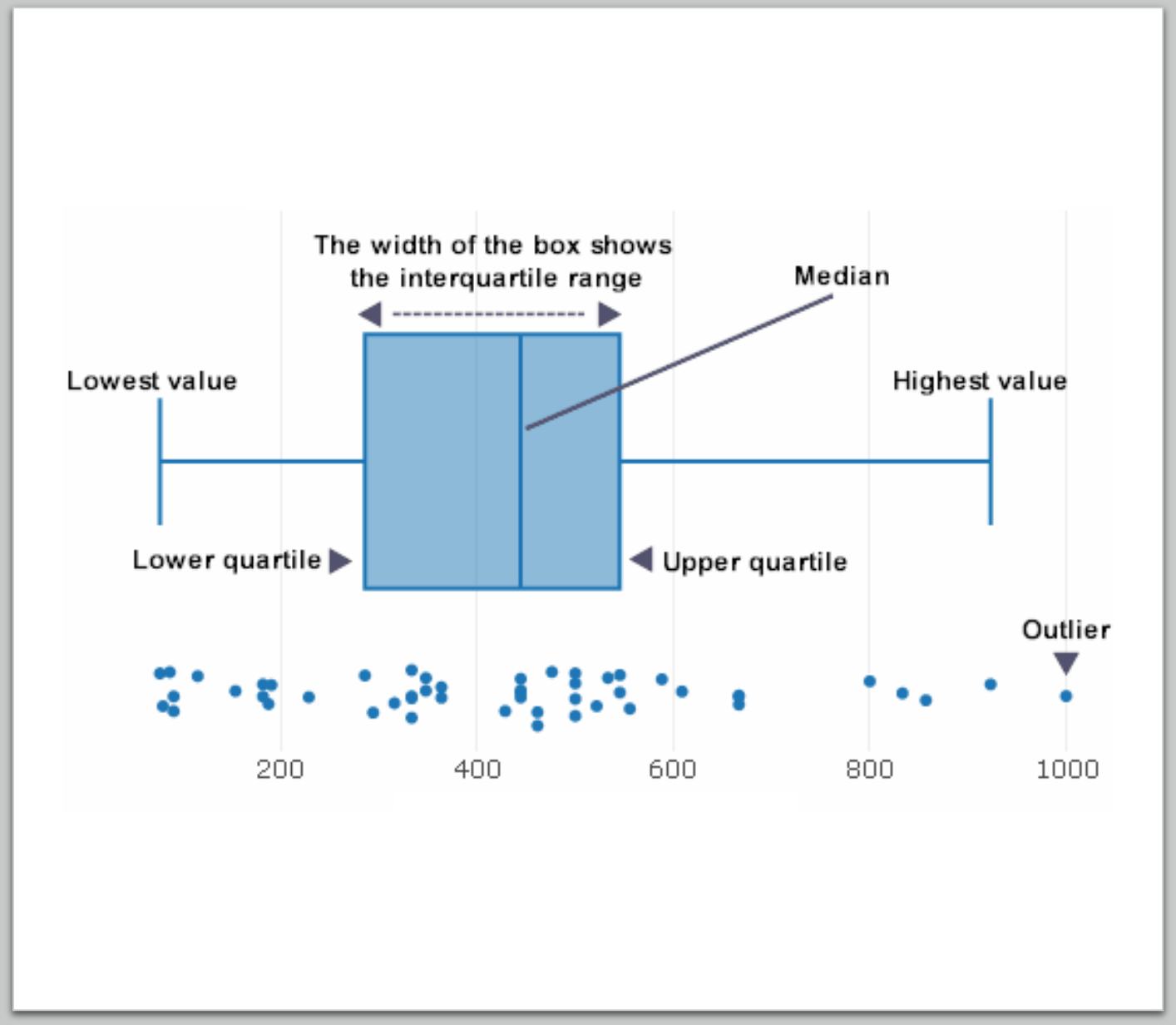


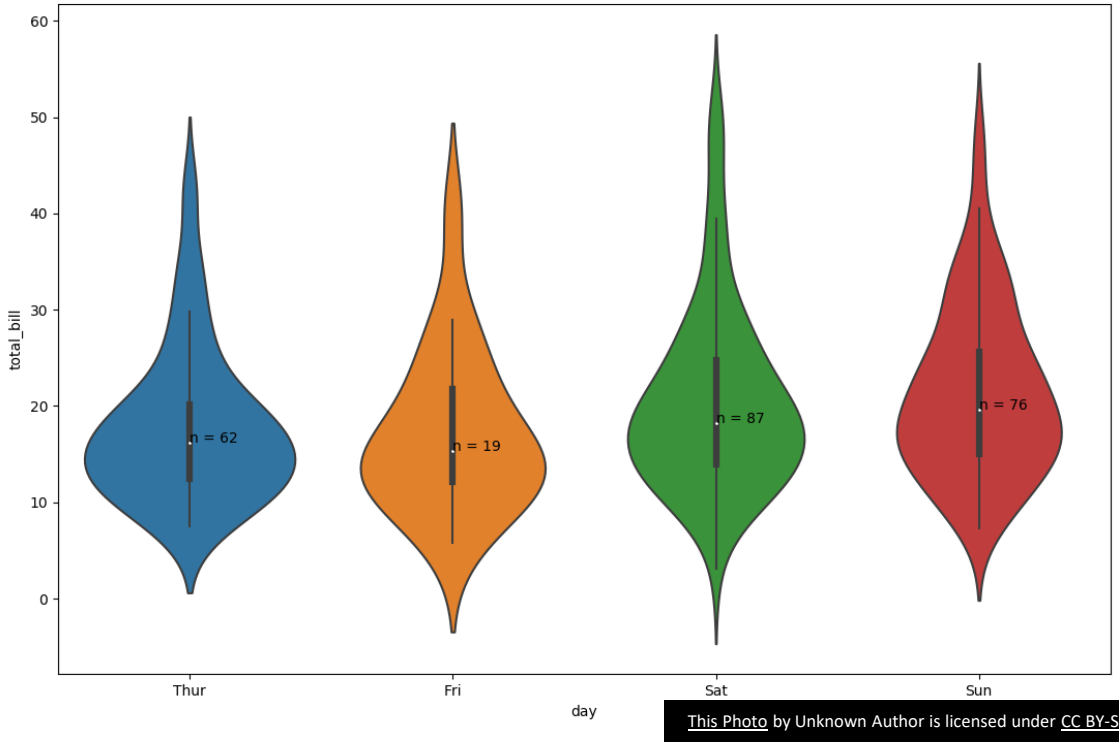
Box-And-Whisper and Bee Swarm Chart

- Same data can be shown as a ‘bee swarm’
- A plot of points but ‘jittered’ (randomly distributed when they overlap)
- Gives more exact data but is often not detail that is needed



Box-And-Whisper and Violin Chart

- Same data can be shown as a ‘violin’
- A variant of ‘bee swarm’ where the points aren’t ‘jittered’ but instead of a box and whisper box, a variable width shape is used.
- Some degree of smoothing of data is done to width change to give smooth shape.



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Line Charts

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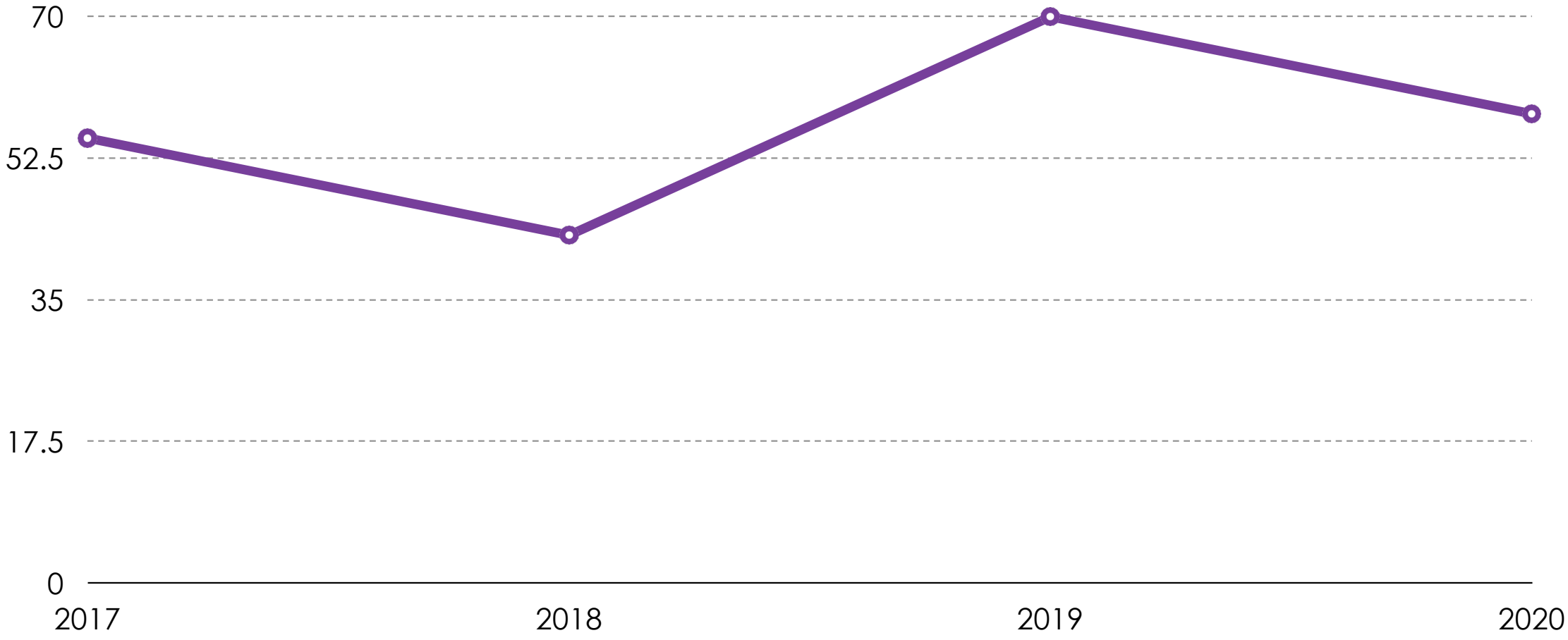
Line Charts



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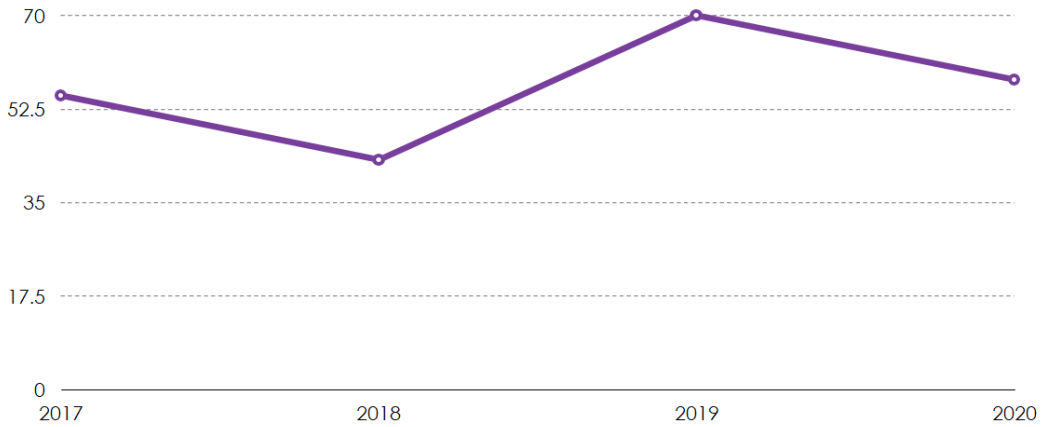
Line Charts

- Data changing over time
- Y (up-down is response)
- X is interval (it is clearest if this is consistent scale)
- Predict trends



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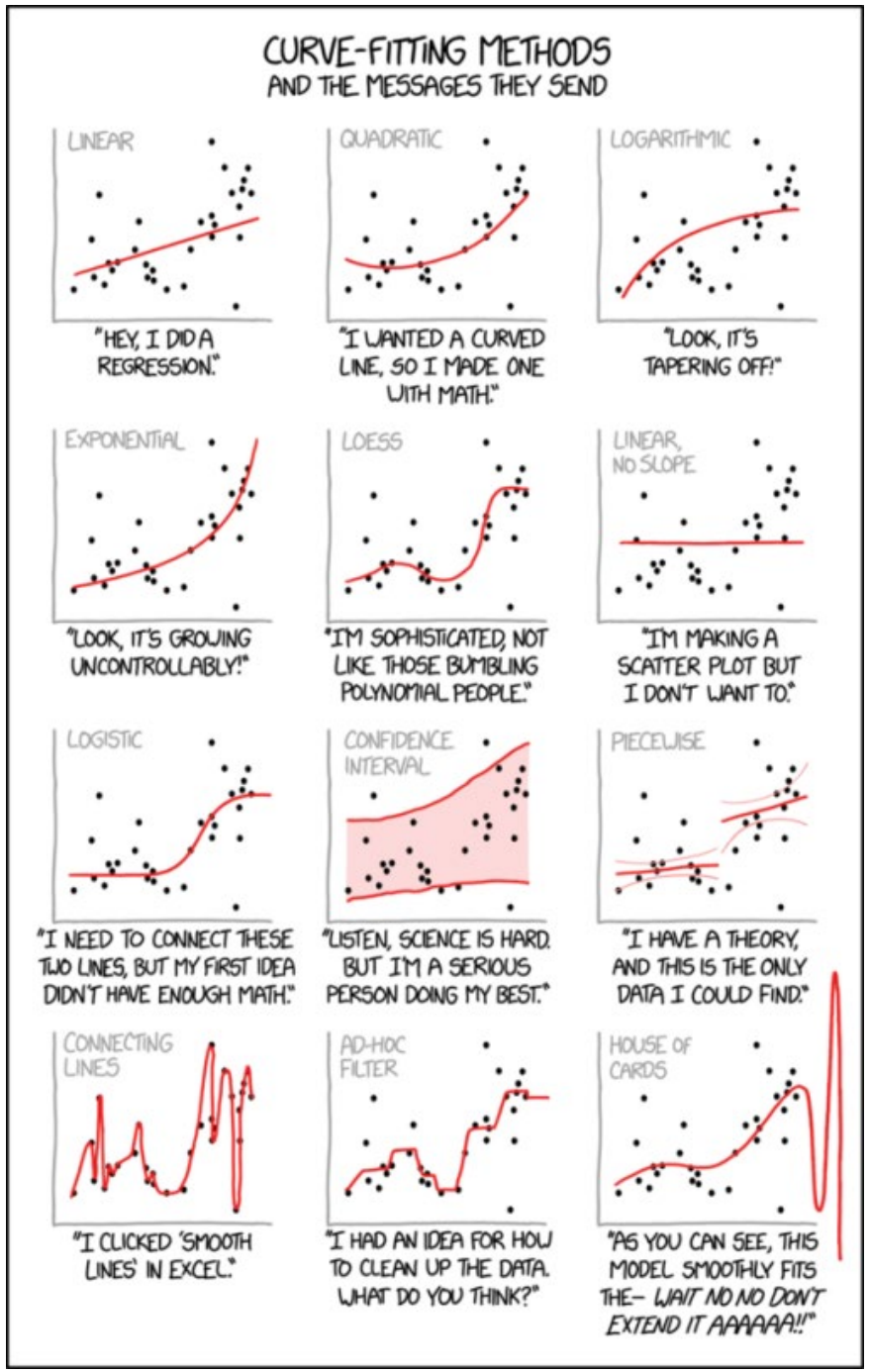
Line Charts

- Data changing over time
- Y (up-down is response)
- X is interval (it is clearest if this is consistent scale)
- Imply trends?



