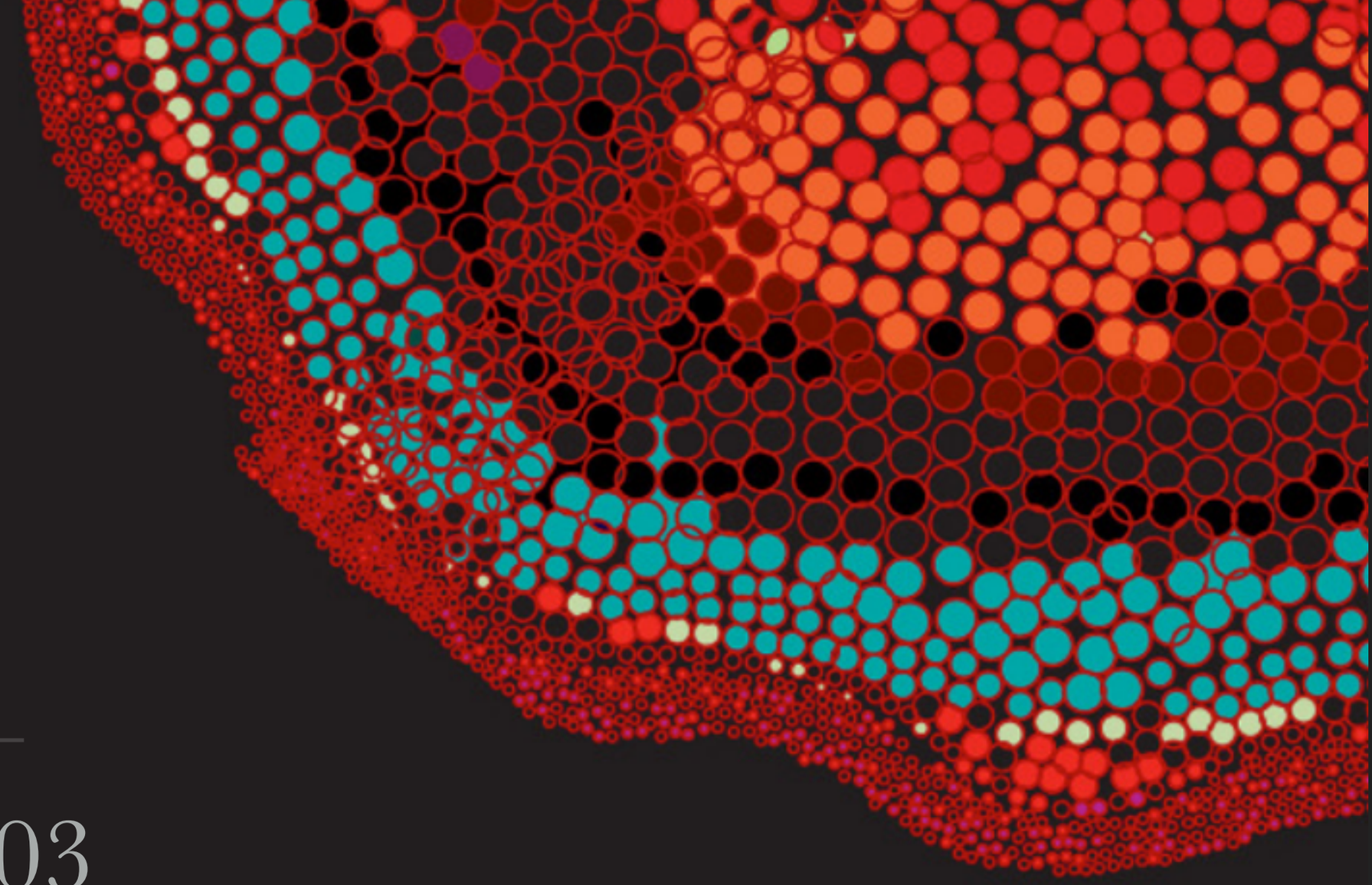


LECTURE 03

Classic Visualizations

The Big Picture

task
questions, goals
assumptions

data
physical data type
conceptual data type

domain
metadata
semantics
conventions

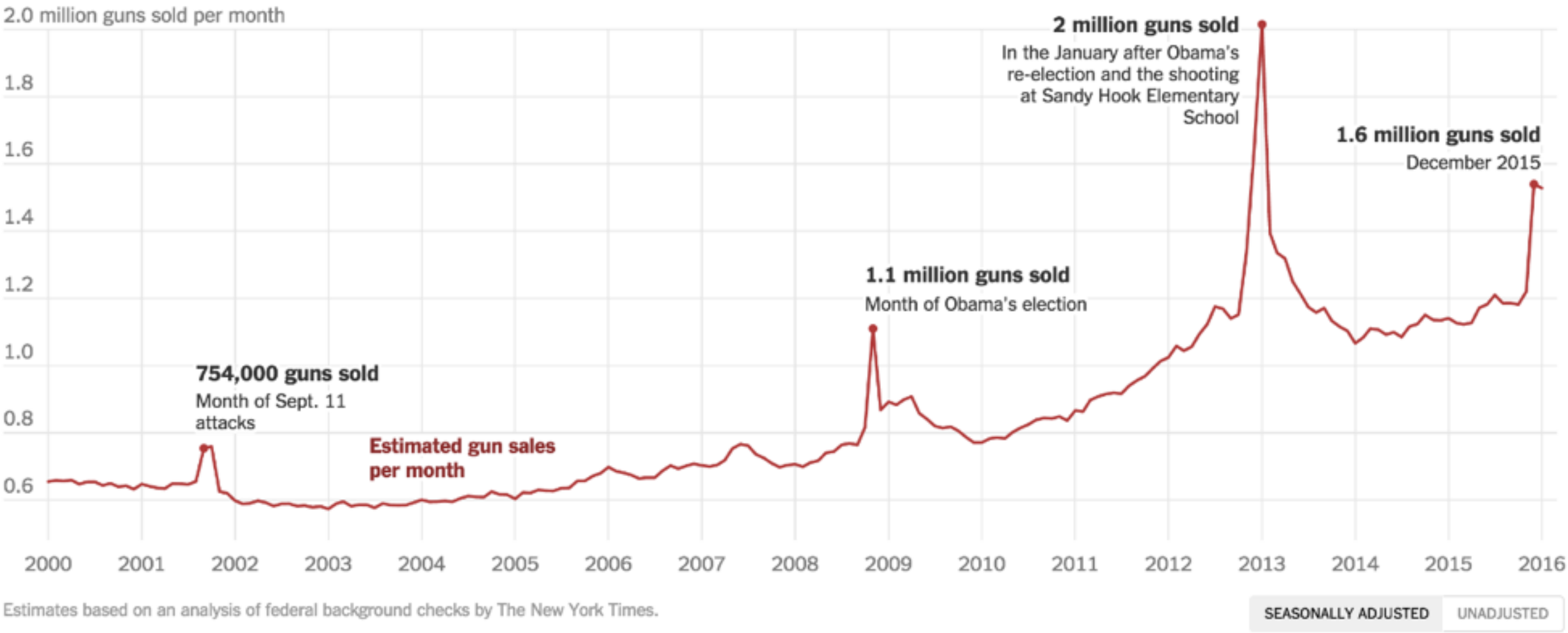
processing
algorithms

mapping
visual encoding

image
visual channel
graphical marks

Gun Sales Soar After Obama Calls for New Restrictions

By GREGOR AISCH and JOSH KELLER UPDATED February 3, 2016



source: https://medium.com/@karlsluis/before-tufte-there-was-bertin-63af71ceaa62

Position (x 2)

