MATCHING VISUALIZATIONS TO DATA

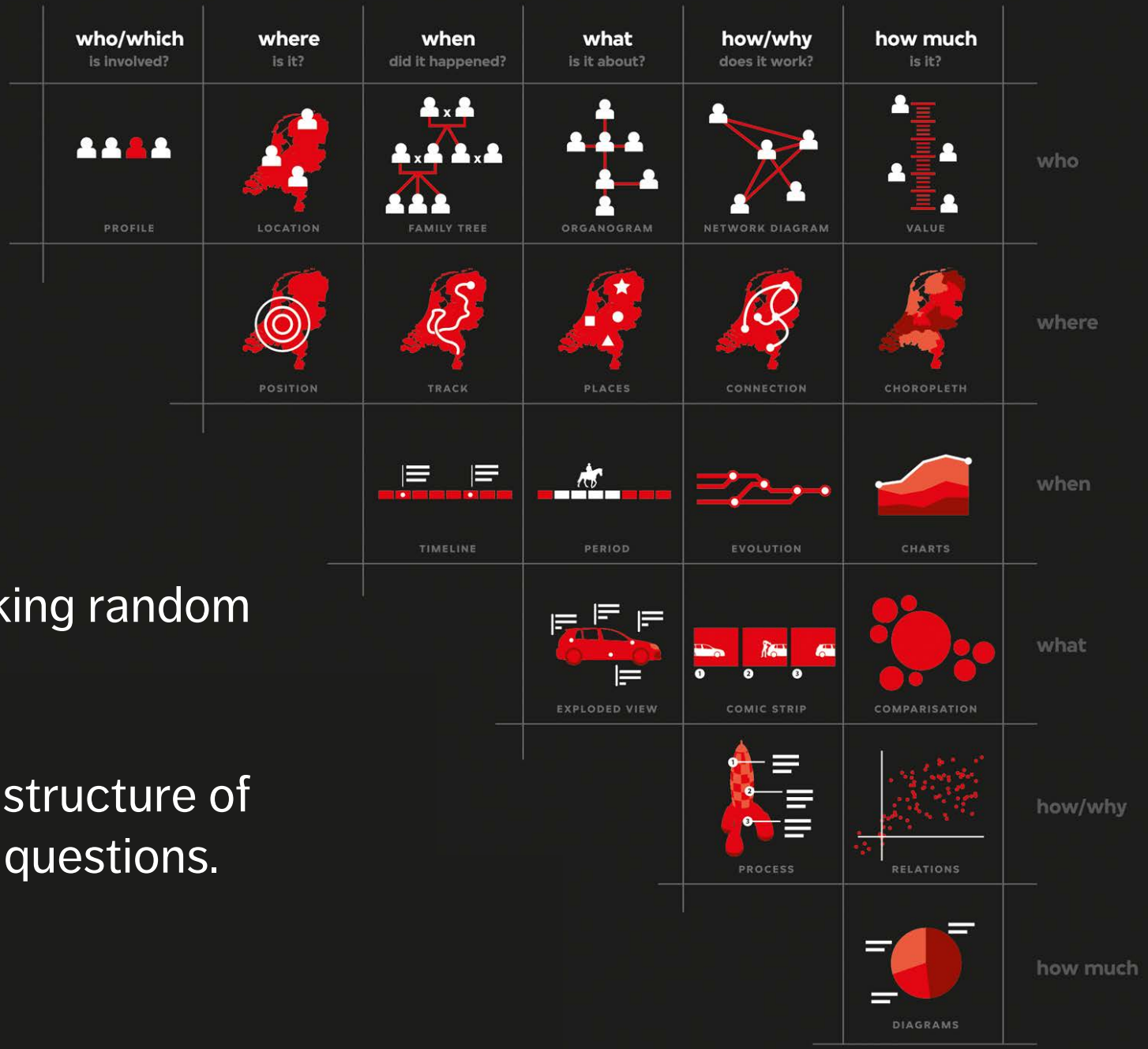
MATCHING VISUALIZATIONS TO DATA

With data displays, we try to highlight:

1. a **relationship** – show a connection or correlation between two or more variables, such as the impact of an aging population on health care;
2. a **comparison** – set some variables apart from others, and display how those two variables interact, such as the number of fans attending hockey games for different teams in a season;
3. a **composition** – collect different types of information that make up a whole and display them together, such as the various search terms that visitors used to land on your site, or how many visitors came from various sources (links, search engines, or direct traffic), and
4. a **distribution** – lay out a collection of related or unrelated information to see how it correlates (if at all), and to understand if there's any interaction between the variables, such as the number of bugs reported during each month after a new software release.

[F. Ruys, Vizualism.nl]

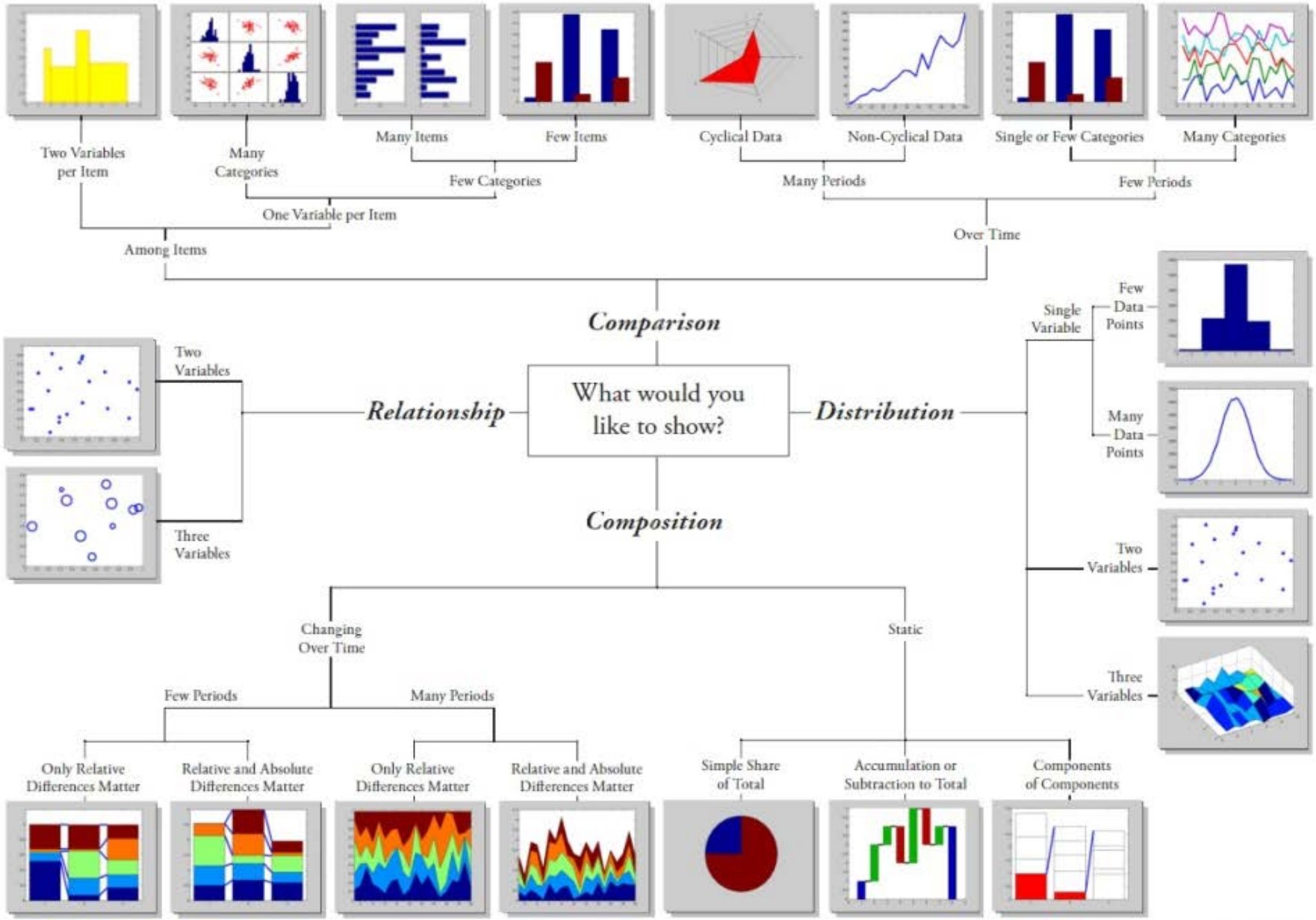
WHICH METHOD SHOULD YOU USE?



Infographics are not just about picking random visualization methods.

The result varies depending on the structure of the data and the (combinations of) questions.

Chart Suggestions—A Thought-Starter



Modified with permision -Doug Hull
blogs.mathworks.com/videos
hull@mathworks.com 2009

www.ExtremePresentation.com

A CLASSIFICATION OF CHART TYPES

Data comparison charts

Comparison

Bars

Dot plot

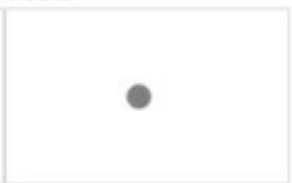
Bullet

1D Scatterplot

Heat map

Slope

Alert



Composition

Pie

Pareto

Multidimensional Pie

Distribution

Histogram

1D Scatterplot

Boxplot

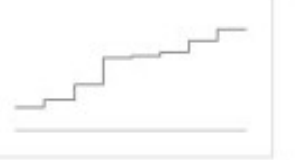
Data reduction charts

Evolution

Line

Horizon

Step



Connected Scatterplot

Relationship

Scatterplot

Connected Scatterplot

Bubble

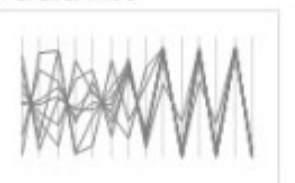
Profiling

Grouped bars

Cycle plot

Reorderable matrix

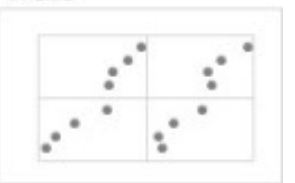
Parallel Plot



Scatterplot matrix

Horizon

Trellis



v 0.9

excelcharts.com

VISUALIZATION CATALOGUE

WORKHORSE DATA EXPLORATION VISUALIZATIONS

Line Chart/Rug Chart/Number Line

Histogram

Line Graph

Boxplots

Bar Chart

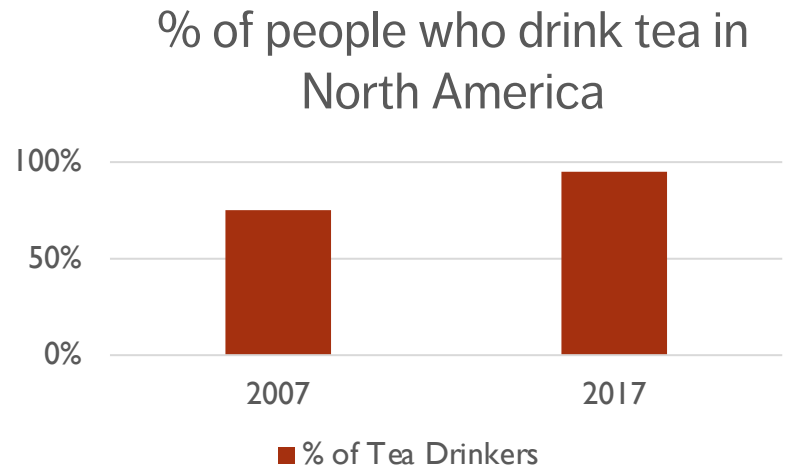
Scatterplot

SIMPLE TEXT

One or two numbers to focus on.

