Lecture 04

Basic Visualisation Techniques II
General Activities to Support Using Visualisation

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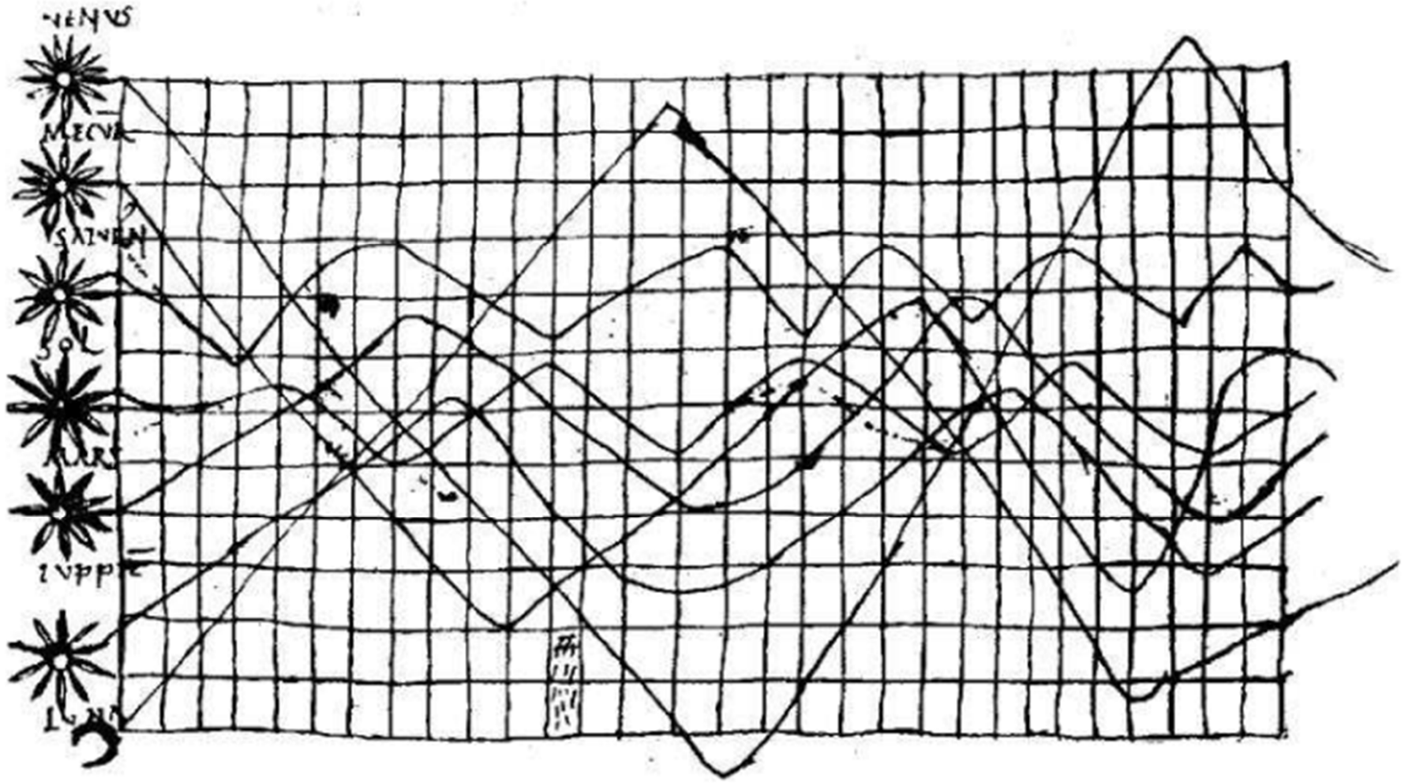
CS5044 – Information Visualization

University of
St Andrews

history detour

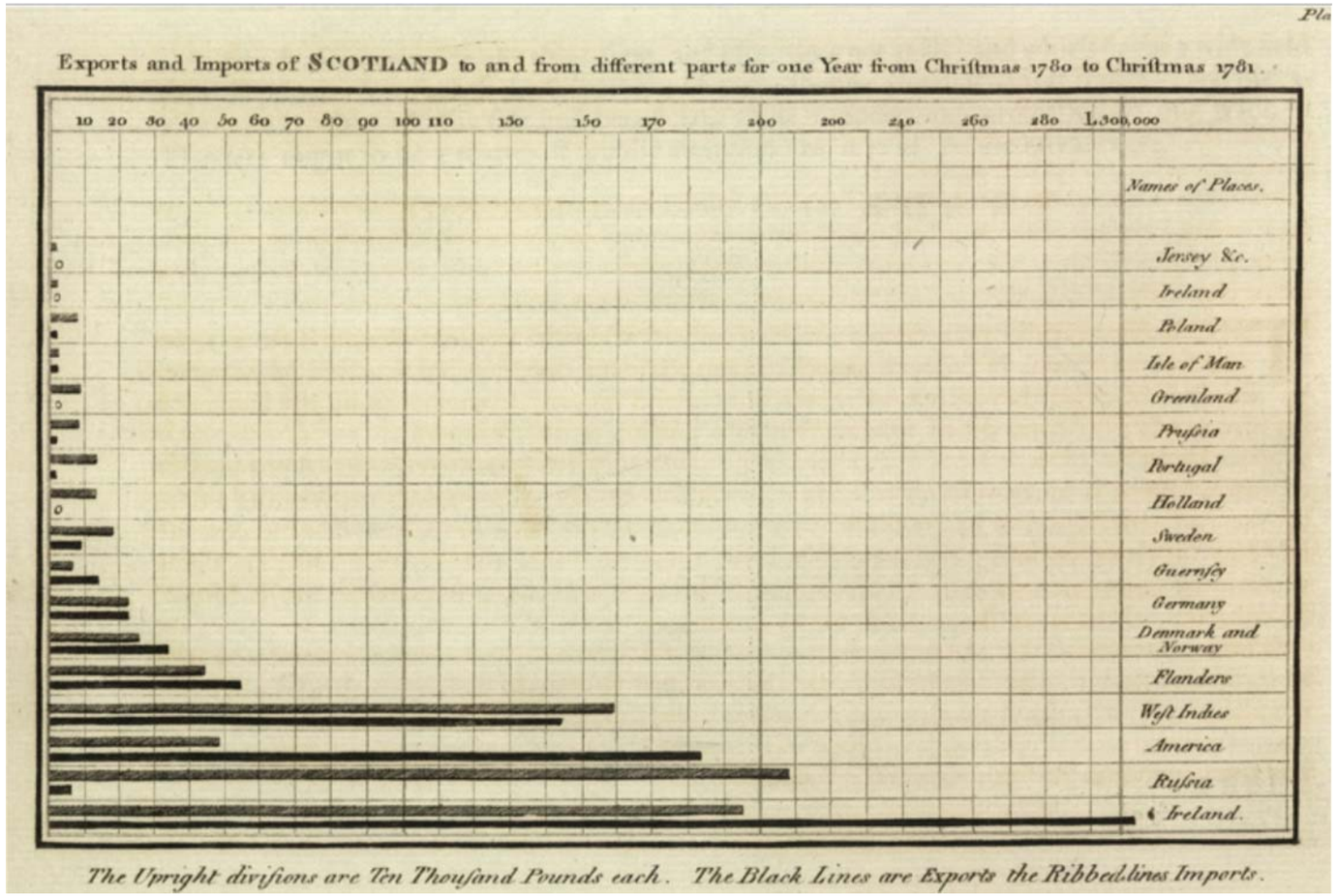
early line graphs



10th century

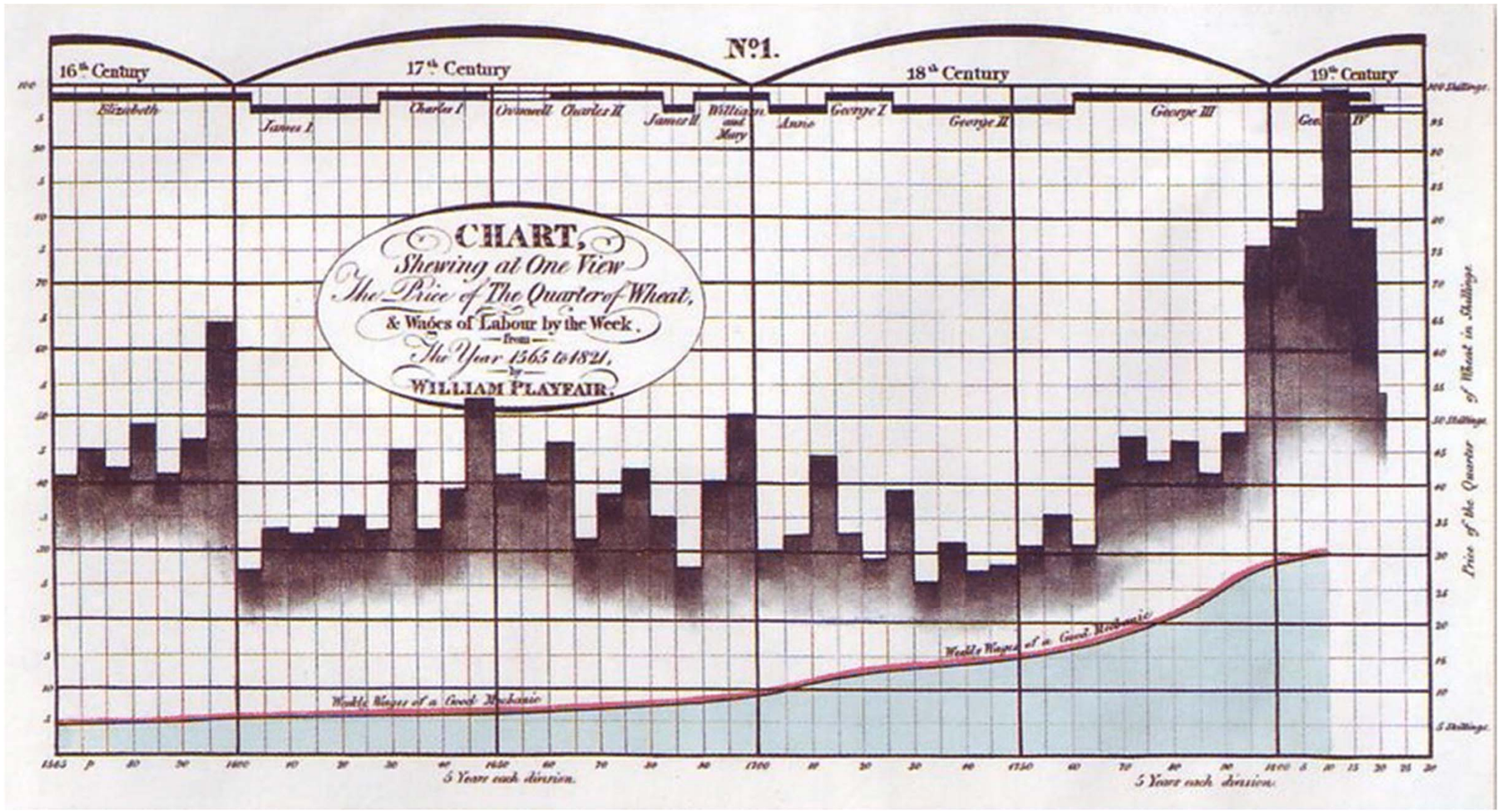
Planetary movements visualized by unknown astronomer

the first bar chart



1786, William Playfair (Scottish engineer and political economist)
Scotland's imports and exports in 1781

multiple time series



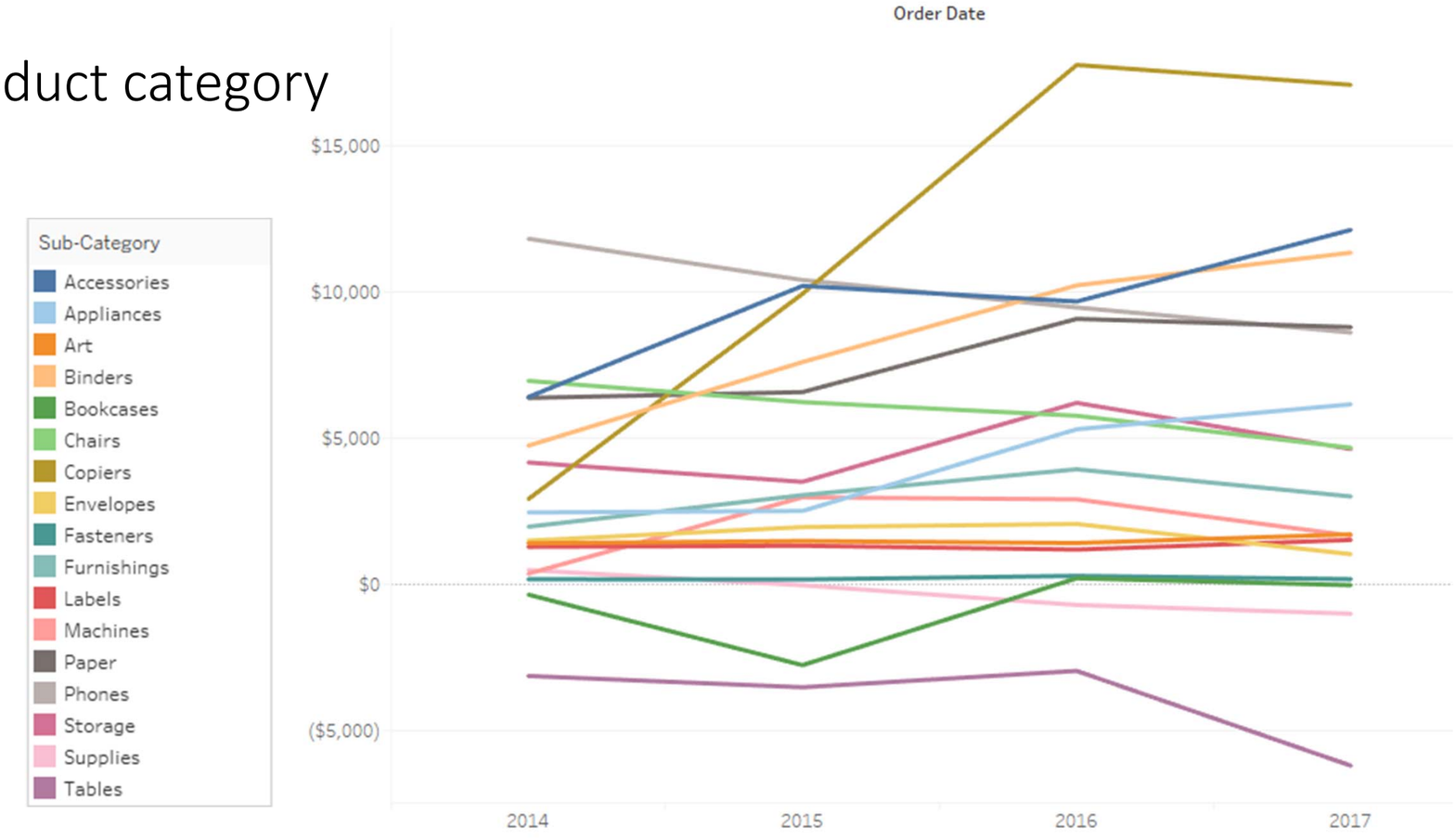
1821, William Playfair (Scottish engineer and political economist)

