

UN5550 – Sp25

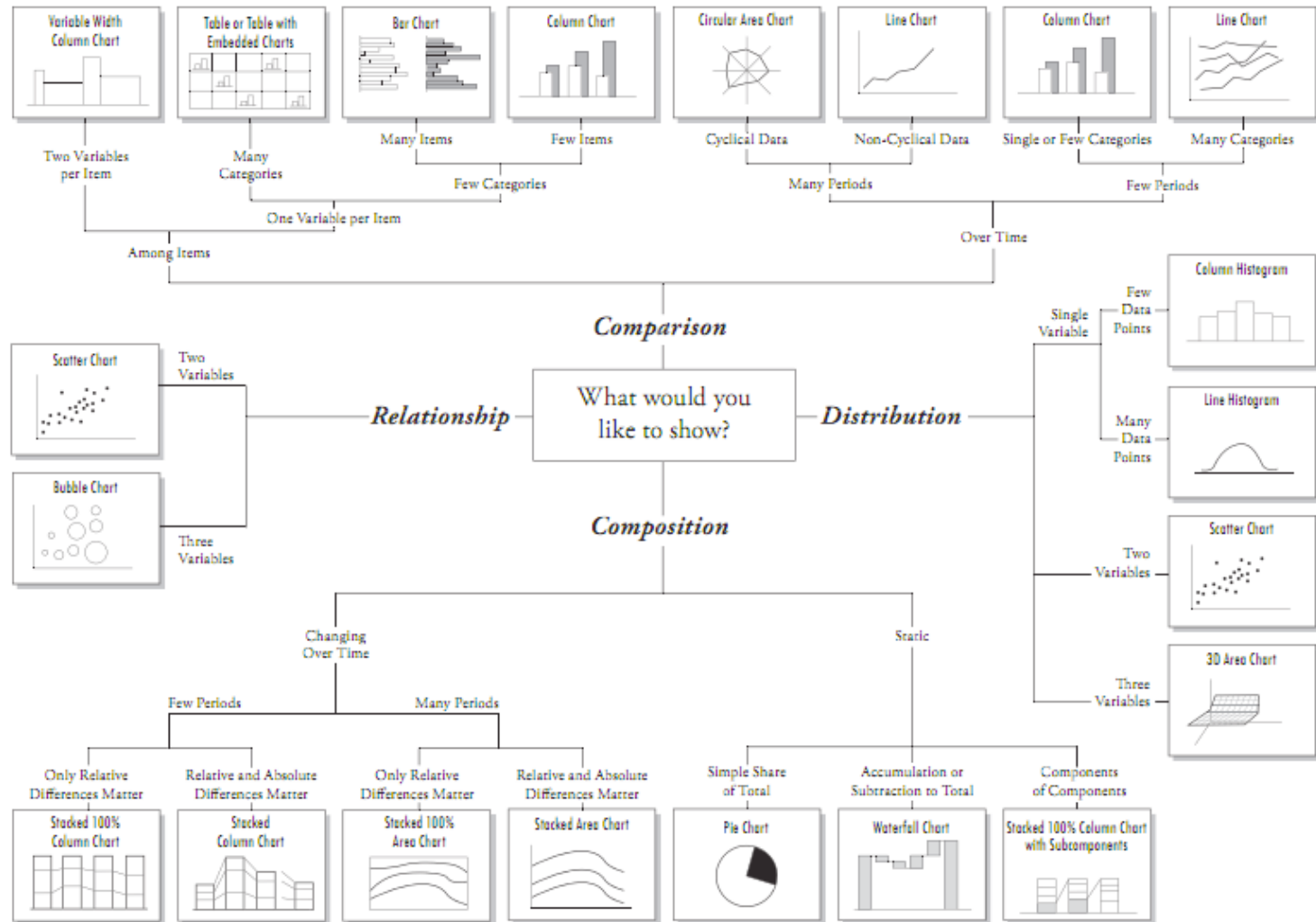
## Visualization

Sujan Kumar Roy, PhD

T 01/21

# Chart Selection – Andrew Abela

## Chart Suggestions—A Thought-Starter



# Chart Selection – Juice Analytics

Chart Chooser Data templates for the picking.

## Welcome to the Chart Chooser

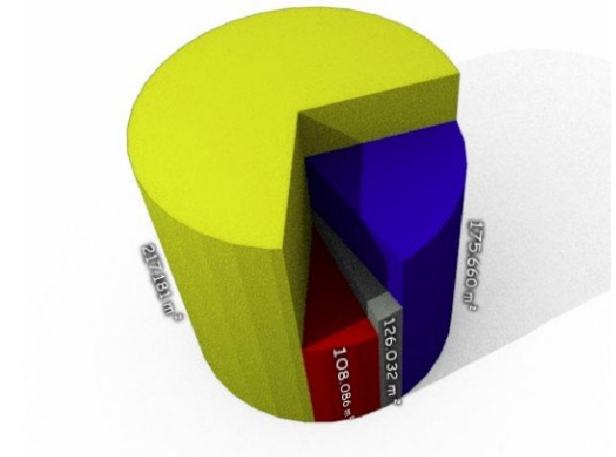
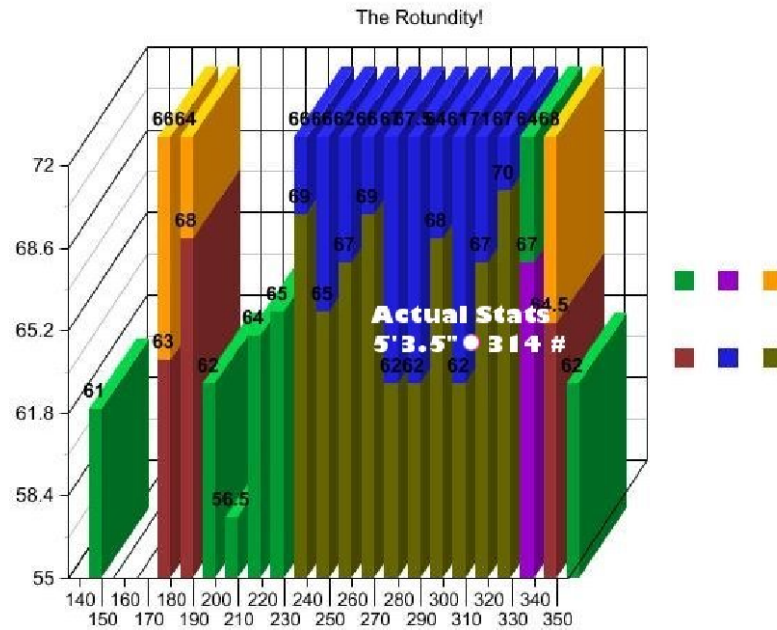
Use the filters to find the right chart type for your needs. Then download as Excel or PowerPoint templates and insert your data.