Size

Value

Texture

Color

Orientation

Shape

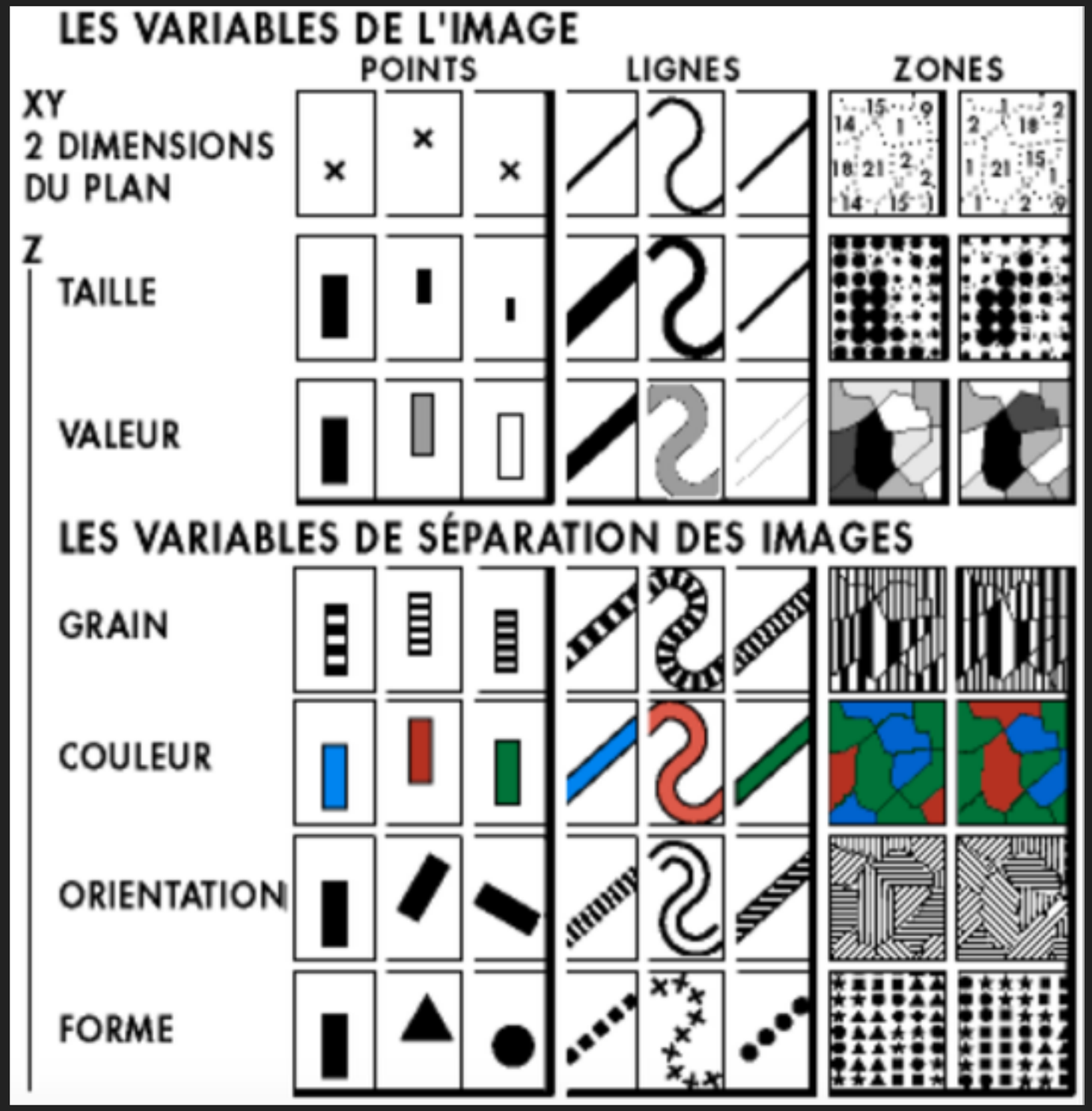
Transparency

Blur / Focus ...

Length

Area

Volume



Choosing Visual Encodings

- N data attributes, K visual encodings

  -> pick the 'best' encoding among a combinatorial set

- Principle of Consistency
  - The properties of visual variables should match the properties of the data
- Principle of Importance Ordering
  - The most important information should be encoded in the most effective way

Bertin's "Levels of Organization"

Position	N	O	Q
Size	N	O	Q
Value	N	O	Q
Texture	N	O	
Color	N		
Orientation	N		
Shape	N		

Nominal

Ordinal

Quantitative

Note: **Q** ⊂ **O** ⊂ **N**

[Bertin, 1967]

Design Criteria

- Expressiveness 表达性
  - Visually express all the facts in the set of data and only the facts in the data Tell the truth and nothing but the truth!
- Effectiveness 有效性
  - Well deliver the information

Use encodings that people decode better!

[Mackinlay 86]

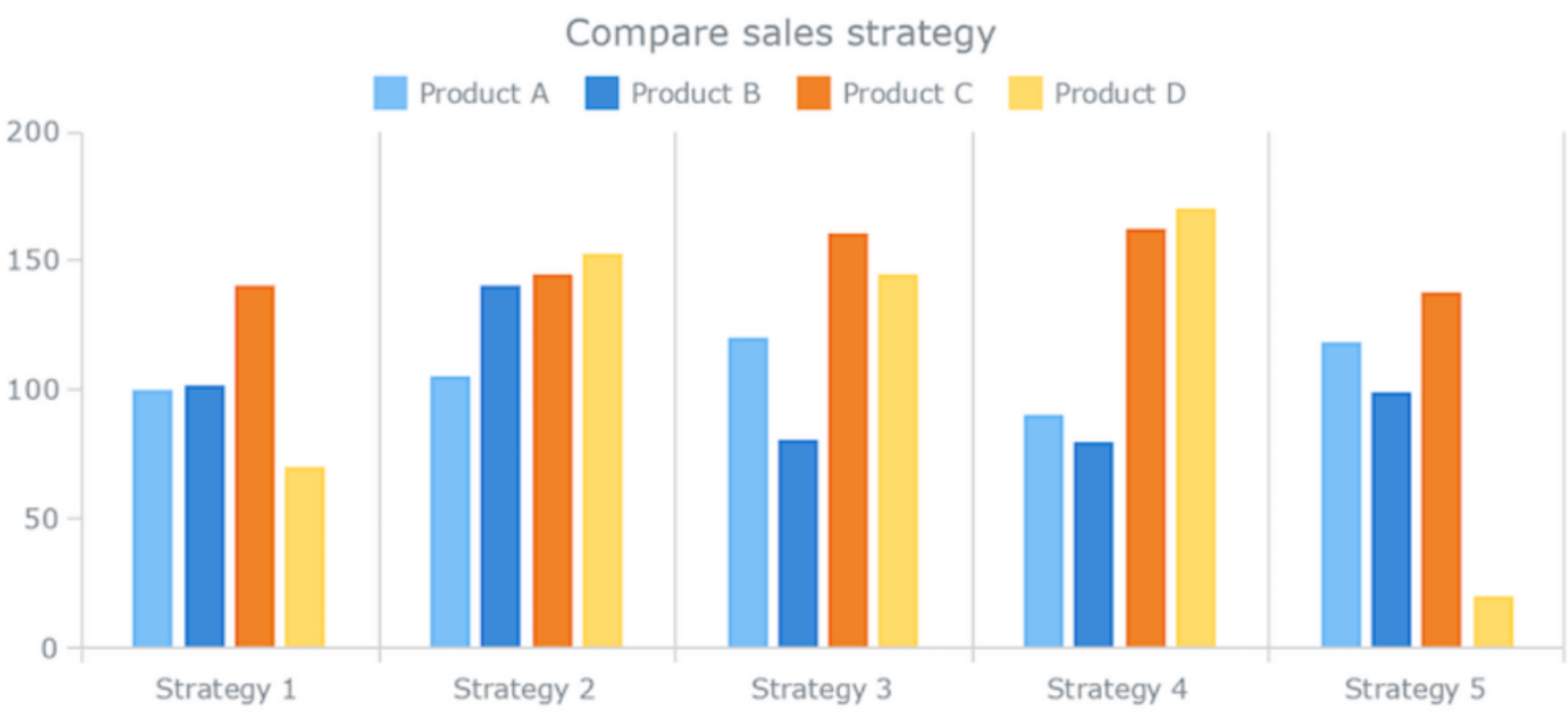
Effectiveness Rankings [Mackinlay 86]

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Value)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