Good at “setting the scene”.

Draws focus to an area of the report.



95% of the population

drinks tea today compared to

75% in 2007

TABLE

Tables interact with our **verbal** system, which means we **read** them:

- used to **compare** values
- audiences will look for **their** rows

Table design needs to blend into background

- the data should stand out, not the borders
- dense table/data: use **alternating** row colour

Name	Last Year	This Year
Bob	20	30
Fred	30	40
George	10	15

Name	Last Year	This Year
Bob	20	30
Fred	30	40
George	10	15

TABLE HEATMAP

Leverage colour to convey magnitude

- use **single colour saturation** rather than differentiation (different colours)
- with a legend (white = low, blue = high), numbers can be removed without altering the message

	Last Year	This Year	Next Year	Optimum
George	20	20	20	20
Peter	40	35	30	25
John	10	10	5	5
Sandra	25	30	35	40

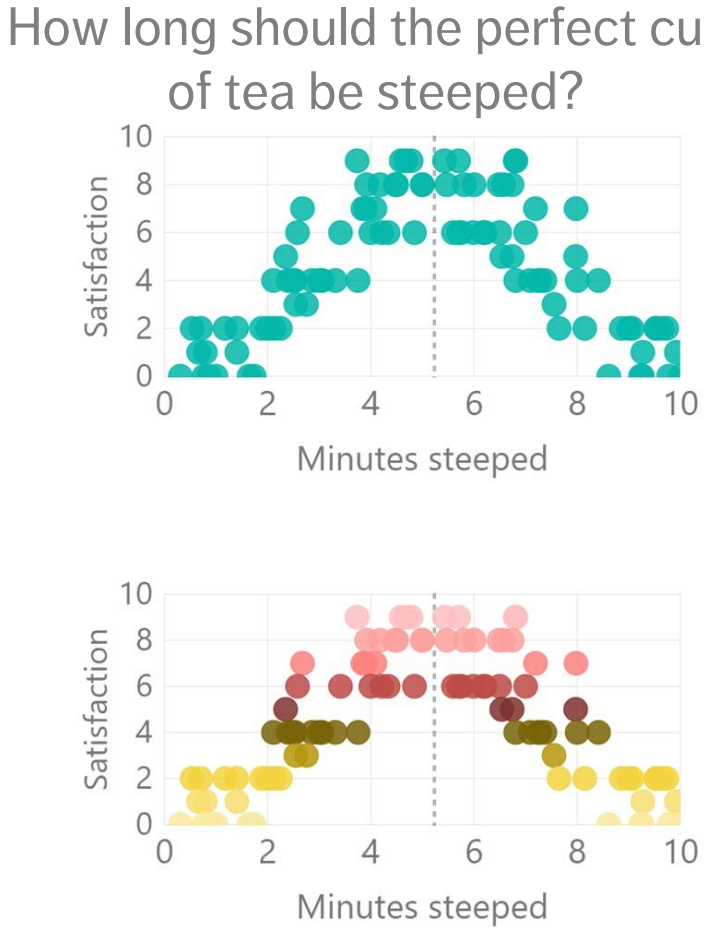
	Last Year	This Year	Next Year	Optimum
George	20	20	20	20
Peter	40	35	30	25
John	10	10	5	5
Sandra	25	30	35	40

	Last Year	This Year	Next Year	Optimum
George				
Peter				
John				
Sandra				

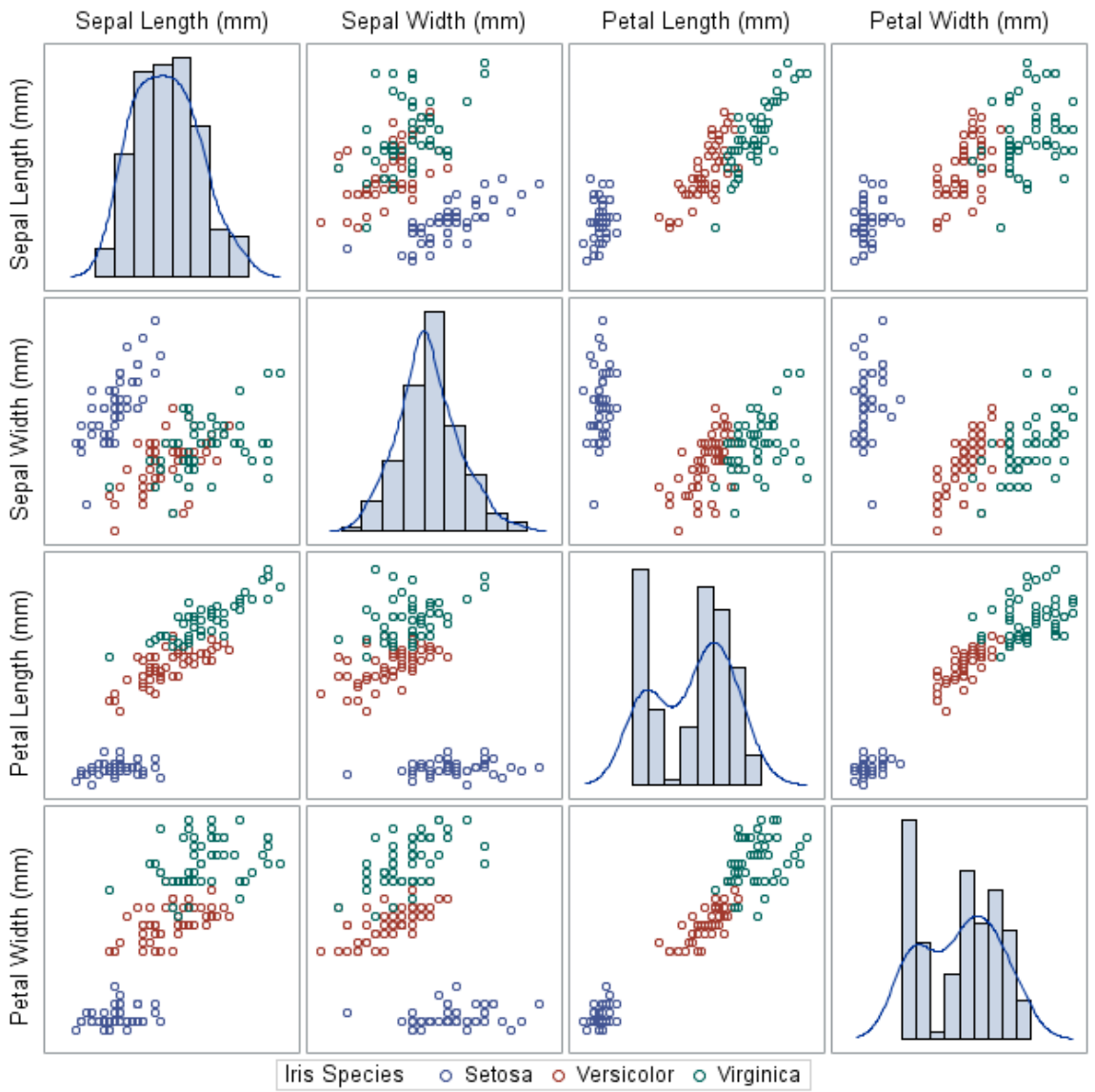
SCATTERPLOT

Show relationship between 2 variables (**scatterplot**) or 3 variables (**bubble plot**)

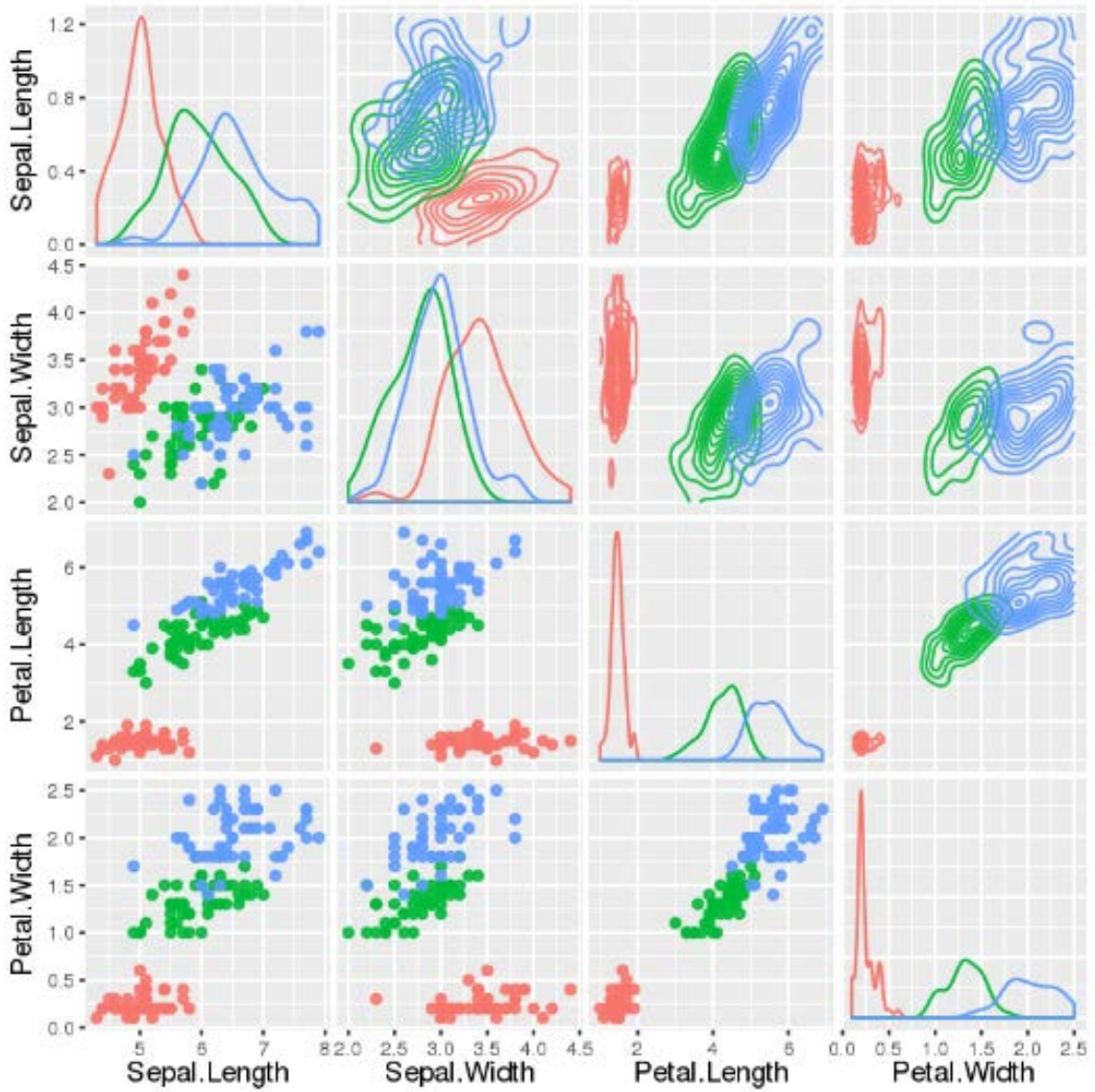
- use average lines (dotted lines) to provide context
- far fewer options in Power BI than Excel
- consider using groupings to add clarity (e.g. **colour gradients**)