- ☐ Comparison
- ☐ Distribution
- ☐ Composition
- ☐ Trend
- ☐ Relationship
- ☐ Table

17 charts selected



# Bad Visualizations



# Bad/Misleading Visualizations

## MOST WICKETS IN DEATH OVERS IN ODIS

SINCE THE START OF JANUARY 2017

■ WKTS ■ AVE



NUMBERS UPDATED TILL MAY 14, 2019

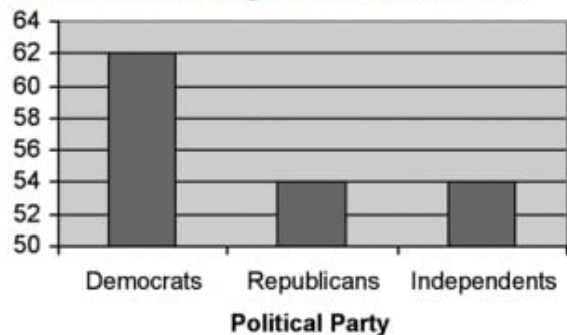
## PET OWNERSHIP BY GRADE

26%  
8TH GRADE

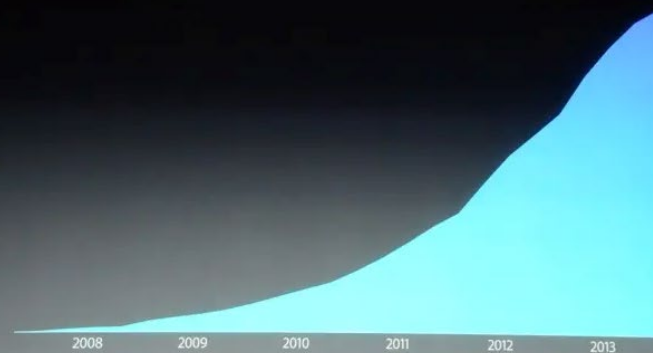
63%  
6TH GRADE

50%  
7TH GRADE

## Percent Who Agreed With Court



## Cumulative iPhone sales



# Other Aspects of Visualization

- Cognitive and Human-factors with visualization
  - Rules and principles of scientific visualization:
  - <http://www.siggraph.org/education/materials/HyperVis/percept/visrules.htm>
- Artistic aspects of visualization
  - Edward Tufte: <http://www.edwardtufte.com/tufte/>
- Many more data types
- Good practices

# Two Primary Goals of Viz

- **Explore/Calculate**

- Analyze
- Reason about Information

- **Communicate**

- Explain
- Make Decisions
- Reason about Information

# Anatomy of a Graph

- Framework
  - Sets the stage
  - Kinds of measurements, scale, ...
- Content
  - Marks
  - Point symbols, lines, areas, bars, ...
- Labels
  - Title, axes, tic marks, ...