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Area Charts

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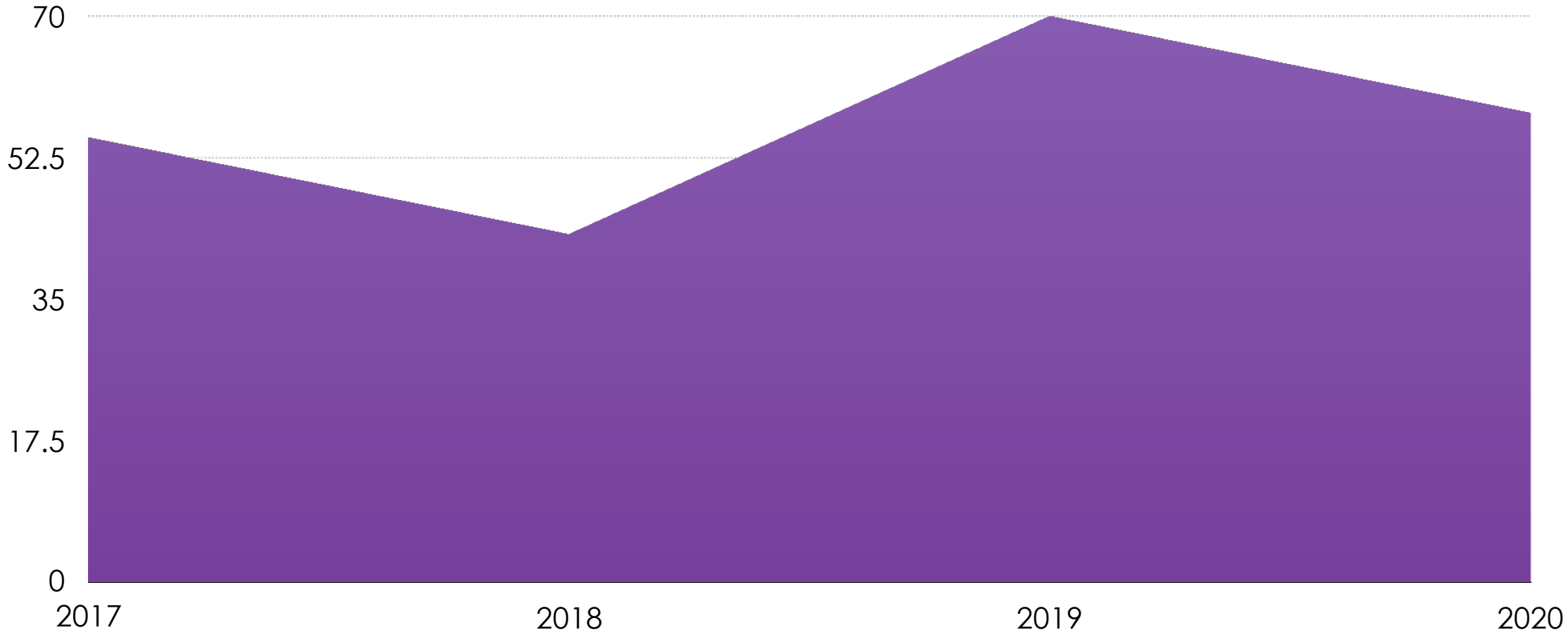
Area Charts



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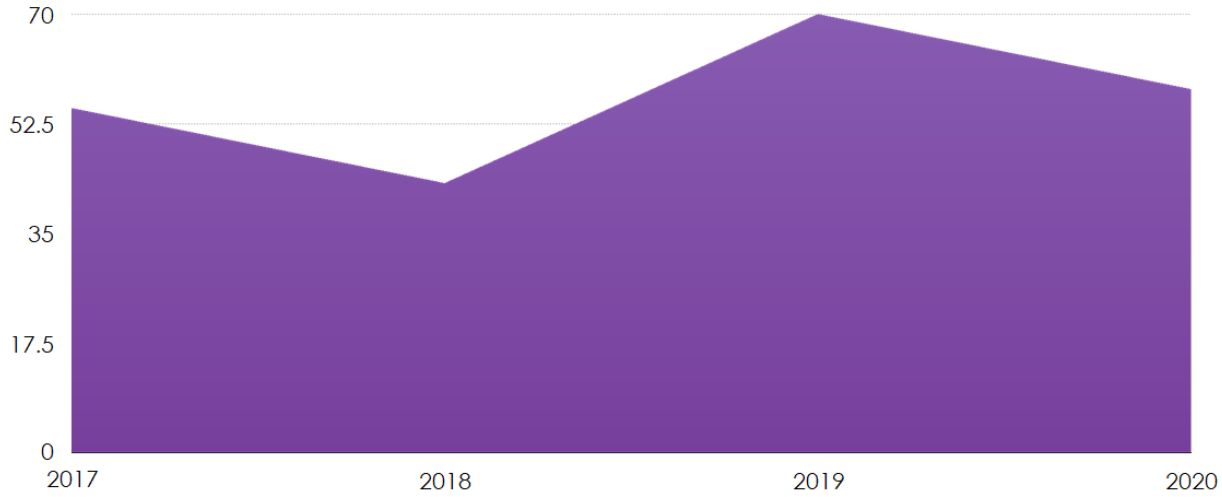
Area Charts

No immediate benefit over a line chart, but when only 1 line gives more emphasis to quantity

Also works better when 0 is meaningful quantity relative to Y data

Most useful when combined with stacking



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Line vs. Area

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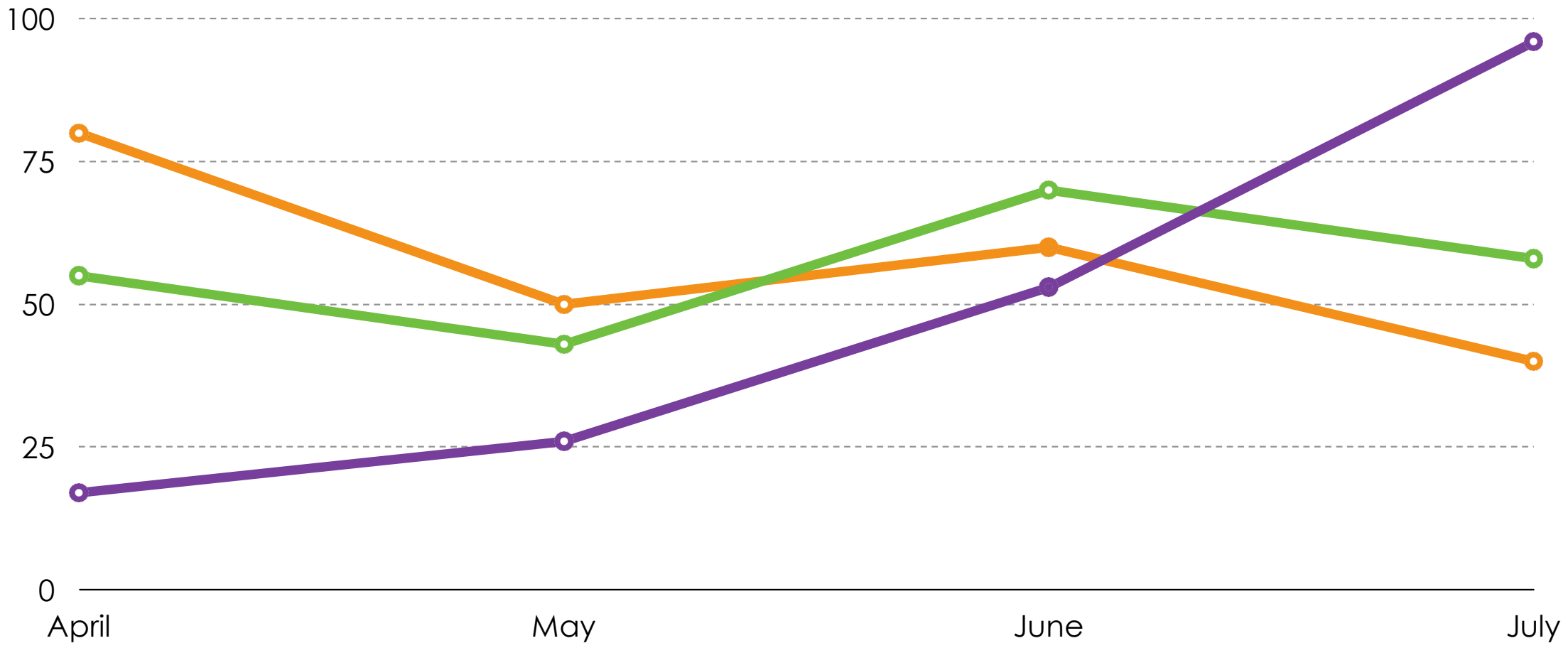
Line Chart



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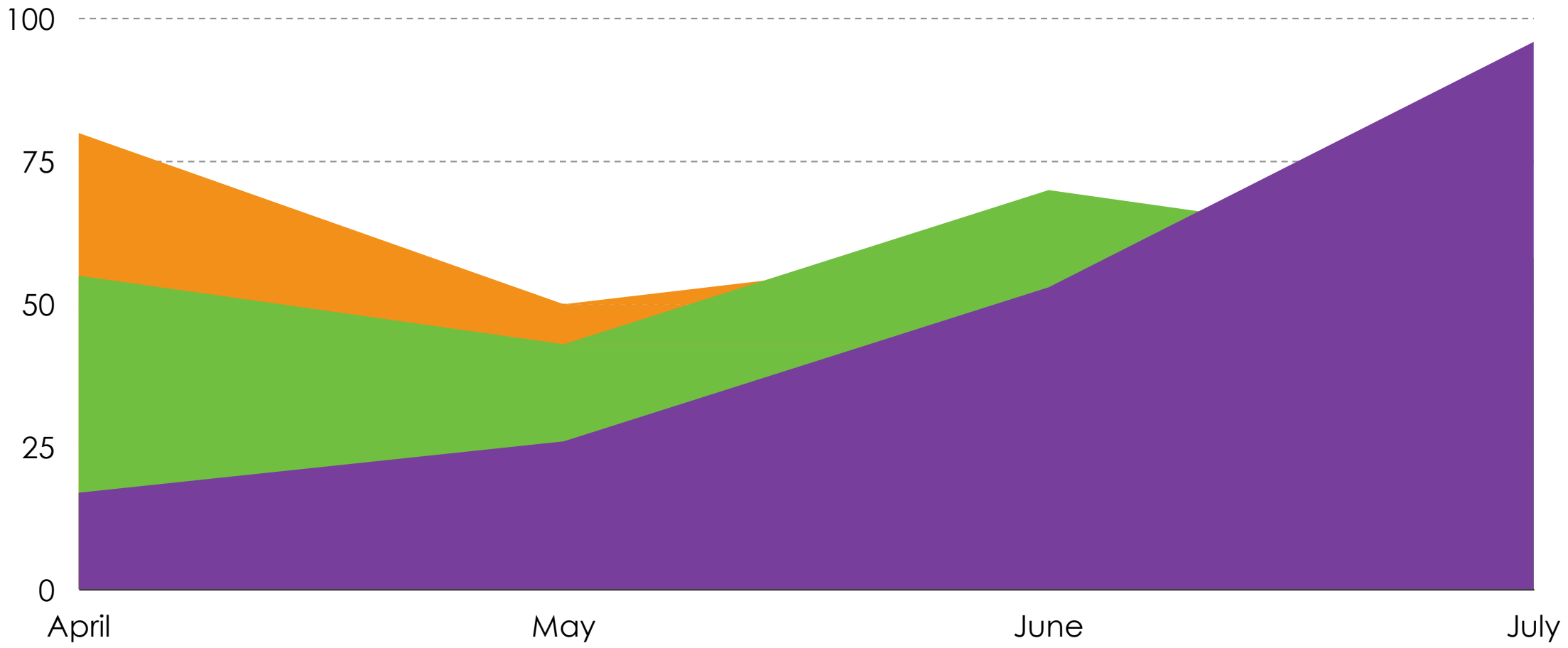
Area Chart



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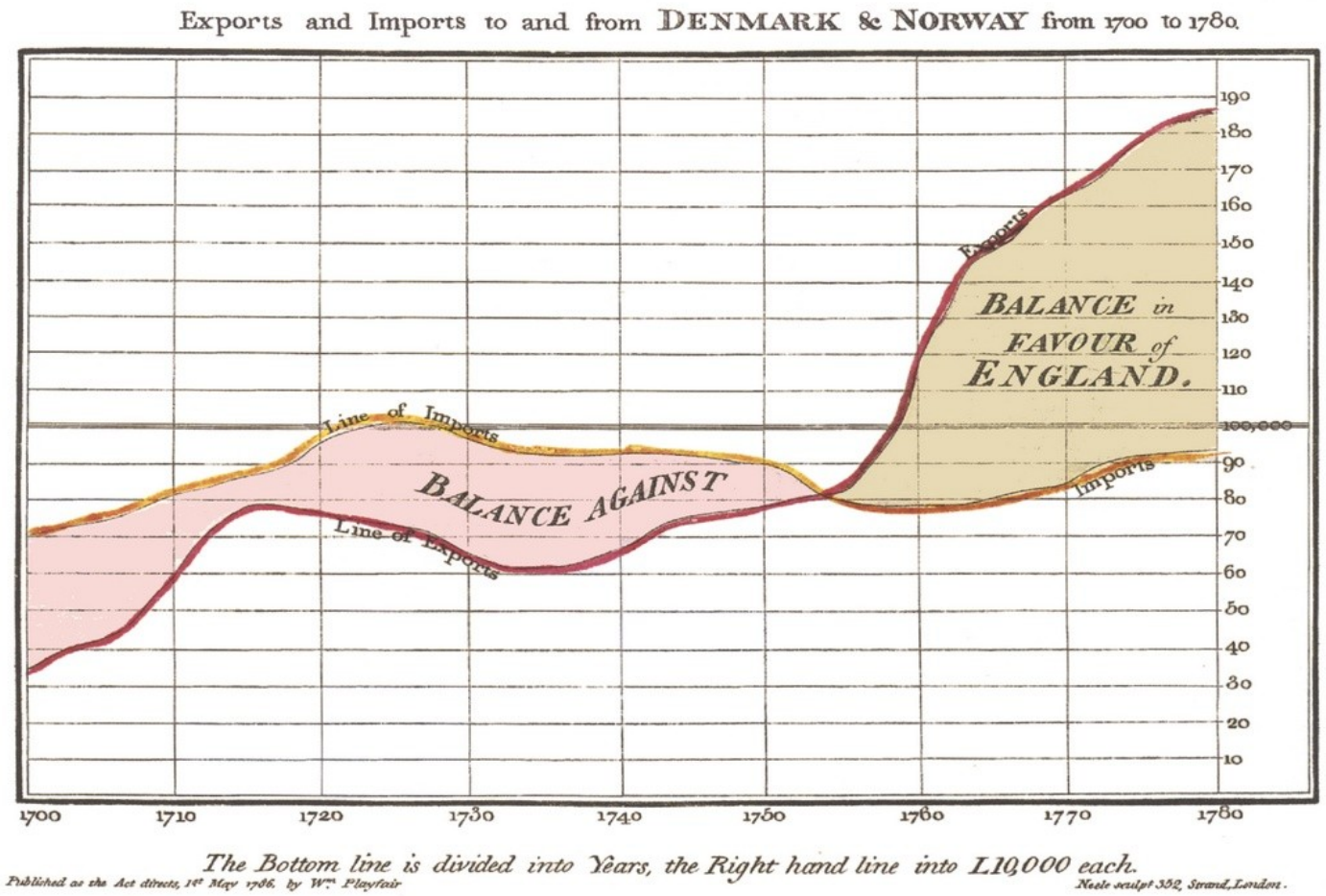
William Playfair - The Commercial and Political Atlas, 1786