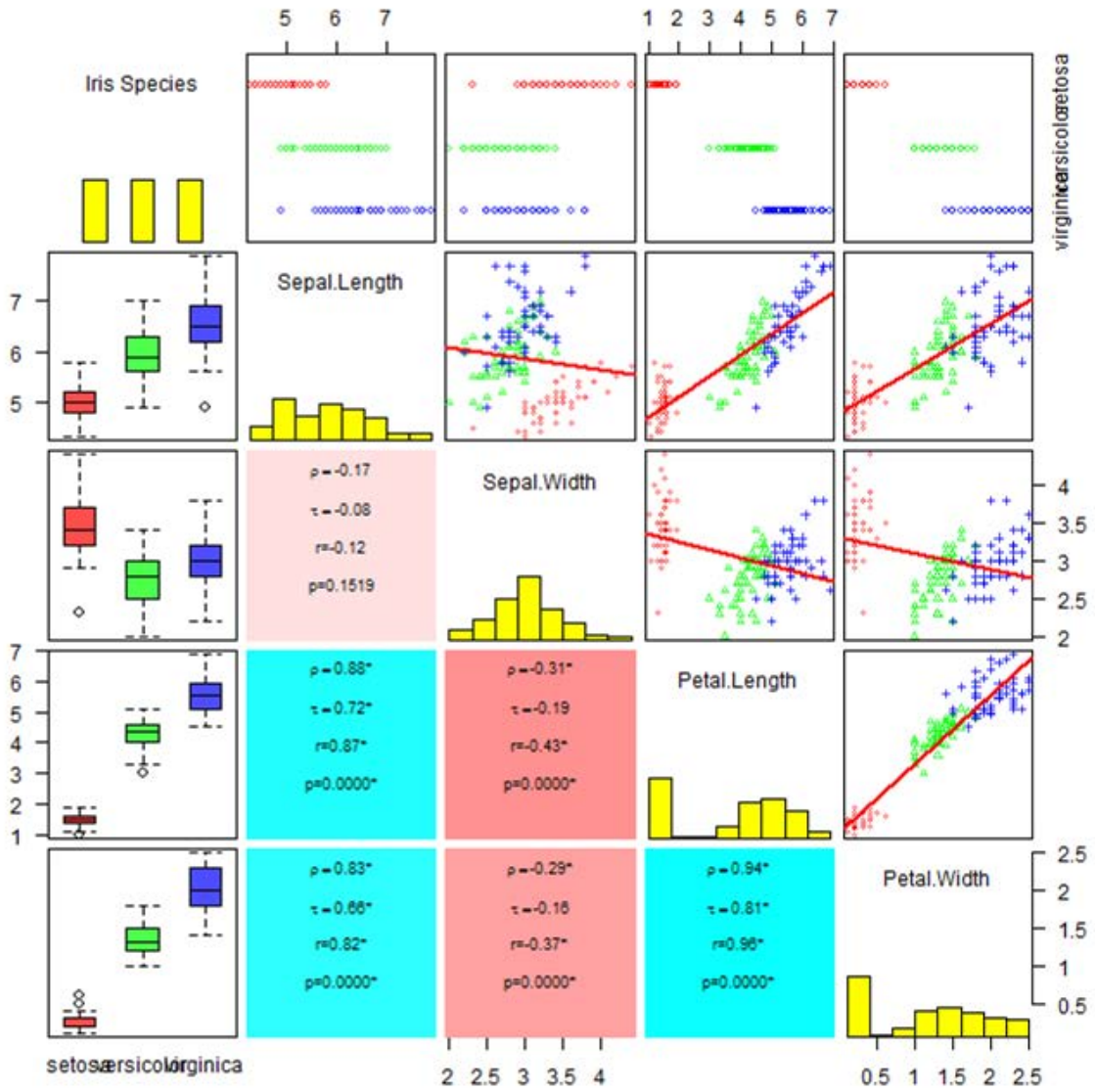
[Created using SAS `proc sgscatter`]



[Created using R's `ggpairs()`]



[Author unknown, found online]



Is this starting to get too cluttered?

LINE CHART

Line chart can show a single series or multiple series of data.

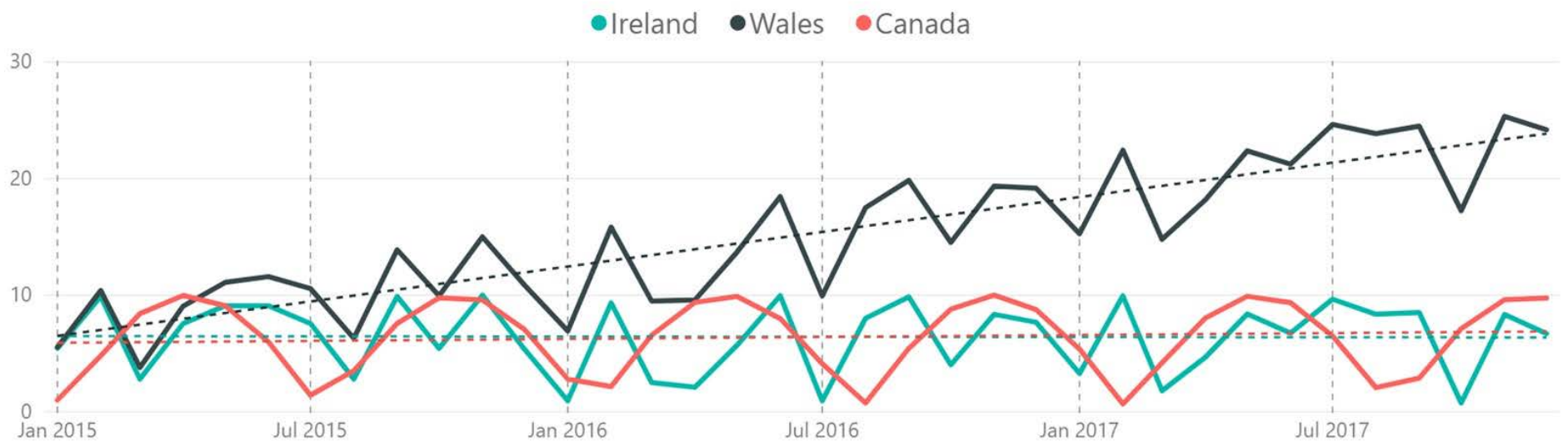
- particularly useful to show time series

Axis scale should be clear and relevant.

May wish to "anchor" y −axis if using dynamic filters

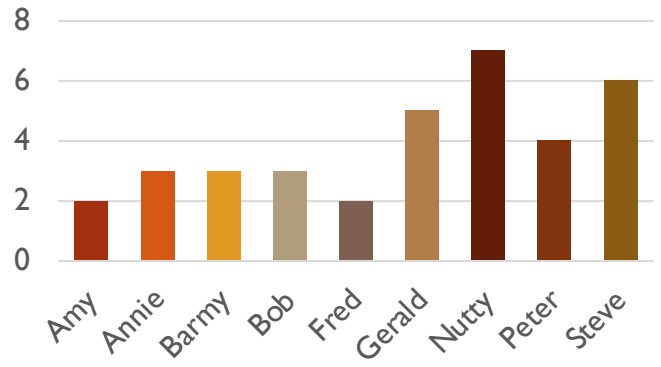
- otherwise the graph can jump around as people interact with it

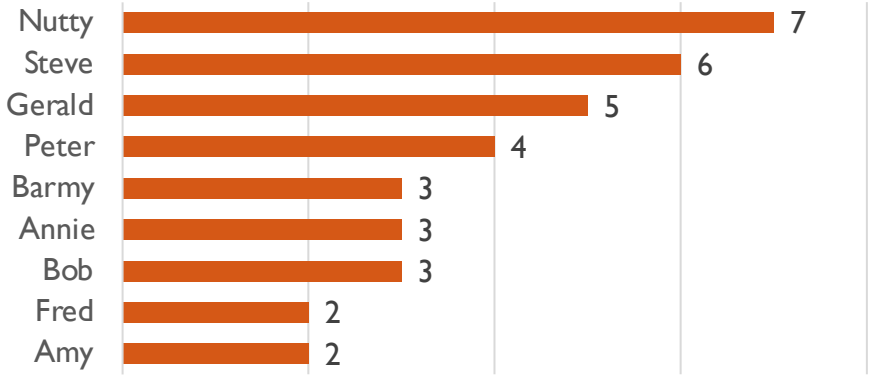
LINE CHART



Comparison of Countries – cups of tea drunk per week per person

BAR CHART (VERTICAL & HORIZONTAL)





Very versatile and useful.

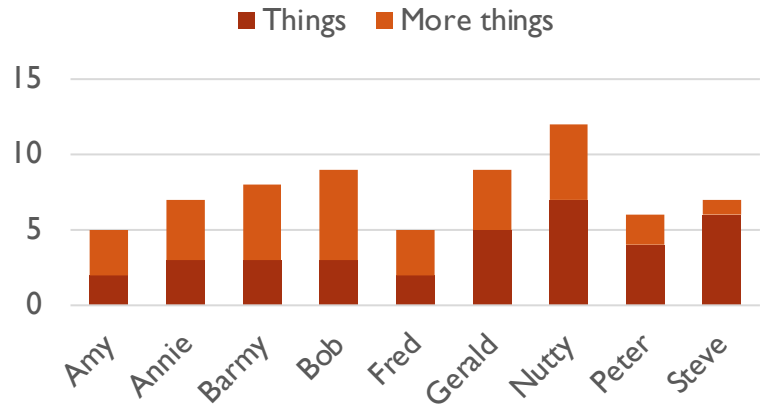
ALWAYS (?) have a zero baseline.

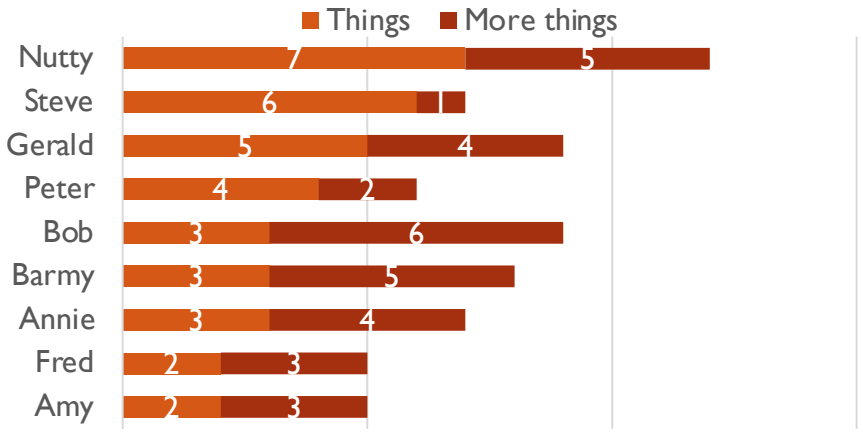
Use graph axis OR data labels. Axis for broad statements, data labels for more detail.

Horizontal charts are apparently easier to read (according to many studies).

Think about the ordering of categories.