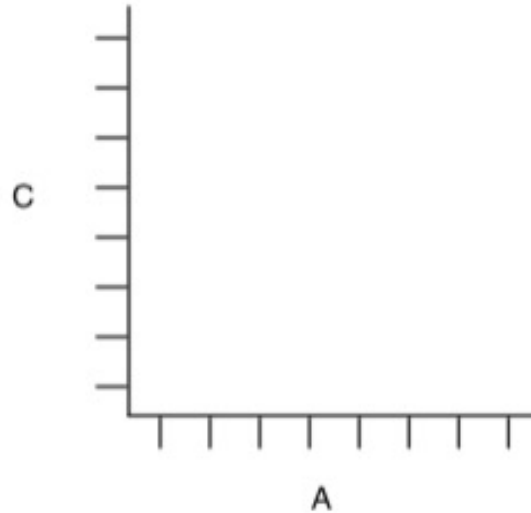


# Elements of a Plot

## Geometric Objects



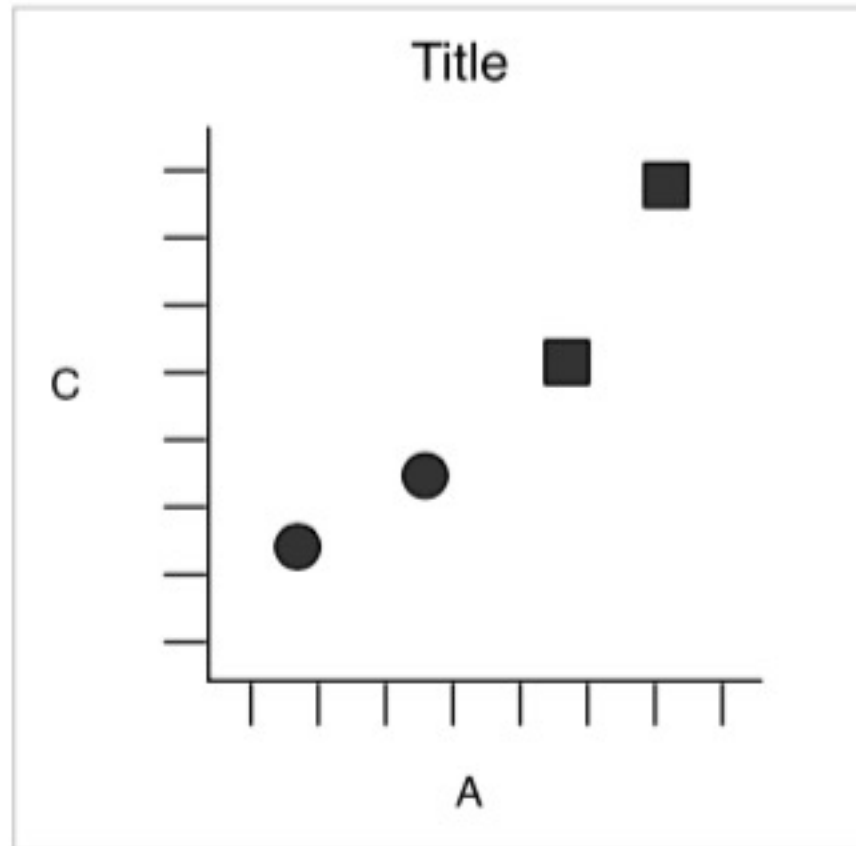
## Scales & Coordinates



## Annotations

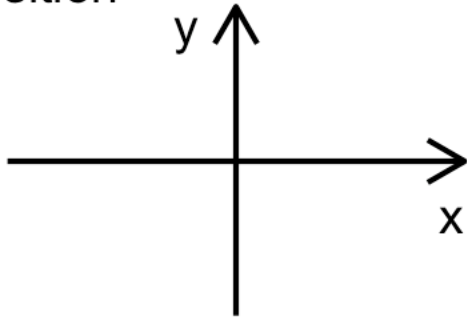


# Elements of a Plot



# Aesthetics of a Plot

position



shape



size



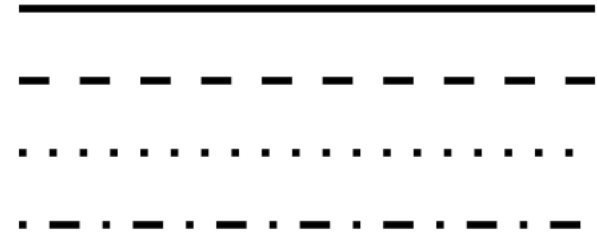
color



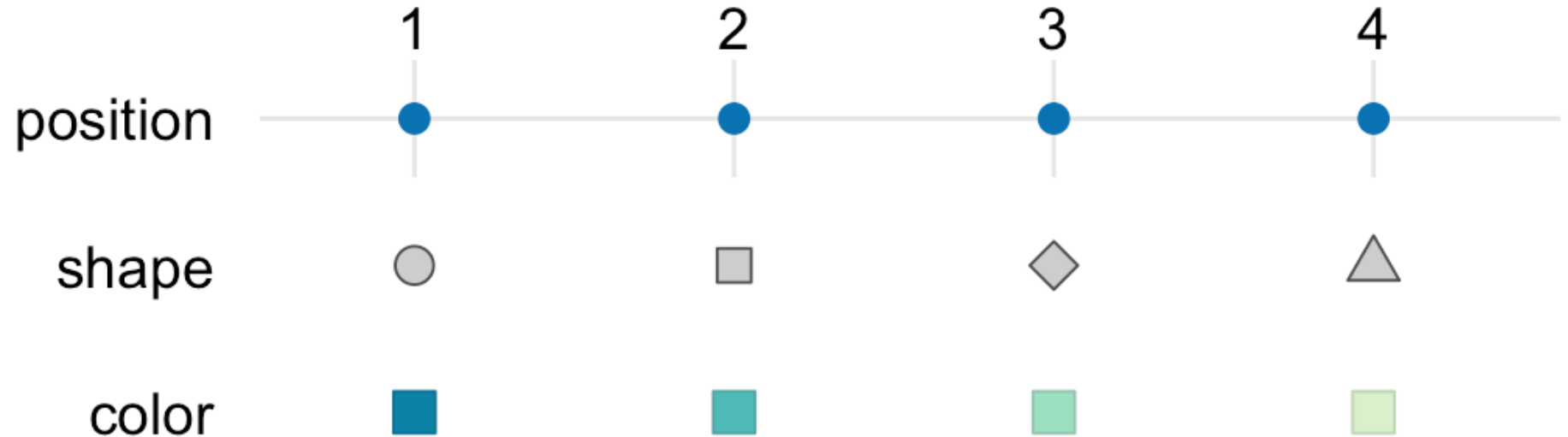