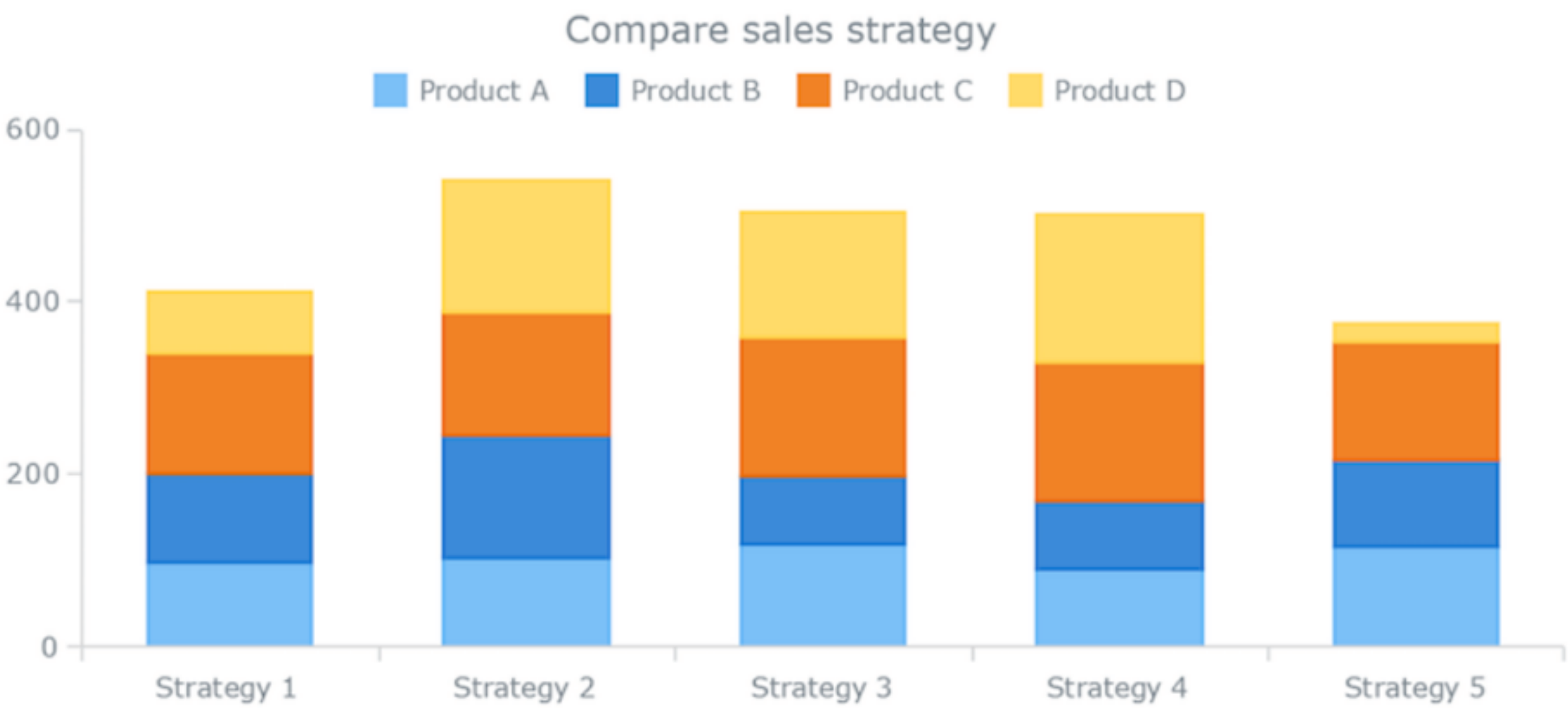
Bar Chart

Single-series Bar Chart

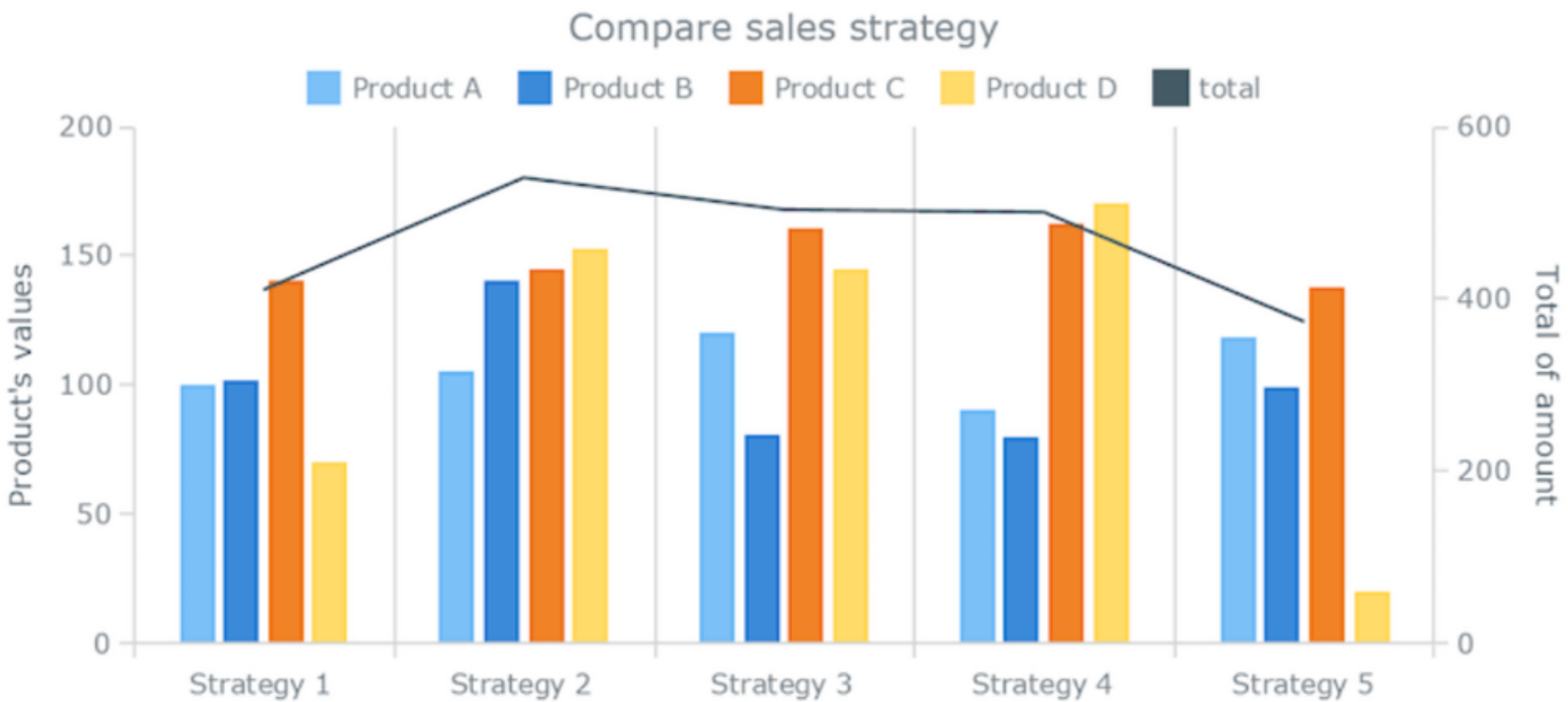
Multi-series Bar Chart



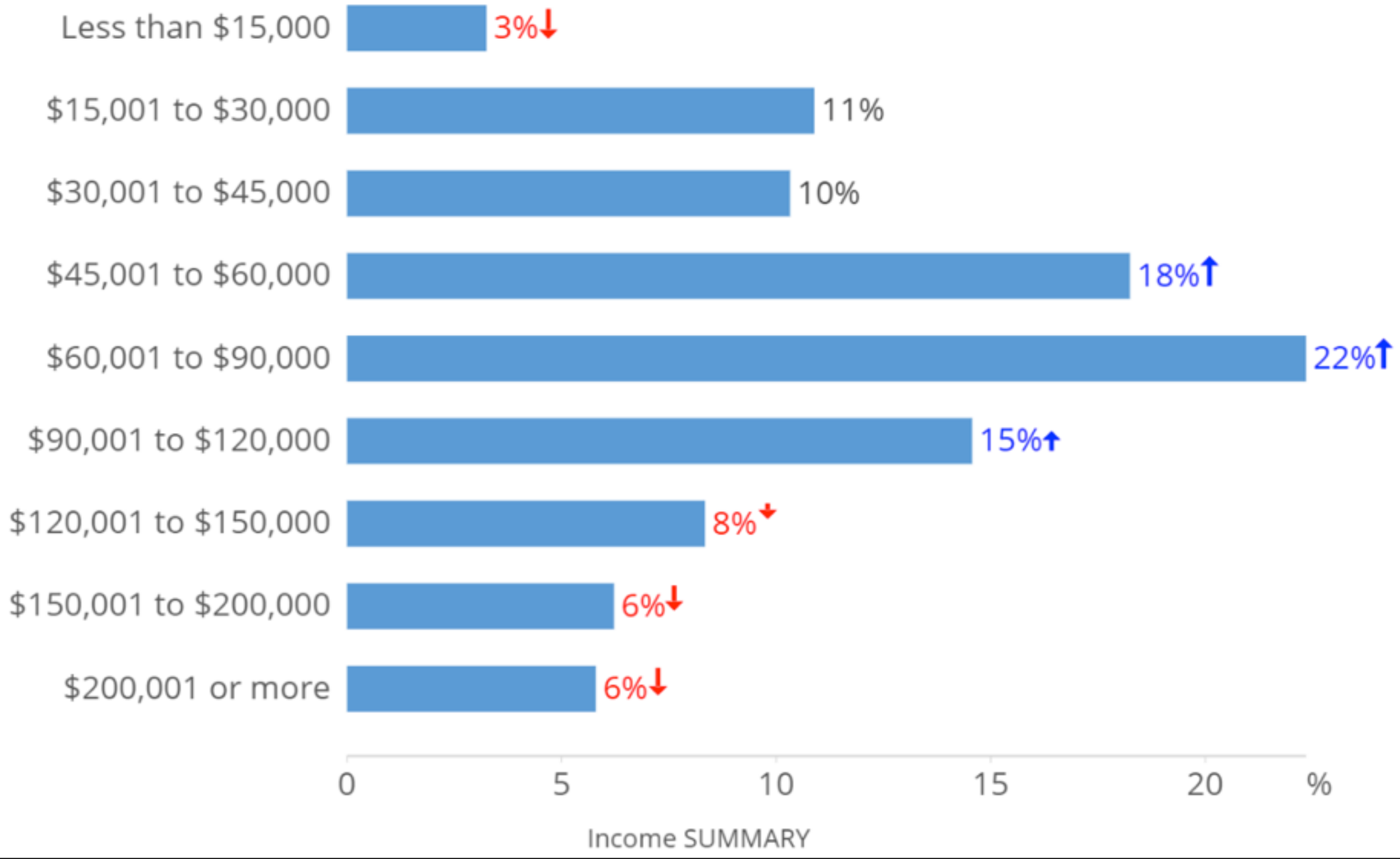
Stacked Bar Chart



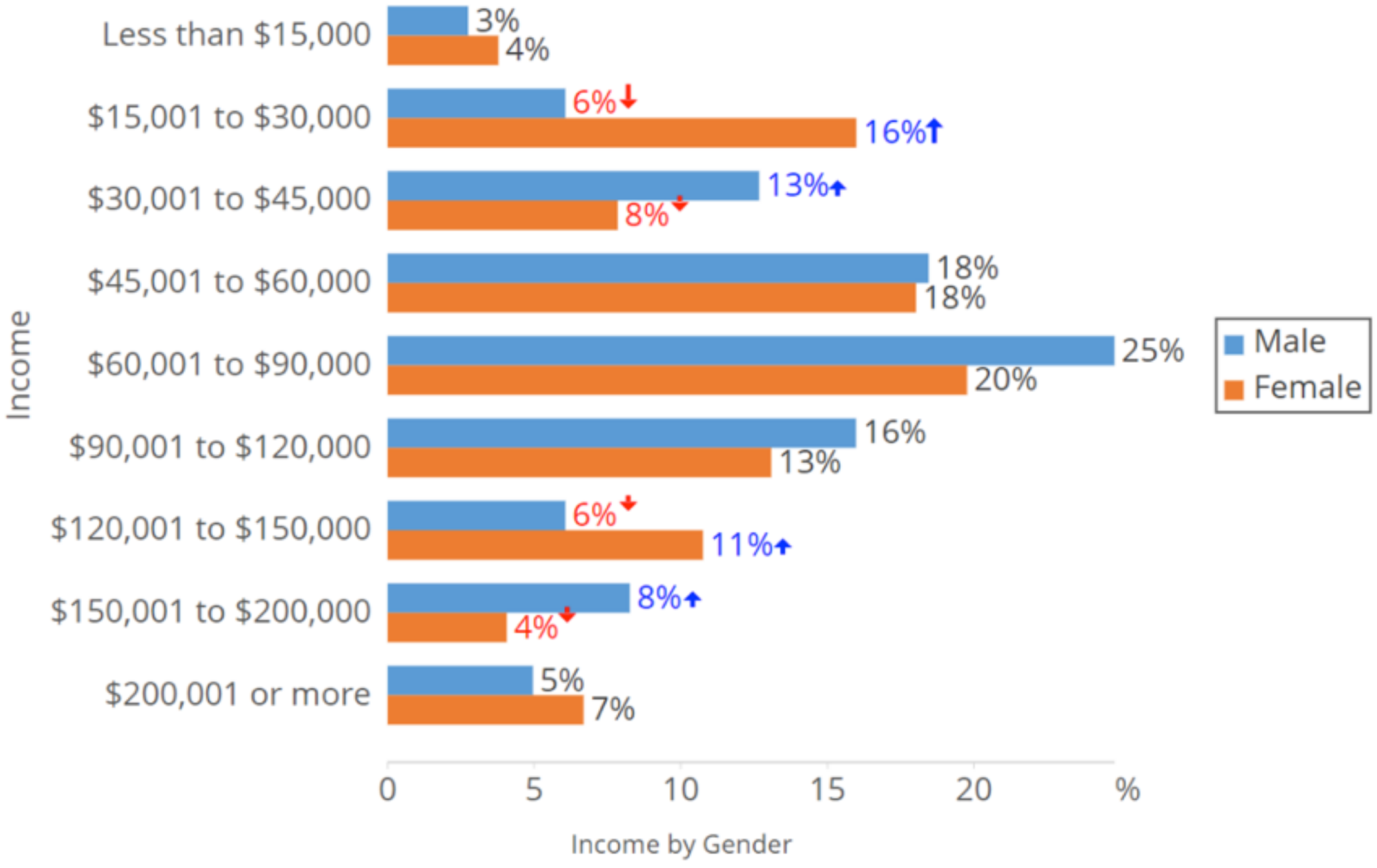
Dual Bar Chart