STACKED BAR CHART (VERTICAL & HORIZONTAL)



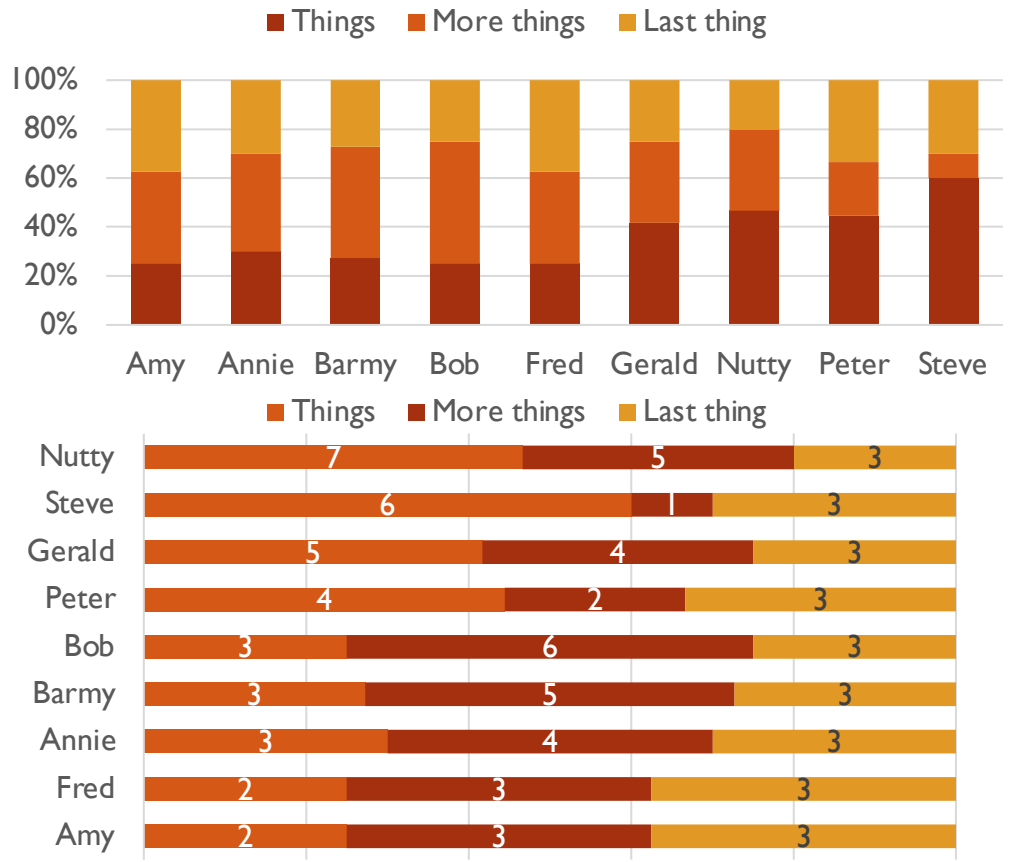


Designed for **comparing totals**, but can quickly become **overwhelming**.

Hard to sort / order.

Filtering is complicated in Power BI (what do you click on & how the chart responds when filter is clicked on?)

100% BAR CHART (VERTICAL & HORIZONTAL)



Work well for visualizing portions of a whole on scale from negative to positive

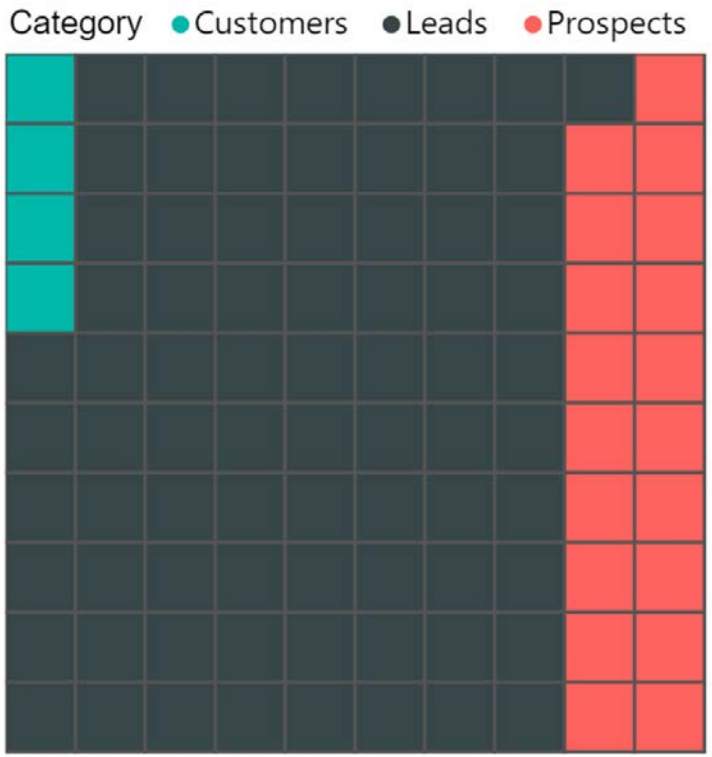
Consistent baseline on far left and right

Easy to compare

Issue is no relative measure to magnitude of data

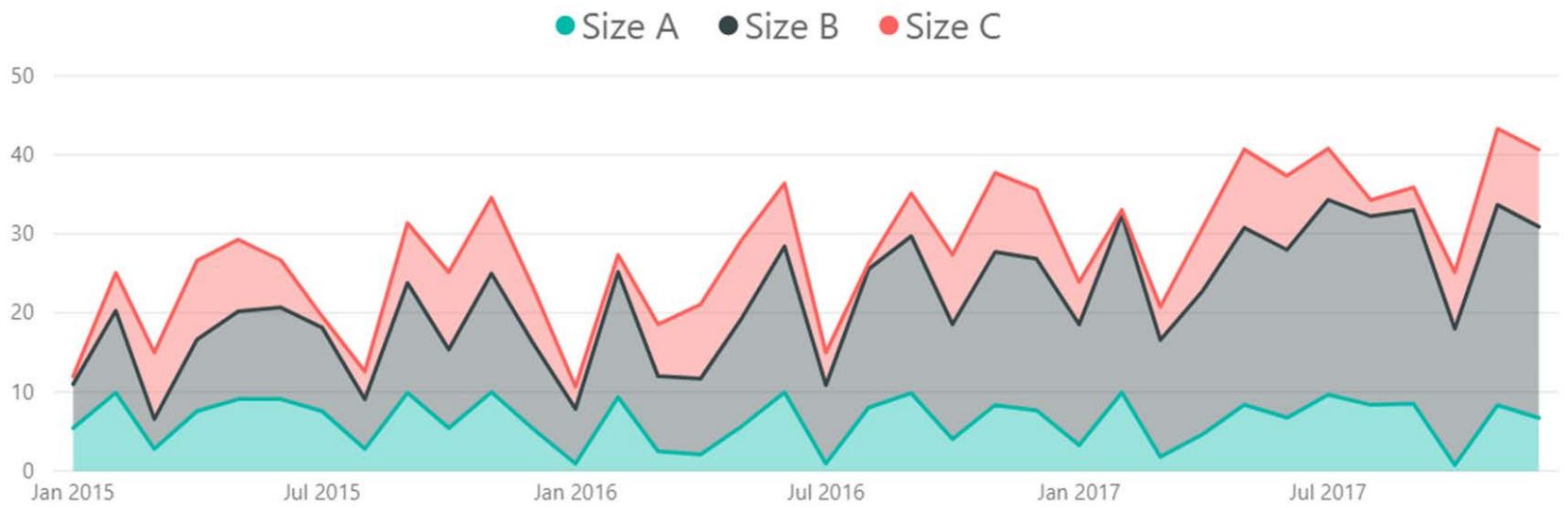
Research shows that horizonal is easier to process than vertical

AREA CHART



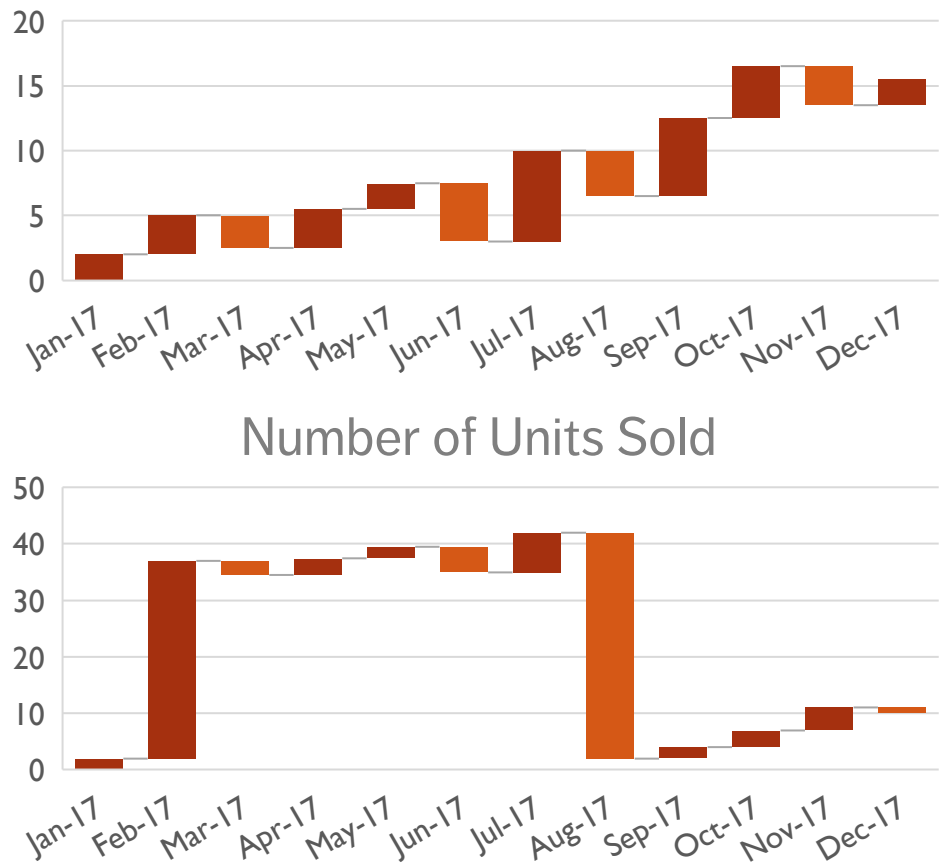
Try to avoid: human brains have a hard time attributing a value to a 2D area...

... except for numbers with **vastly different** magnitudes.



IDLEWYLD Sysabee DAVI

WATERFALL



Shows how initial value increases or decreases using a series of intermediate values.

Different colours can be used for increases and decreases.

Hard to remove elements without removing context (hard to **declutter** the chart).

Large increases / decreases look odd...