line width



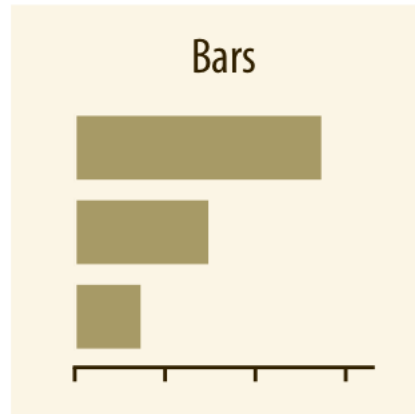
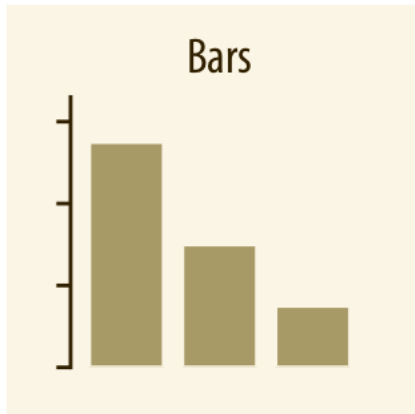
line type



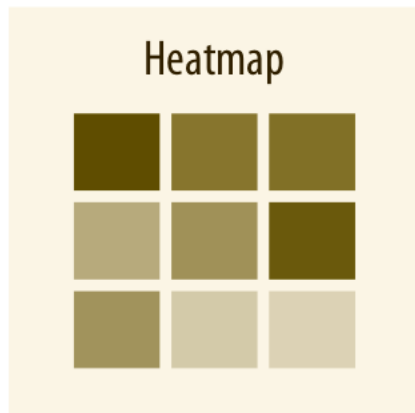
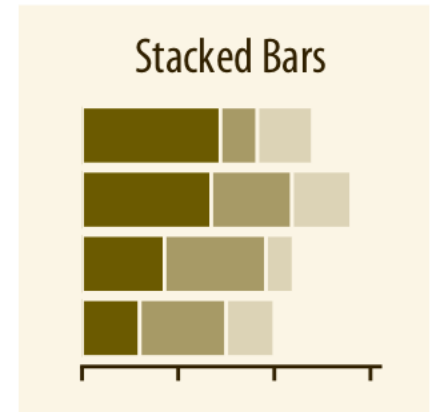
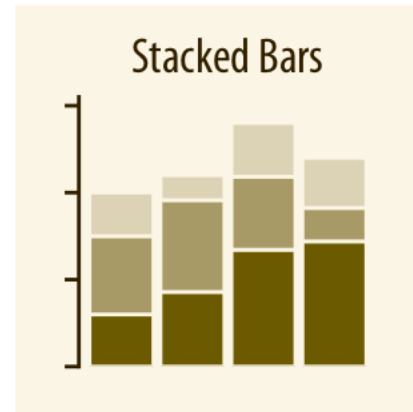
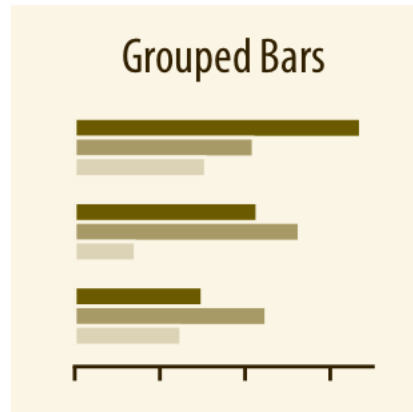
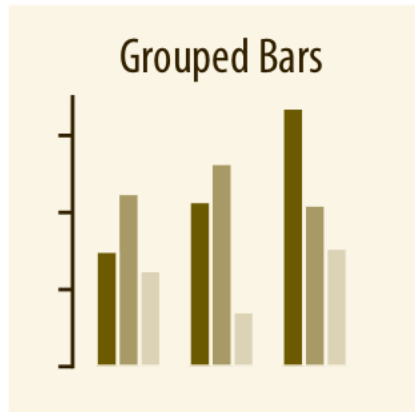
# Aesthetics Map Data to Visual Representation