Price of wheat and wages

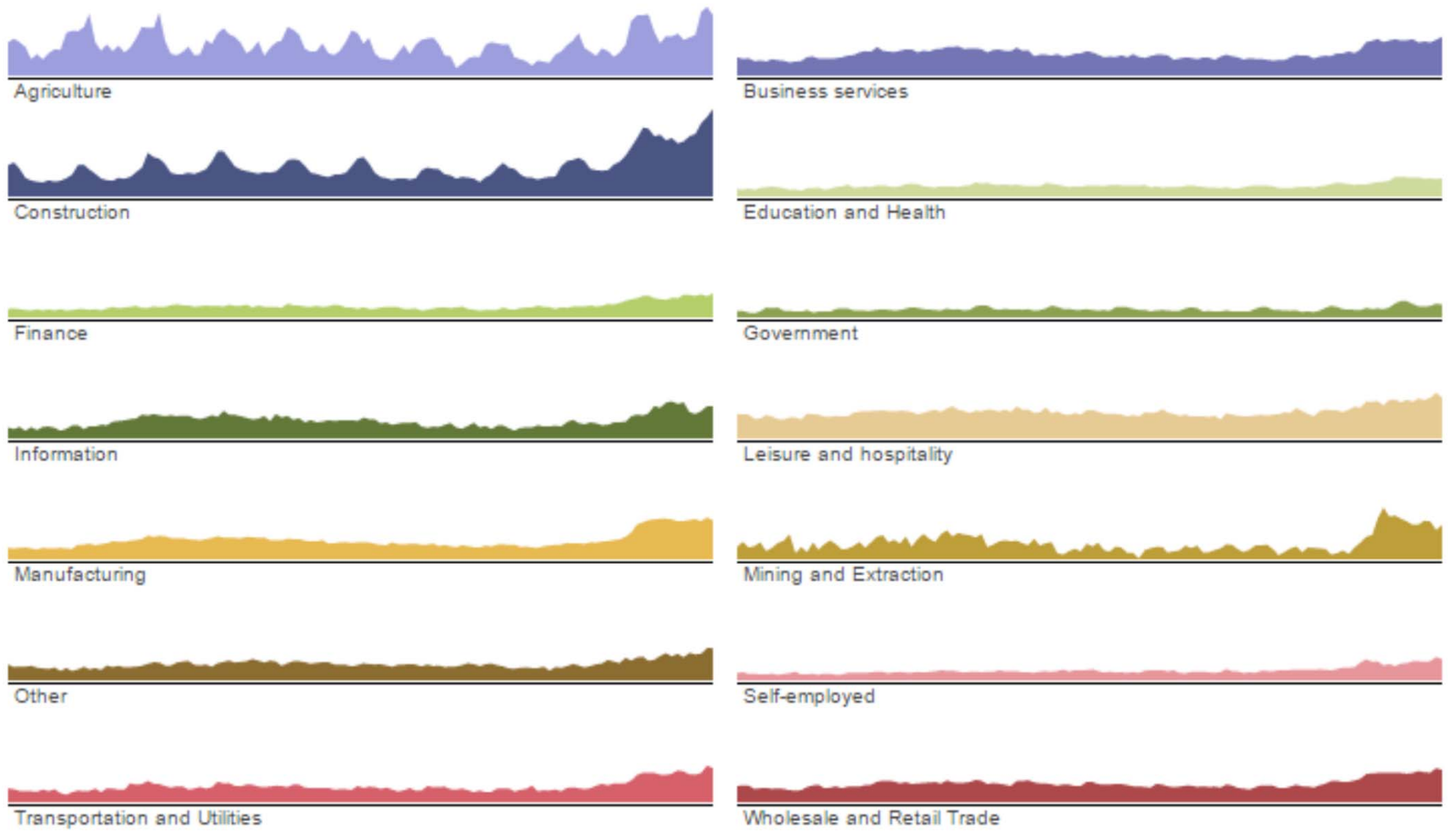
more visualisation techniques

showing multiple attributes through line charts

- Primary attribute: year
- Secondary attribute: product category
- Value: profit

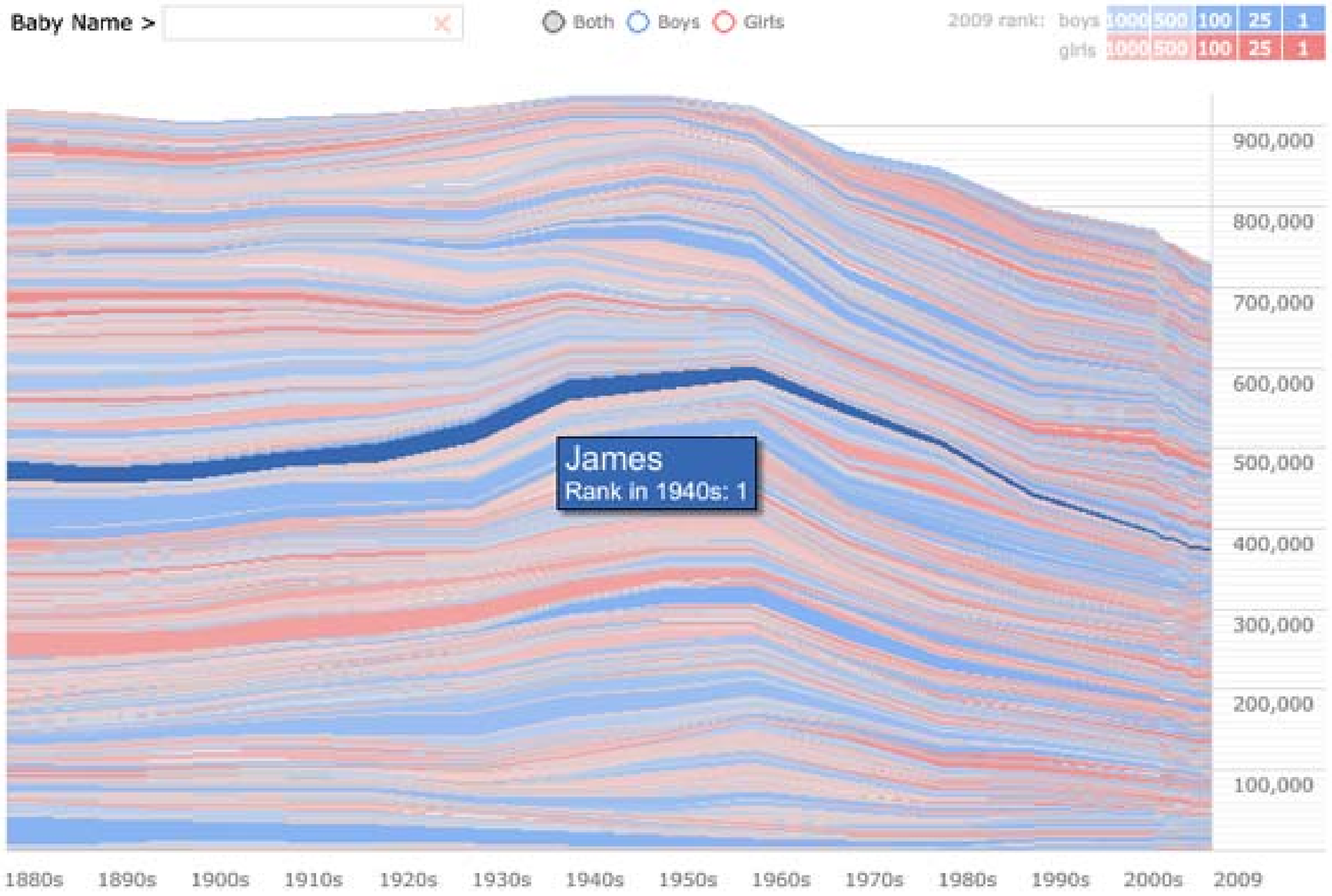


multiple area charts



US unemployment rates 2000 - 2010
http://homes.cs.washington.edu/~jheer//files/zoo/ex/time/multiples.html

stacked area graphs

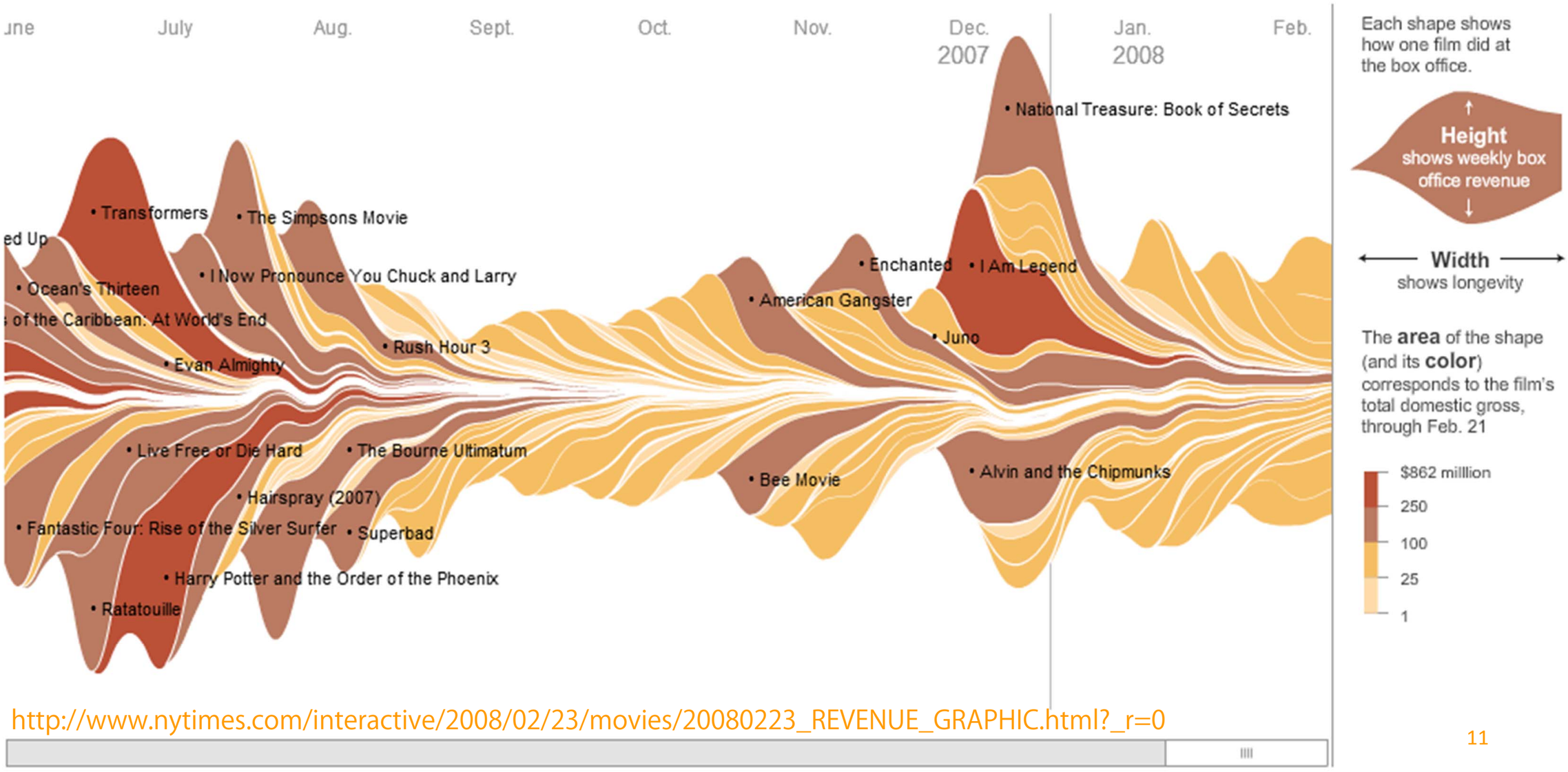


Name Voyager, 2005
http://www.bewitched.com/namevoyager.html

stacked area graphs

Artefacts of the presence era
http://alumni.media.mit.edu/~fviegas/ICA/

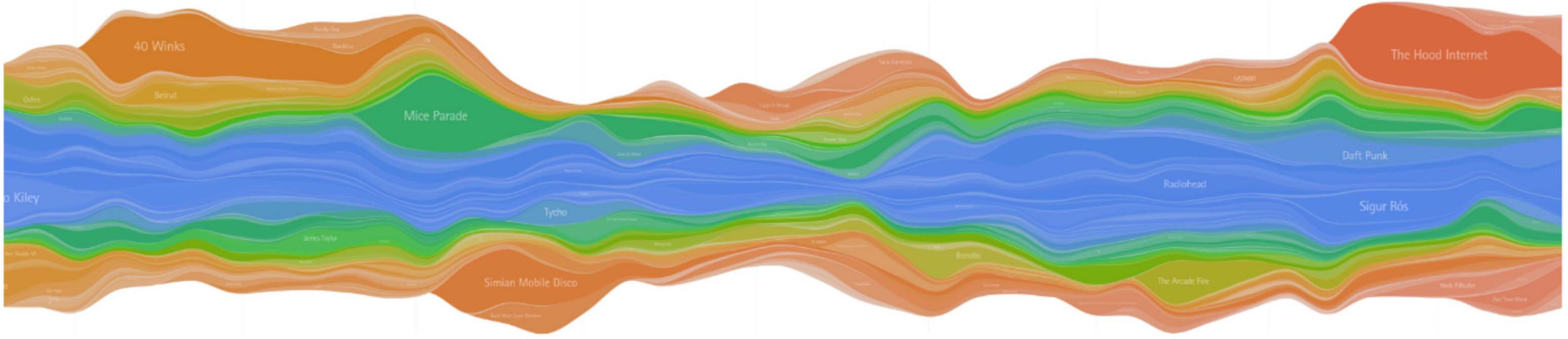
streamgraphs



http://www.nytimes.com/interactive/2008/02/23/movies/20080223_REVENUE_GRAPHIC.html?_r=0

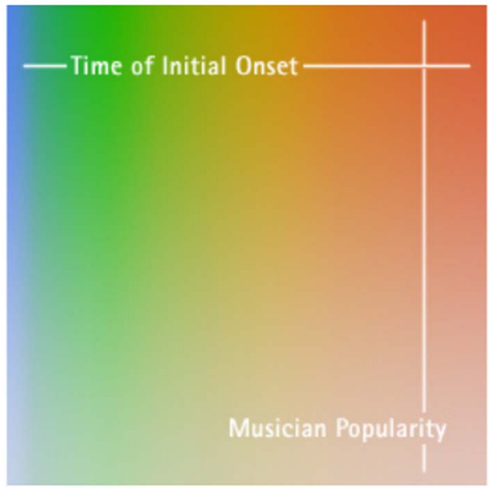
stream graphs

- Closely related to stacked bar charts
- Emphasis on continuity of the horizontal layers

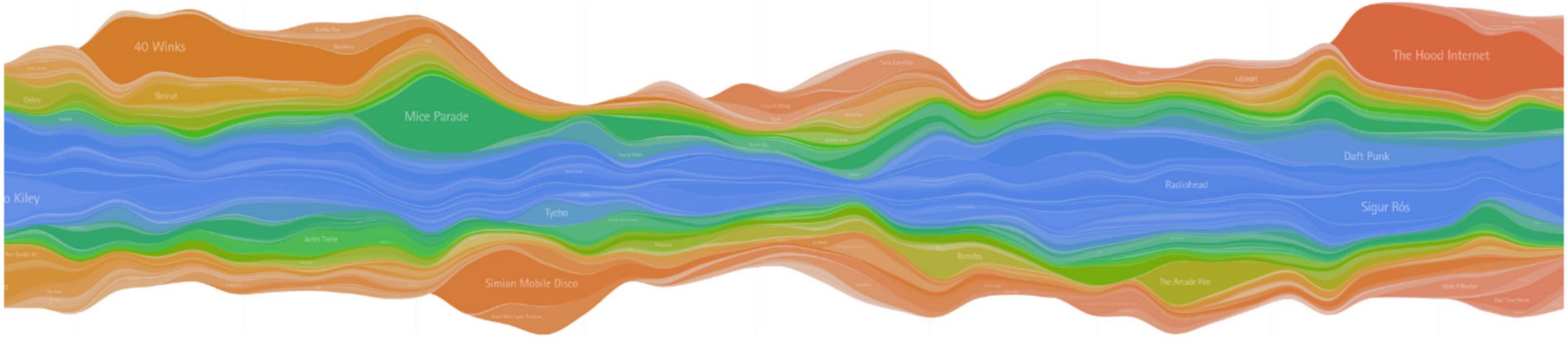


Music listening history. Byron and Wattenberg, 2008
http://leebyron.com/streamgraph/stackedgraphs_byron_wattenberg.pdf