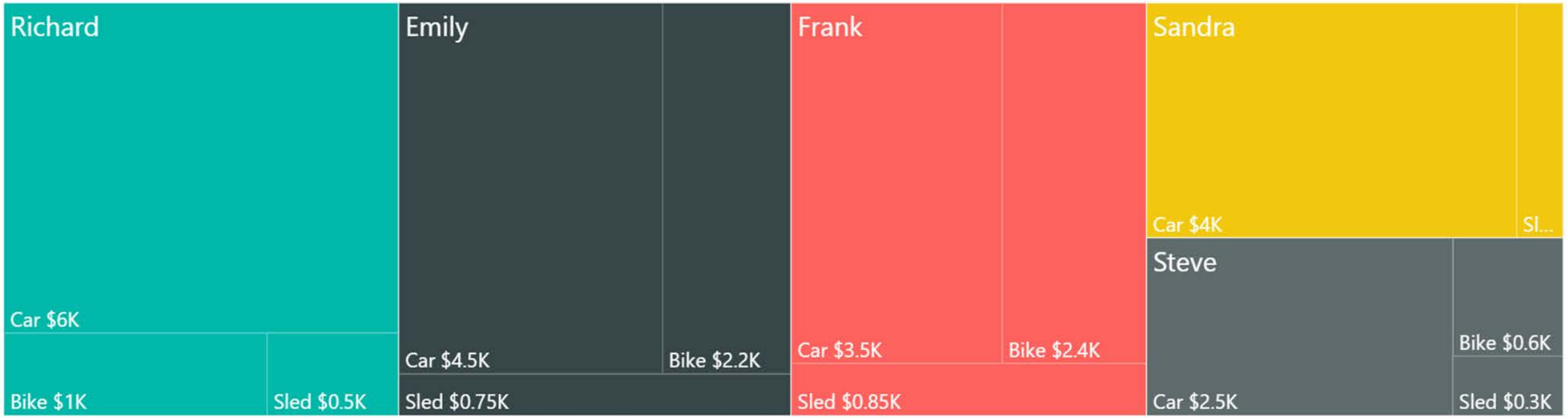
TREEMAP

Simultaneously show big picture and can compare related easily.

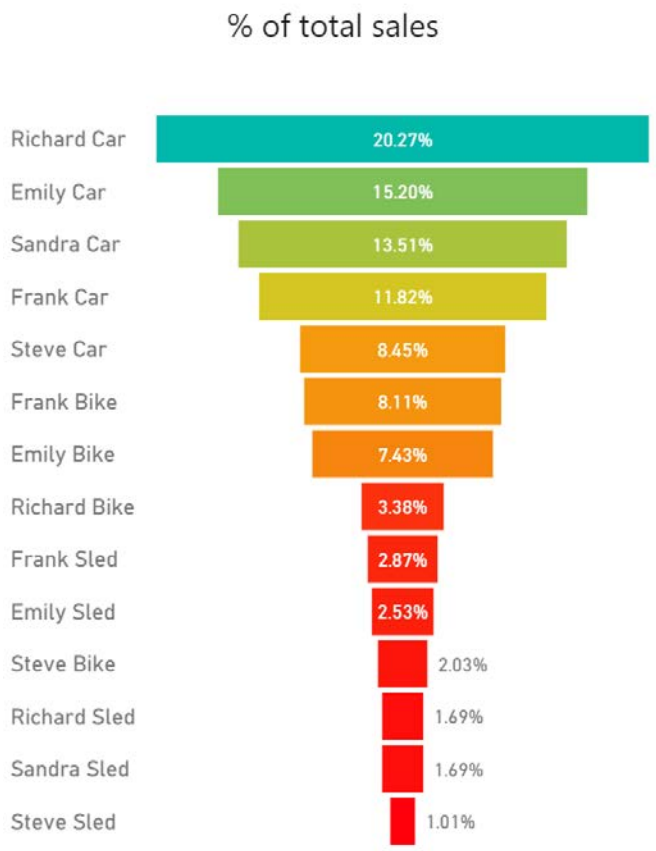
Easy to process data sub-categories.

Useful to prioritize “big ticket items” in dynamic dashboards.

Labeling and colouring are tricky.



FUNNEL CHART

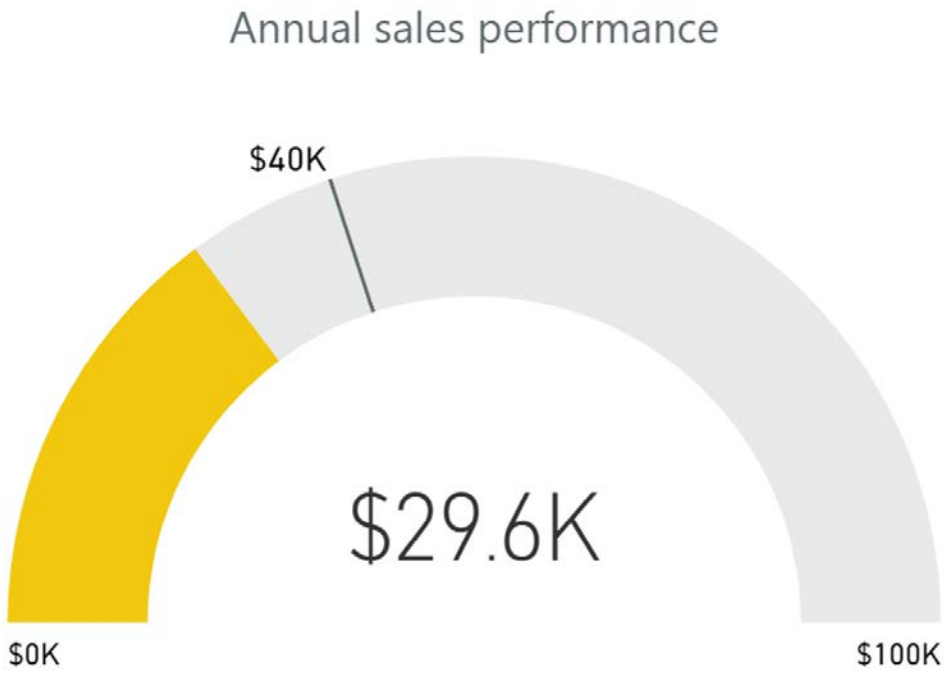


Typically represents **decreasing proportions** amounting to 100% total (not always though).

Power BI does not default sort, so users should ALWAYS sort from high to low (otherwise, plot looks messy).

VERY useful to help audience quickly prioritize items without having to actively filter.

GAUGE



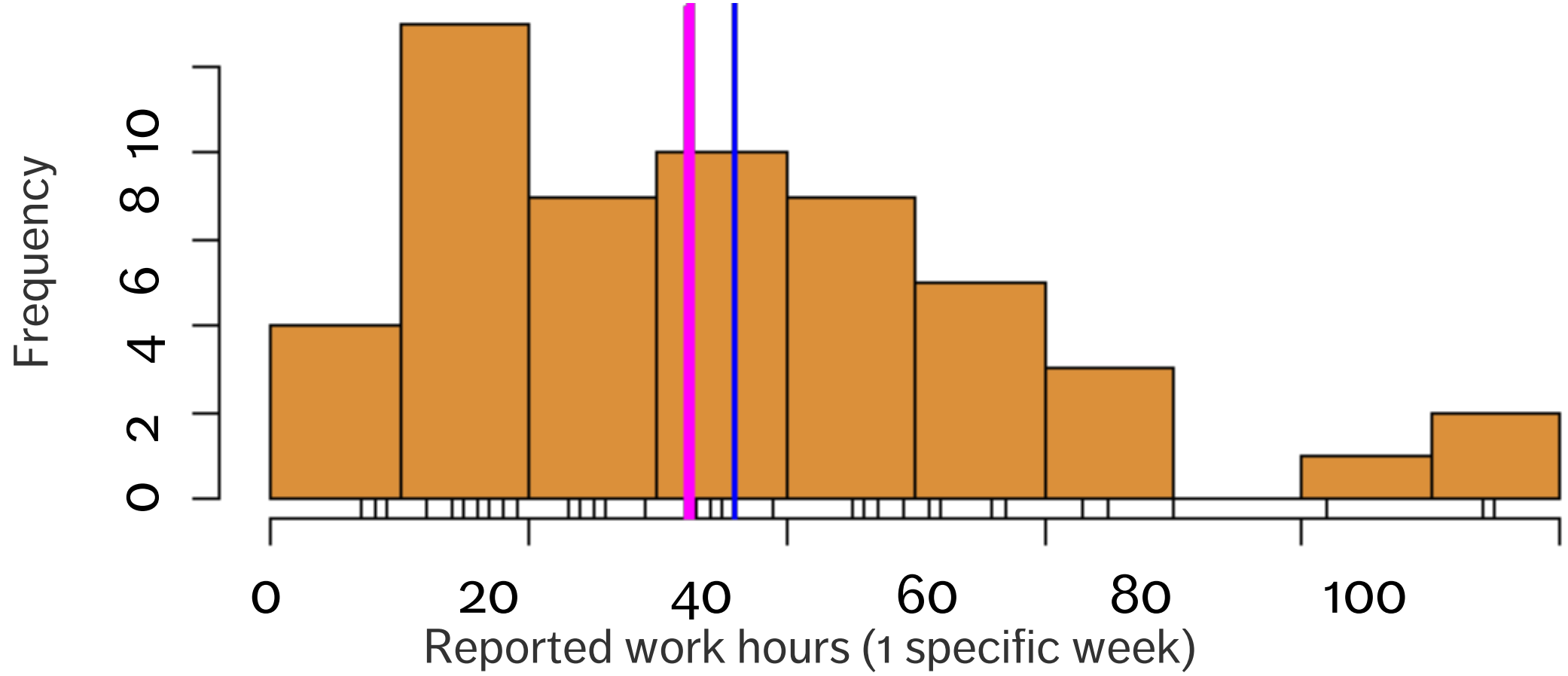
Often used as a dashboard component (with or without needle).

Displays single value measures towards goal / KPI.

Great to show progress (a bit of a management fad, though...)

Displays information that can be quickly **scanned** and **understood**.

HISTOGRAMS


Frequency
0
2
4
6
8
10
0
20
40
60
80
100
Reported work hours (1 specific week)

HISTOGRAMS

Pros:

- known by many non-technical individuals
- easy to read (looks like something right out of high-school)
- can be adorned with added information (median, mean, hairs, etc.)

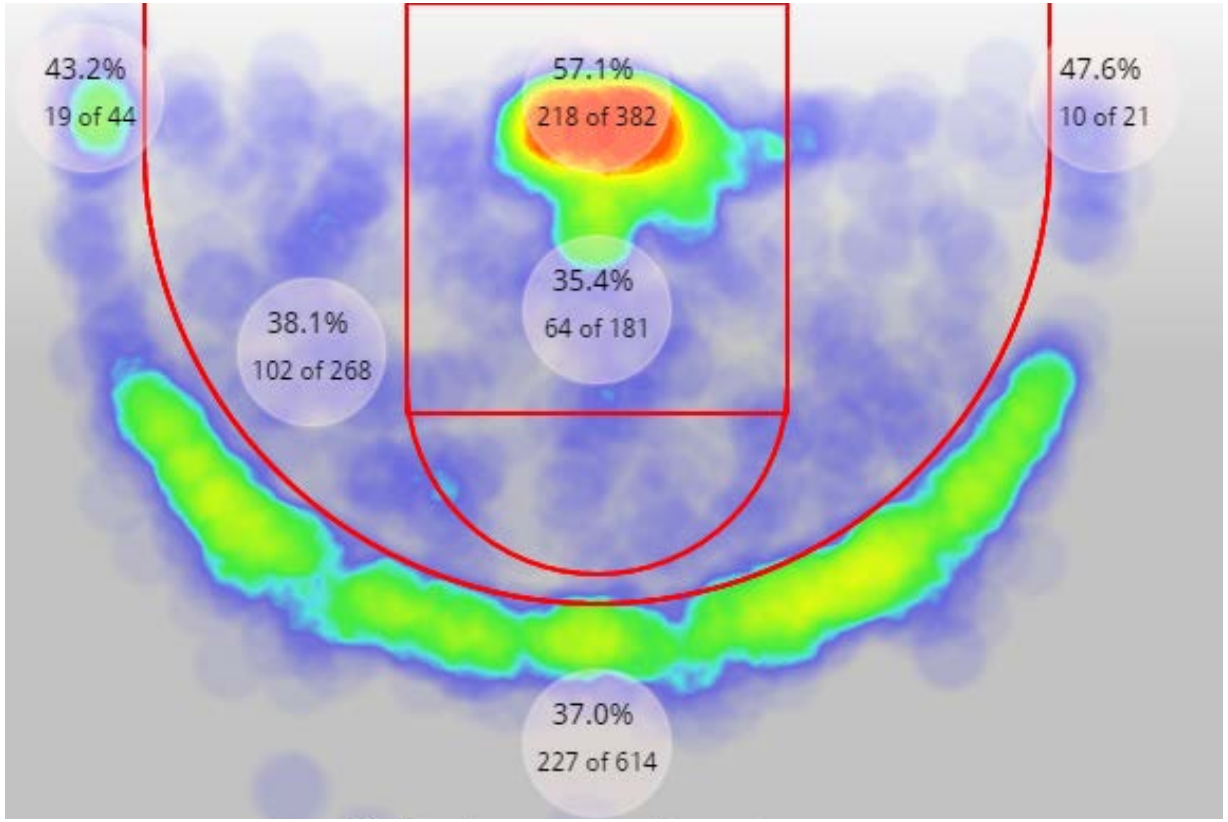
Cons:

- somewhat depressingly, a vast majority of the population does not know how to read them... yet it's conceivably one of the simplest graphical representations.