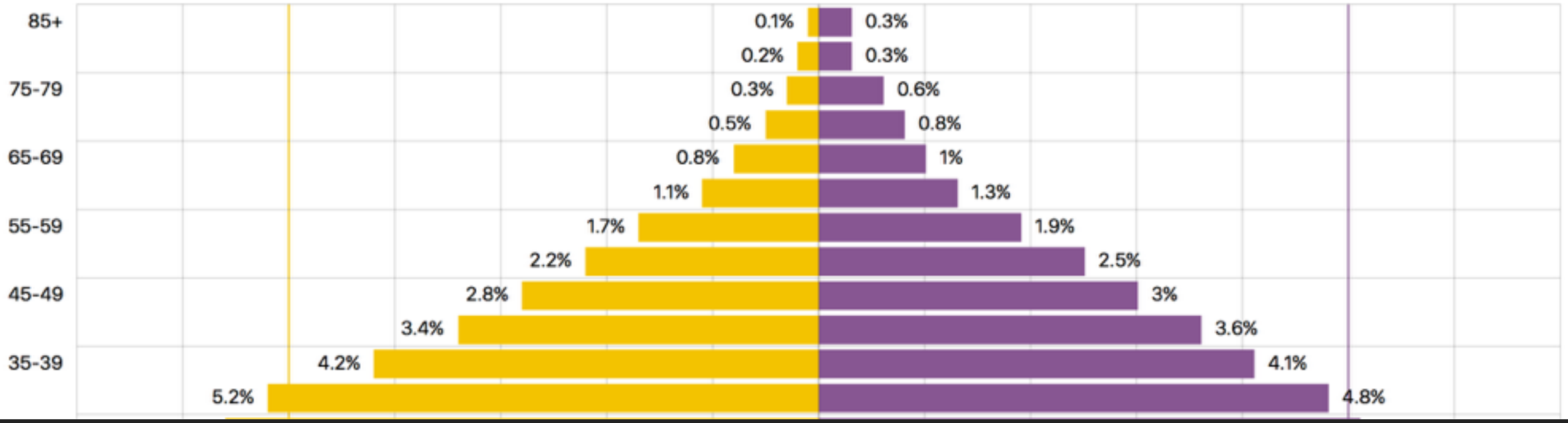
Horizontal Bar Chart



Horizontal * Stacked Bar Chart

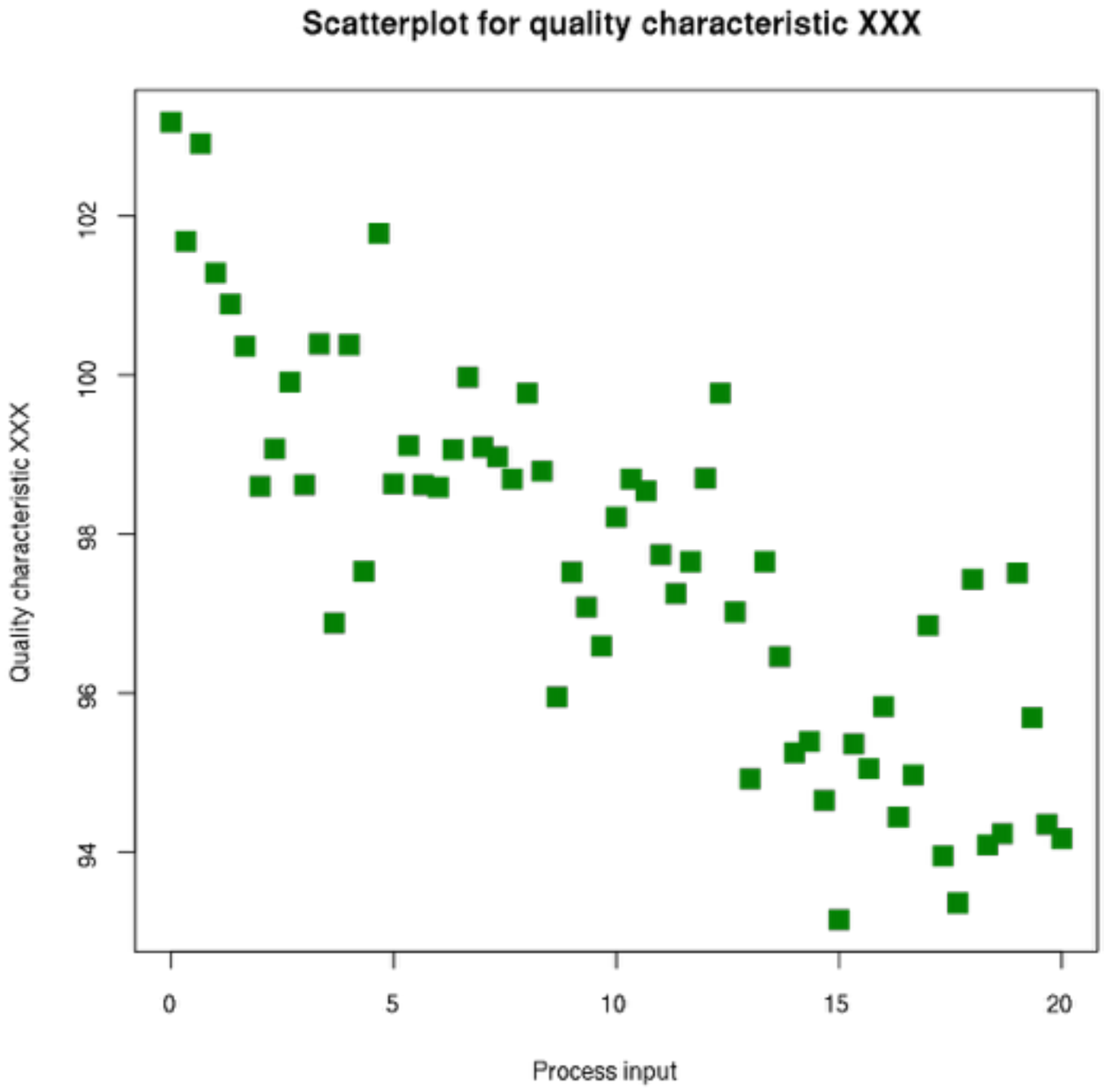


Negative Bar Chart



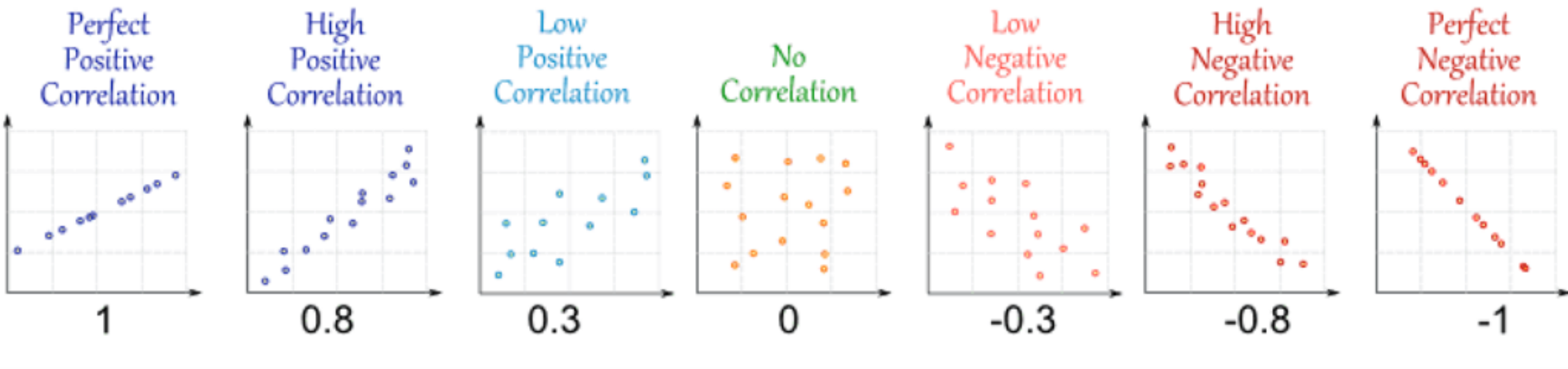
Horizontal * Stacked * Negative Bar Chart

Scatterplot


Scatterplot for quality characteristic XXX