streamgraphs

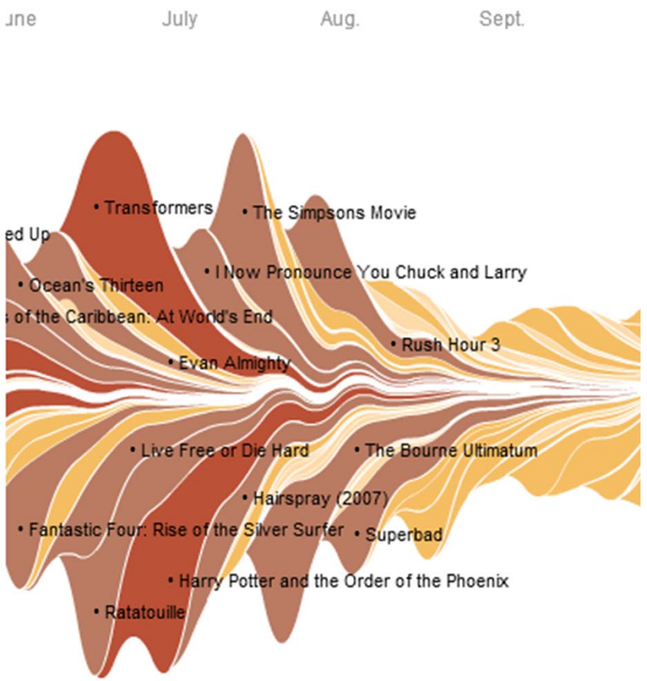


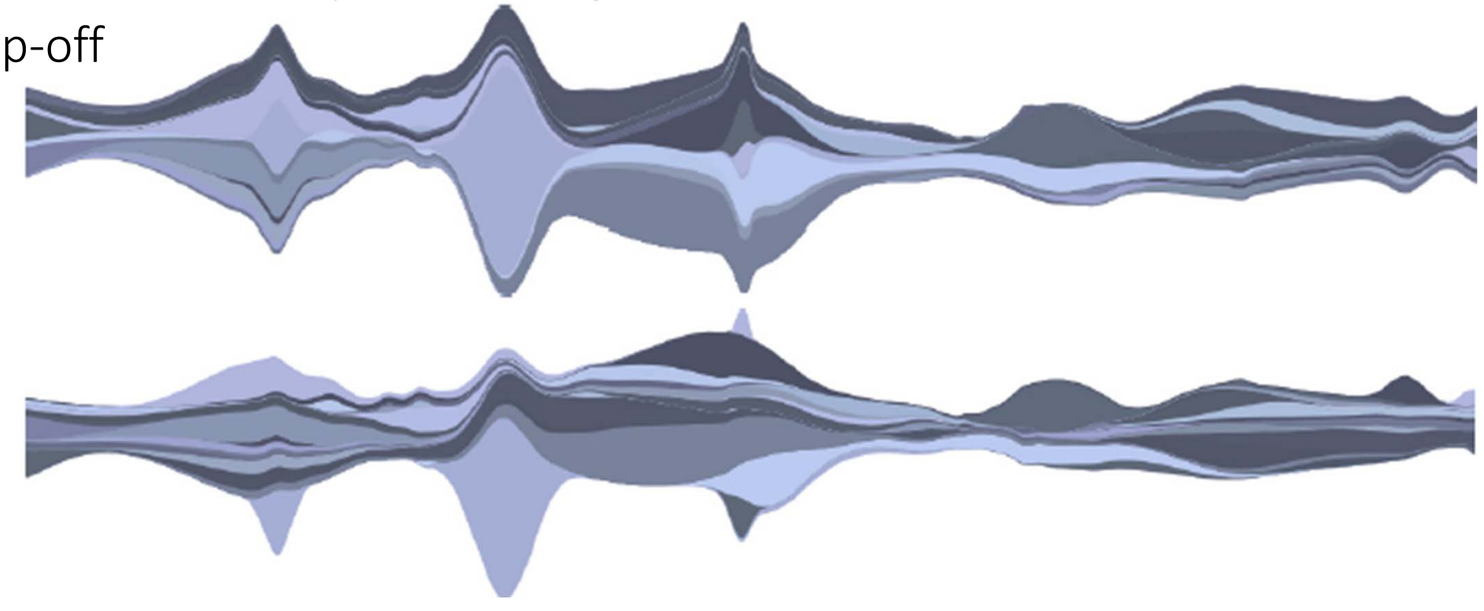
- Each layer represents one artist that was listen to
- Ordinal attribute (time) → x-position
- Quantitative attribute (# of times listening to one artist at a point in time) → height
- Quantitative attribute (total counts of listening to one artist) → brightness/saturation
- Ordinal attribute (first time a songs were heard) → hue; from cold to warm hues



streamgraphs

- Layer order driven by aesthetic considerations
  - Not too much “wiggling” in the baseline
  - Deviation of a layer from a horizontal baseline
  - Depends on the data
  - With music artists: first peak and then many later resurgence
  - With movies: peak then drop-off

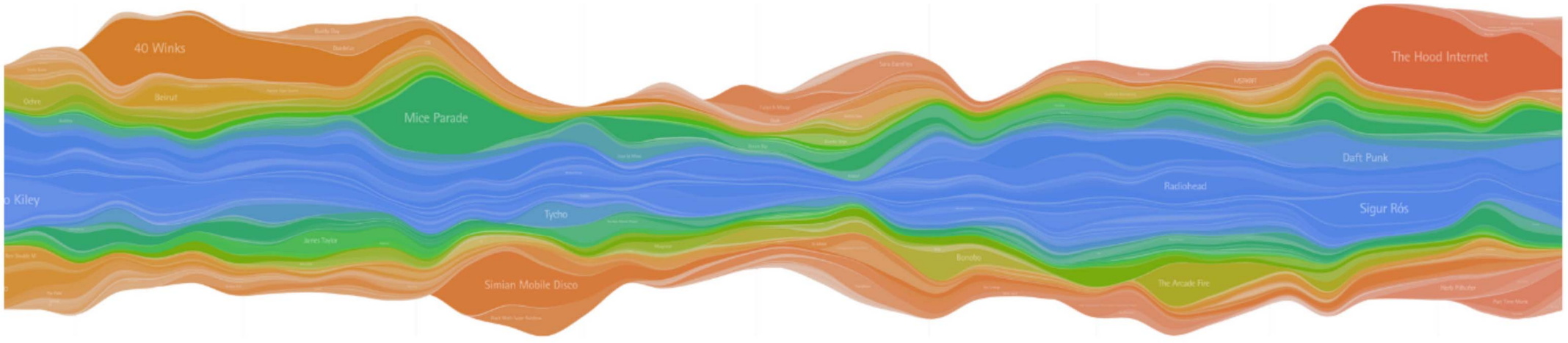




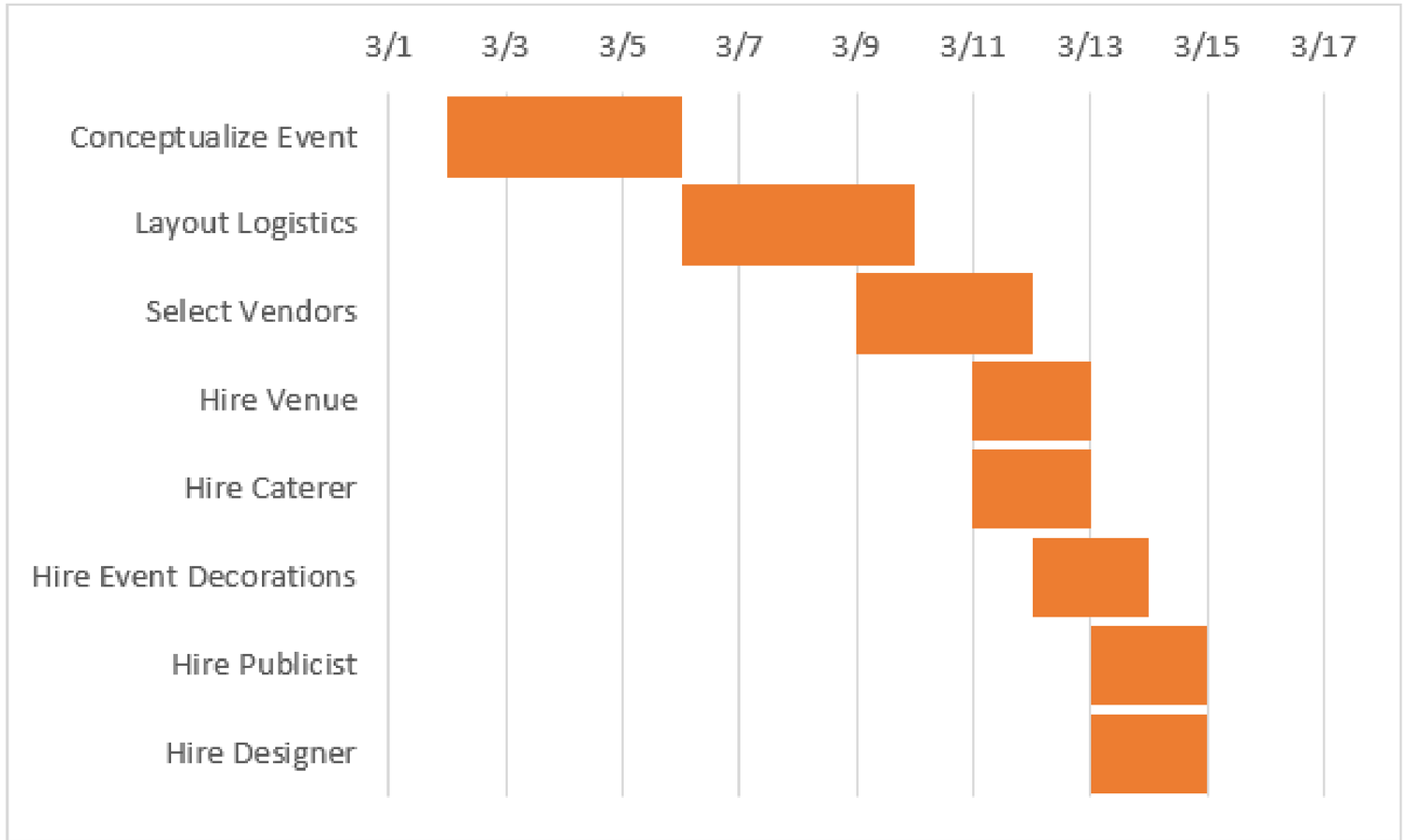
streamgraphs

why

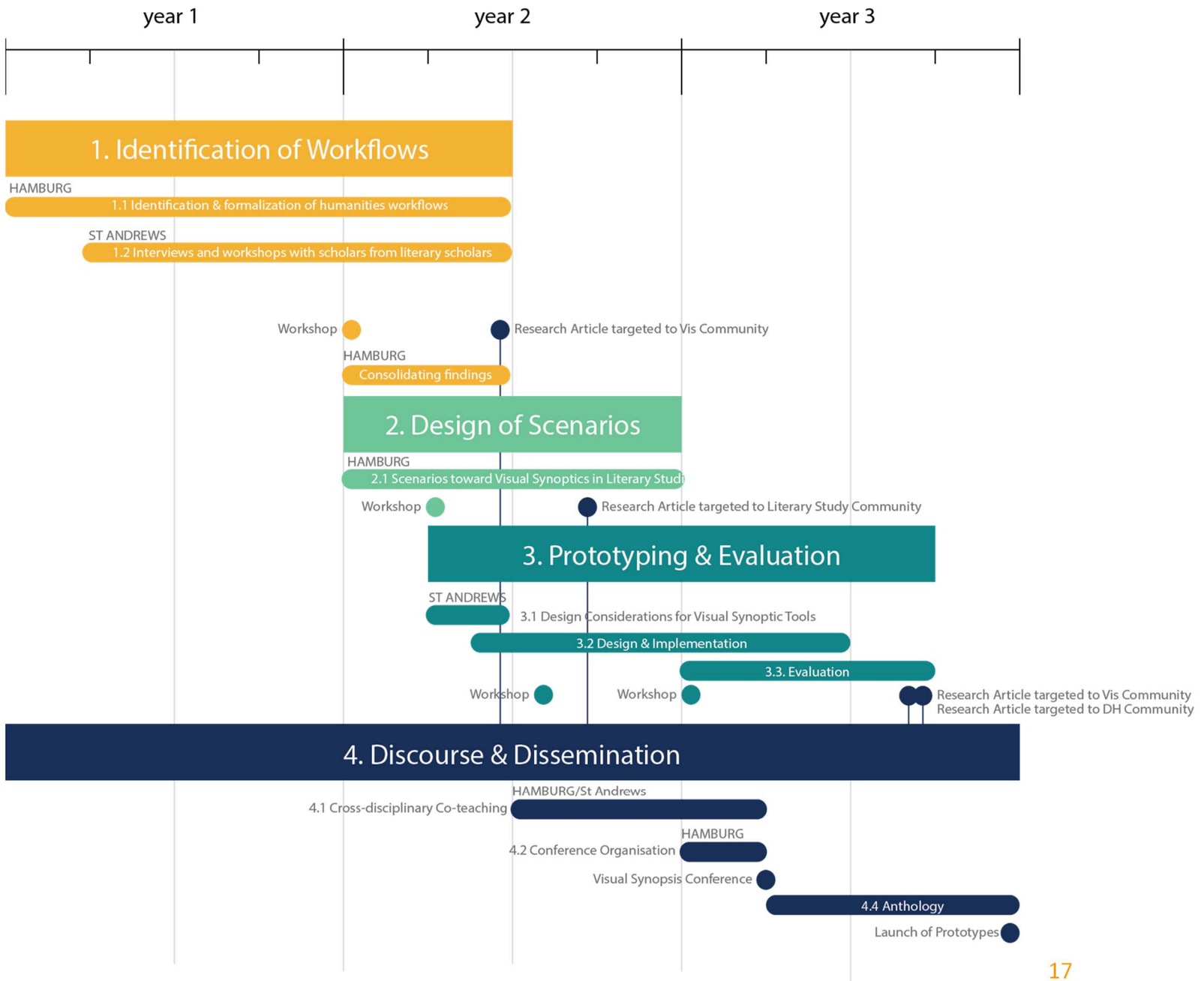
- Tasks similar to stacked bar charts
  - Part-of-the-whole relationship, finding trends
- Lookup and comparison can be difficult



gantt chart

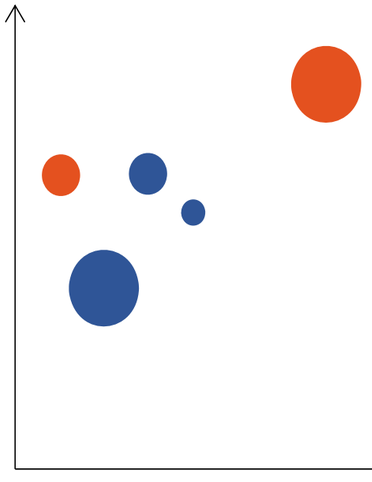

3/1
3/3
3/5
3/7
3/9
3/11
3/13
3/15
3/17
Conceptualize Event
Layout Logistics
Select Vendors
Hire Venue
Hire Caterer
Hire Event Decorations
Hire Publicist
Hire Designer

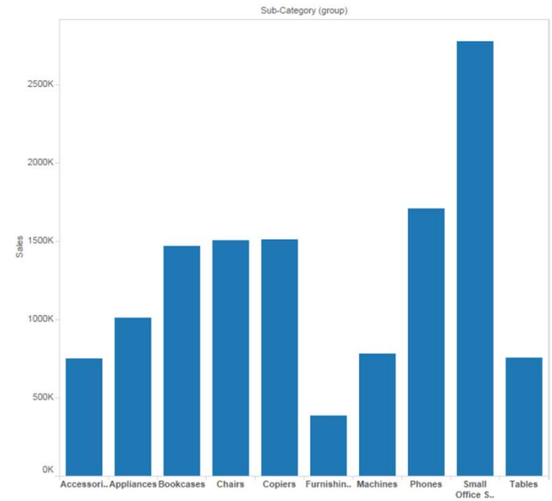
gantt chart

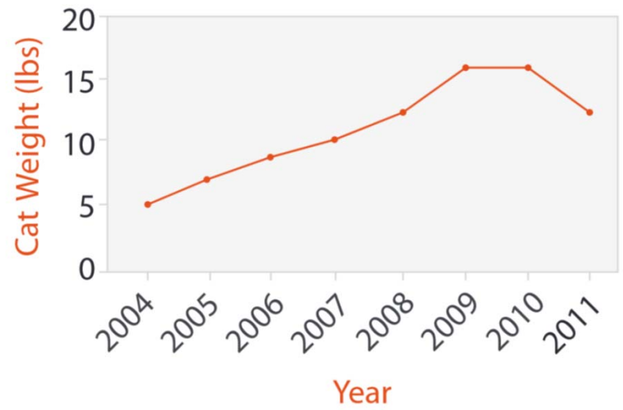

year 1
year 2
year 3
1. Identification of Workflows
HAMBURG
1.1 Identification & formalization of humanities workflows
ST ANDREWS
1.2 Interviews and workshops with scholars from literary scholars
Workshop
Research Article targeted to Vis Community
HAMBURG
Consolidating findings
2. Design of Scenarios
HAMBURG
2.1 Scenarios toward Visual Synoptics in Literary Studi
Workshop
Research Article targeted to Literary Study Community
3. Prototyping & Evaluation
ST ANDREWS
3.1 Design Considerations for Visual Synoptic Tools
3.2 Design & Implementation
3.3. Evaluation
Workshop
Workshop
Research Article targeted to Vis Community
Research Article targeted to DH Community
4. Discourse & Dissemination
HAMBURG/St Andrews
4.1 Cross-disciplinary Co-teaching
HAMBURG
4.2 Conference Organisation
Visual Synopsis Conference
4.4 Anthology
Launch of Prototypes