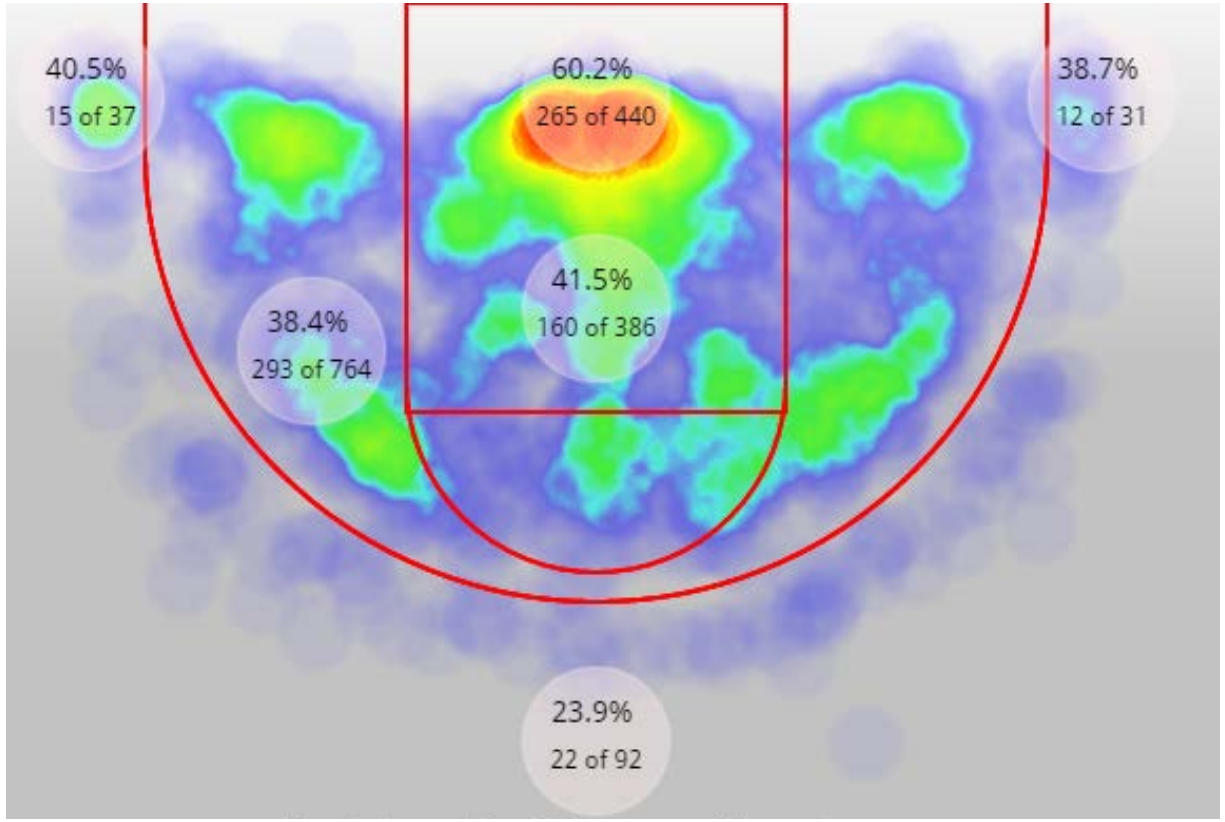
HEAT MAPS

NBA FG% (2015-16)

Kyle Lowry

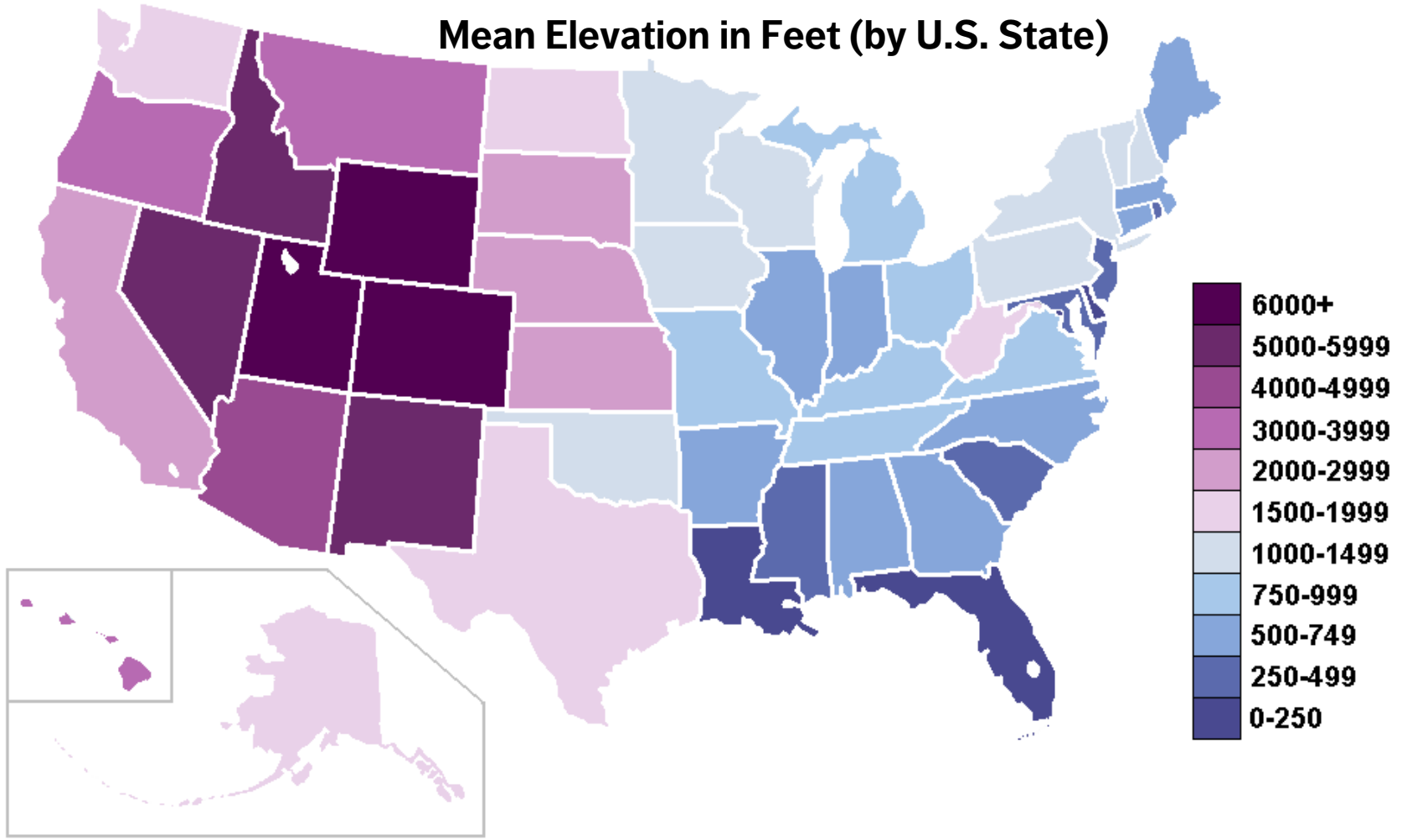


DeMar DeRozan



[Author unknown]

HEAT MAPS (CHOROPLETHS)



HEAT MAPS

Ideal to look at the relationship between 3 or 4 variables

- if one of them represents a percentage or a value within a set range (in order to fix the colour scale, for comparison purposes)
- and the other can act as categorical variables / size variables

Better to **bin the data**, even if the axes variables are continuous (decreases the number of required observations for usefulness)

Easier to read if colours are selected along natural colour gradients, such as

Red → **Green** or **Red** → **Yellow** → **Green**

for instance (but that's not ideal if colour blind)

[Upside Down Maps]

MAPS

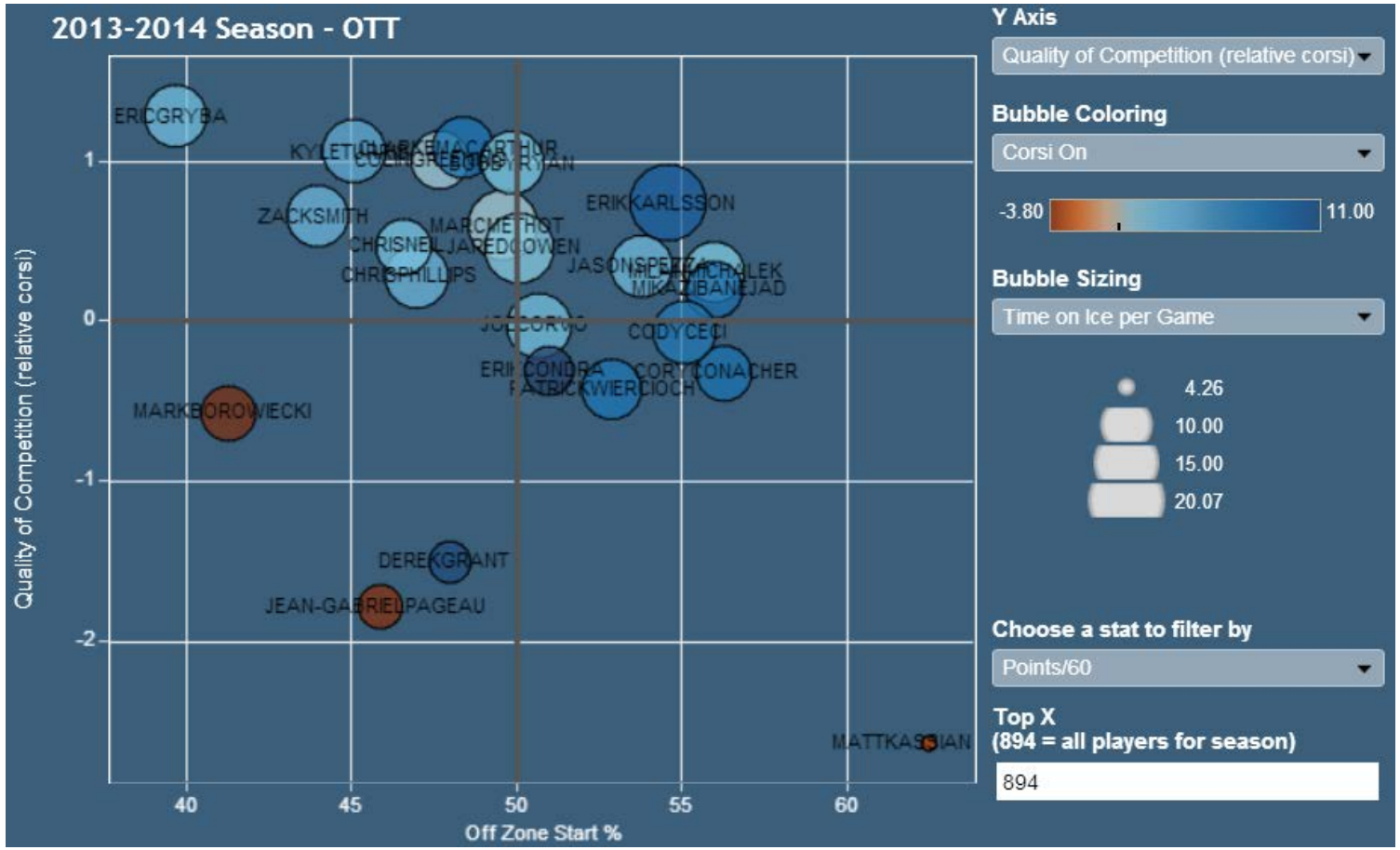
Most of us are quite familiar with geographical maps, so they tend to be easier to interpret.