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Stacked Area Charts

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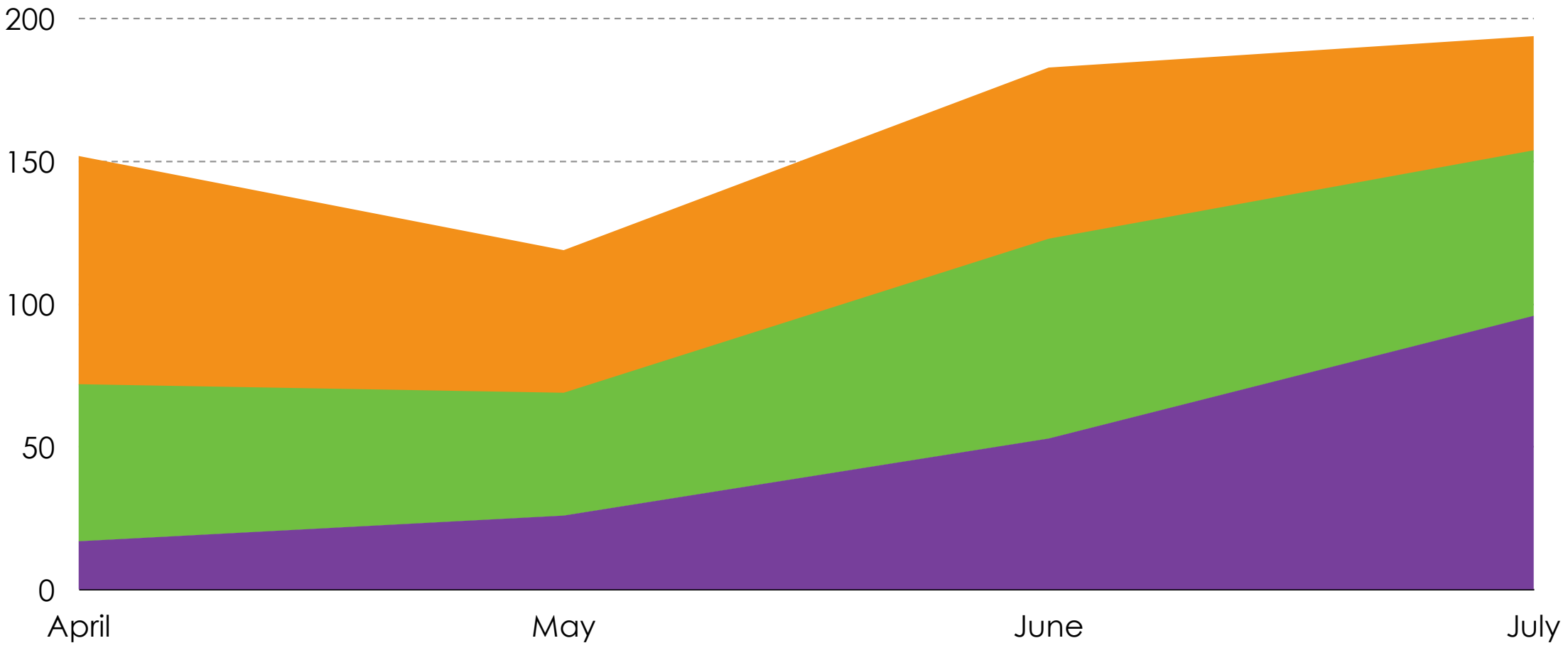
Stacked Area Charts



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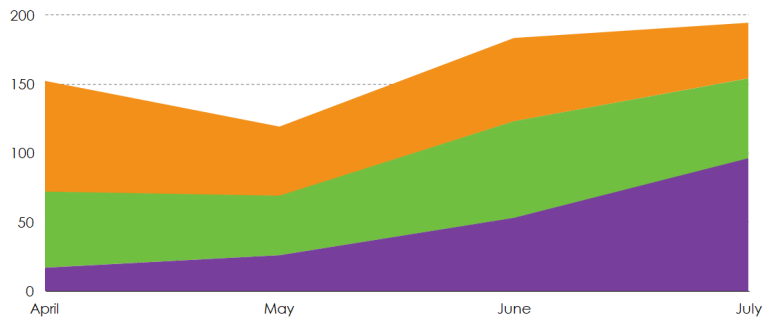

Stacked Area Charts

- A line chart form of stacked bar chart
- The top line becomes cumulative measure and partial measures are indicated by portions between each line
- Choice of stack order can be deceiving
- A danger with these is that visual area can be a distraction from being able to determine numerical data from chart

Pie Charts and Donut Charts

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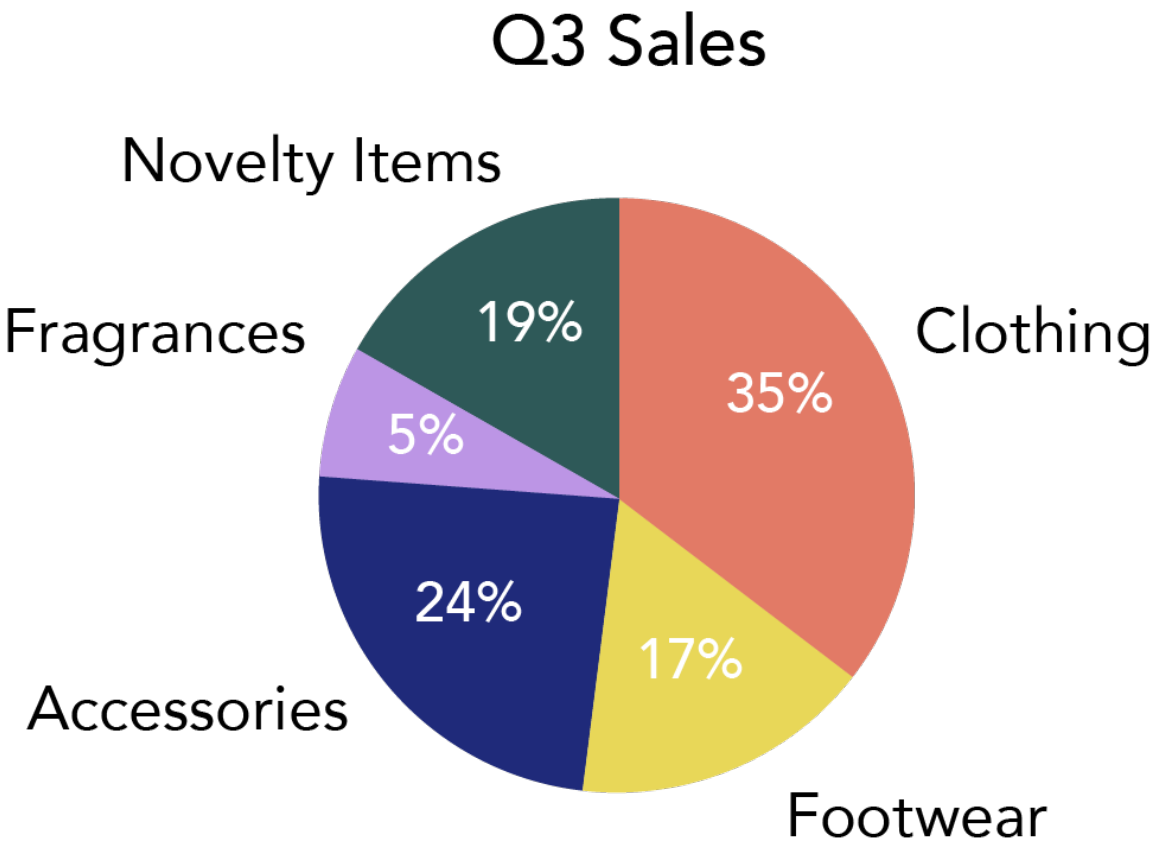
Pie/Donut Charts

- Part of whole
- Natural idea of 100% being the complete circle (or donut)
- Each slice should have area proportional category value
- Hard to accurately draw by hand



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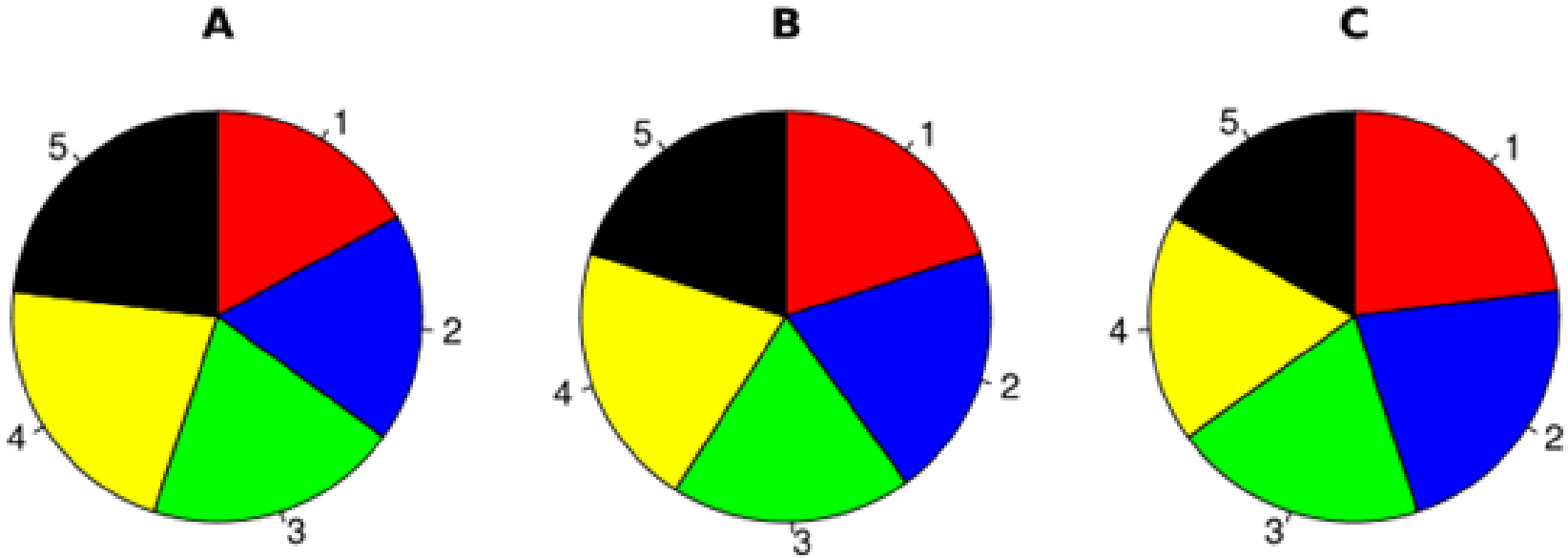

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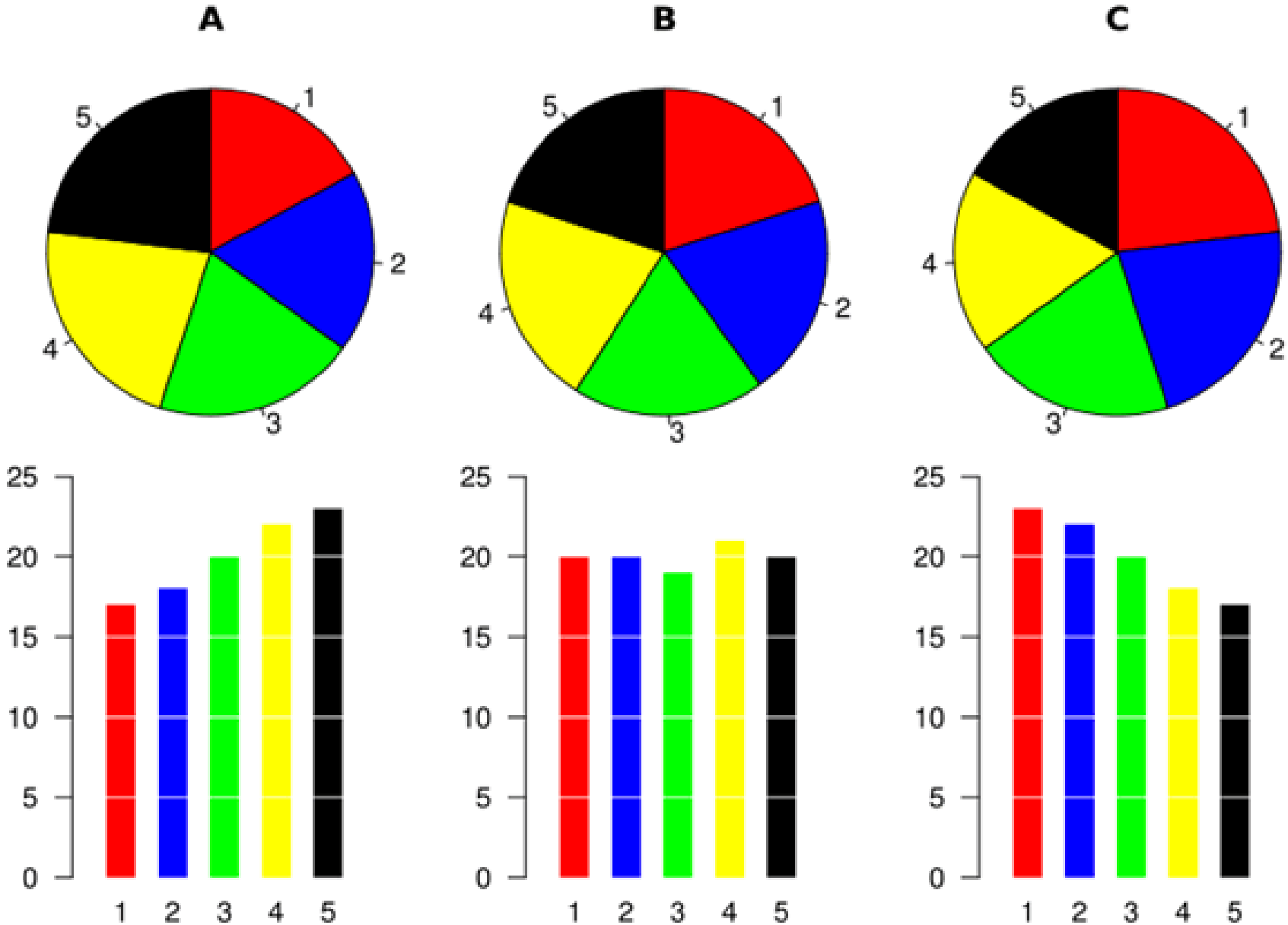