# Amounts

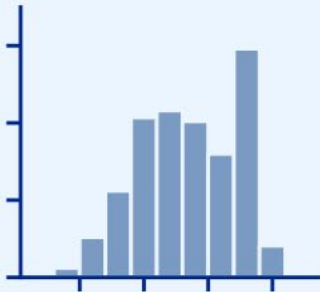


# Amounts – Two or More

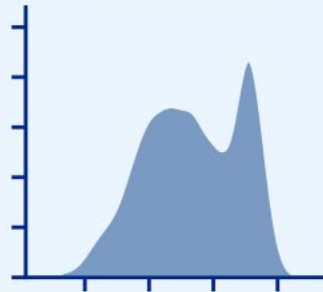


# Distributions

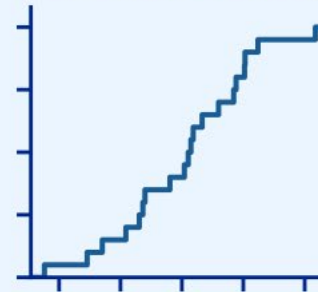
Histogram



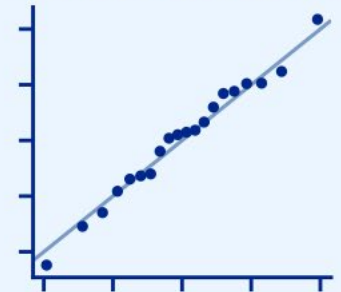
Density Plot



Cumulative Density

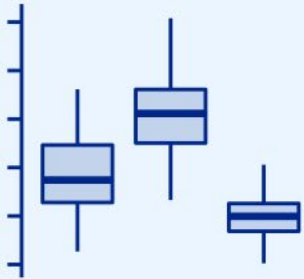


Quantile-Quantile Plot

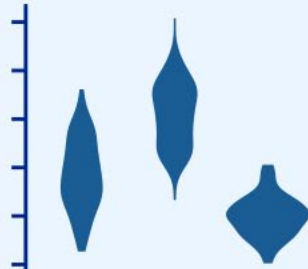


# Distributions: Multiple

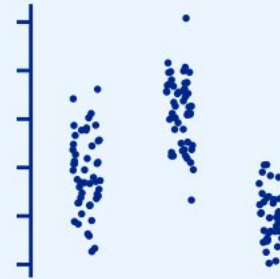
Boxplots



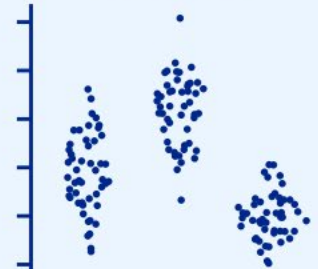
Violins



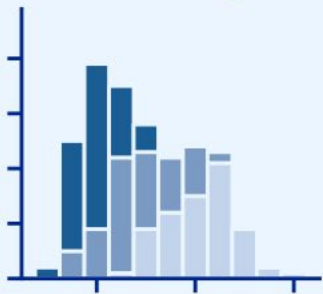
Strip Charts



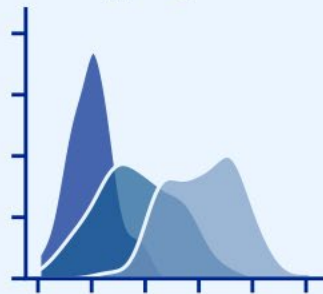
Sina Plots



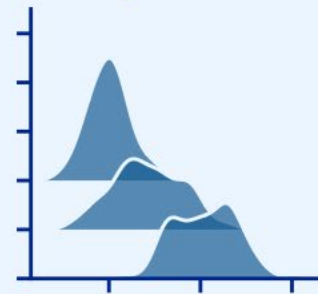
Stacked Histograms



Overlapping Densities



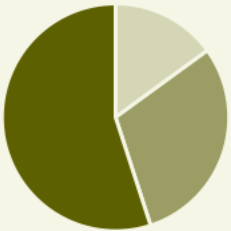
Ridgeline Plot



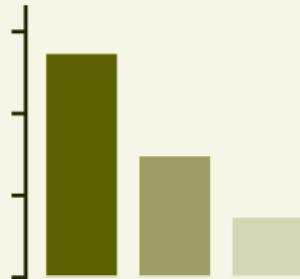


# Proportions

Pie Chart



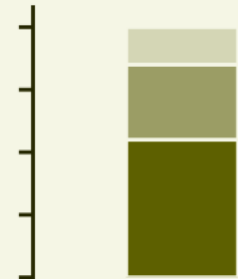