Can produce a striking effect when the data visualization shows **un-expected results**

- which may mask significant information
- or lack of significant information
- or change the way you view things

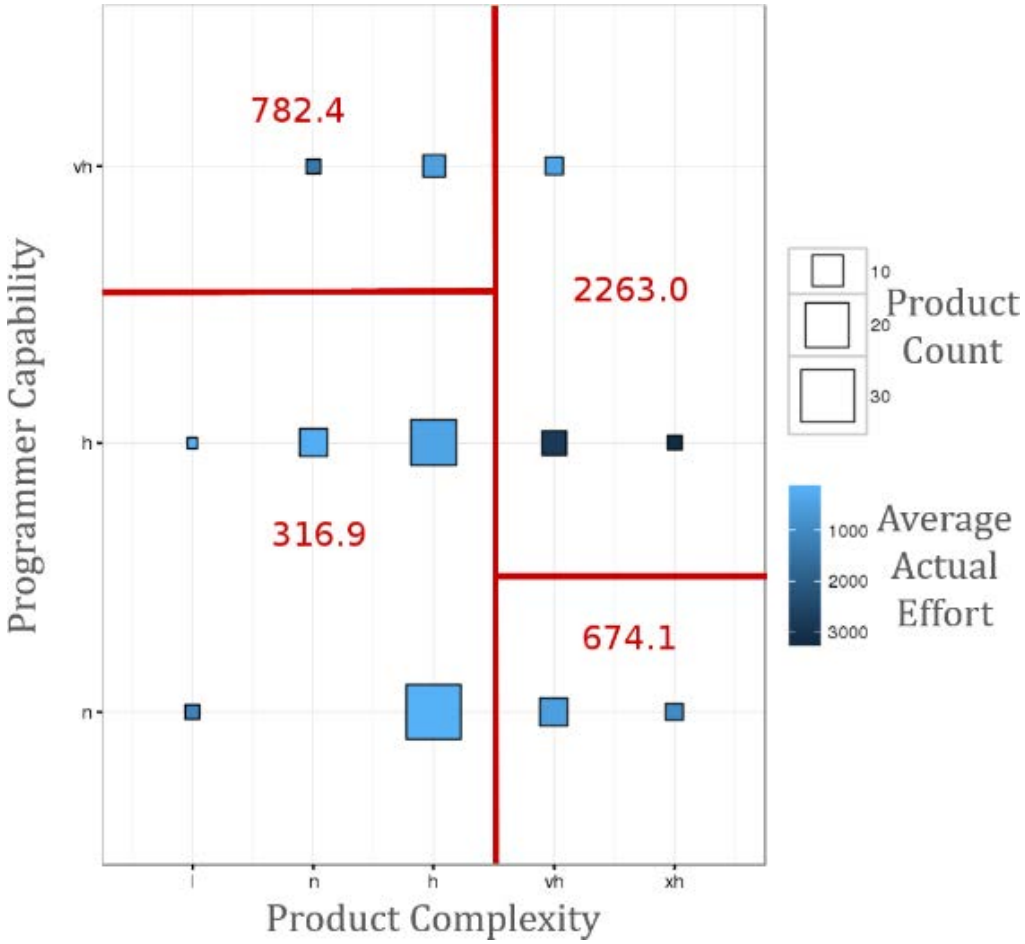
[Hockey Abstract] [Personal files]

BUBBLE CHARTS



NHL Player Usage (Ottawa Senators)

NASA COCOMO Dataset



BUBBLE CHARTS

Colour + **geometry** allow us to plot (at least) 2 extra variables on a 2D scatter plot

May need to re-scale or bin the available data

A movie could be used to visualize an additional ordinal variable

Text can also be added to visualize an additional categorical variable

Works best when chart is **not too encumbered**

A **personal favourite** – a good mixture of traditional and modern features

WORD CLOUDS

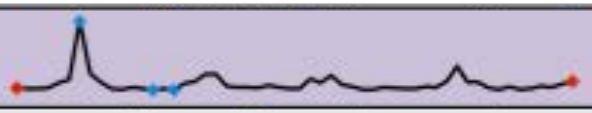
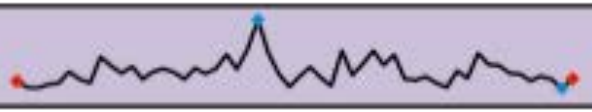
For maximal impact, font size should be a function of frequency.

Typically used for univariate categorical data, but **small multiples**, **cloud shape**, **word placement**, **colour**, and **hue** could be used to integrate more variates.

Word placement and colour choice algorithm are “hidden”.

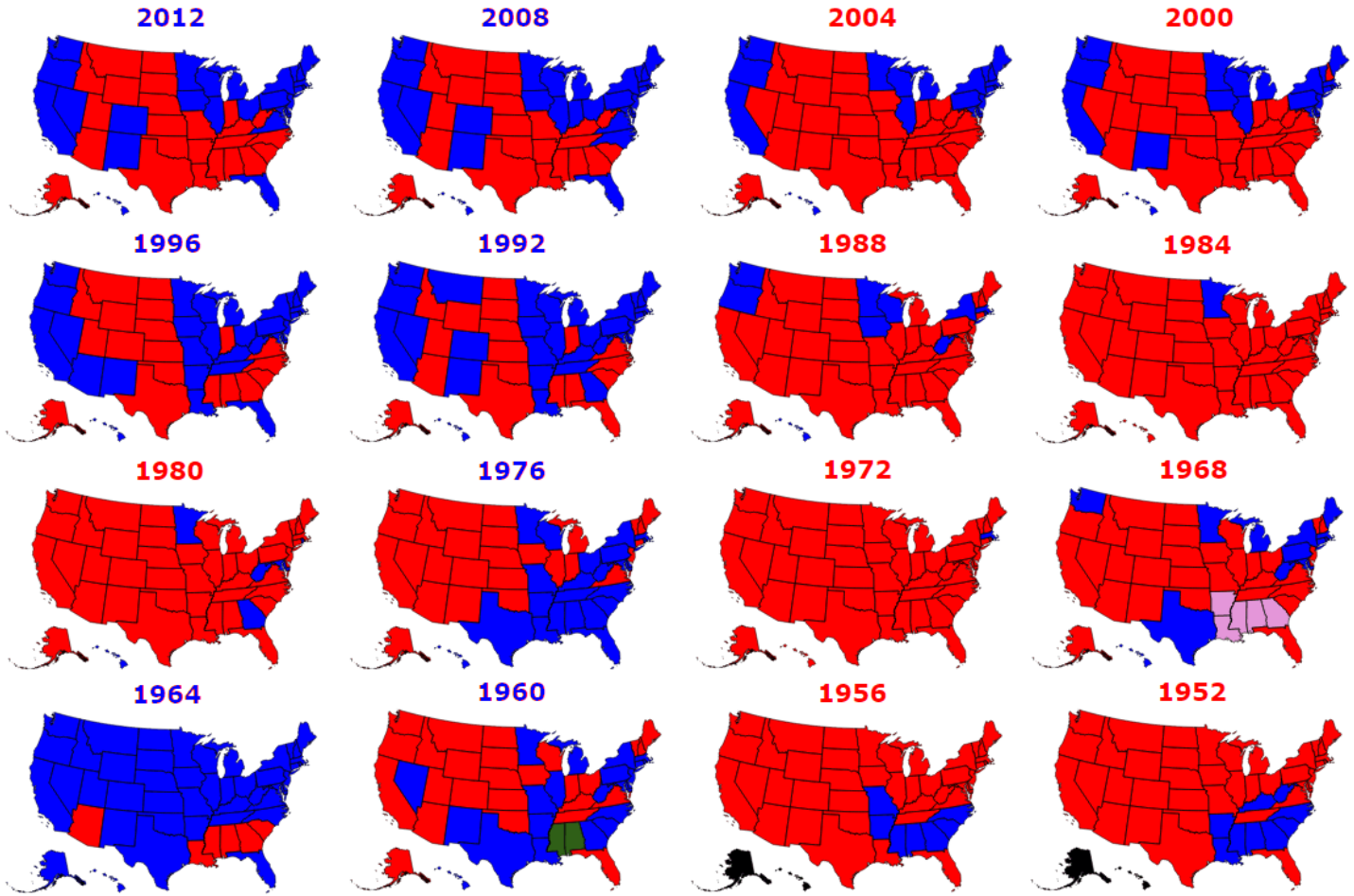
Could be used to answer authorship questions.