Quality characteristic XXX
94
96
98
100
102
0
5
10
15
20
Process input

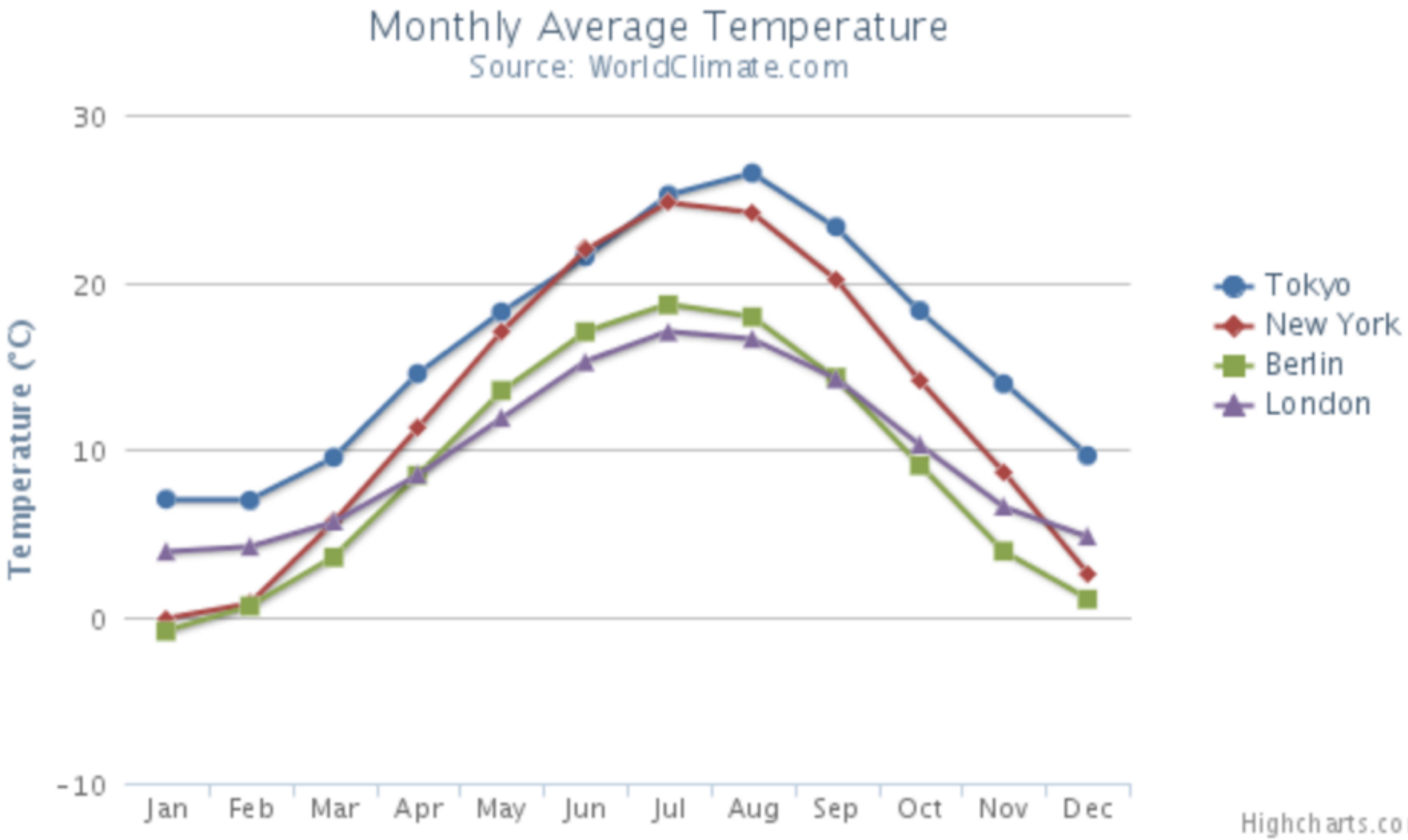
Horizontal * Stacked * Negative Bar Chart

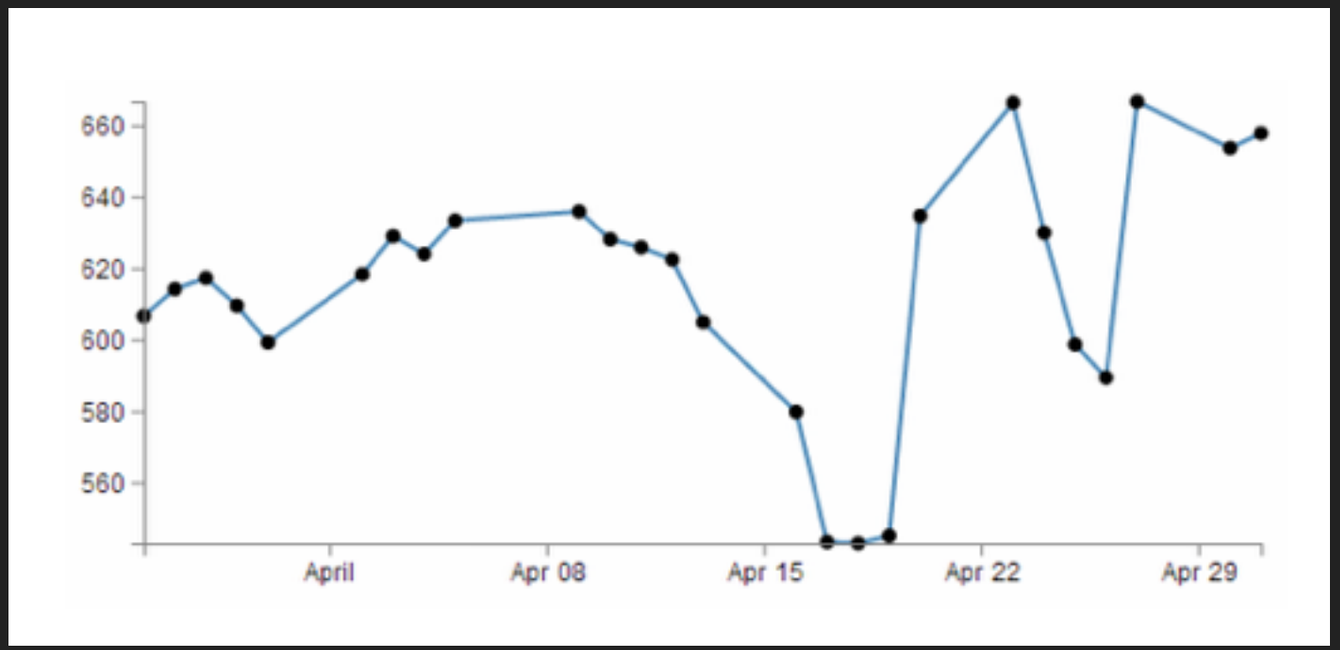
Scatterplots can show correlation between two variables