Bars



Bars



Stacked Bars

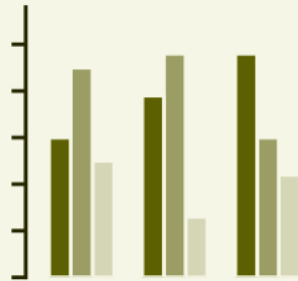


# Proportions: Multiple

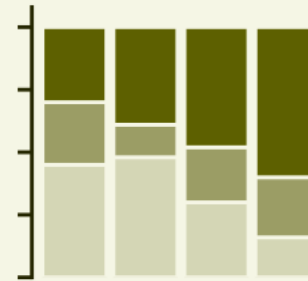
Multiple Pie Charts



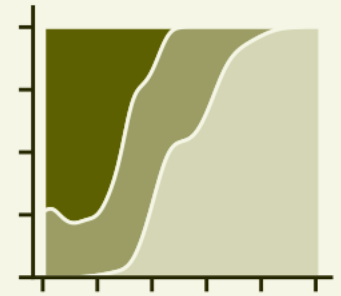
Grouped Bars



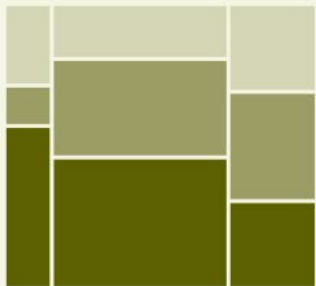
Stacked Bars



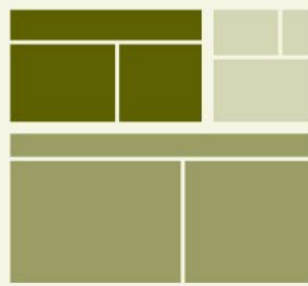
Stacked Densities



Mosaic Plot



Treemap

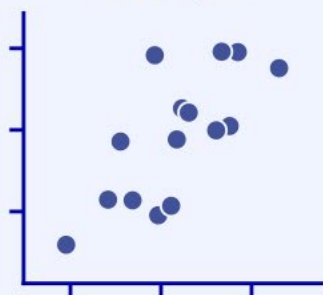


Parallel Sets

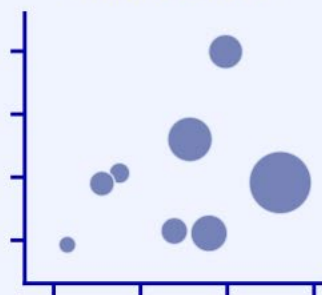


# X-y Relationships

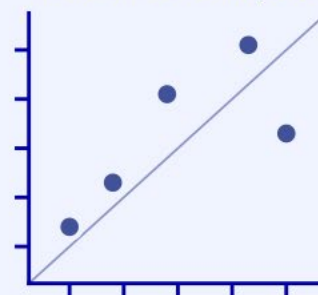
Scatterplot



Bubble Chart



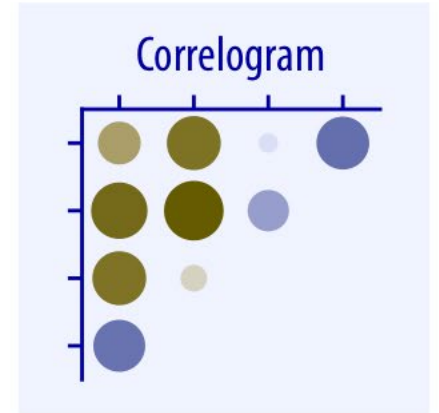
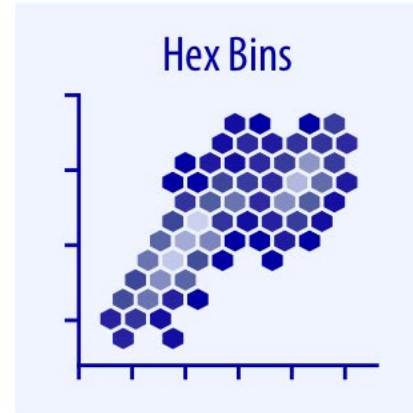
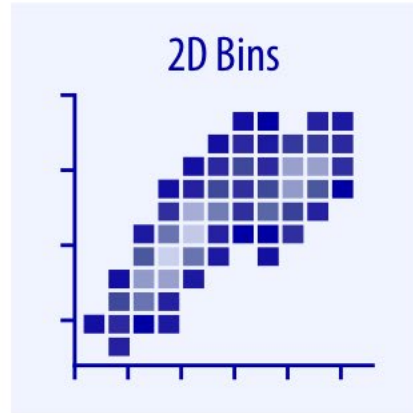
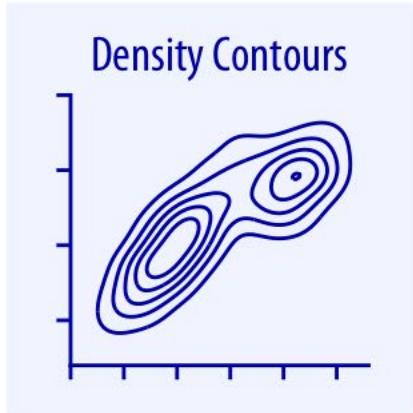
Paired Scatterplot



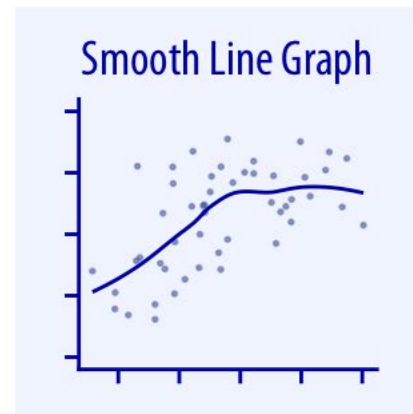
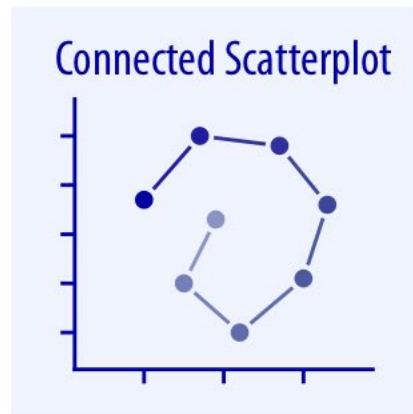
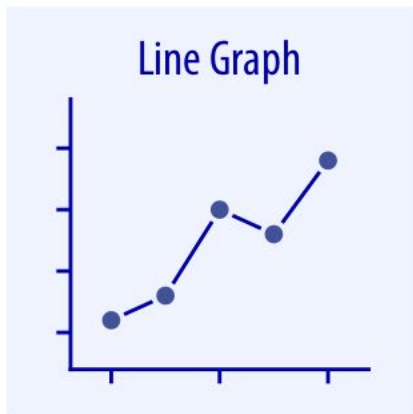
Slopegraph