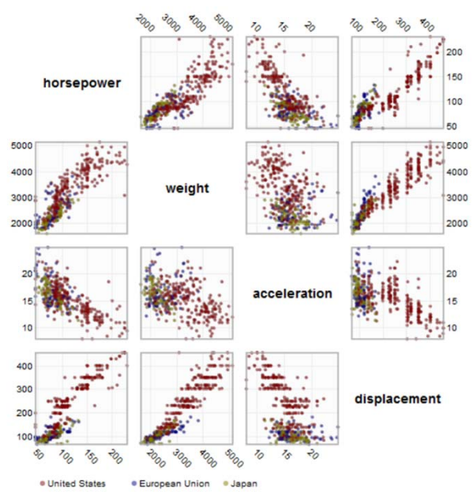
classifying visualisation techniques

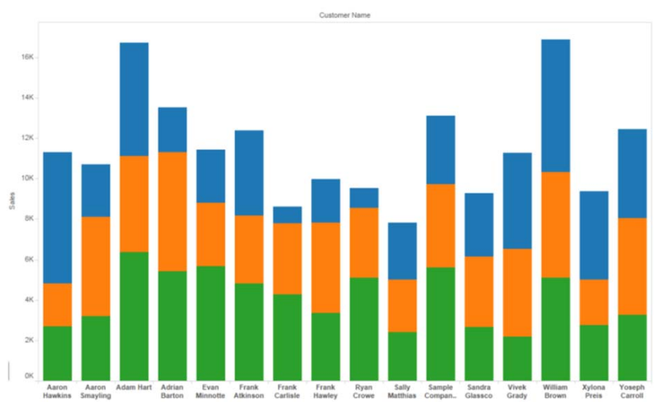
→ Orthogonal axes

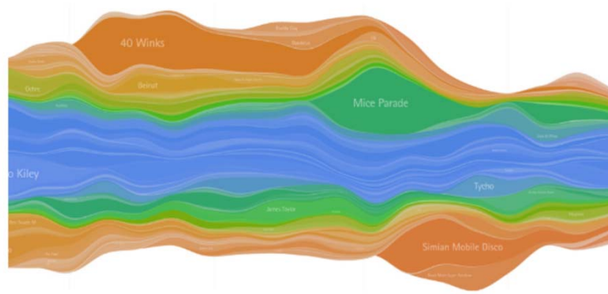








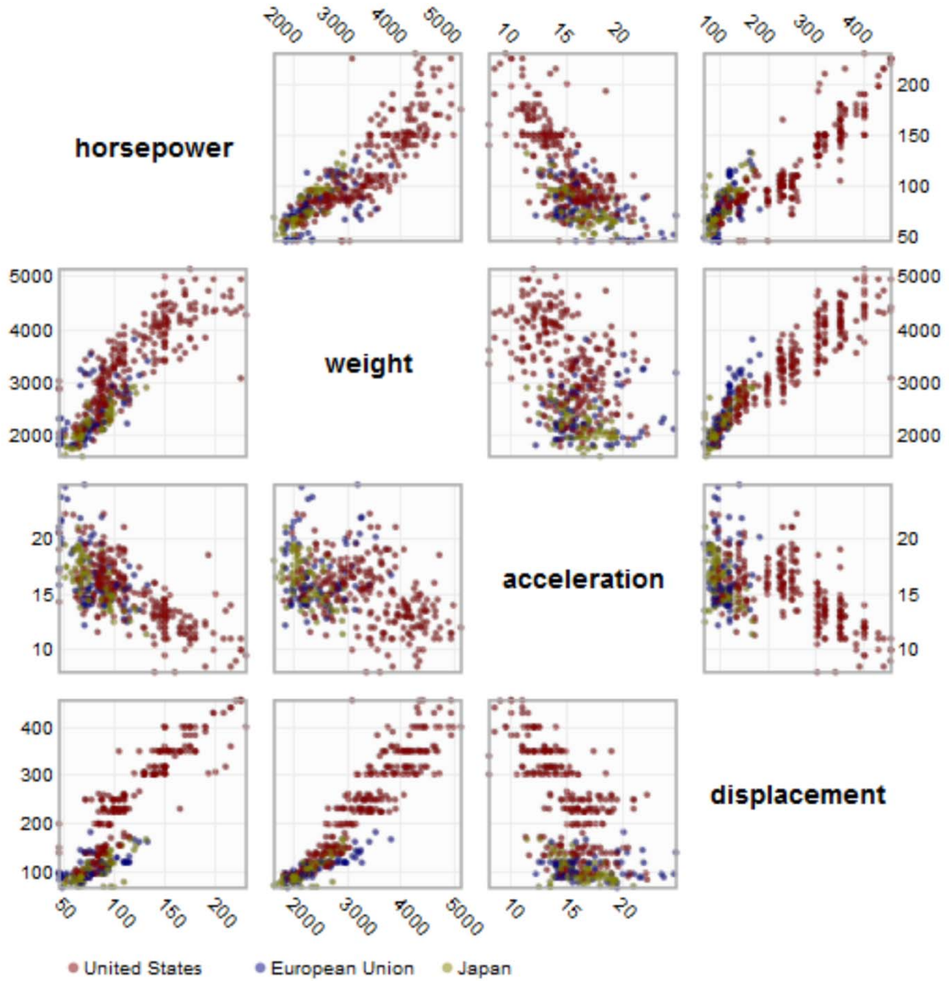




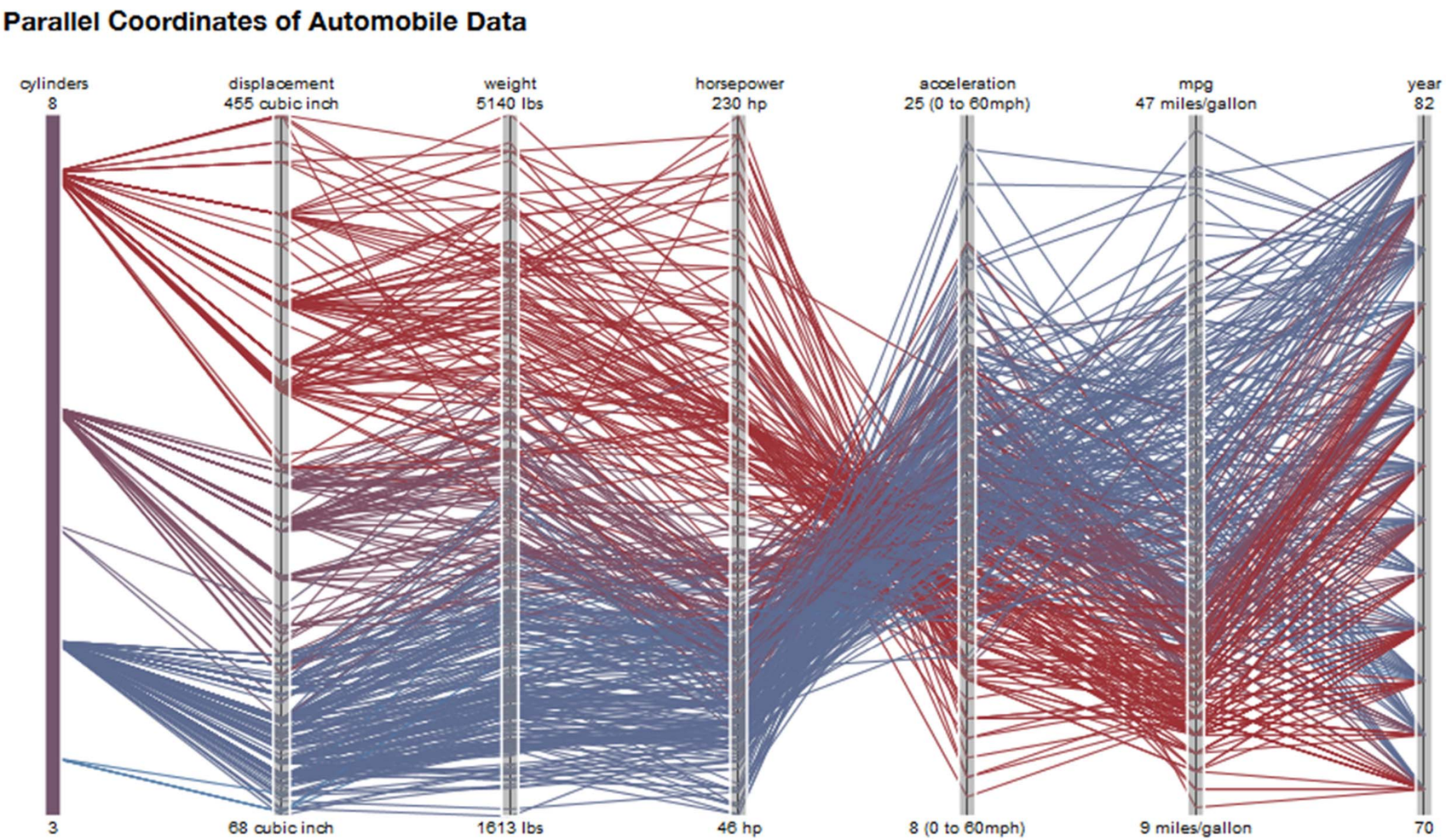
parallel axes

visualizing many quantitative attributes

- Scatterplots only show one pairwise correlation at a time

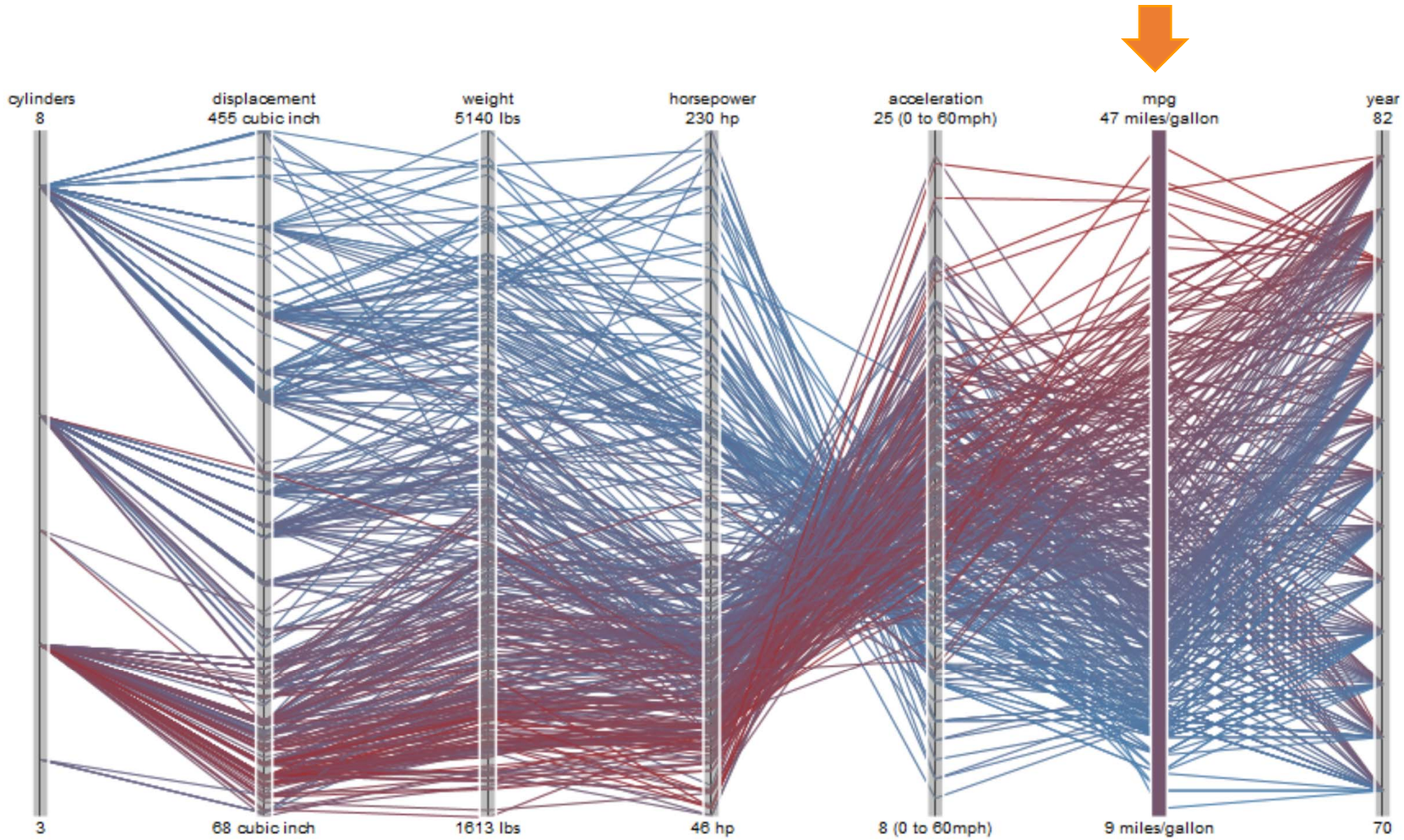


parallel coordinates



http://homes.cs.washington.edu/~jheer//files/zoo/ex/stats/parallel.html

parallel coordinates



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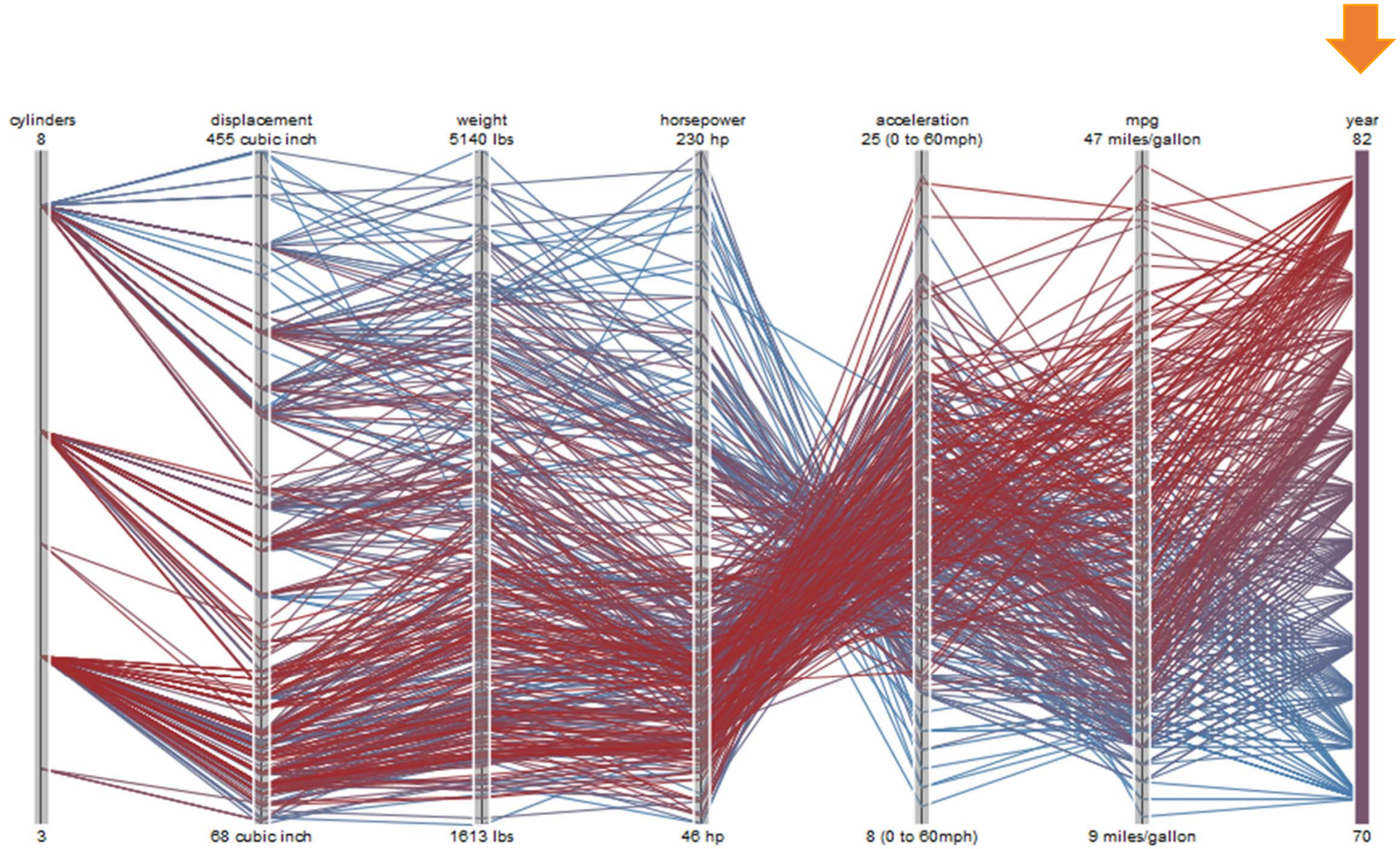
parallel coordinates