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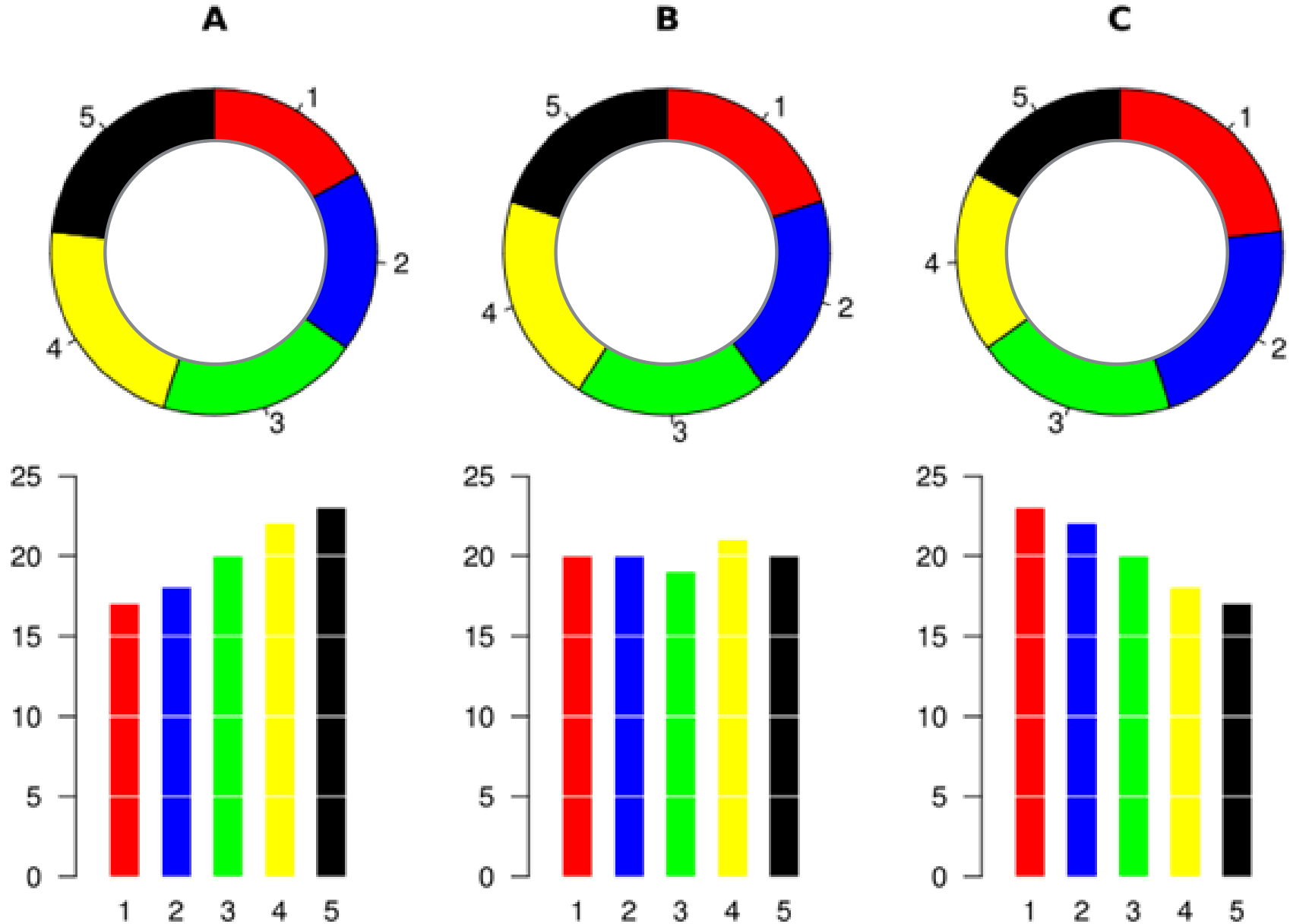

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Mekko Charts (Colour Blocking Charts)

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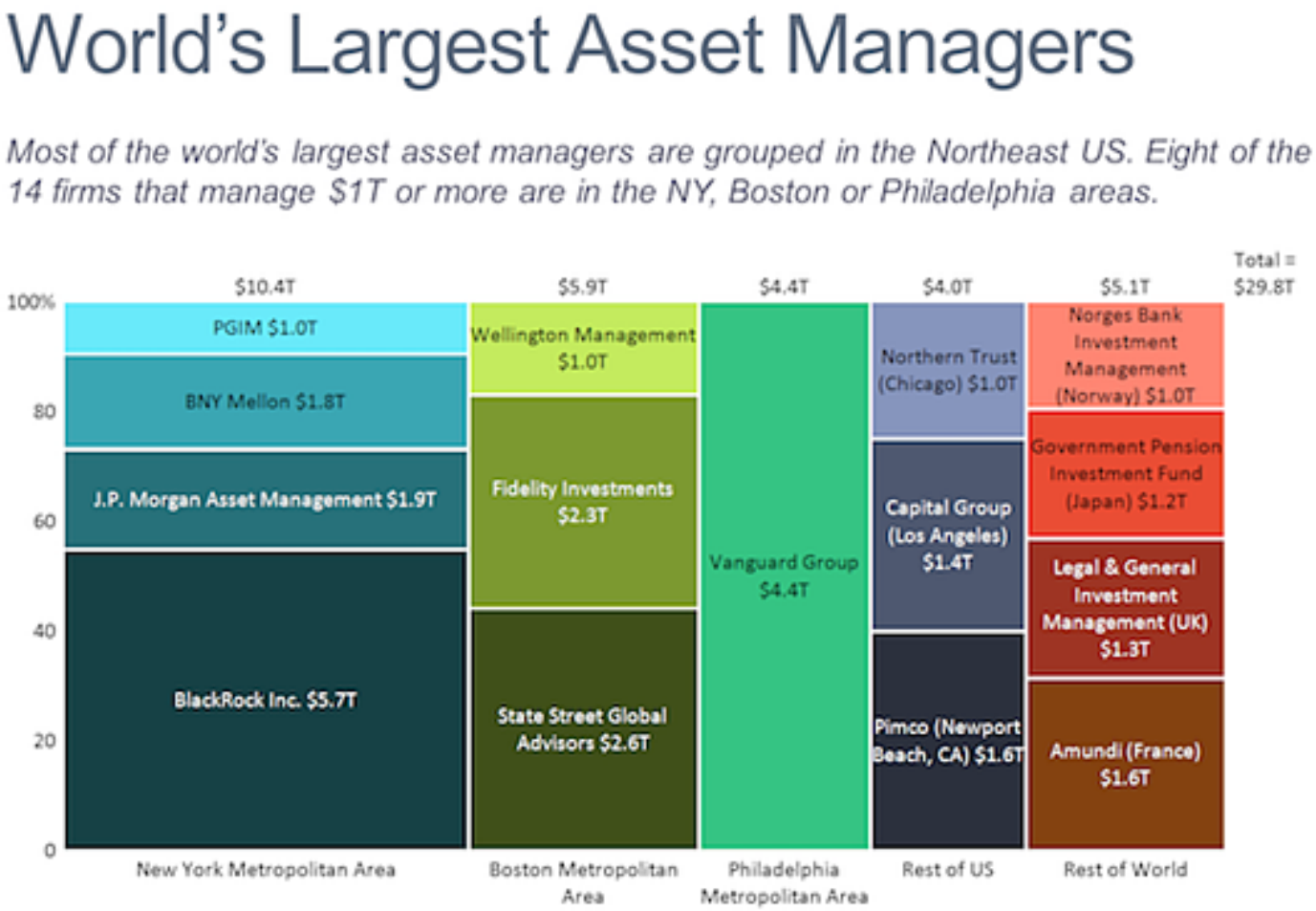
Mekko Chart



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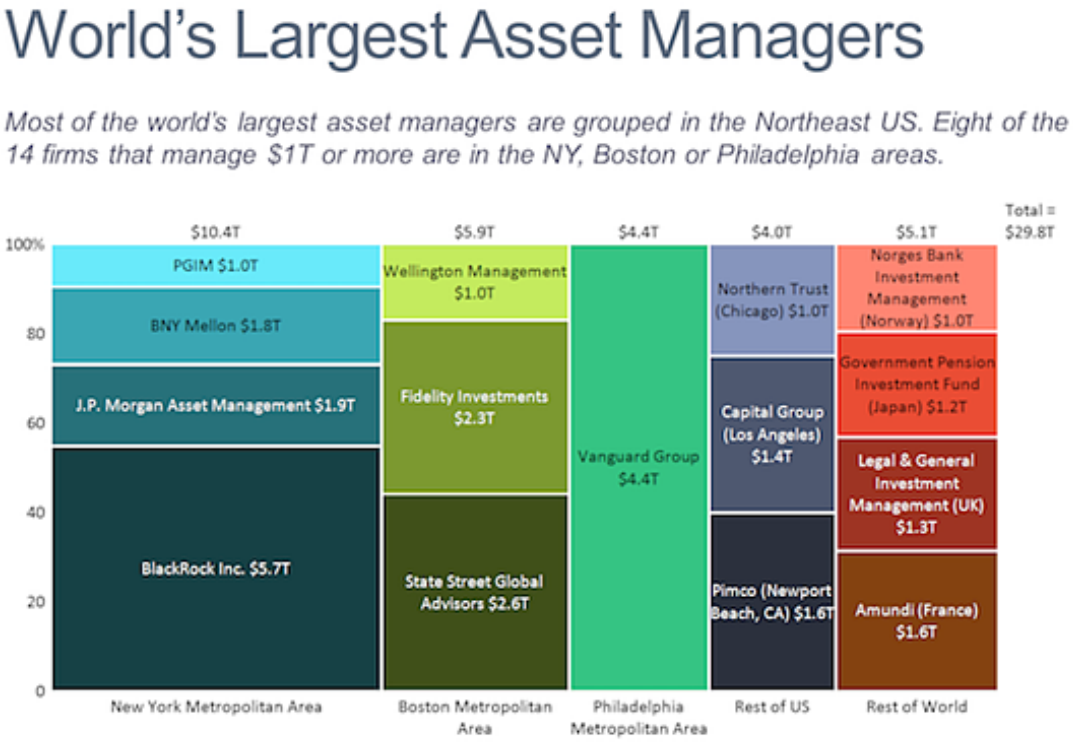
Mekko Chart

- Combination of column chart with pie chart functionality
- Parts of a whole idea
- Each sub area is relative part of whole area
- Also can compare data as a category and often stacked part of category as seen in this example
- Colour block charts don't include column chart properties (basically a rectangular pie chart)



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Scatter Charts (Plots)

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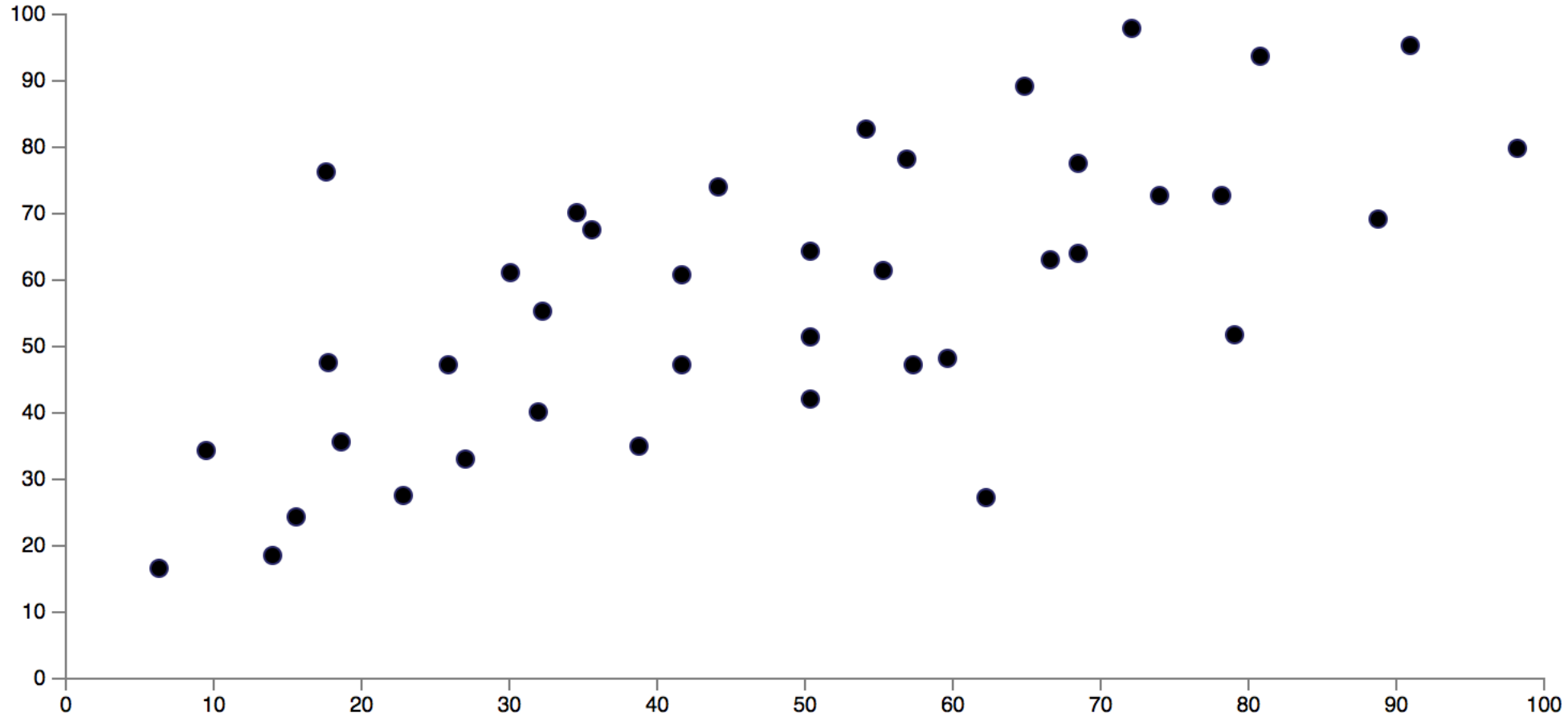
Scatter Plots