# X-y Relationships with lots of data



## Adding Time

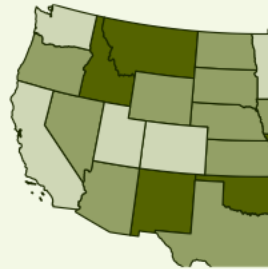


# Geospatial Data

Map



Choropleth



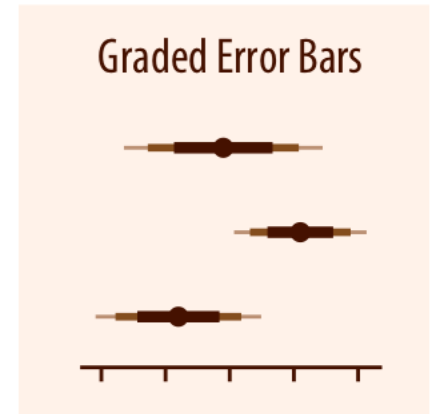
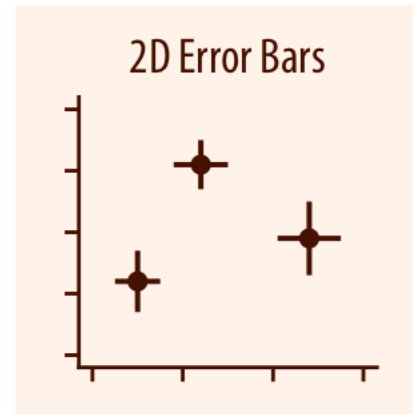
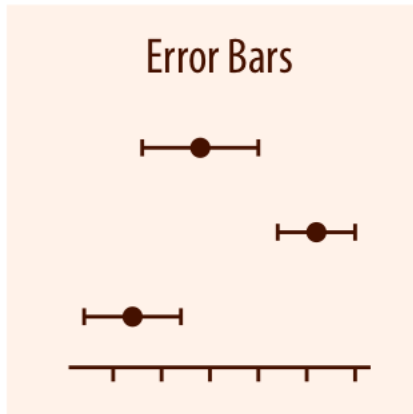
Cartogram



Cartogram Heatmap

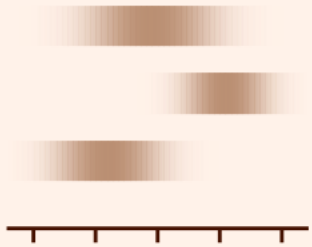


# Uncertainty

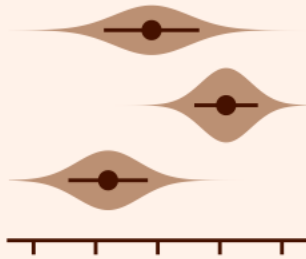


# Uncertainty

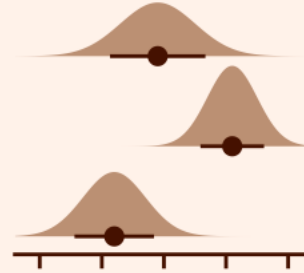
Confidence Strips



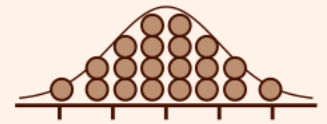
Eyes



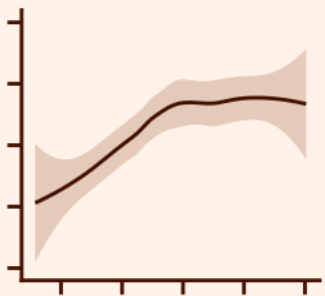
Half-Eyes



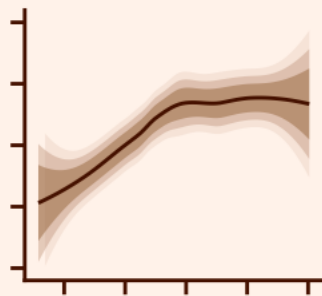
Quantile Dot Plot



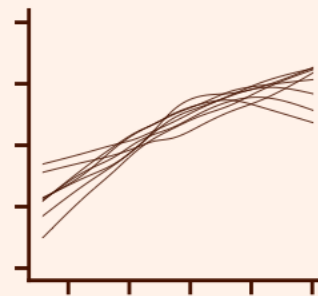
Confidence Band



Graded Confidence Band



Fitted Draws



# Design Considerations

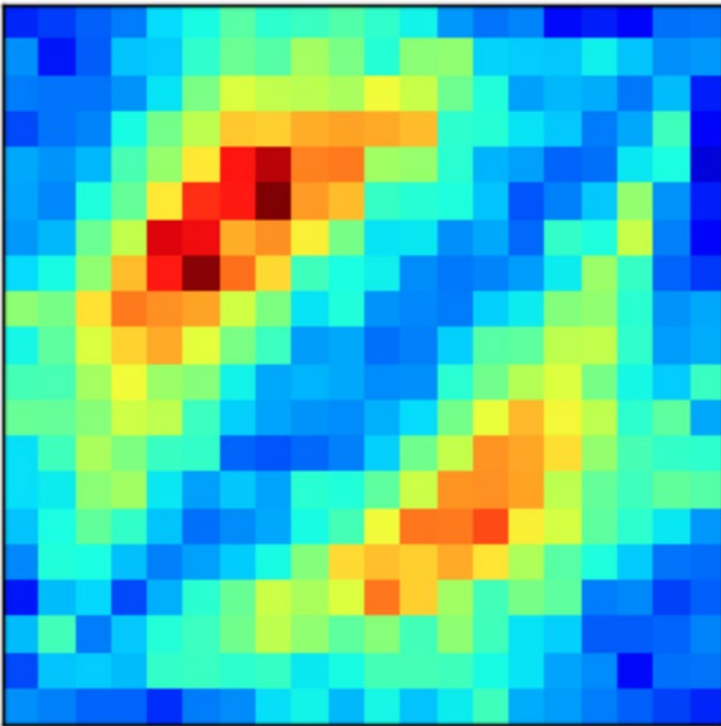
- Reduce chartjunk/tablejunk; increase data-ink ratio
- Lessons from perception: Limit the number of objects displayed at once
- Typography: capitalization, serif/non-serif
- Colors
  - Color scheme
  - Contrast, emphasis
- 6 Gestalt Psychology principles (1912):
  - For groups of objects: proximity, similarity, enclosure, connection
  - Visual representation: closure, continuity