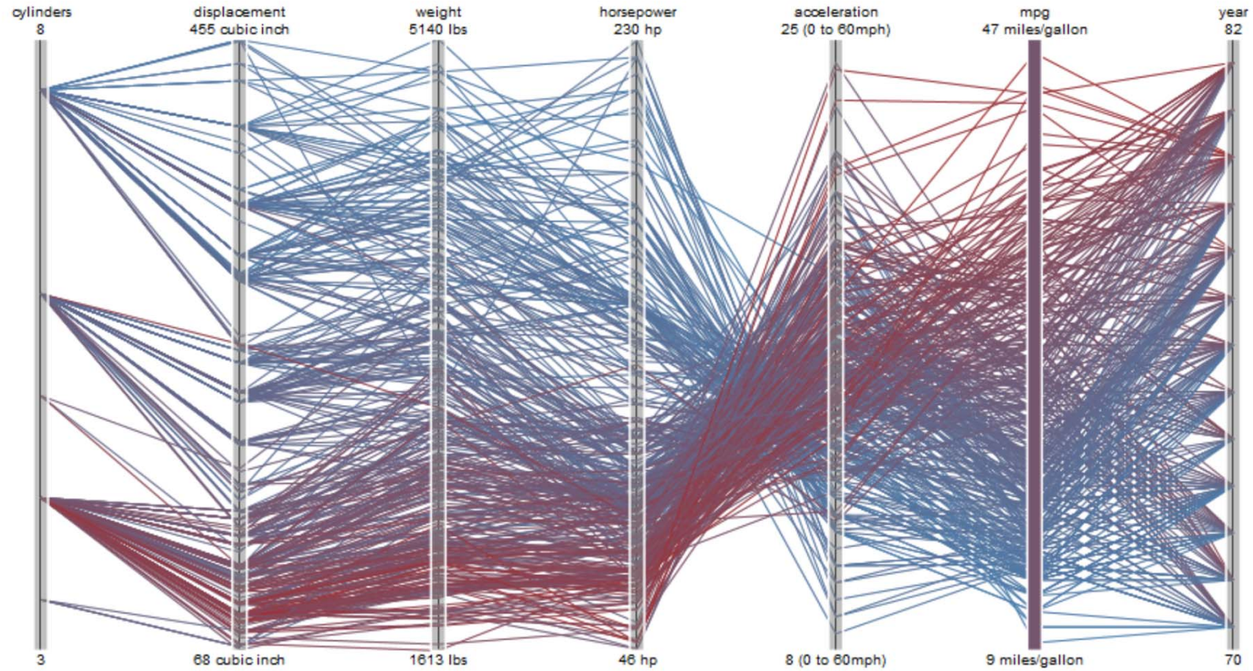
http://homes.cs.washington.edu/~jheer//files/zoo/ex/stats/parallel.html

parallel coordinates

what Visualizing multiple quantitative/ordinal attributes

how Use of parallel axes

- Positive correlation: parallel lines
- Negative correlation: crossing lines



http://homes.cs.washington.edu/~jheer//files/zoo/ex/stats/parallel.html

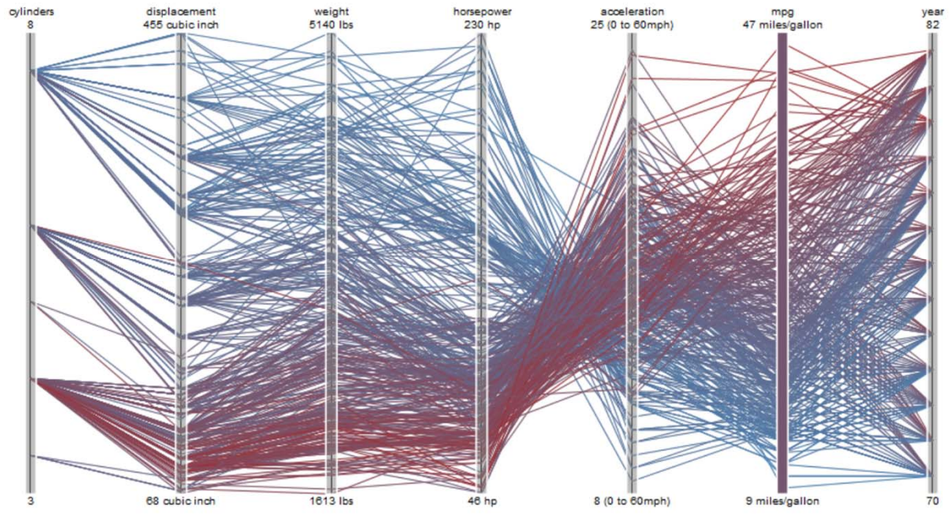
parallel coordinates

why

- Finding correlations
- Identifying ranges of particular attributes; extremes
- Identifying outliers
- Ordering of axes is crucial

scale

- Large number of data points (100s; not 1000s)
- Moderate number of attributes (approx. 12)



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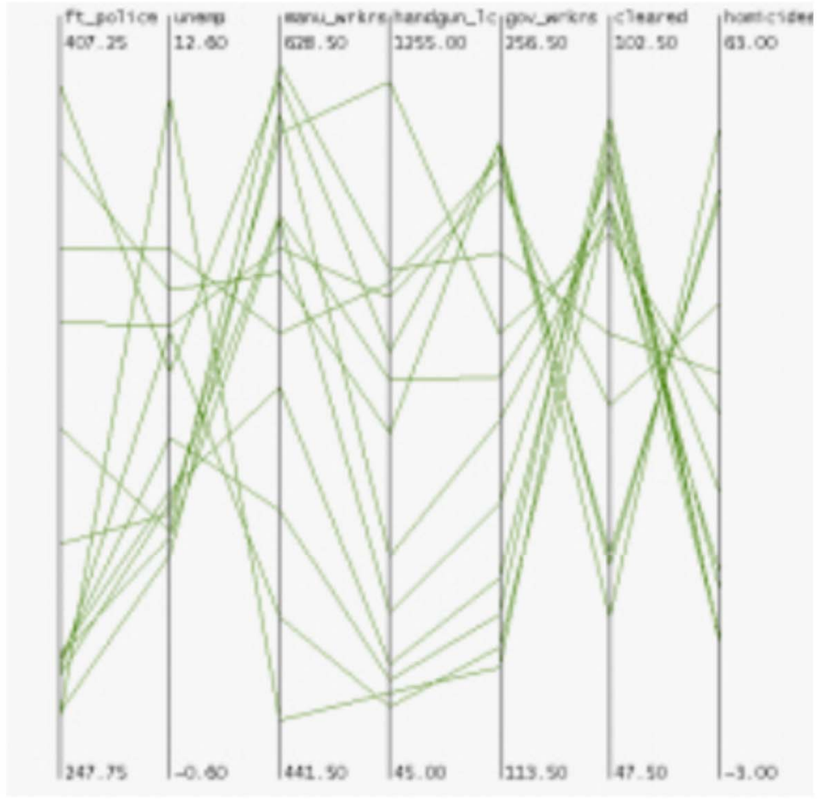
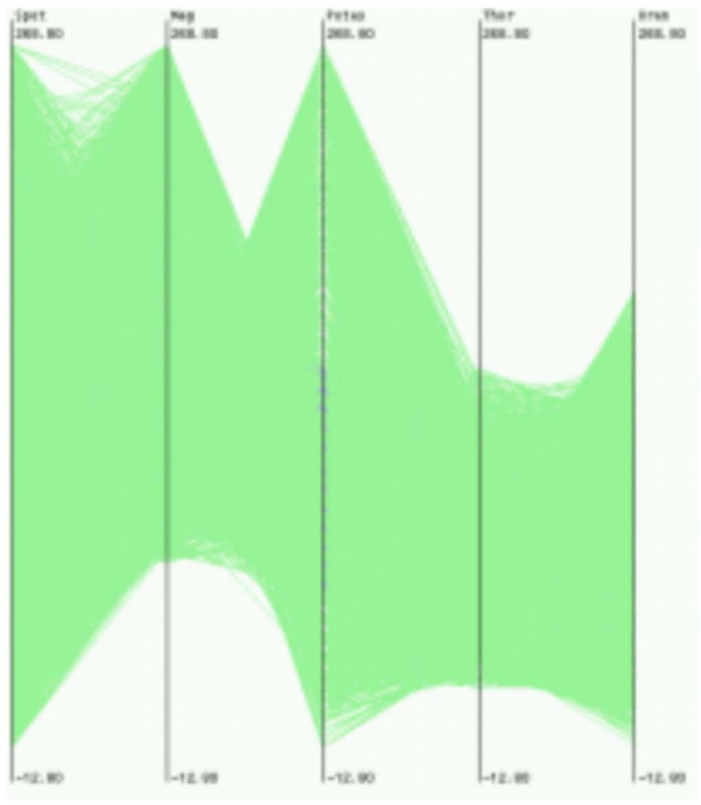
parallel coordinates





Fua et al., 1999
http://dl.acm.org/citation.cfm?id=319355

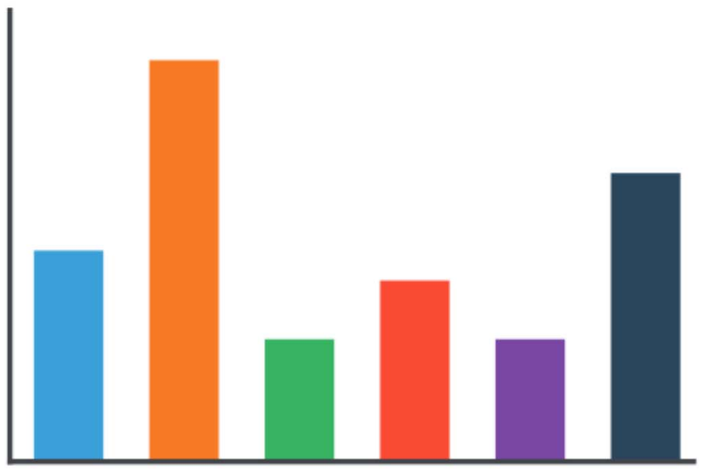
radial axes

radial bar charts

what One categorical attribute; one quantitative value

how Use of radial position (angle) + length

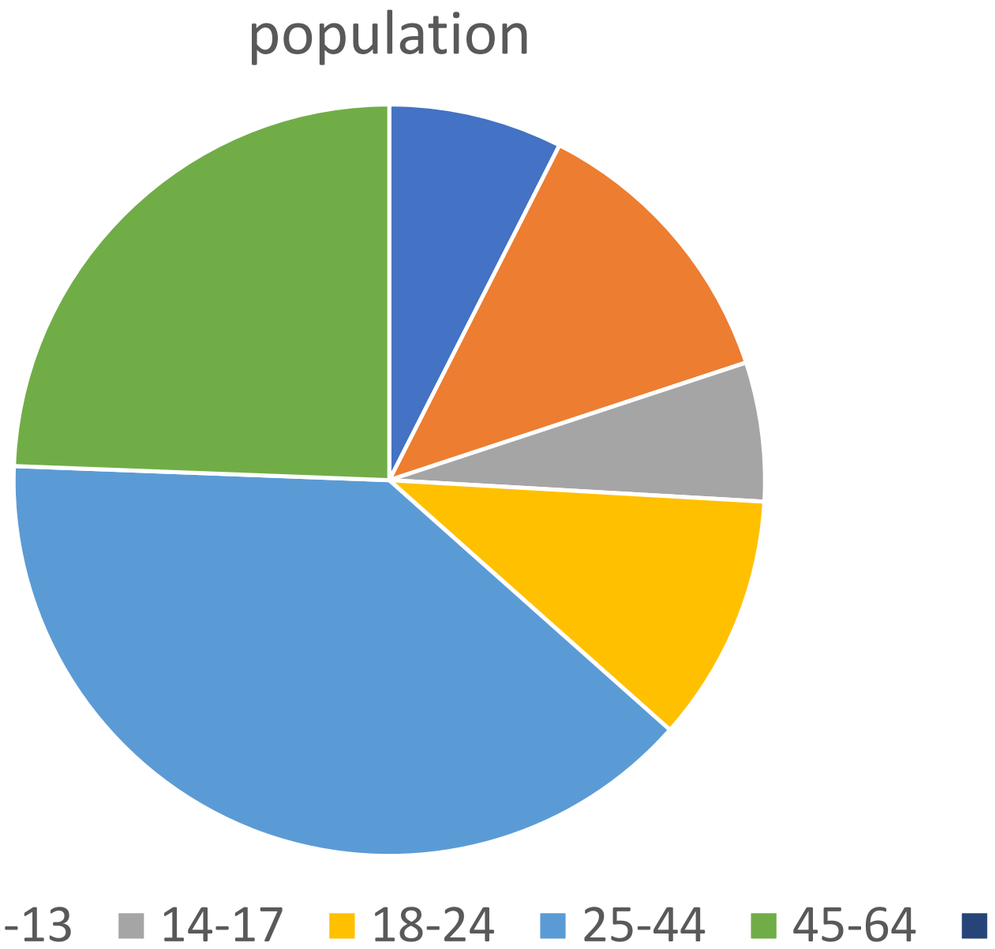
- − Angle as a visual variable is less accurate than rectilinear position
- + Angle is perceived cyclic rather than linear. Good for showing data that has inherent cycles or periodic patterns



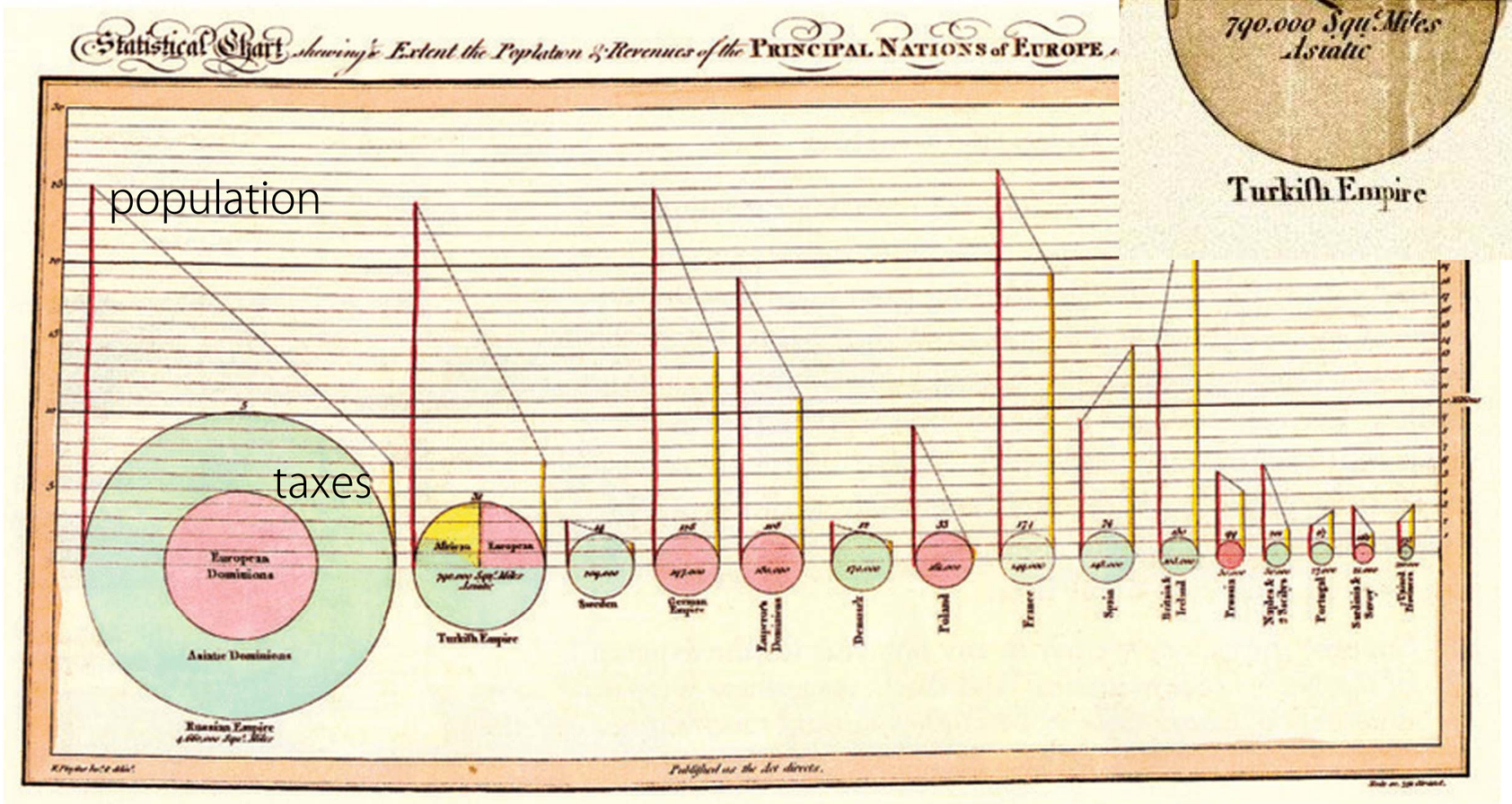
Bar chart

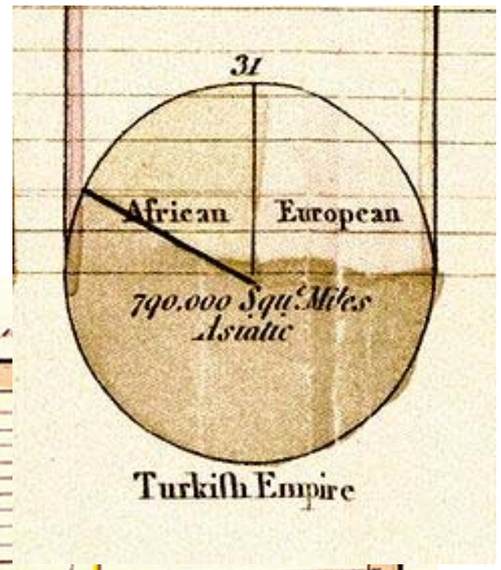
Radial bar chart

pie charts



the first pie charts





1801, William Playfair (Scottish engineer and political economist)