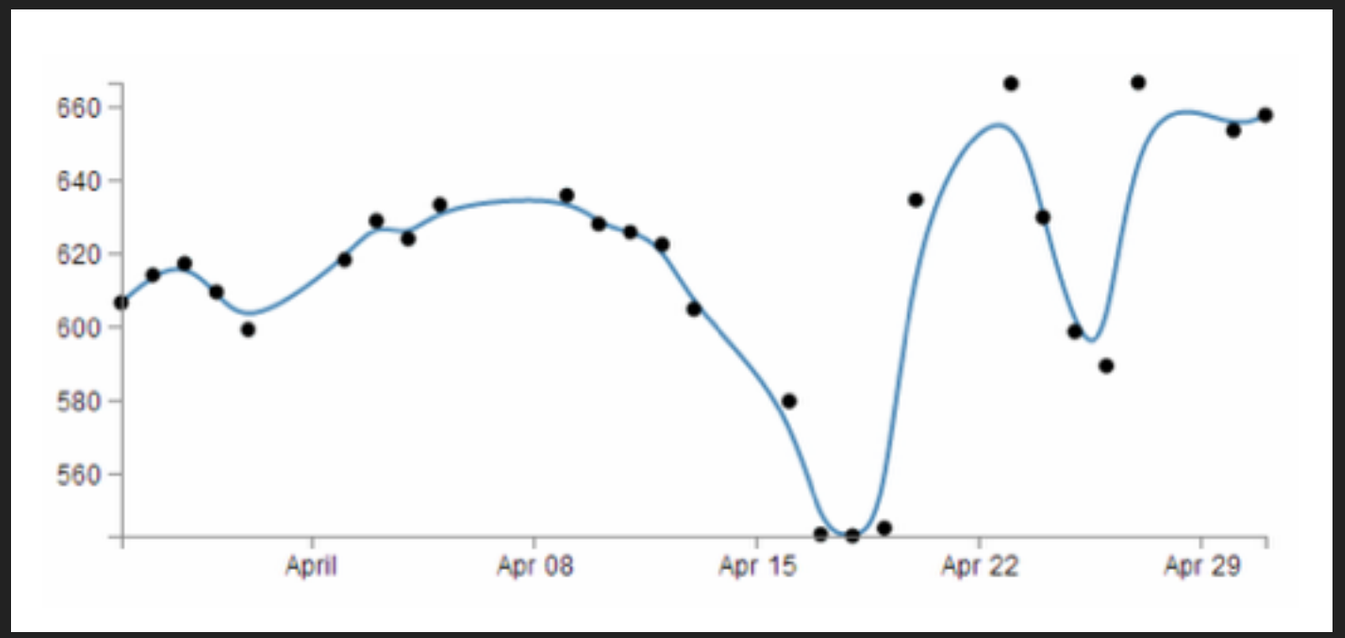


Hans Rosling's 200 Countries Scatterplot

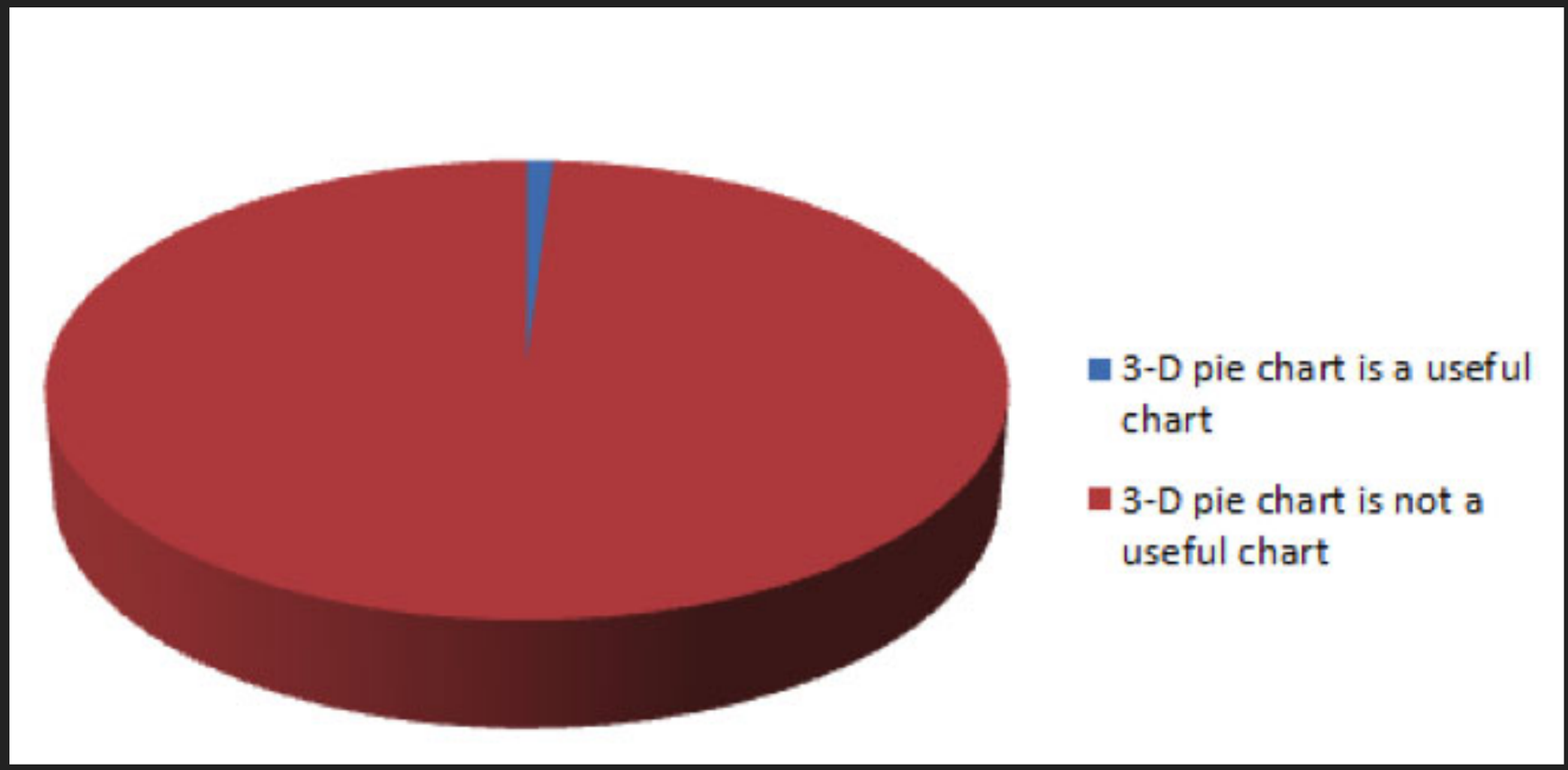
Line Chart

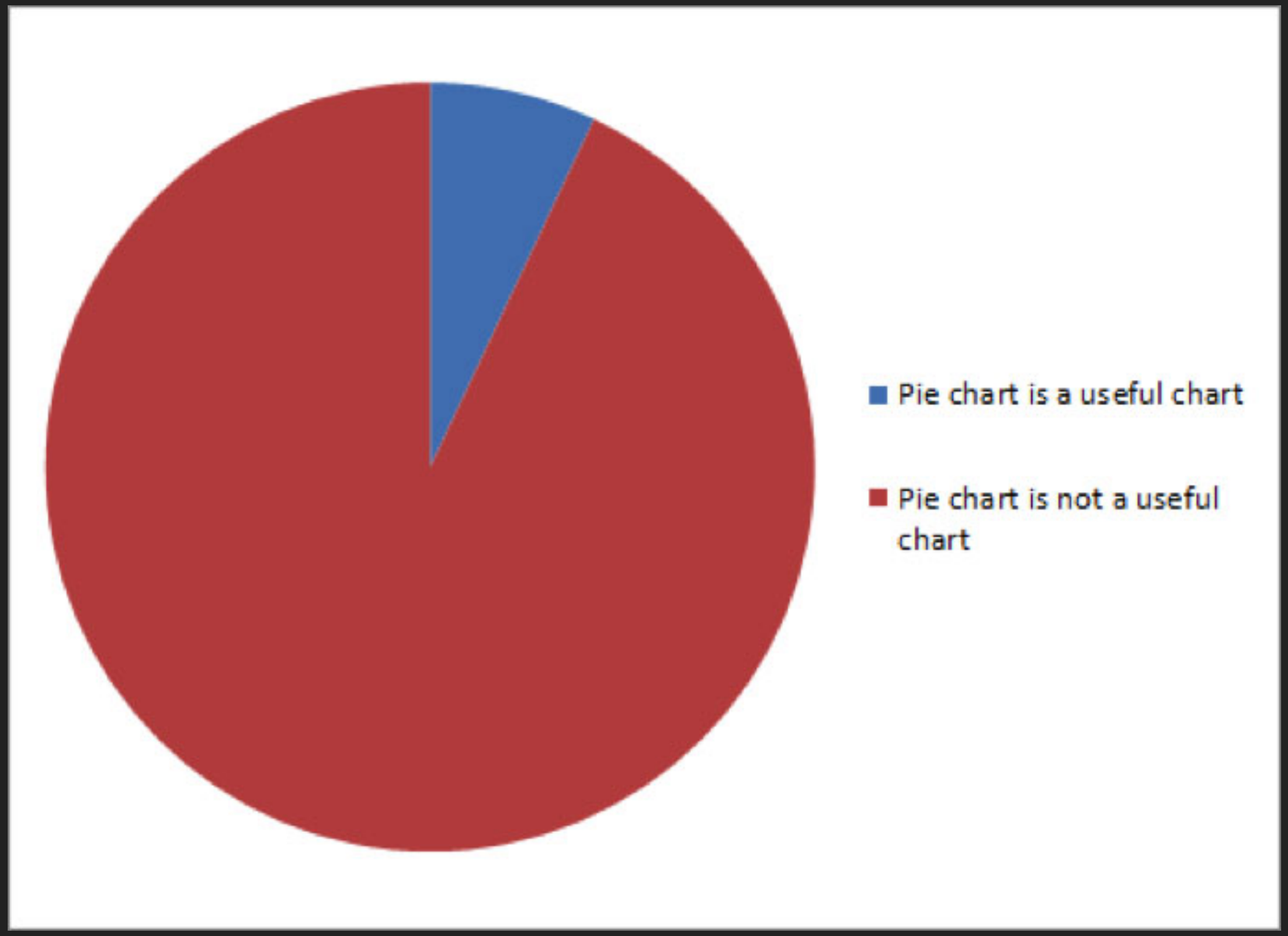

Monthly Average Temperature
Source: WorldClimate.com
Temperature (°C)
30
20
10
0
-10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Tokyo
New York
Berlin
London
Highcharts.com