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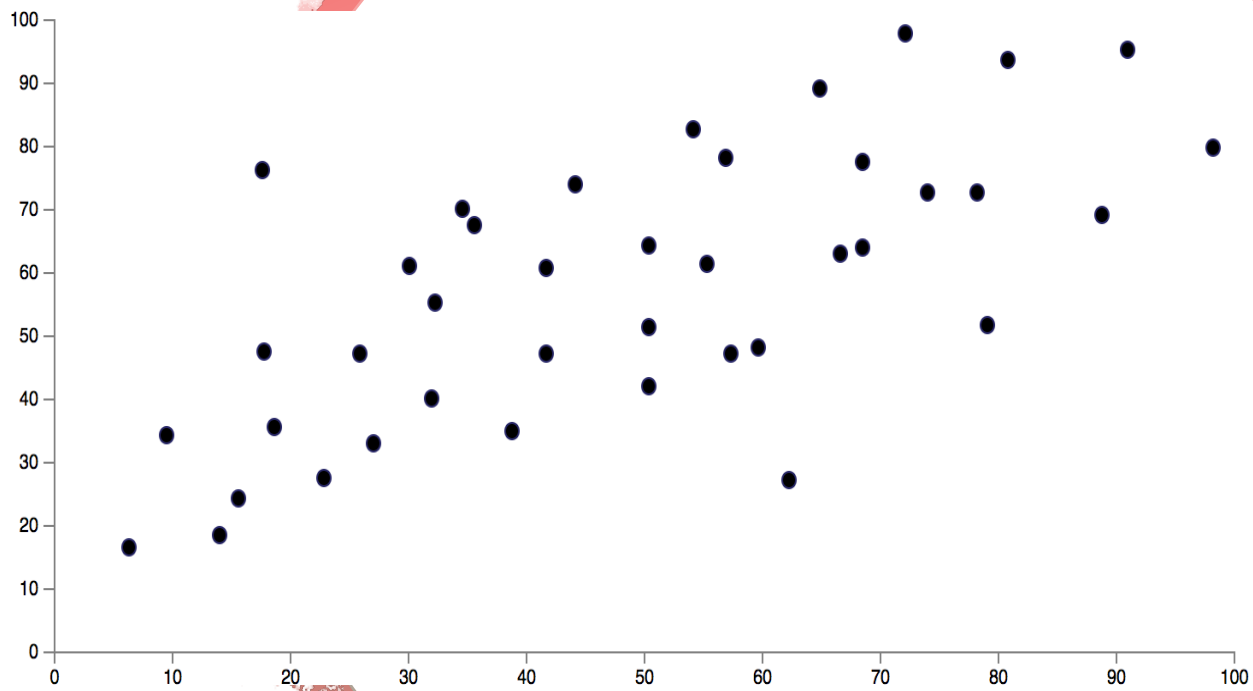
Scatter Plots

- Relationship between two variables
- Often from numerous experiments or measurements
- Reveals distributions (clusters of points, or pattern of points imply relationships or correlations)
- Can find outliers in data otherwise existing in a table of data



Bubble Charts

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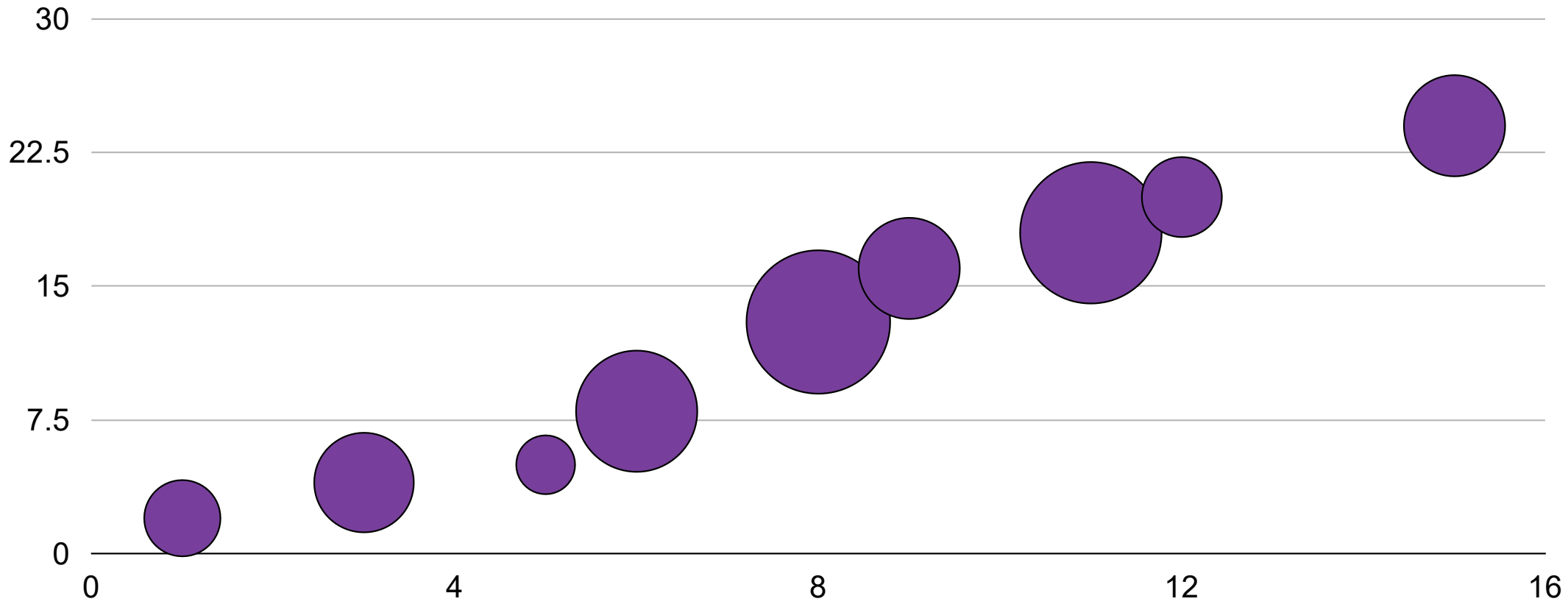
Bubble Chart



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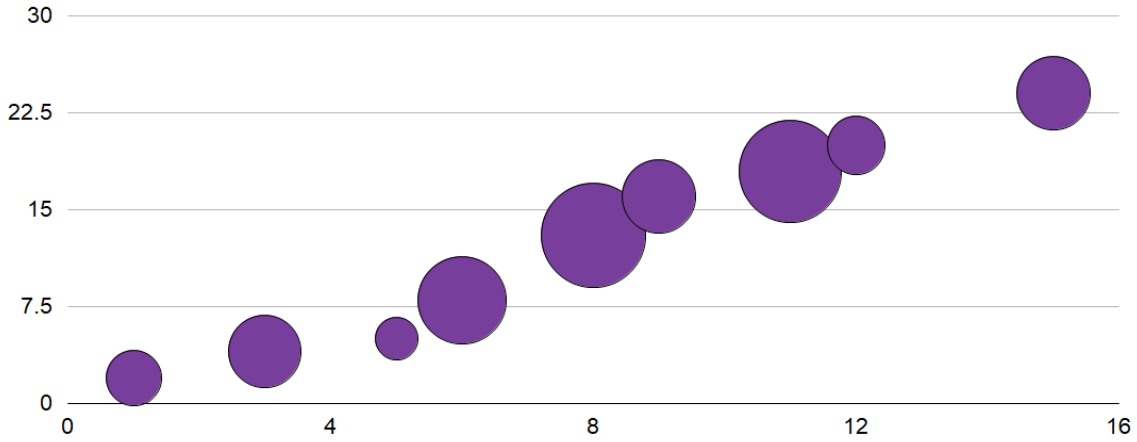
Bubble Chart

- Generally lets you expand data with and X and Y to have a third Z characteristic
- Sometimes X is category and Y is response, but sometimes both are inputs and Z (area) is response
- **Remember from visualization that size isn't great for quantitative data (I get gut reaction of ordering but not clear numerical number)**
- **Sometimes colour is a fourth variable and often a way to give a category when X and Y are both input variables**



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Radar Charts

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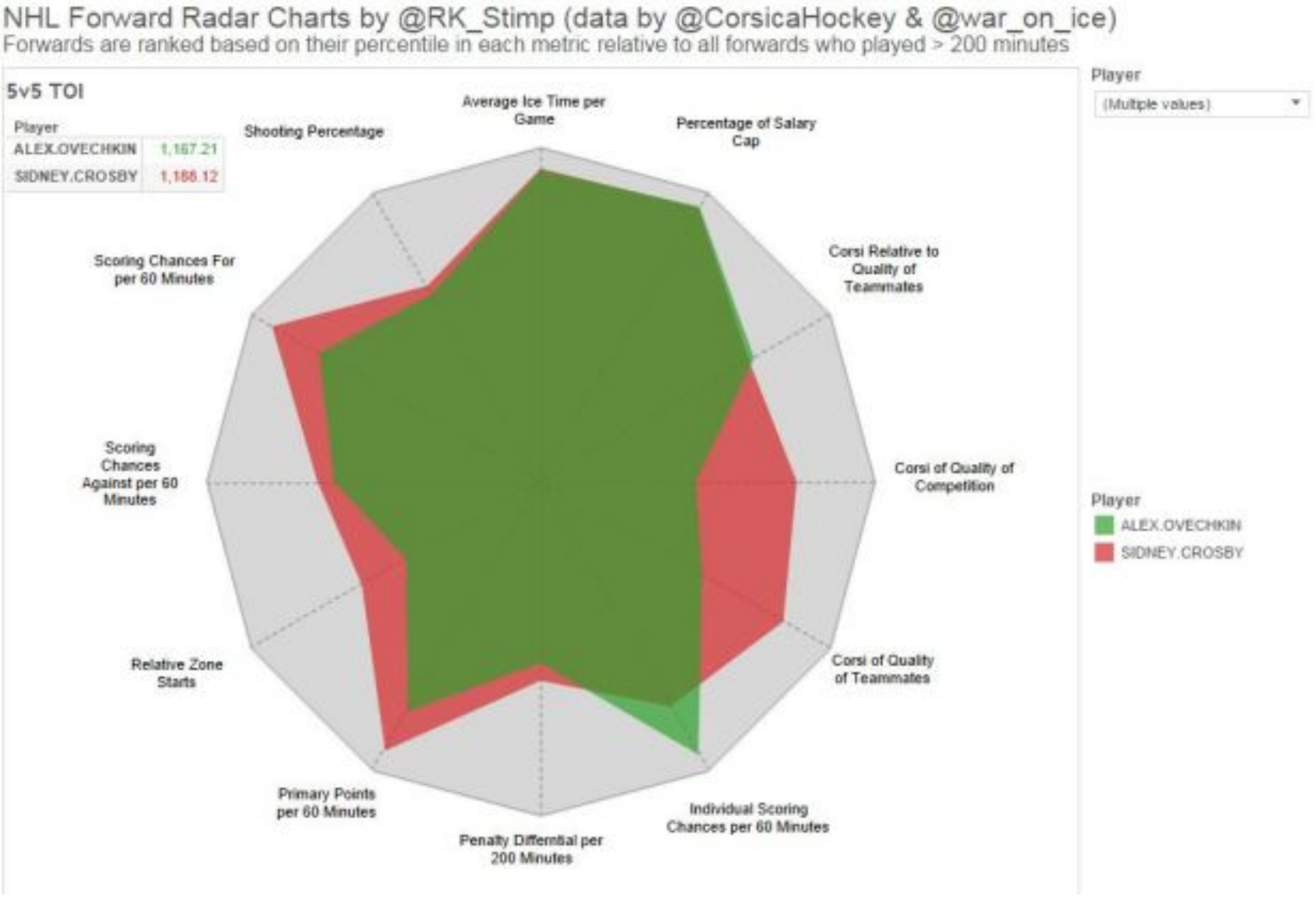
Radar Charts



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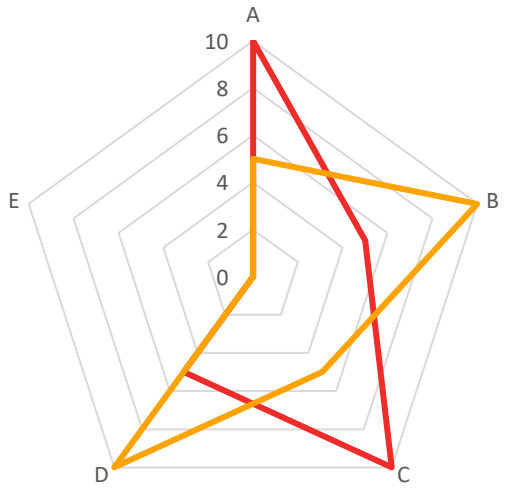
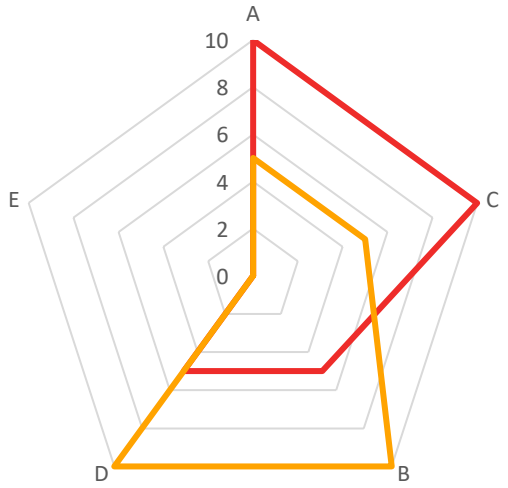
Radar Charts

- Like a circular line chart of categories
- Ordering and area are deceiving visually
- Stacking becomes hard to perceive
- Quantity of categories also makes data less clear
- Is there a common scale for categories?