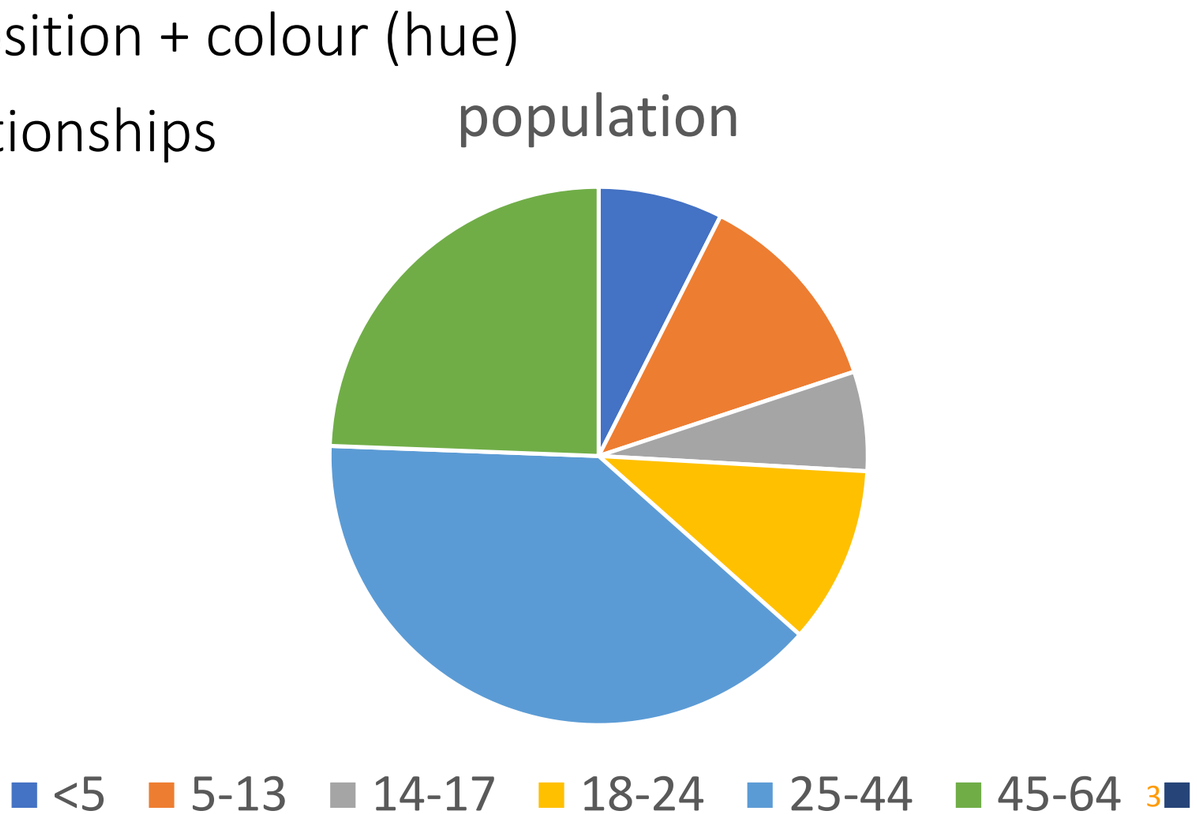
Chart comparing population, taxes and size of European countries

pie charts

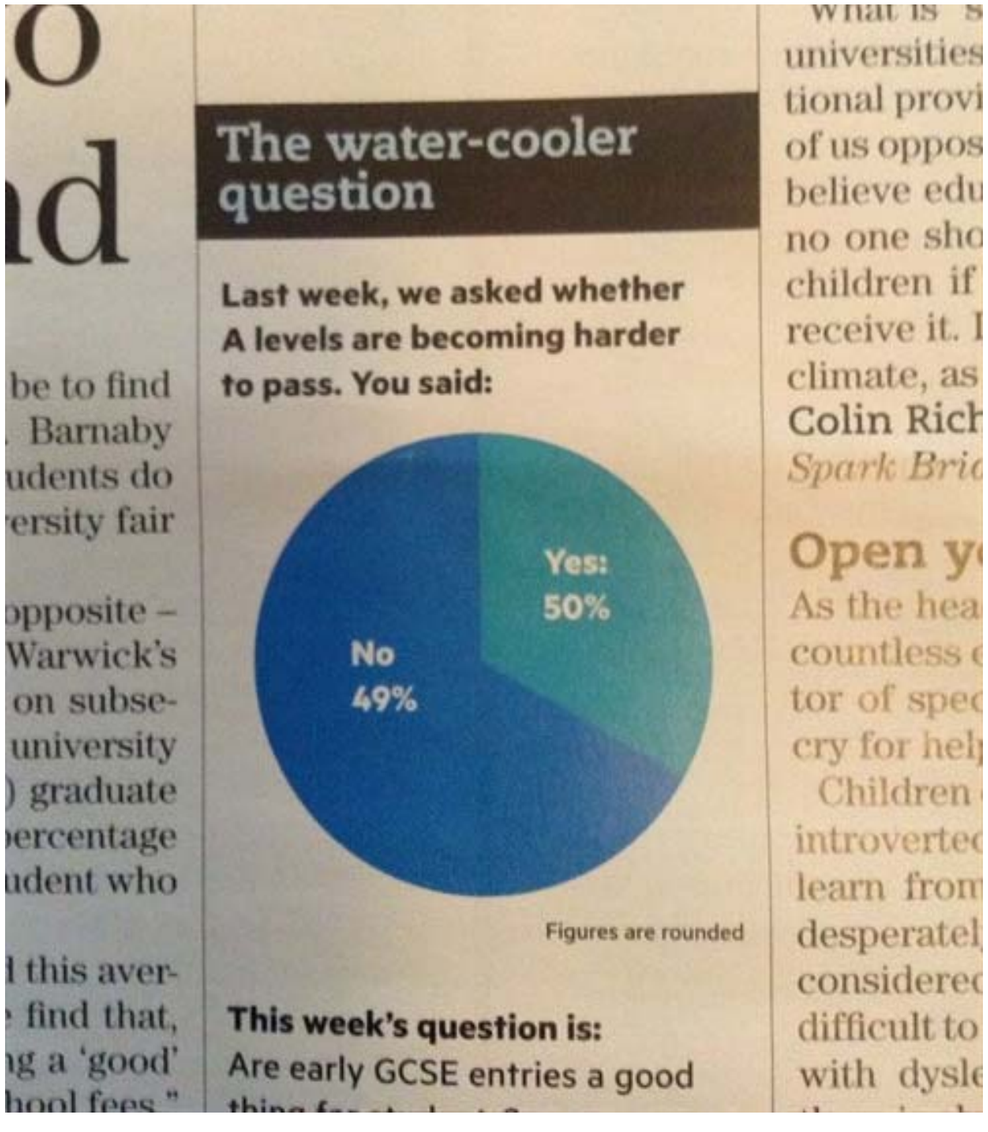
- Area mark in radial layout
- One quantitative attribute → angle size + area size
- One categorical attribute → radial position + colour (hue)

why

- Good for showing part-of-whole relationships



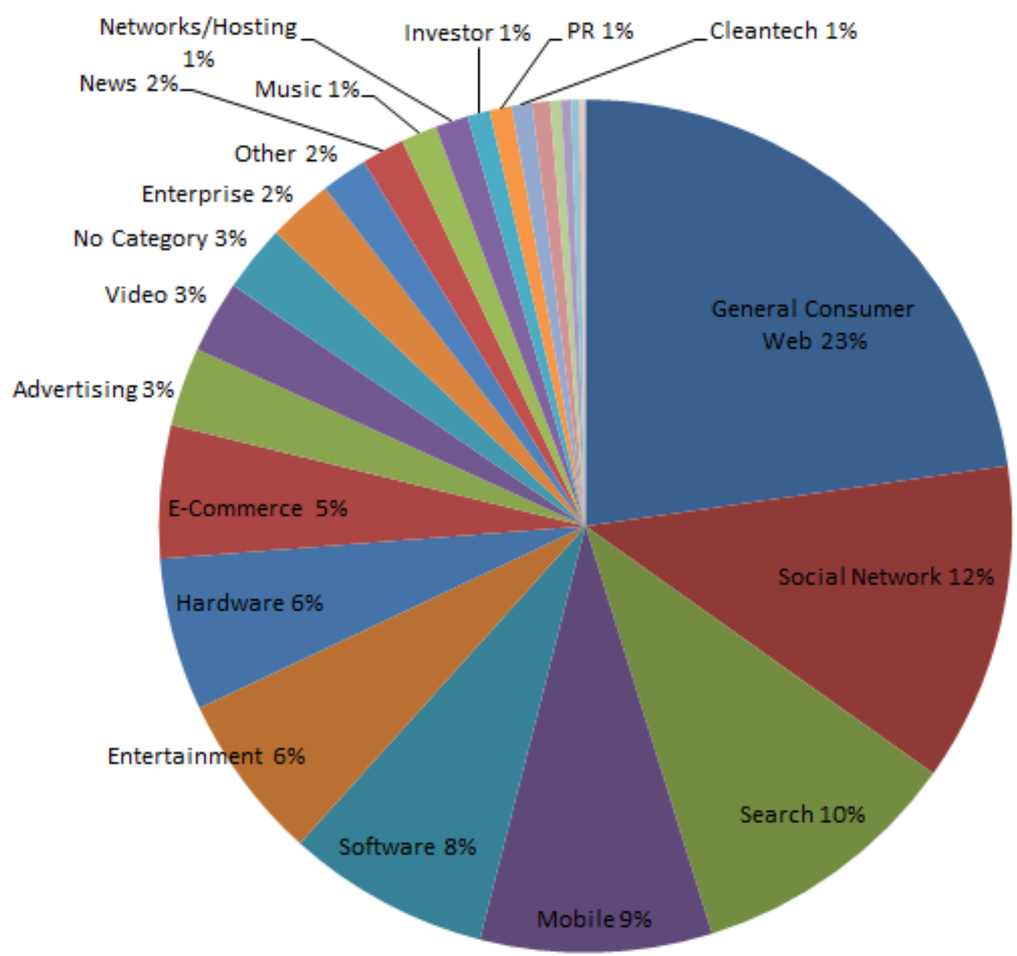
misuse of pie charts



https://www.shinobicontrols.com/blog/6-common-mistakes-with-data-visualization/

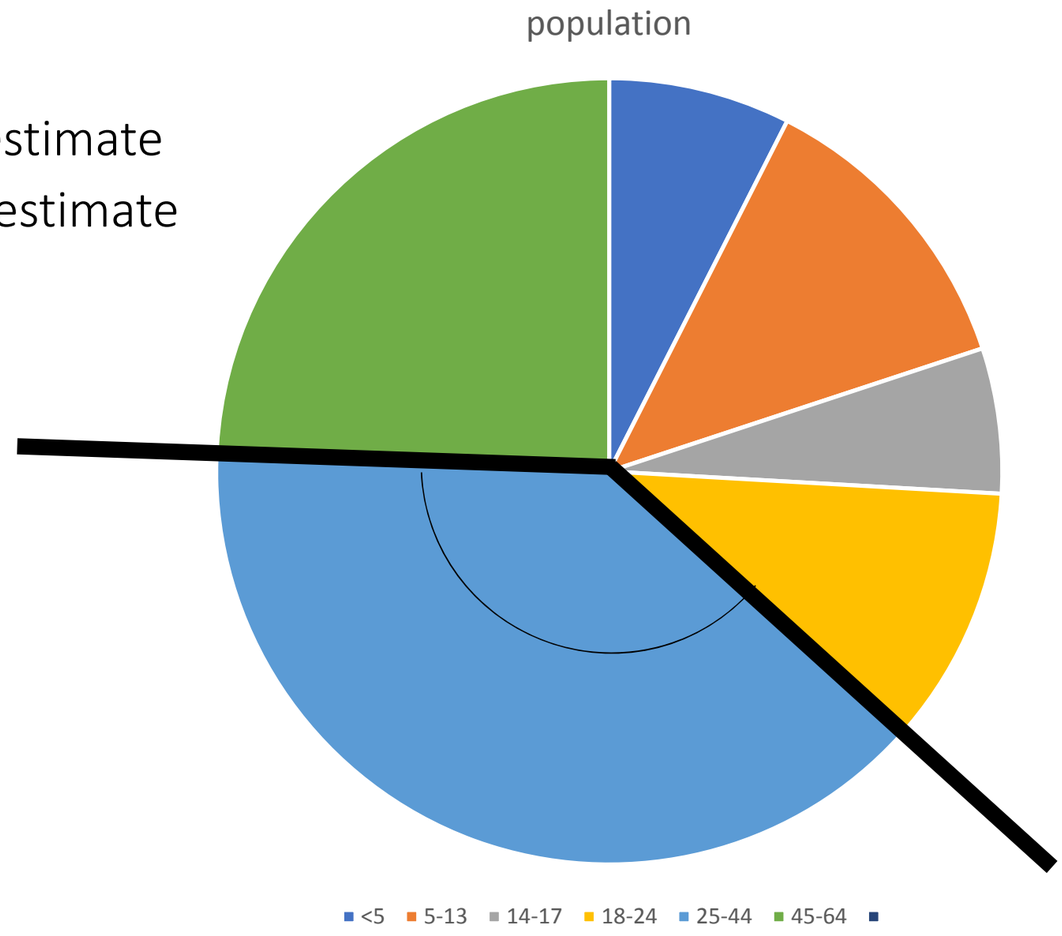
pie charts

scale < 12 categories



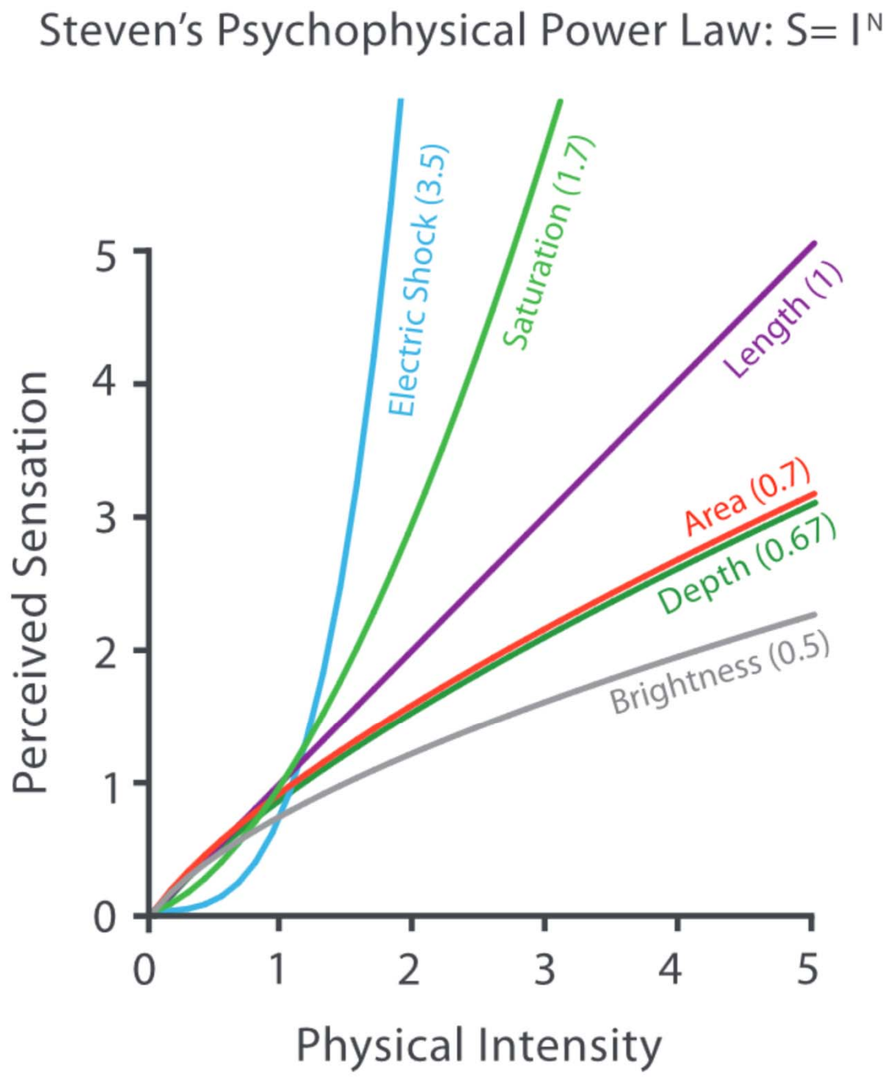
pie charts

- Limitations & issues
  - Angle and arc length not accurate to estimate
  - Sizes of irregular areas are difficult to estimate
  - Interference colour (hue) + area