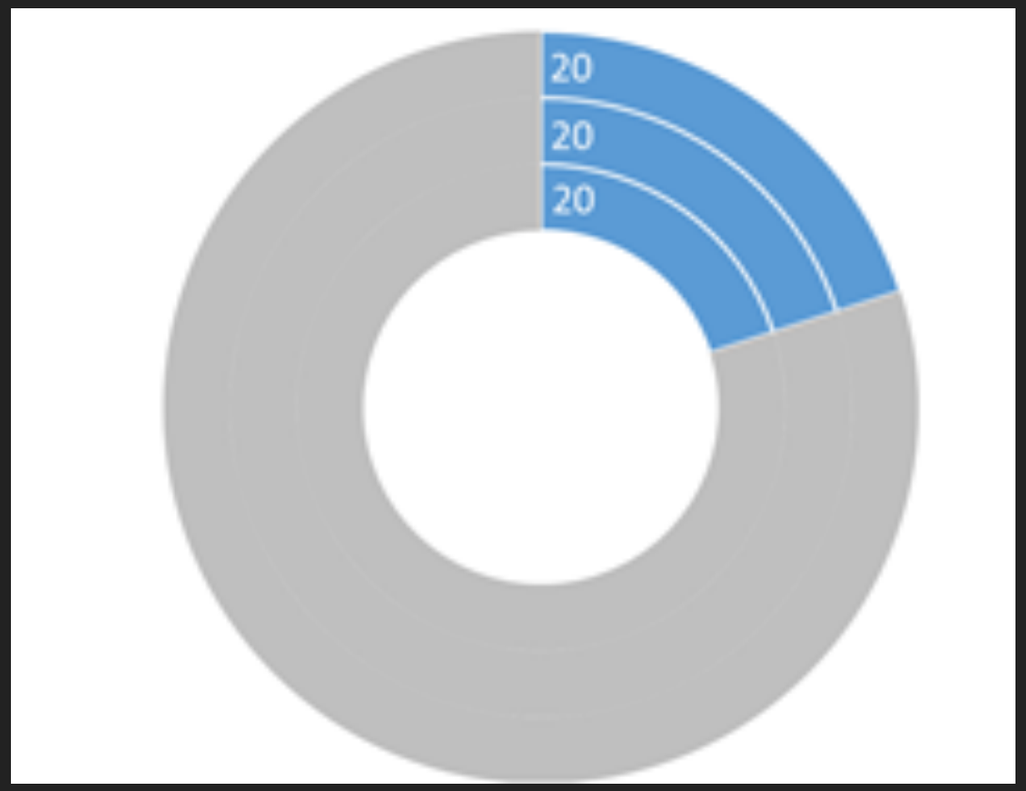

660
640
620
600
580
560
April
Apr 08
Apr 15
Apr 22
Apr 29

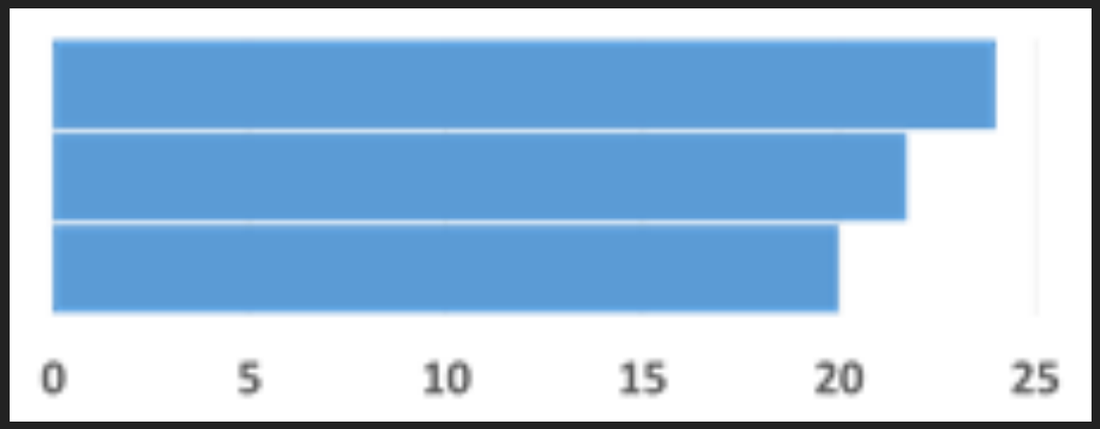

660
640
620
600
580
560
April
Apr 08
Apr 15
Apr 22
Apr 29

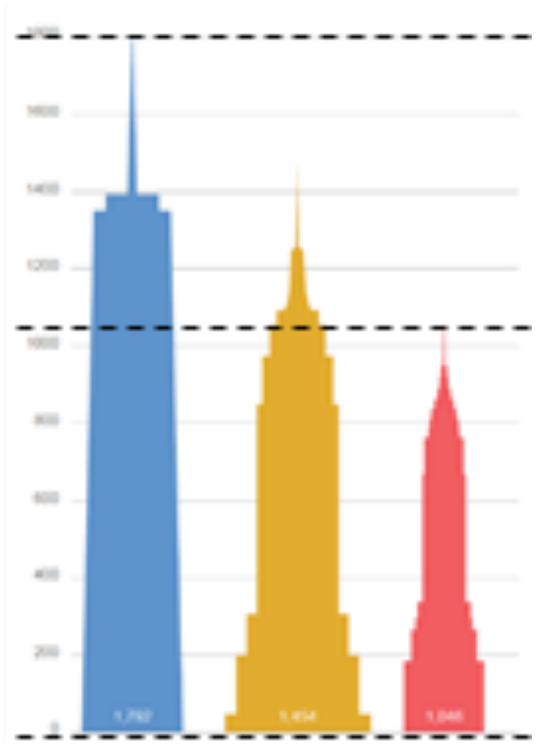
Pie Chart


3-D pie chart is a useful chart
3-D pie chart is not a useful chart

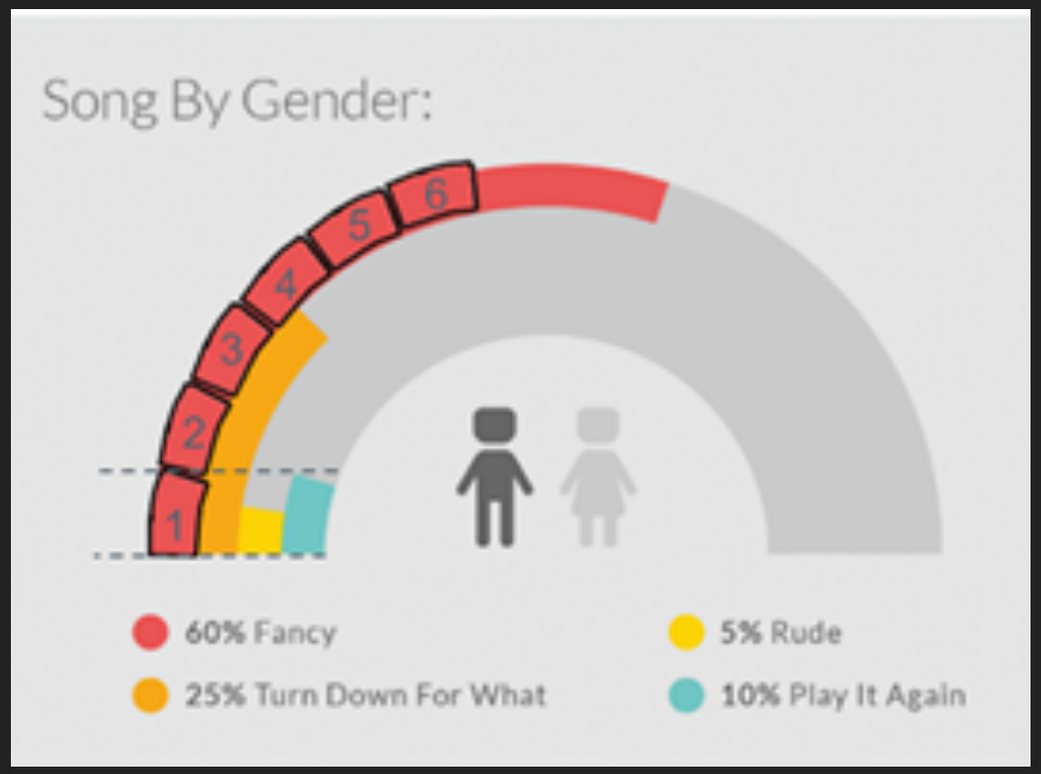

Pie chart is a useful chart
Pie chart is not a useful chart

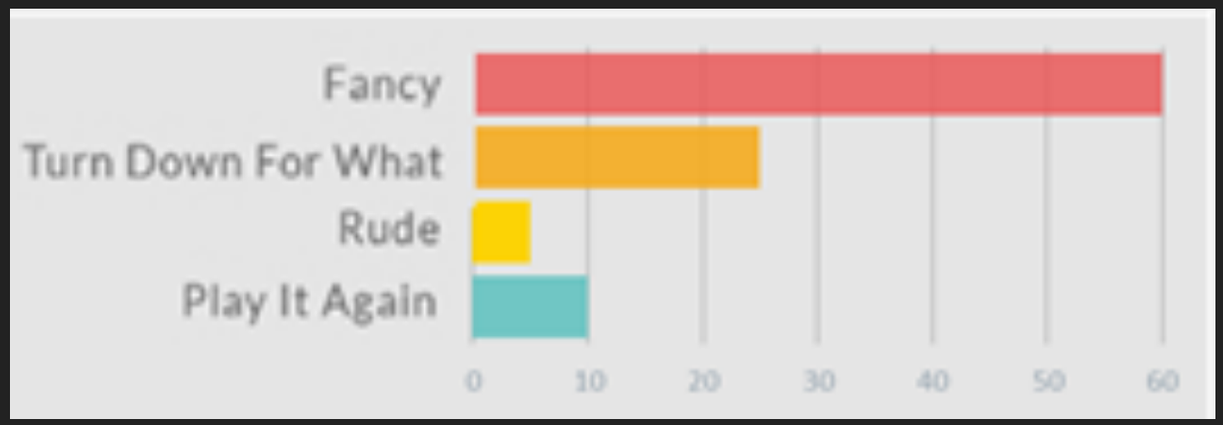

20
20
20


0
5
10
15
20
25


1,792
1,454
1,046


WR 43.18
OR 43.49
They're starting in different spots. but they'll end up both racing 400 meters -- just like everyone else in the field

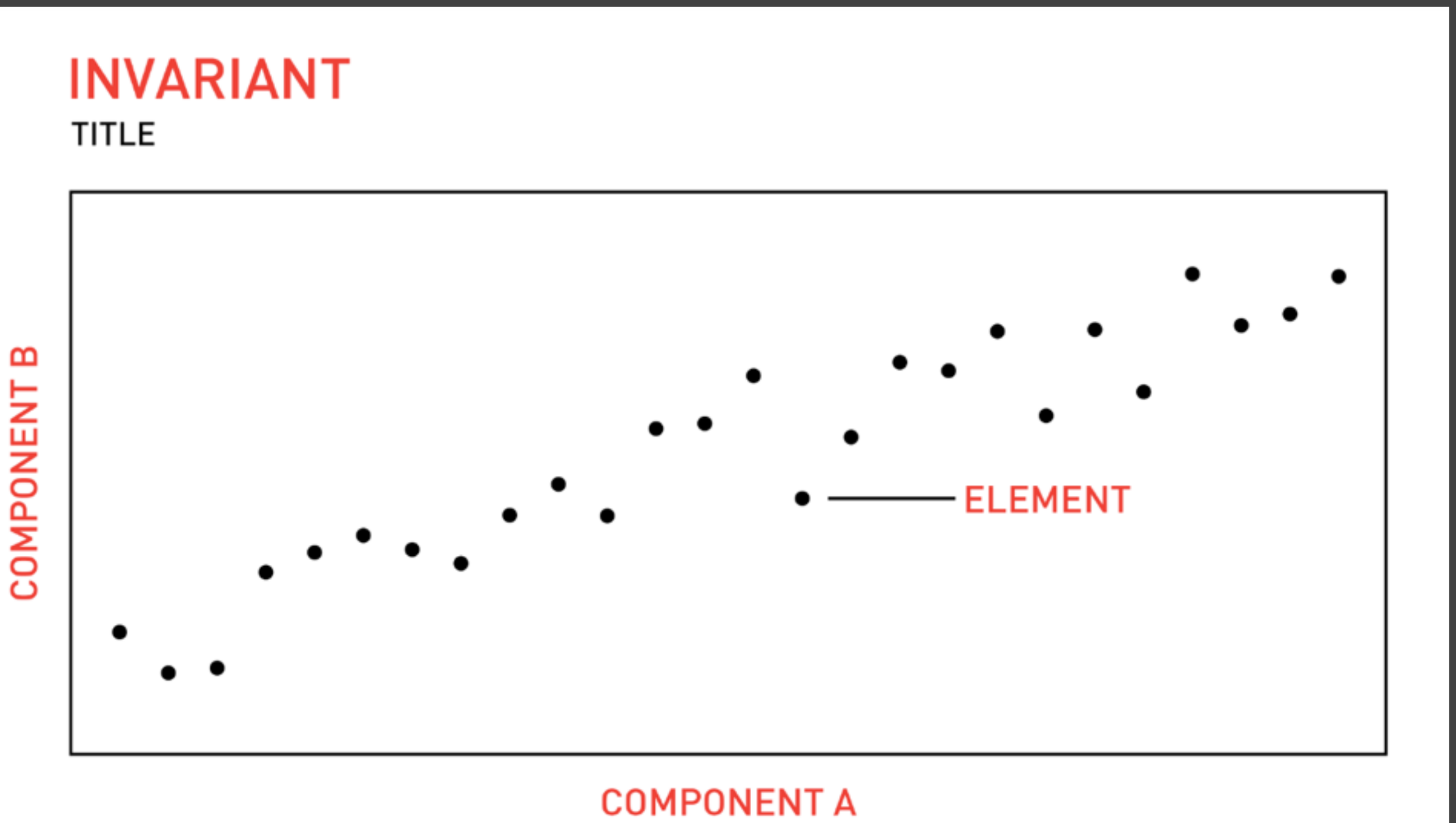

Song By Gender:
1
2
3
4
5
6
60% Fancy
25% Turn Down For What
5% Rude
10% Play It Again


Fancy
Turn Down For What
Rude
Play It Again
0
10
20
30
40
50
60

Map

Design Considerations

Title, labels, legend, captions, source!



Design Considerations

Expressiveness and Effectiveness

Avoid unexpressive marks (lines? gradients?)

Use perceptually effective encodings

Don’t distract: faint gridlines, pastel highlights/fills

The “elimination diet” approach – start minimal

Support comparison and pattern perception

Between elements, to a reference line, or to totals

Use reader-friendly units and labels

Statistical soundness (regression, interpolation)

Design Considerations

Transform data (e.g., filter, log, normalize)

Group / sort data by meaningful dimensions

Reduce cognitive overhead

Minimize visual search, minimize ambiguity
Appropriate size, aspect ratio, legible text
Avoid legend lookups if direct labeling works
Avoid color mappings with indiscernible colors

Be consistent! Visual inferences should consistently support data inferences.