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Parallel Coordinates

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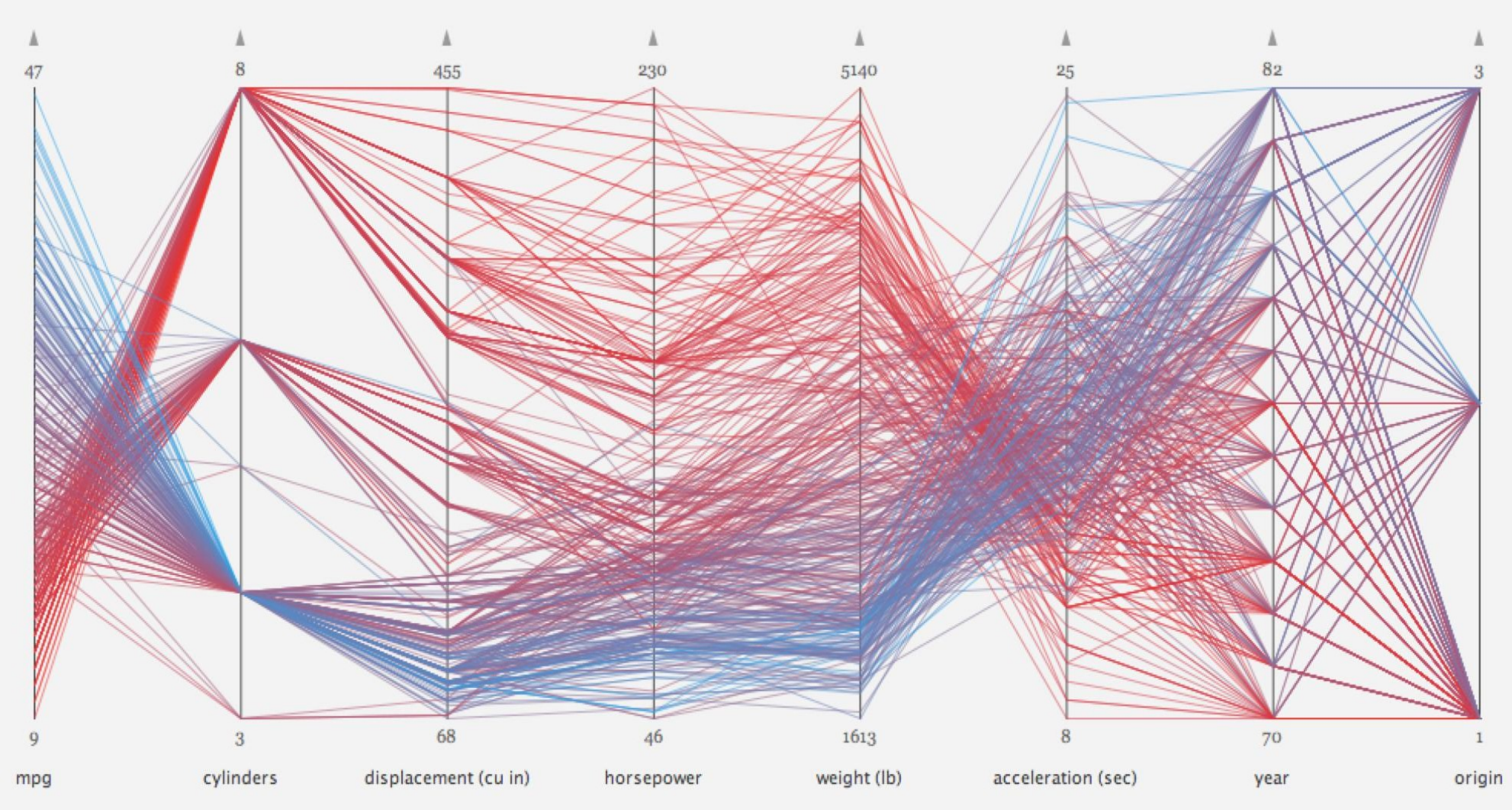
Parallel Coordinates



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Map Charts

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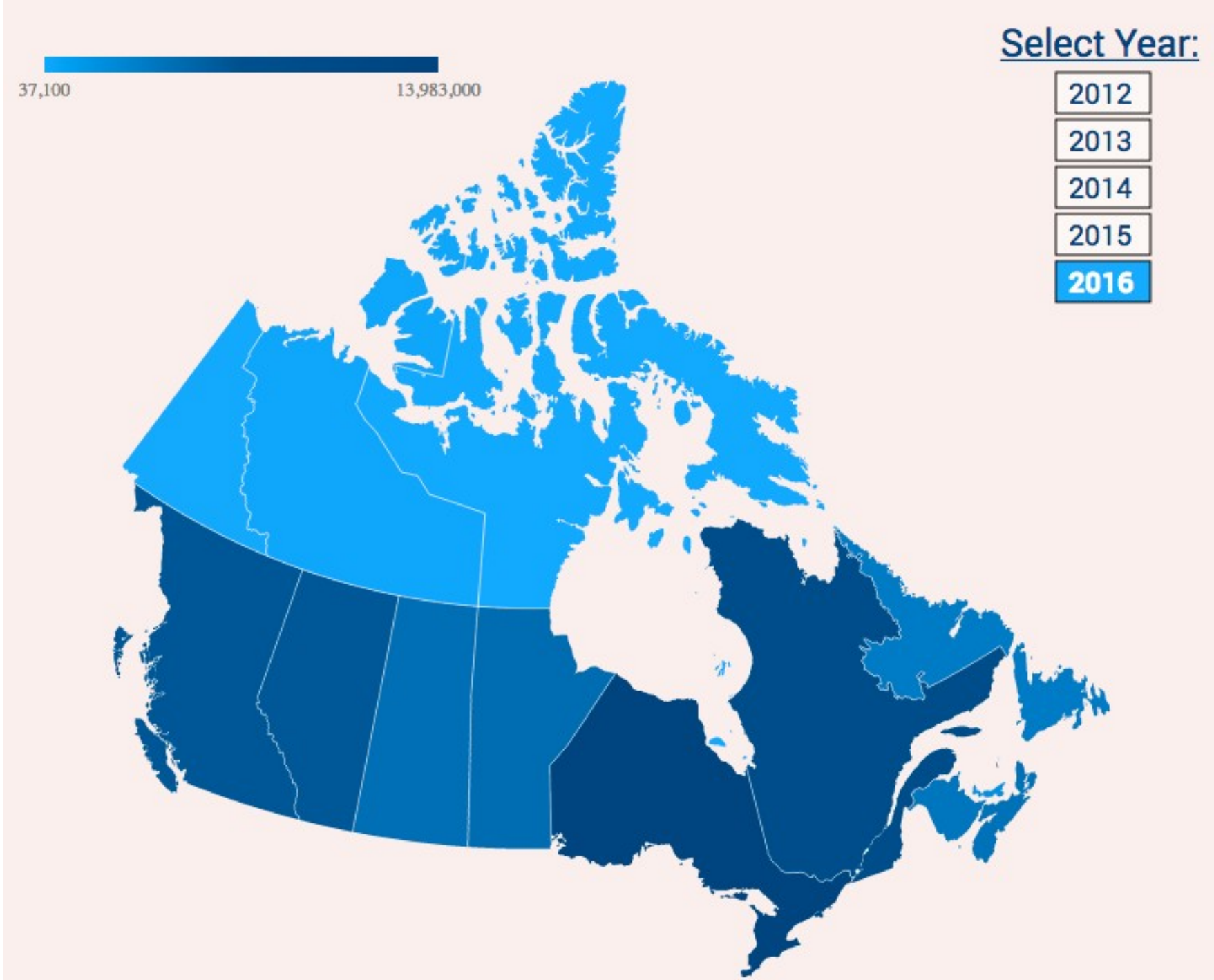

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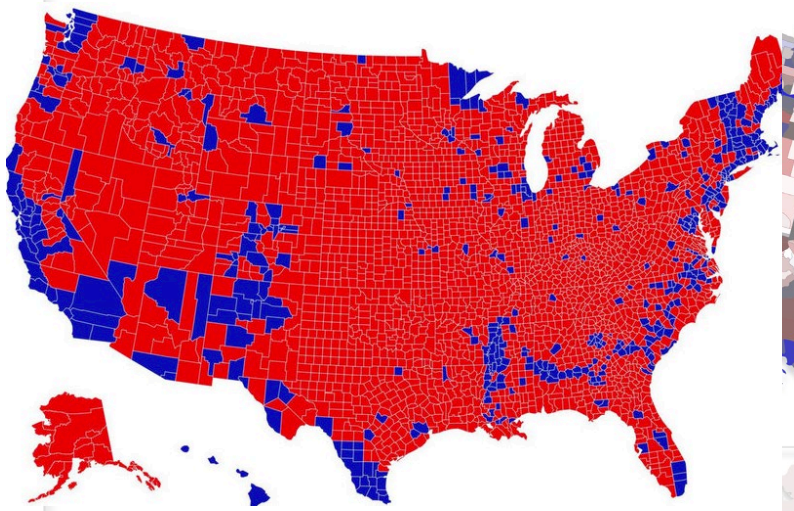
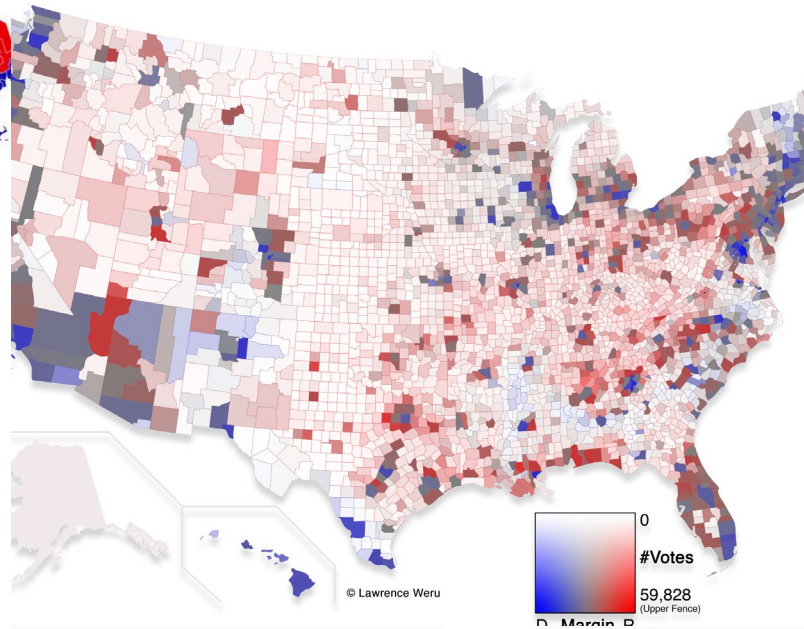
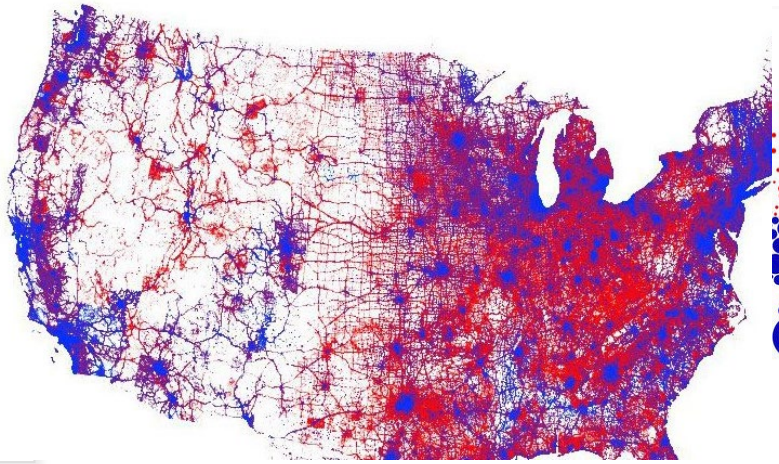
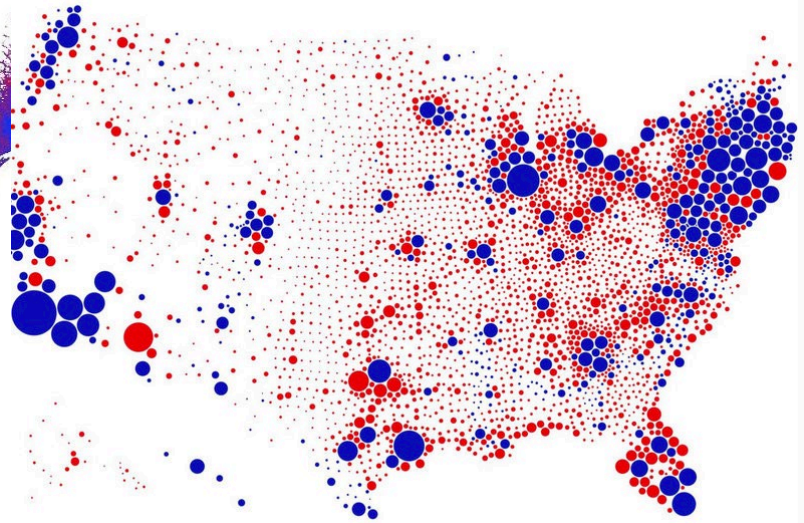
Area/Colour Can Be Deceptive

- Top left is county based voting in 2016 US Presidential election
- Bottom left one dot per vote, density map (https://nymag.com/intelligencer/2018/03/a-new-2016-election-voting-map-promotes-subtlety.html)
- Bottom right is one circle per county, sized per population (https://www.core77.com/posts/90771/A-Great-Example-of-Better-Data-Visualization-This-Voting-Map-GIF)
- Top right is counties colour by scale for both population and extremity of vote (https://nymag.com/intelligencer/2018/03/a-new-2016-election-voting-map-promotes-subtlety.html)