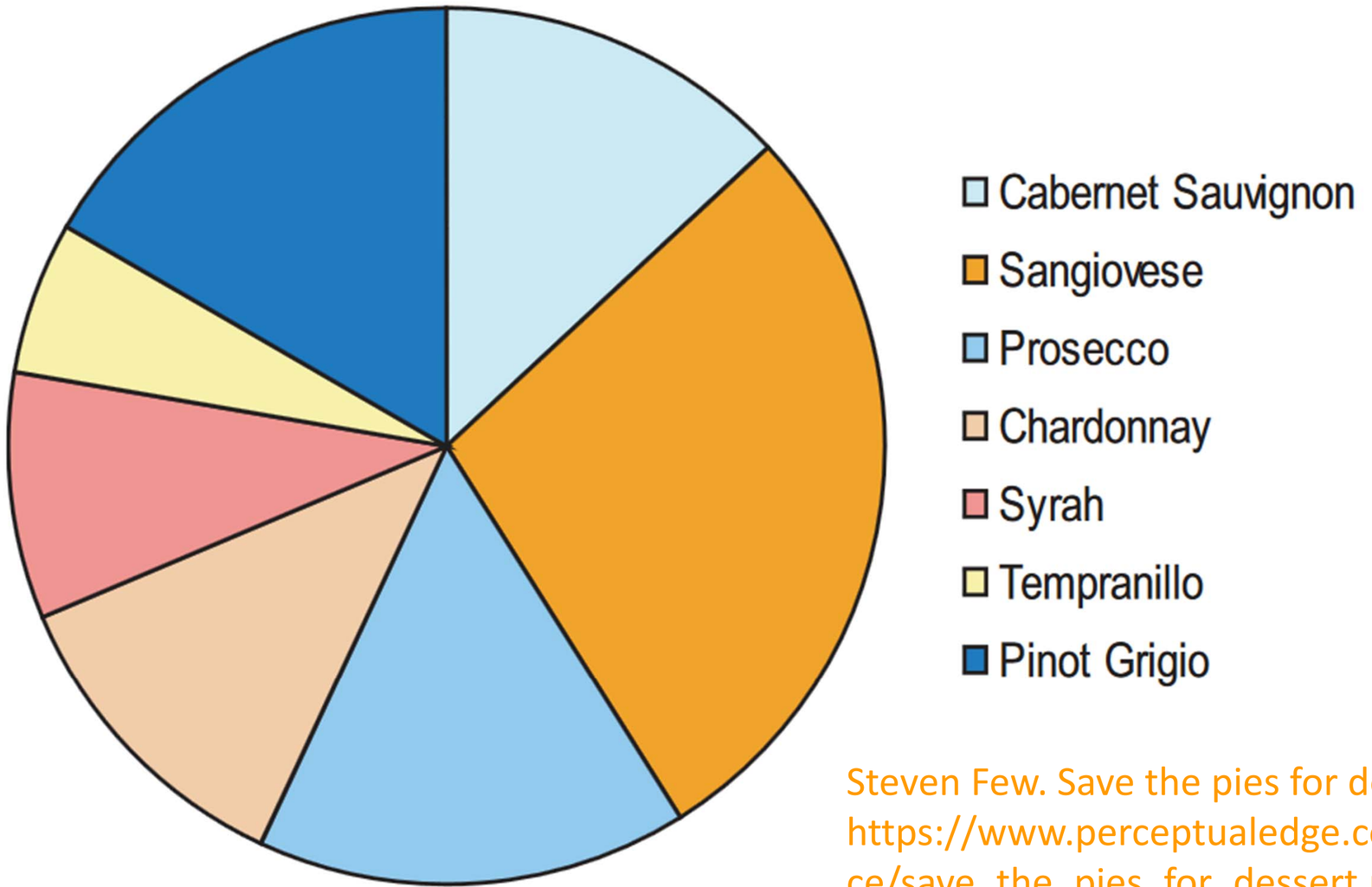


effectiveness principle

- Perceived Sensation (S)
- Physical Intensity (I)

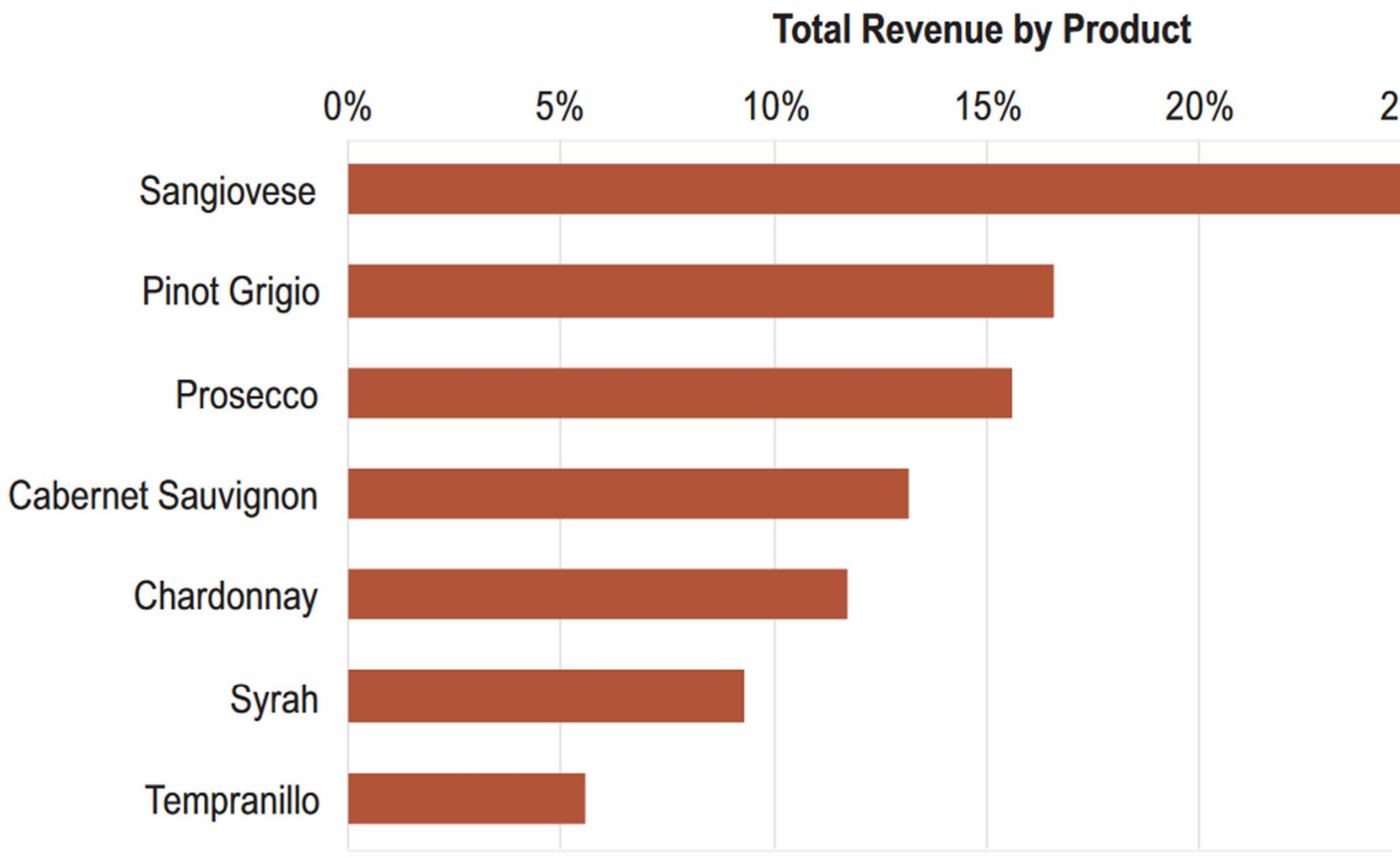


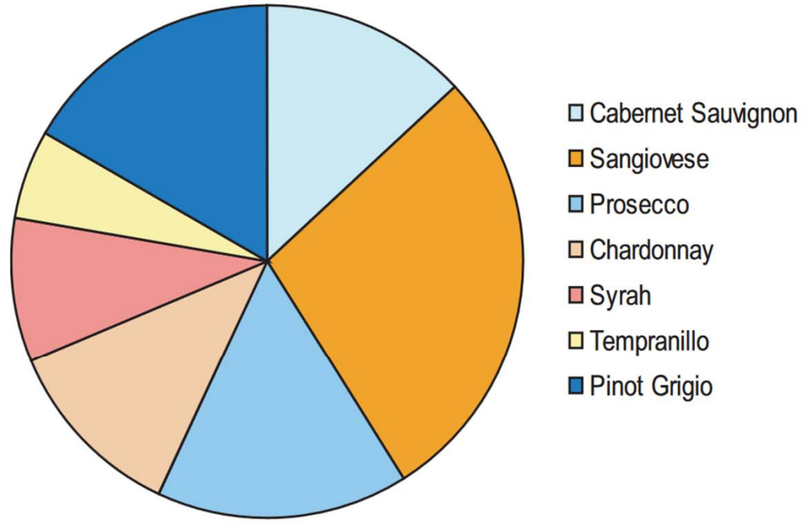
order the slices from largest to smallest



Steven Few. Save the pies for dessert. https://www.perceptualedge.com/articles/visual_business_intelligence/save_the_pies_for_dessert.pdf

order the slices from largest to smallest

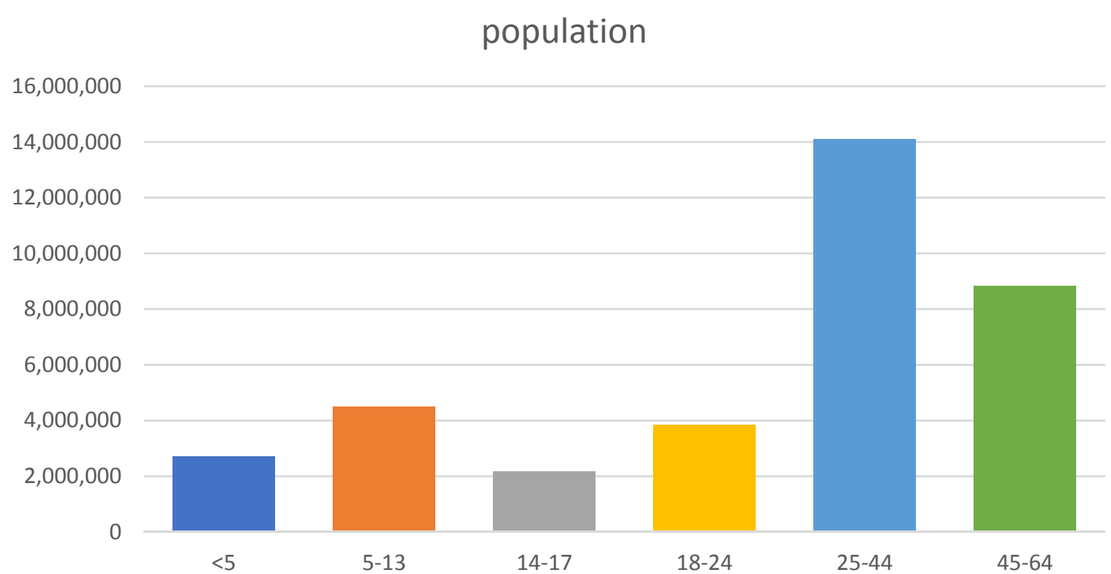


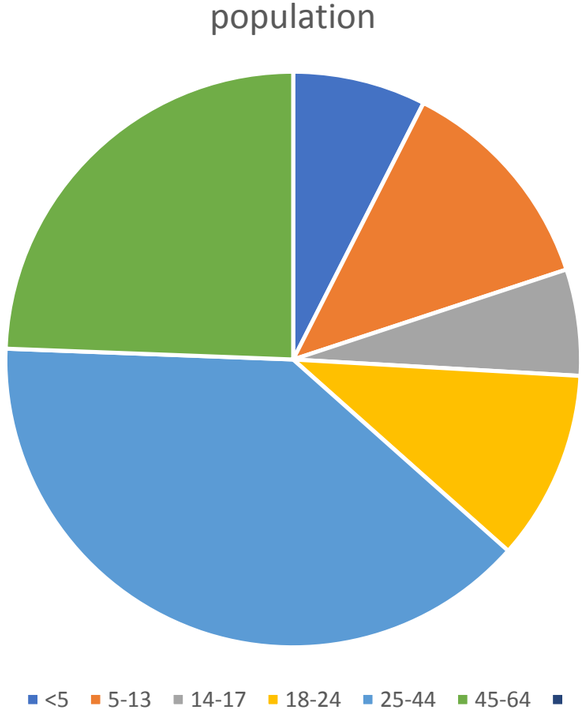


Steven Few. Save the pies for dessert.
https://www.perceptualedge.com/articles/visual_business_intelligence/save_the_pies_for_dessert.pdf

pie charts vs. bar charts

- Pie charts: angle + area judgement
- Bar charts: length judgement





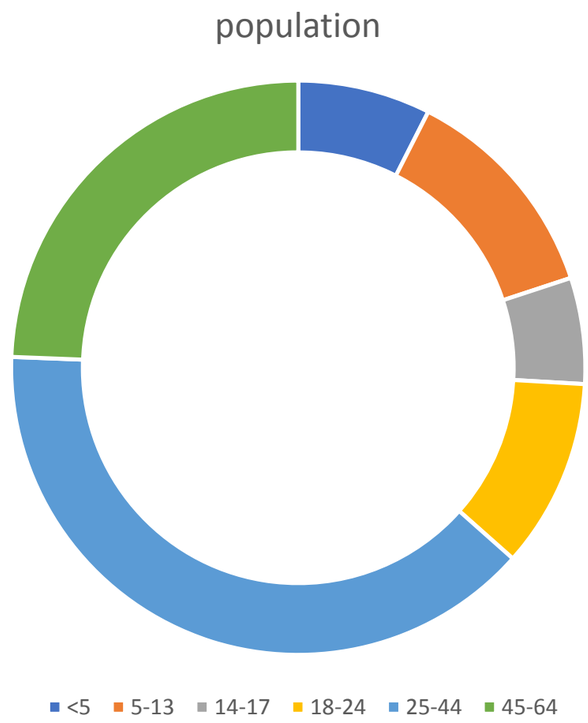
donut charts

what One quantitative attribute; one categorical attribute

how Area mark in radial layout; angle, arc length, area size

why Part-of-whole relationship

scale < 12 categories



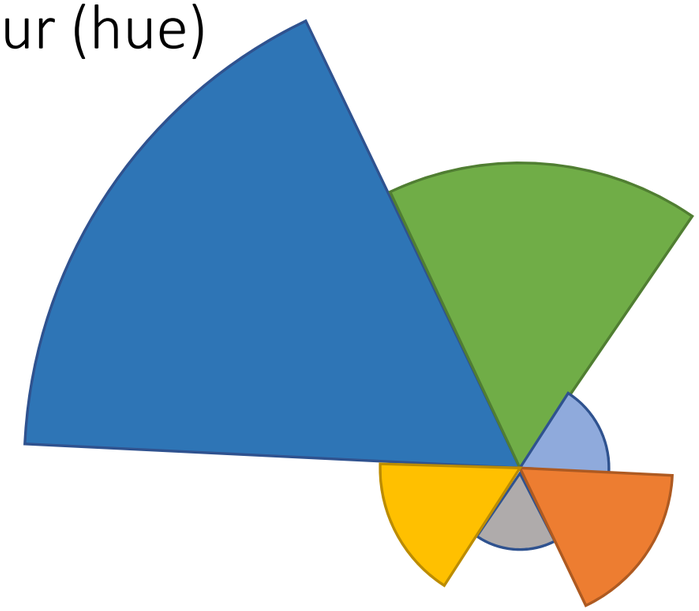
polar area chart

- Area mark in radial layout
- One quantitative attribute → length/area size
- One categorical attribute → radial position + colour (hue)

why Part-whole relationship

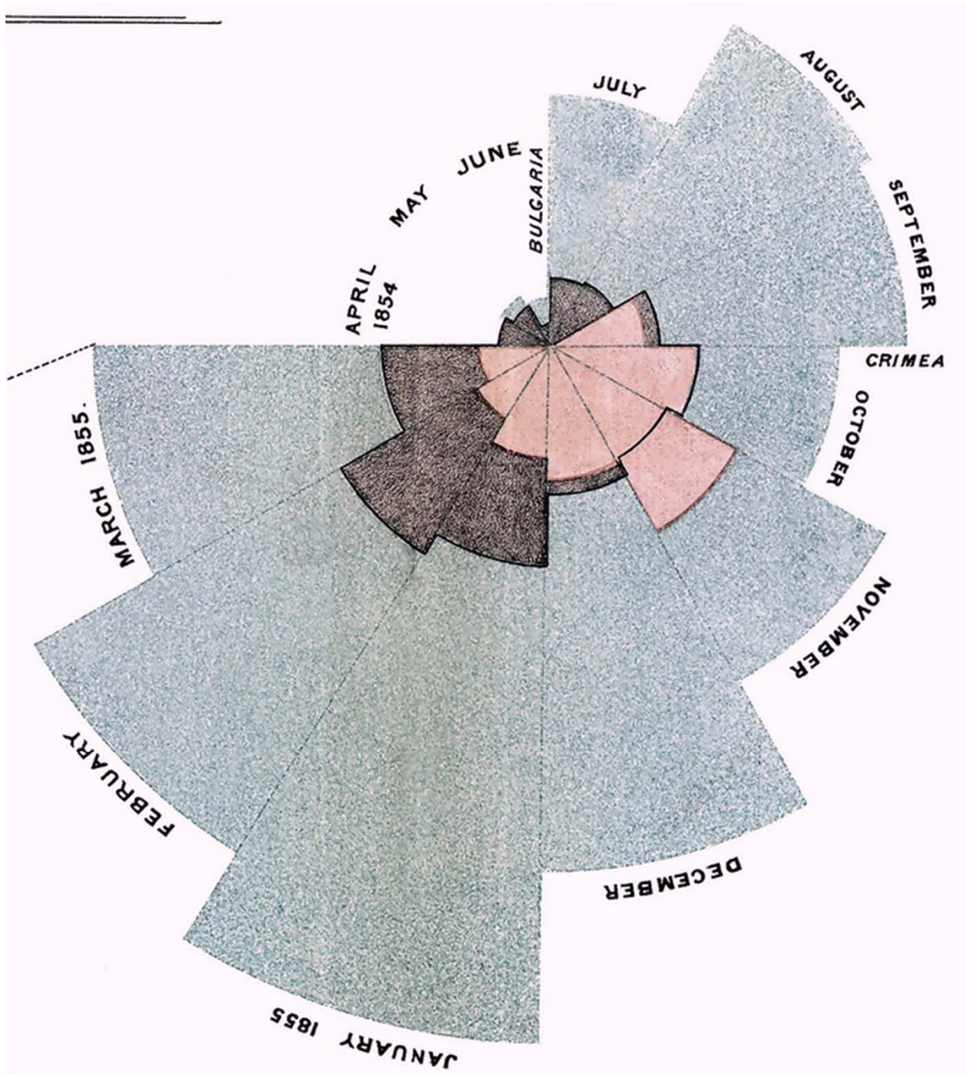
scale < 12 categories

- Closer to bar chart
- We still perceive differences in area



stacked polar area chart

- Wedges = months
- Radius (measured from centre)
  - Death rate
- Colour (hue)
  - Causes of deaths
  - Blue = contagious diseases (e.g., cholera or typhus)
  - Red = wounds
  - Black = other causes
- Area increases exponentially with radius
  - Inaccurate perception of data