SPARKLINES AND SMALL MULTIPLES

	Start	Monthly Number of Cases	End	Low	High	Mean	Std Dev	Blanks	Zeros	Trend
TOTAL	19502		17265	15150	25072	19903	2612	0.0	0.0	379.2
Hospital #1	46		19	3	46	19	9	0.0	0.0	-1.6
Hospital #2	156		240	101	326	194	60	0.0	0.0	9.7
Hospital #3	16		11	2	76	15	15	0.0	0.0	-2.9
Hospital #4	3		13	0	105	9	15	0.0	0.4	-1.8
Hospital #5	42		50	25	91	61	16	0.0	0.0	1.2
Hospital #6	48		53	34	169	67	25	0.0	0.0	0.6
Hospital #7	0		N.A.	0	0	0	0	2.2	9.8	0.0
Hospital #8	56		104	34	150	73	25	0.0	0.0	4.6

[Metrocosm.com]

SMALL MULTIPLES



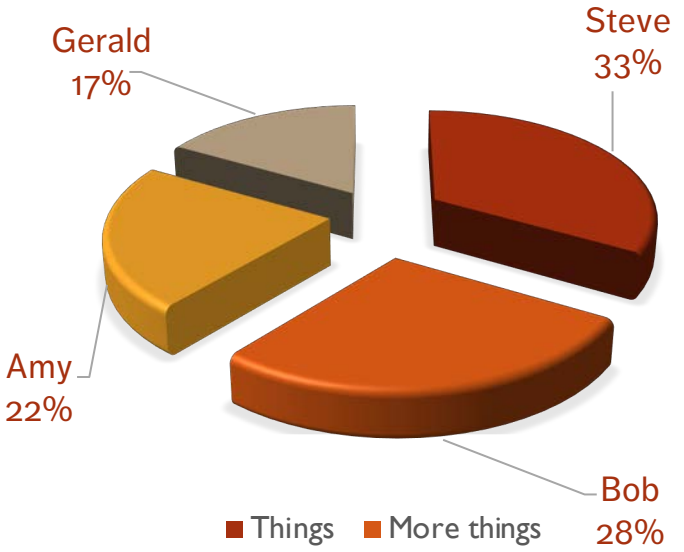
U.S. Electoral College Results 1952 – 2012

CHARTS TO AVOID

ANYTHING with an arc (except gauge)

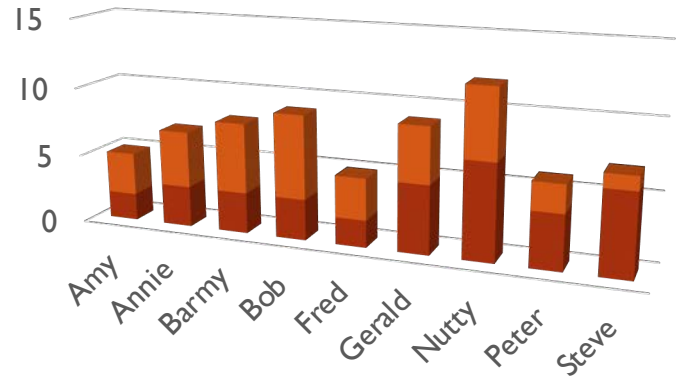
- pie
- donut

Brains cannot compare arcs so they can be misleading: without labels, how easy is it to compare Steve & Bob?



ALL 3D IS EVIL!

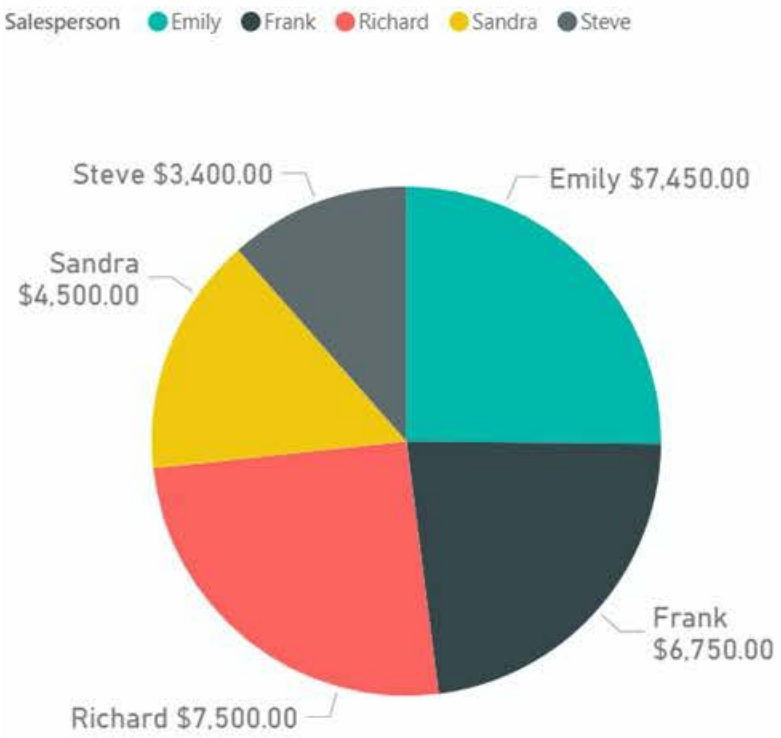
- as with arcs, we cannot easily visually compare data series
- adds way too much clutter



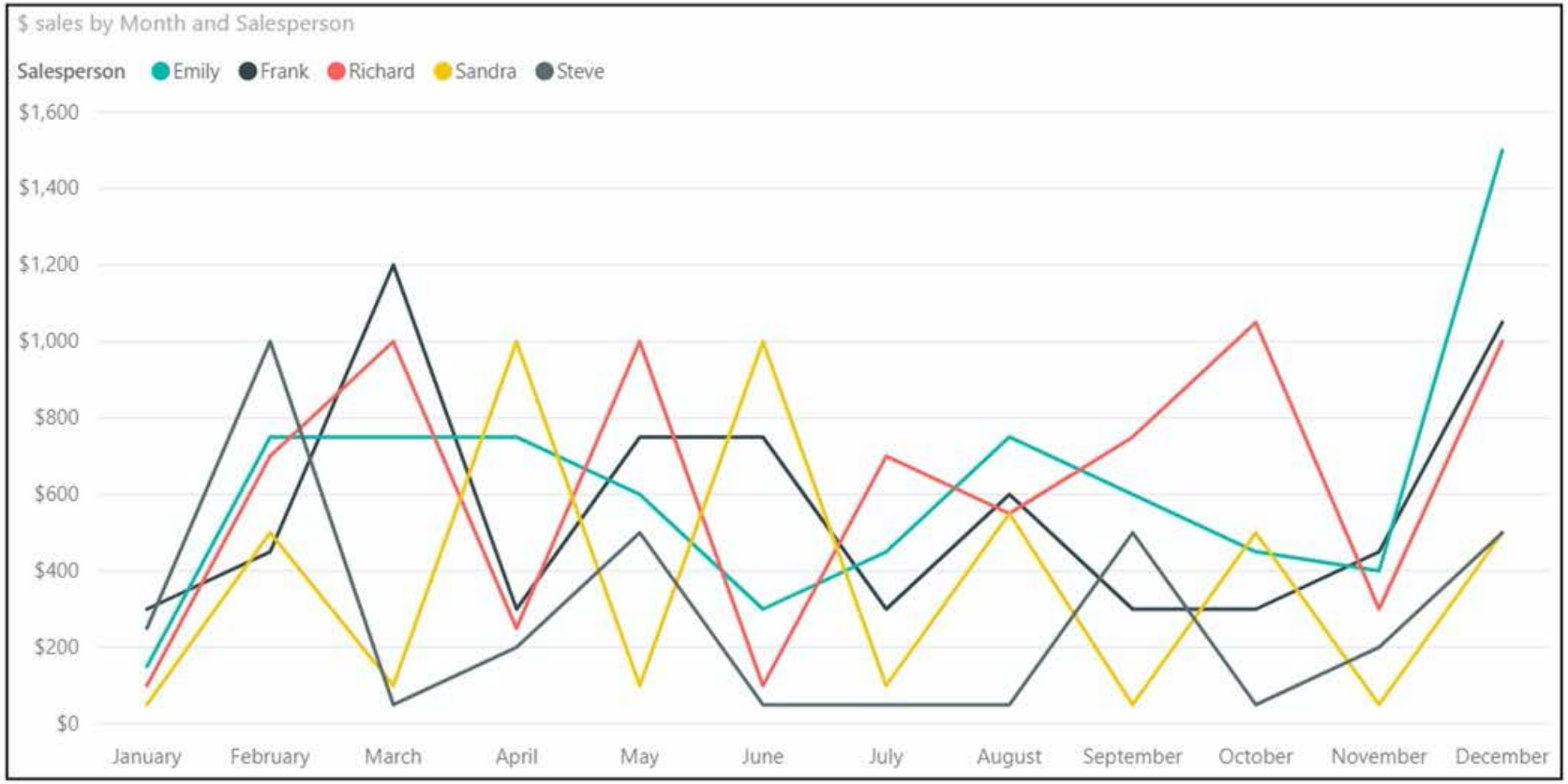
Sales Dashboard

$ sales

$ sales by Salesperson



$ sales by Month and Salesperson



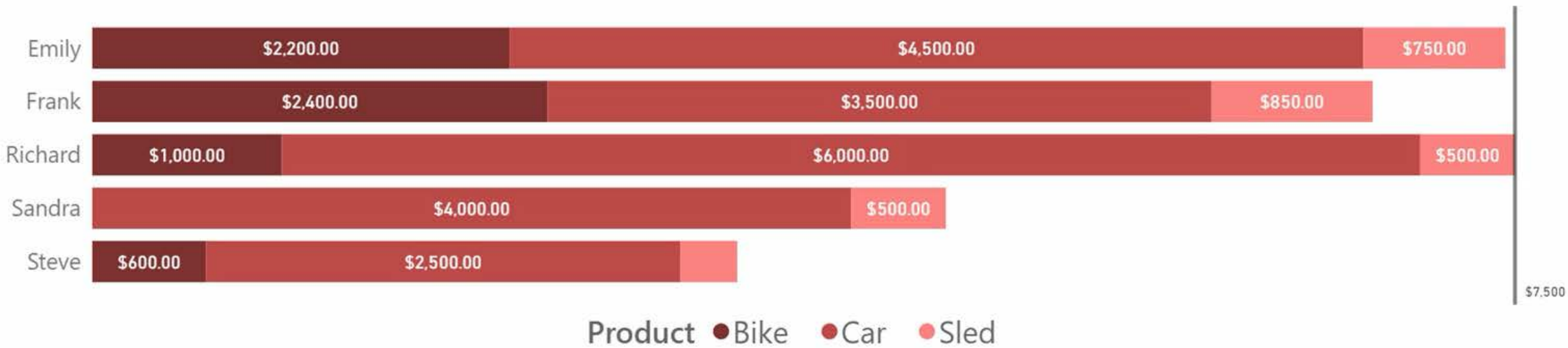
$ sales by Product and Salesperson

Sales Dashboard

Annual Sales for 2017

Total Sales

$29.6K



EXERCISE

Find examples of different charts displaying information about the same dataset?

What are the strengths and limitations of the charts, relative to the specific dataset?

INTERACTIVE AND ANIMATED VISUALIZATIONS

INTERACTIVE AND ANIMATED VISUALIZATIONS

Animation **does not always** improve a visualization. What insights can interactivity provide? That depends on the data, and on the visualization method.

Examples:

- The Clubs That Connect the World Cup, NY Times, 2014
- Who Marries Whom, Bloomberg, 2016
- Hipparcos Star Mapper, European Space Agency, 2016
- The Internet of Things – a Primer, Information is Beautiful, 2016
- The Genealogy and History of Popular Music Genres, Musicmap, 2016

INTERACTIVE AND ANIMATED VISUALIZATIONS

Examples (continued):

- Sequences Sunburst, Kerry Rodden, 2015
- Health and Wealth of Nations, Gapminder Foundation
- Mobius Transformations Revealed, Arnold D.N, Rogness, J, 2007
- Visualizing the Riemann ζ Function and Analytic Continuation, 3Blue1Brown, 2016
- Small Arms and Ammunition – Imports and Exports, Google, 2012
- The Evolution of the Web, Google, Hyperakt, Vizzuality, 2012
- peoplemovin, Carlo Zapponi, 2012

DISCUSSION

"There is always a danger that if certain types of visualization techniques take over, the kinds of questions that are particularly well-suited to providing data for these techniques will come to dominate the landscape, which will then affect data collection techniques, data availability, future interest, and so forth." (P. Boily)

Even when done well, 85% of users don't bother with interactive viz (NY Times).

Take-Away: explore the data and try different methods