2D vs. 3D

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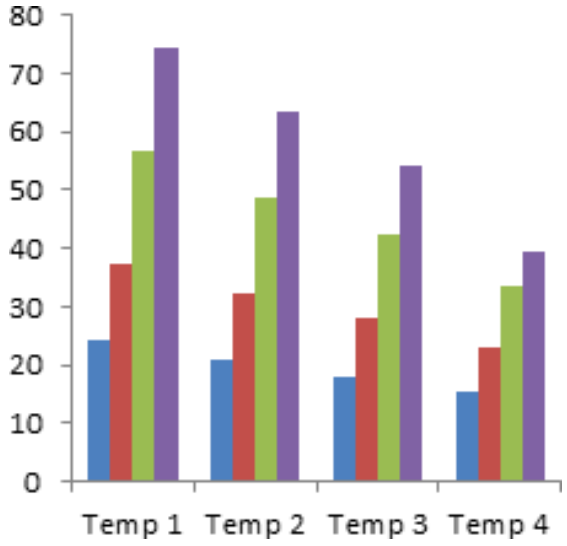
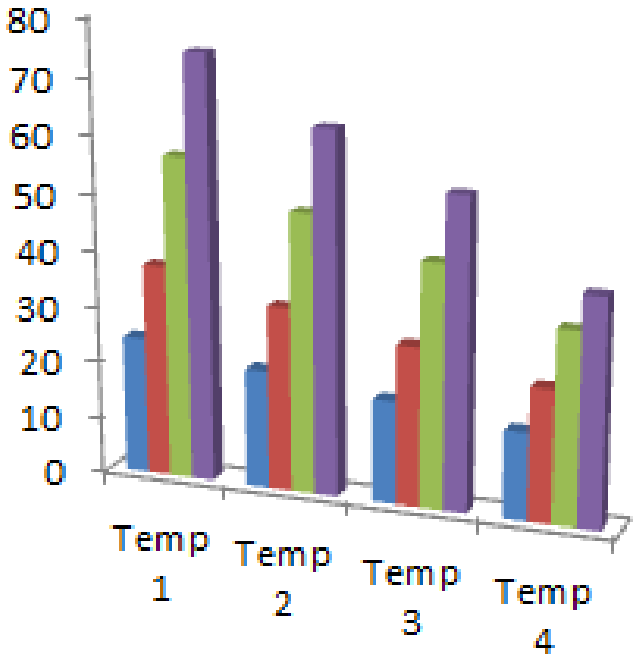
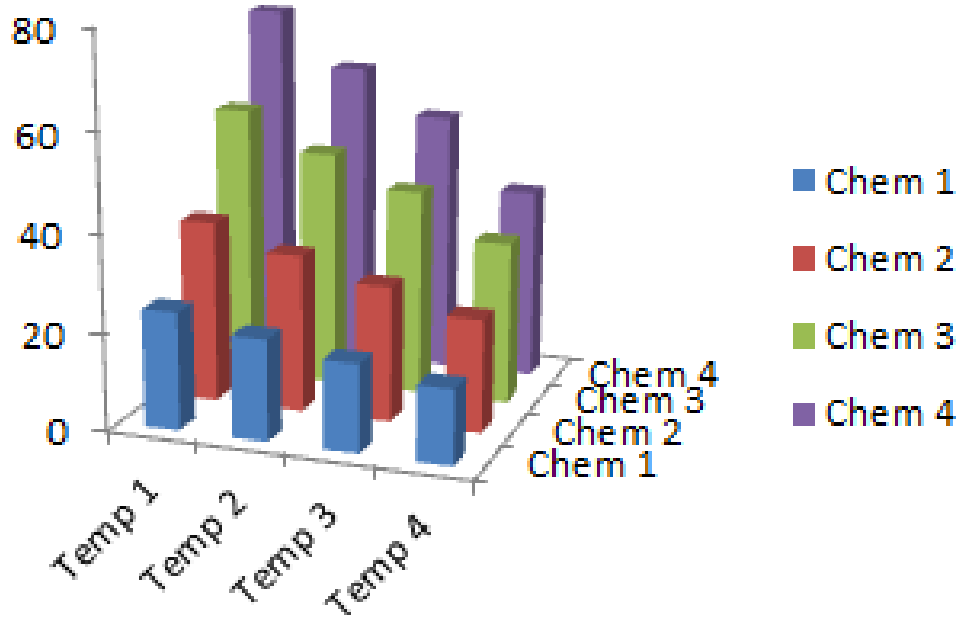
https://peltiertech.com/excel-3d-charts-charts-with-no-value







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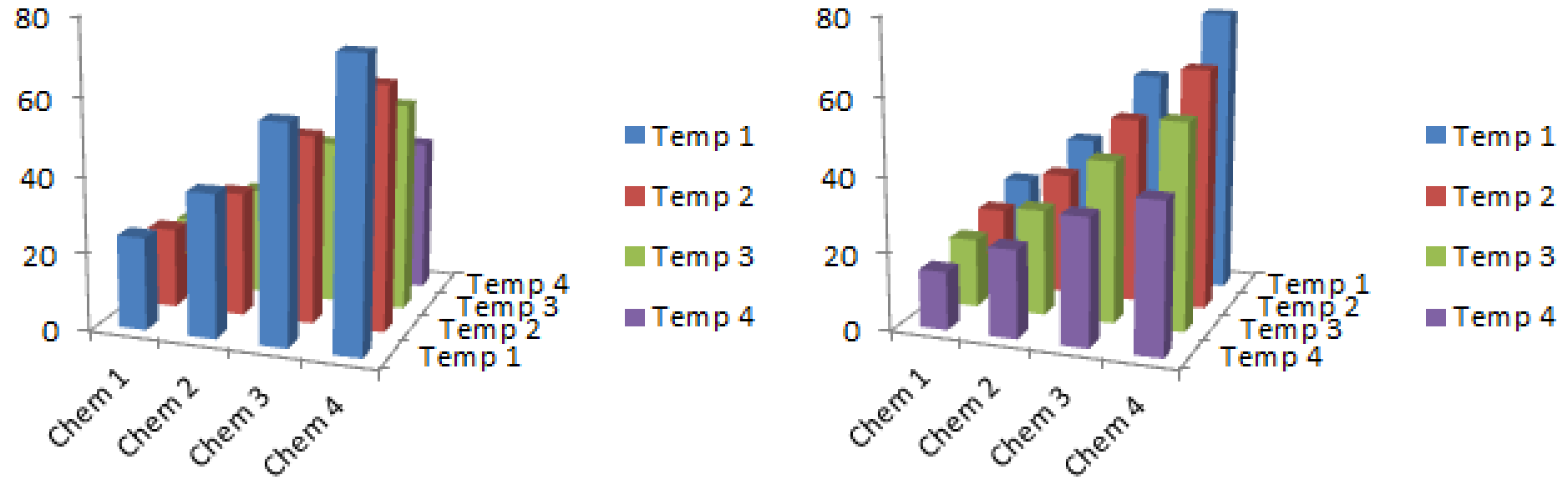

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Two-Axis Charts?

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Two-Axis Charts

- Used to imply correlation
- Generally considered to be bad practice and often deceptive
- Easy to change y-axis scale to manipulate ‘apparent correlation’

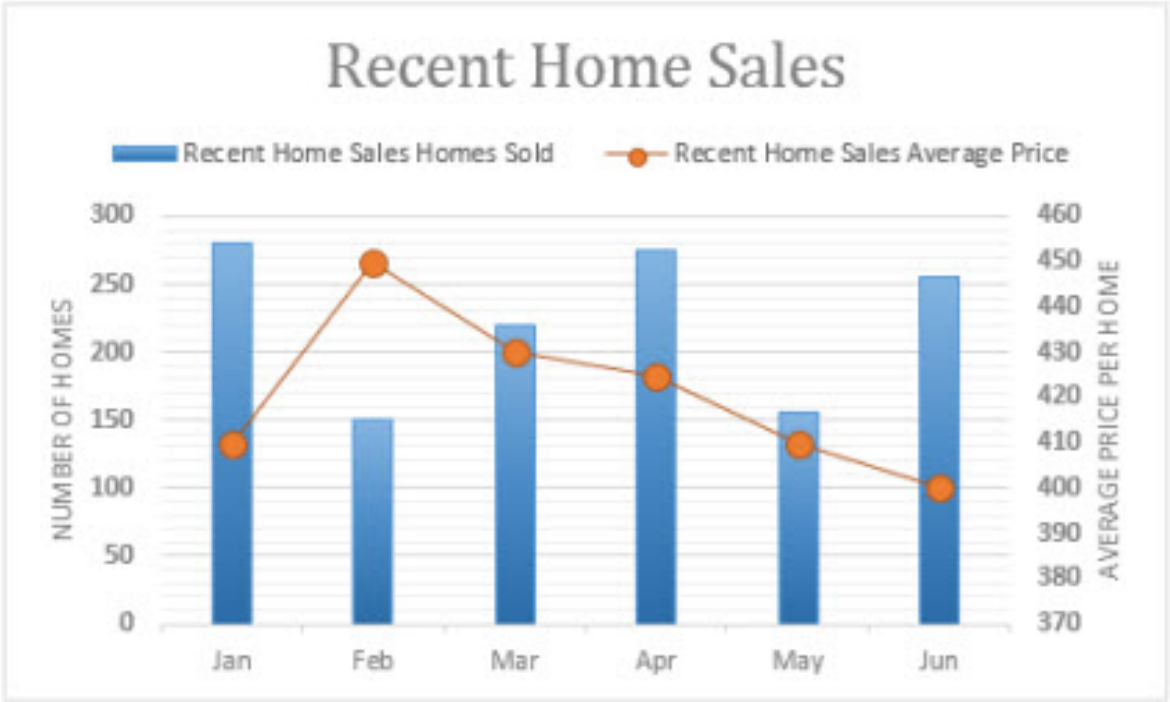

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Chart Junk

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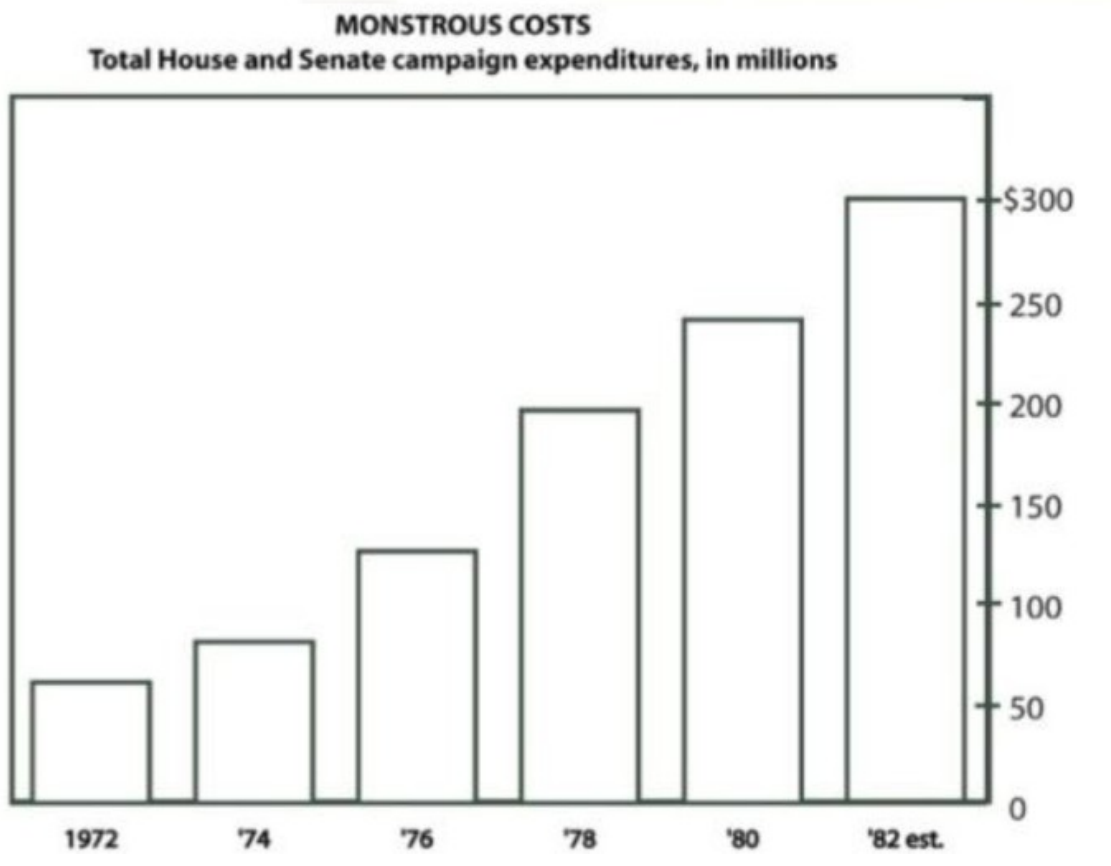
More Art than Data?



Bateman et al. 2010

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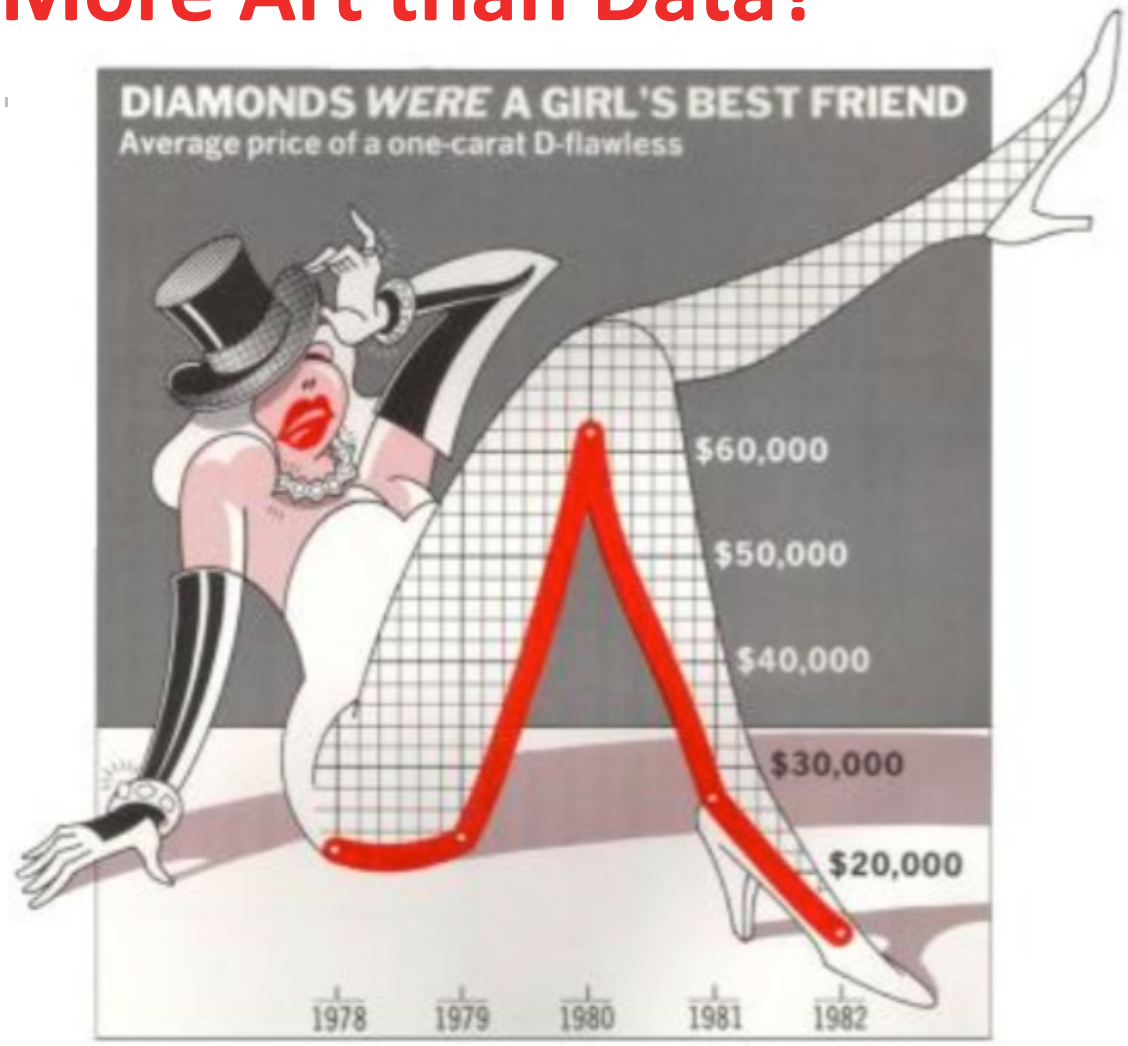