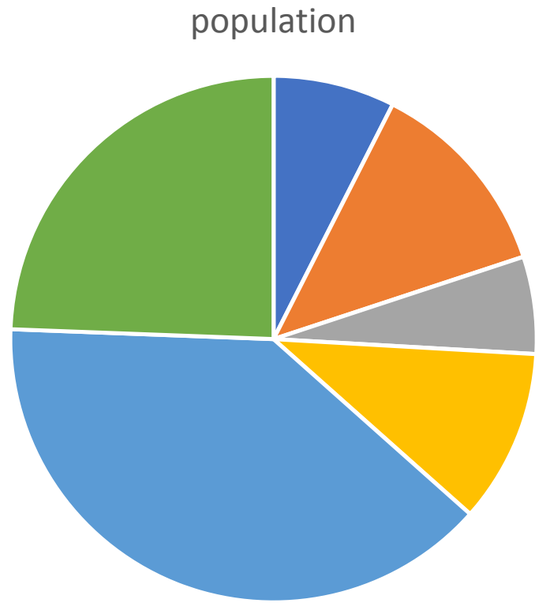


Florence Nightingale, 1856

http://www.datascope.be/sog/SOG-Chapter5.pdf

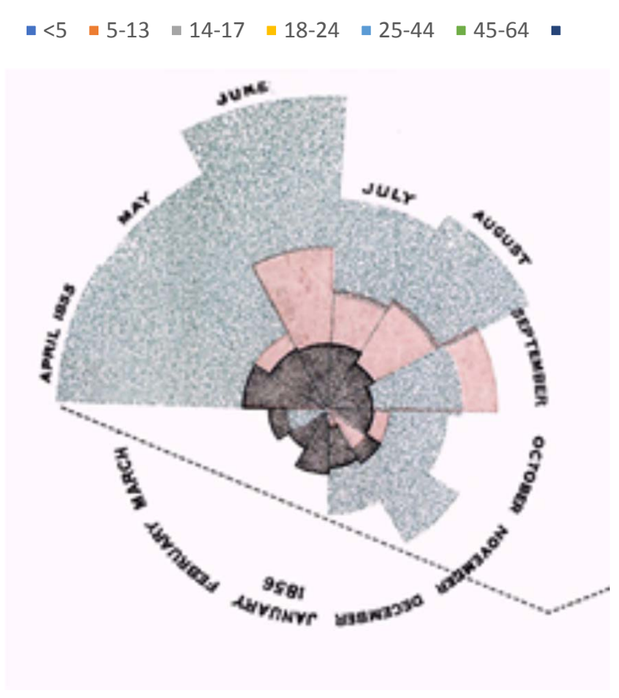
pie charts & polar area charts: problems

- Angle less accurate than length
- Area size difficult to judge or even misleading
- Interaction between colour (hue) & area

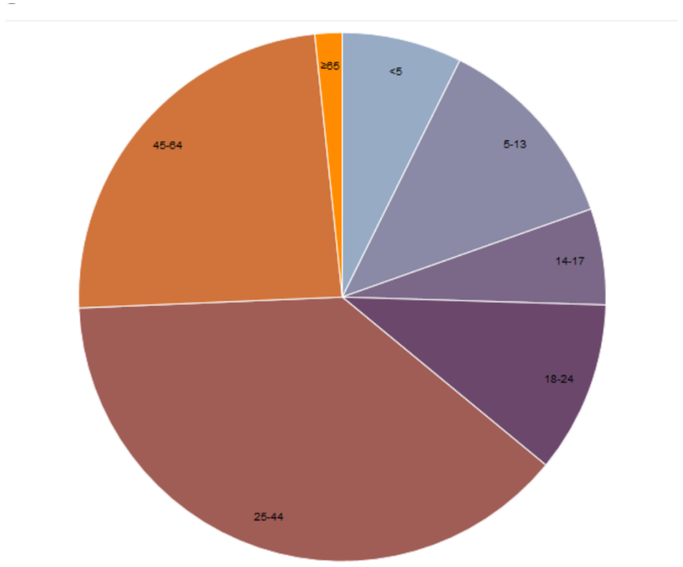


- In case of polar area chart
  - Changes in radius increase area size in a non-linear way

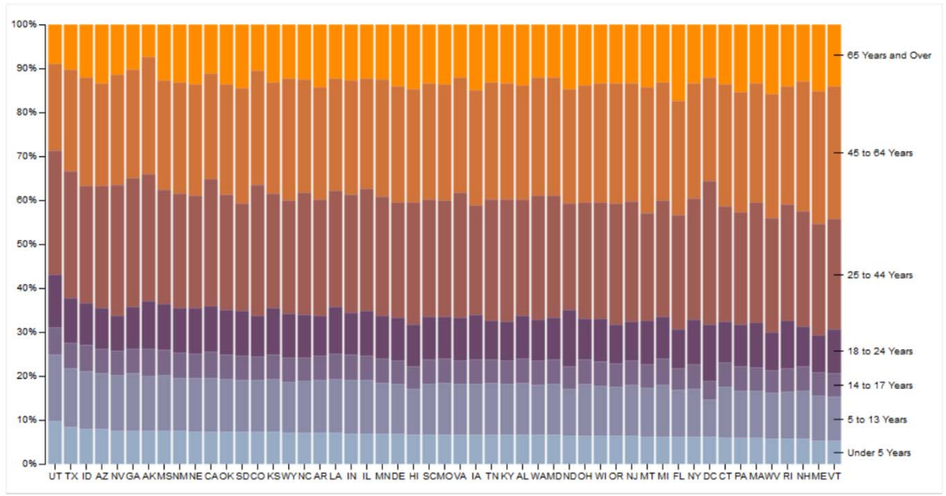
- Problems with space efficiency



space efficiency: pie charts vs. normalized bar chart



https://bl.ocks.org/mbostock/3887235

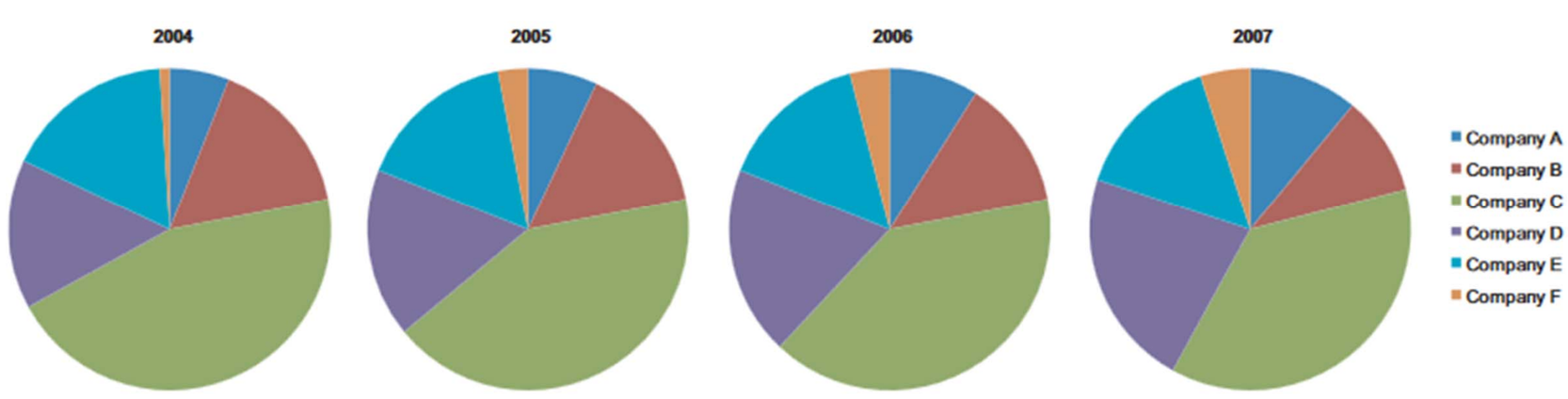


https://bl.ocks.org/mbostock/3886394

comparing multiple pie charts

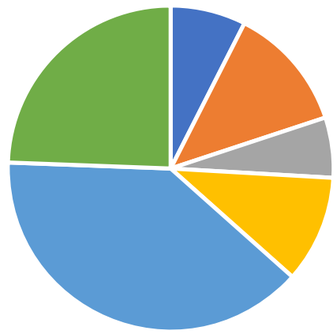
"The only worse design than a pie chart is several of them, for then the viewer is asked to compare quantities located in spatial disarray both within and between pies."

Edward Tufte, The Visual Display of Quantitative Information



Steven Few.
http://www.perceptualedge.com/articles/visual_business_intelligence/save_the_pies_for_dessert.pdf

when a pie chart might be ok

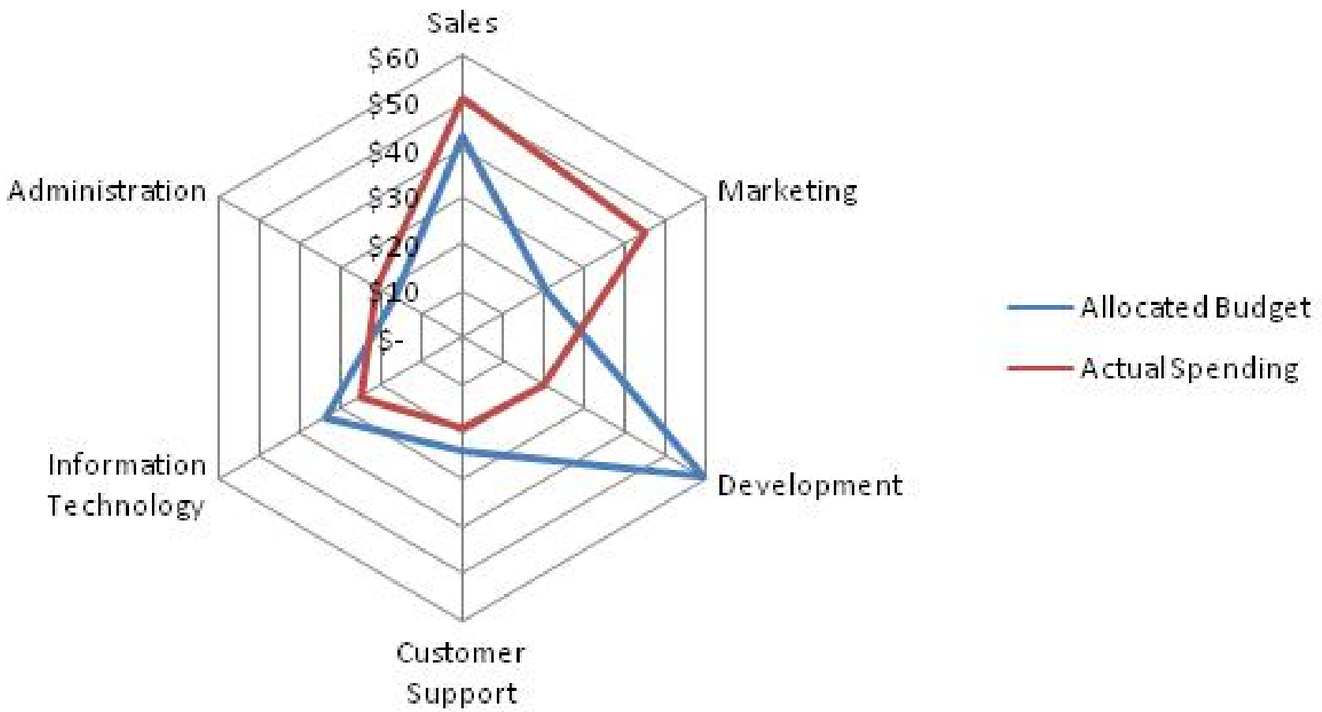


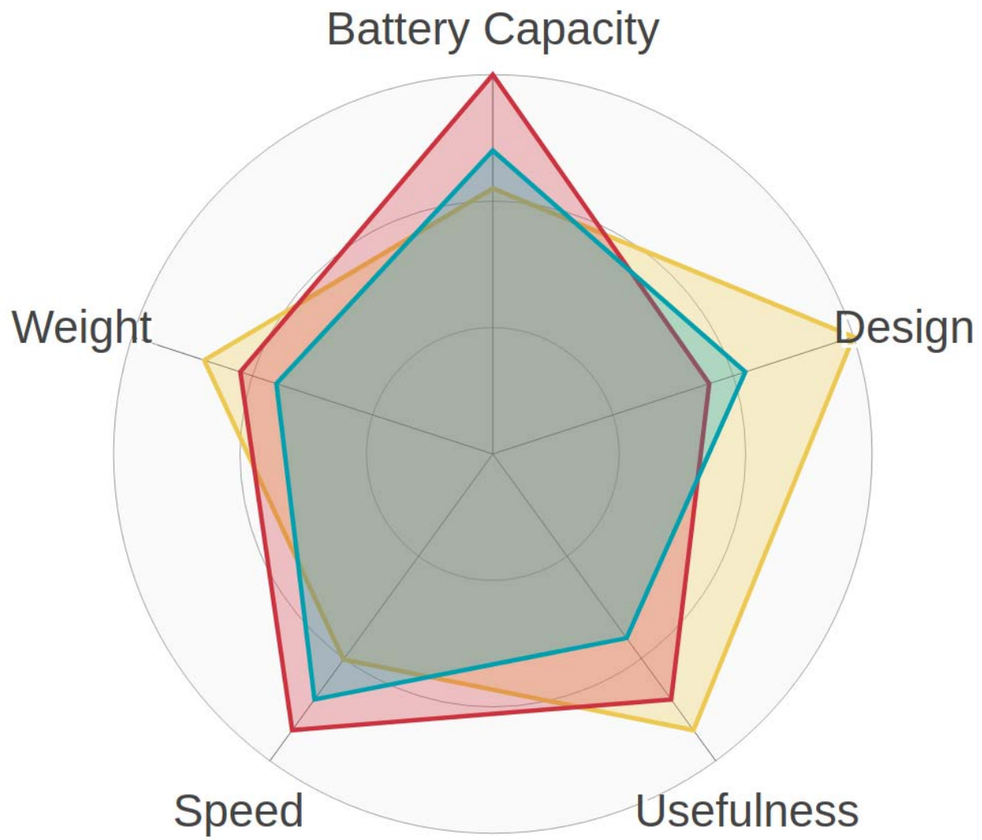
- To show a “parts of a whole” relationship
- When dealing with few categorical attribute levels
- When relative judgement is more important than accuracy
- When there are no important subtle differences in the data

→ All of these points should apply!

radar chart/spider chart

- Parallel coordinates going radial





radar chart/spider chart

- Side-by-side views

next week

- More about tasks visualisation can (and should) support
- Visualisation design guidelines
- Reading: Munzner Chpt. 6: Rules of Thumb
- Monday: Tableau Tutorial II