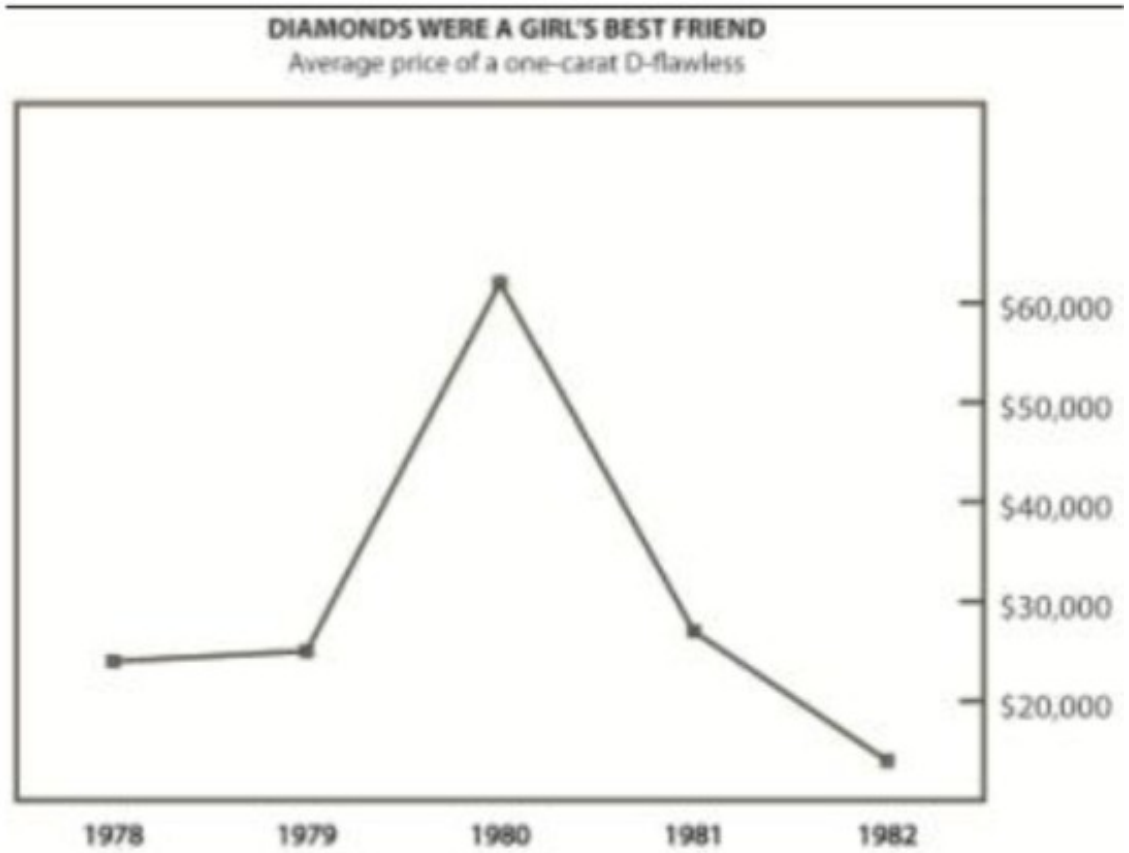

Bateman et al. 2010

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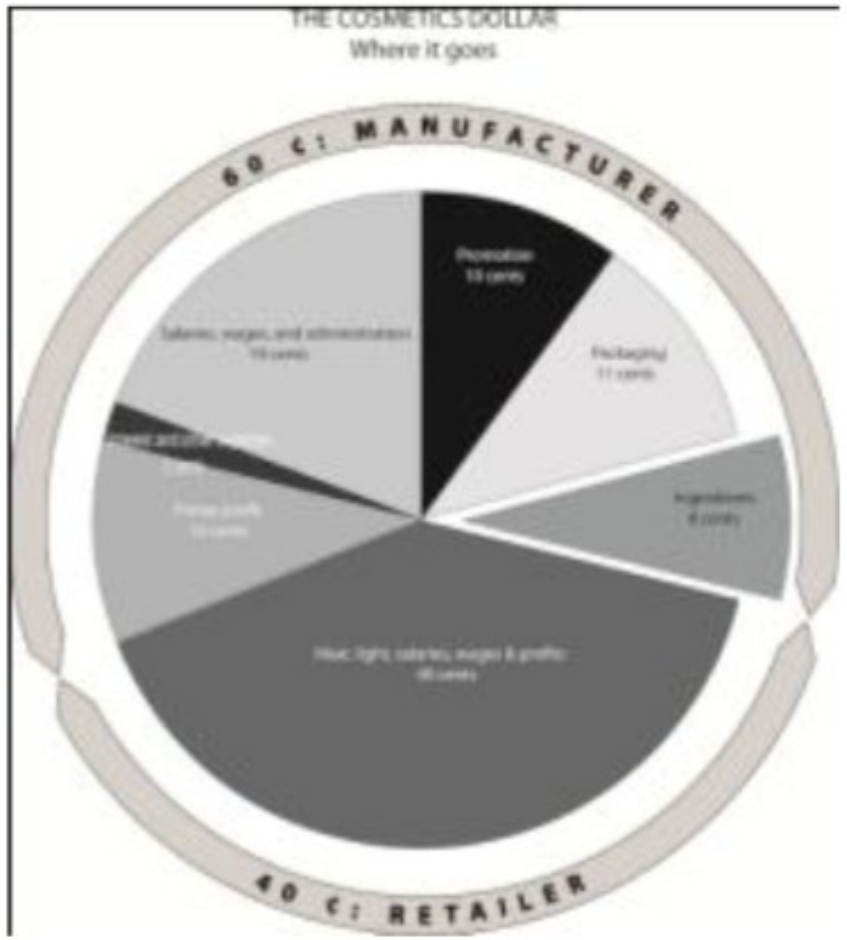

Bateman et al. 2010

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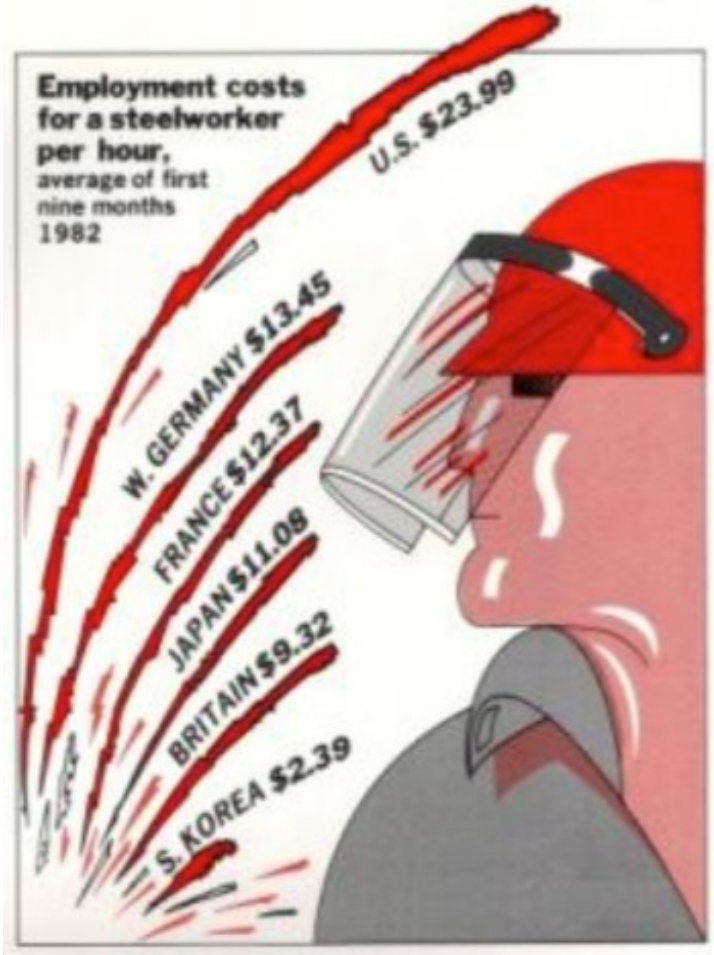

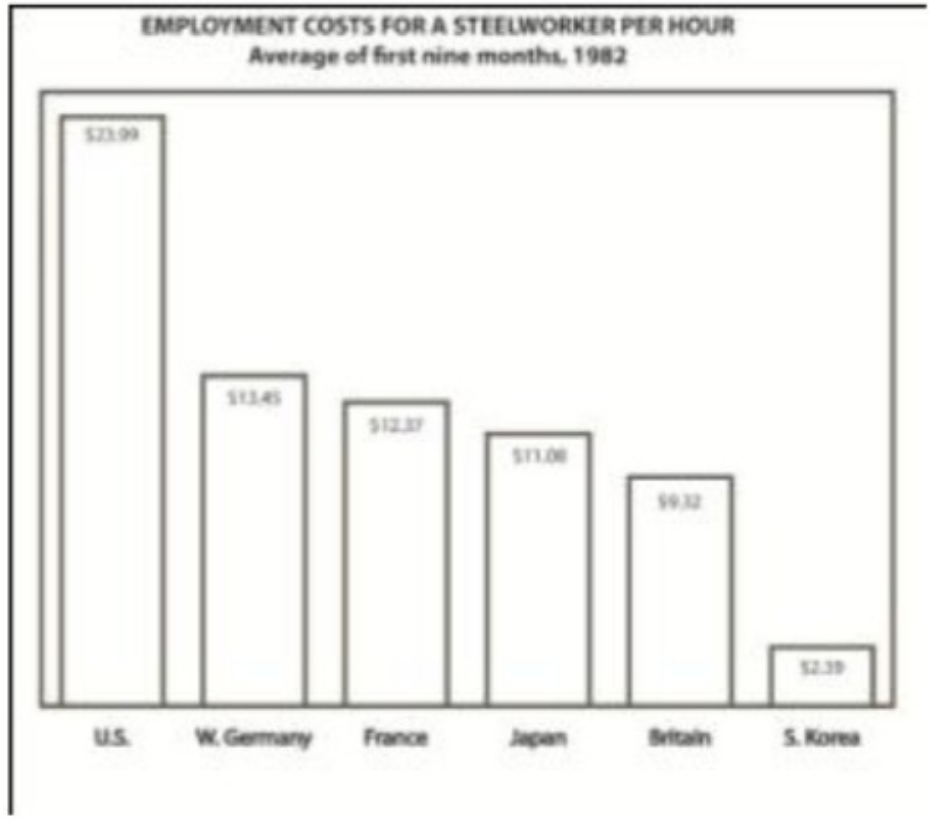

Bateman et al. 2010

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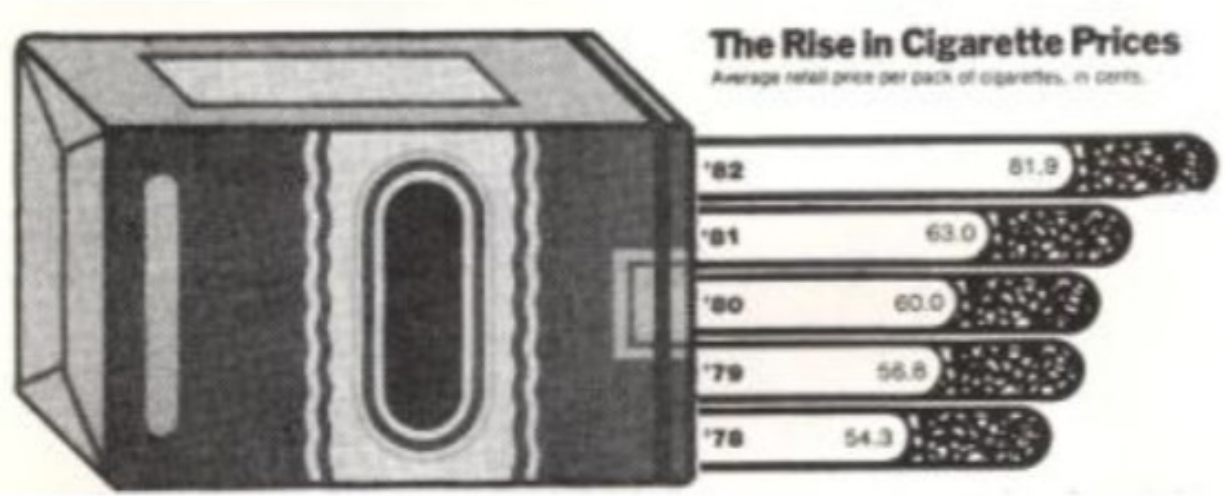

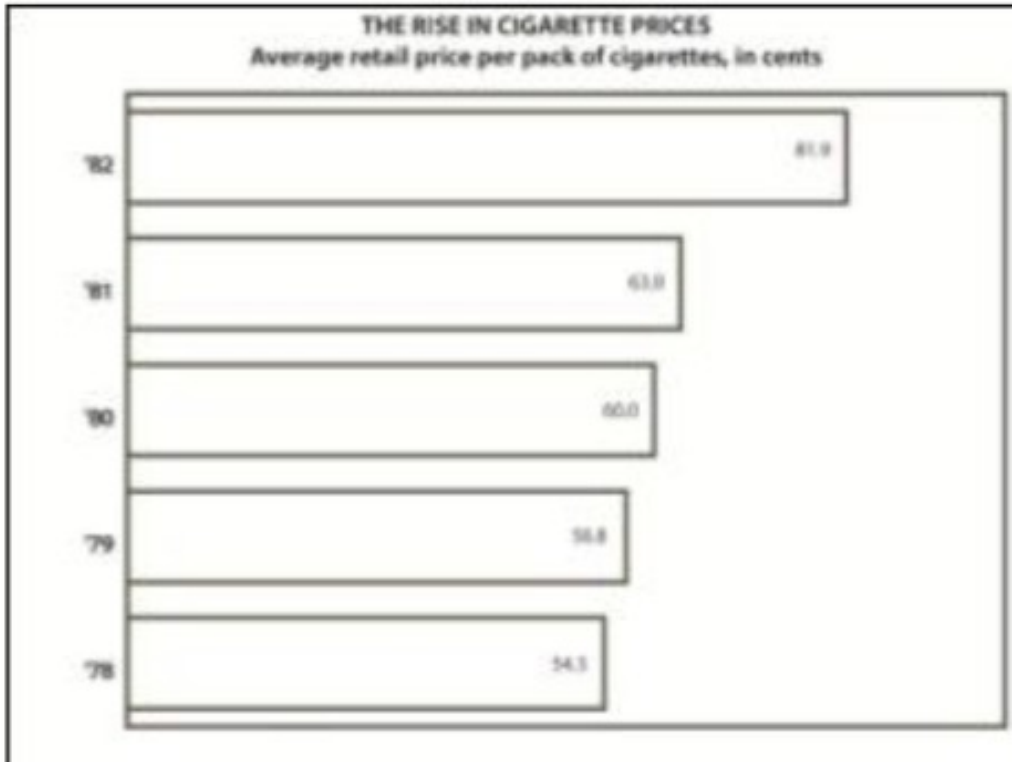

Bateman et al. 2010

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Onward to … Presentations

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