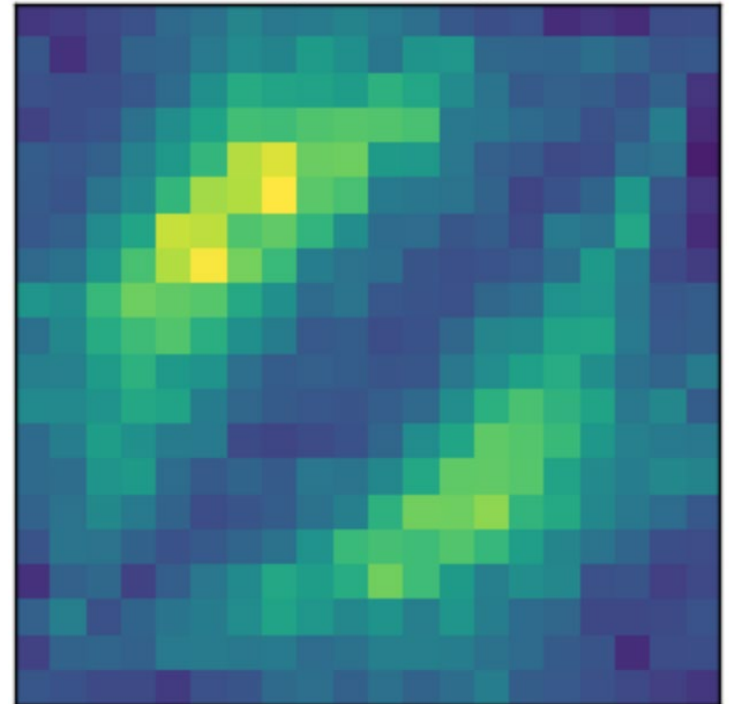


# Color Choices Matter!

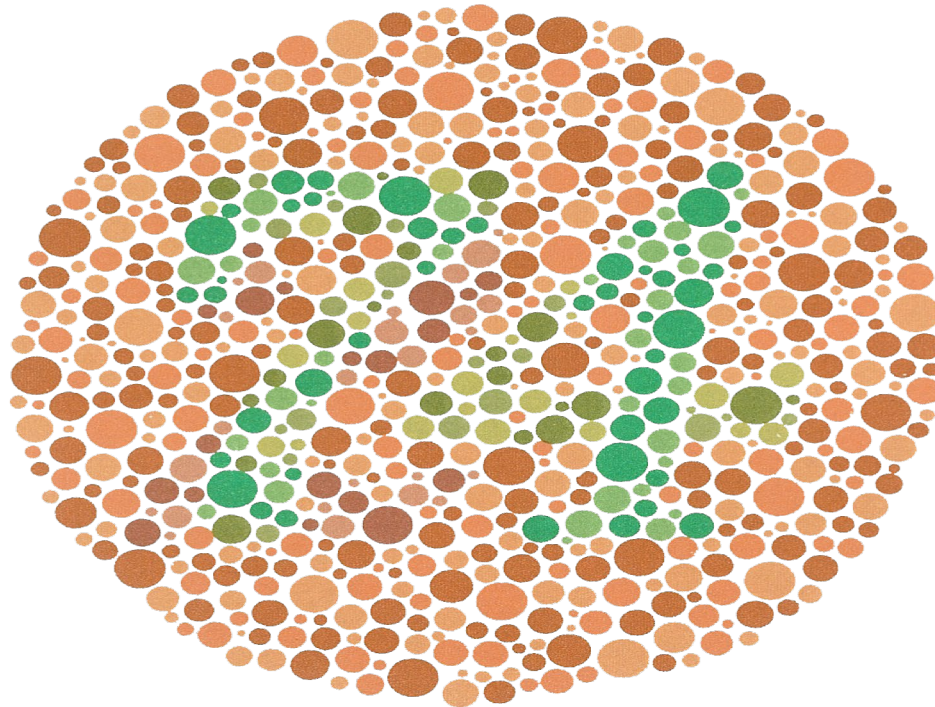
Jet Colormap



Viridis Colormap



# Color Choices Matter!



# Design Considerations

- Color
  - Choose colors based on the information you want to convey
    - Sequential
    - Diverging
    - Categorical
  - Use online resources to discover and record your color schemes
    - Color Brewer
    - Kuler
    - Colour Lovers
  - Be aware of colorblindness issues
    - <https://thenode.biologists.com/data-visualization-with-flying-colors/research/>
    - <https://jfly.uni-koeln.de/color/>

# Design Considerations

- Color

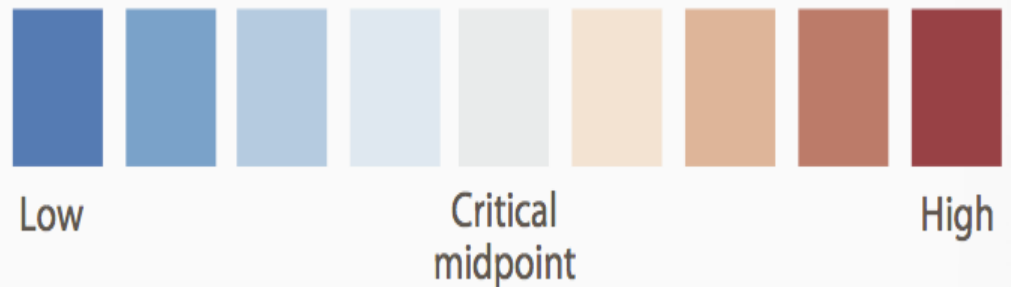
## Sequential

Colors can be ordered from low to high



## Diverging

Two sequential schemes extended out from a critical midpoint value



## Categorical

Lots of contrast between each adjacent color

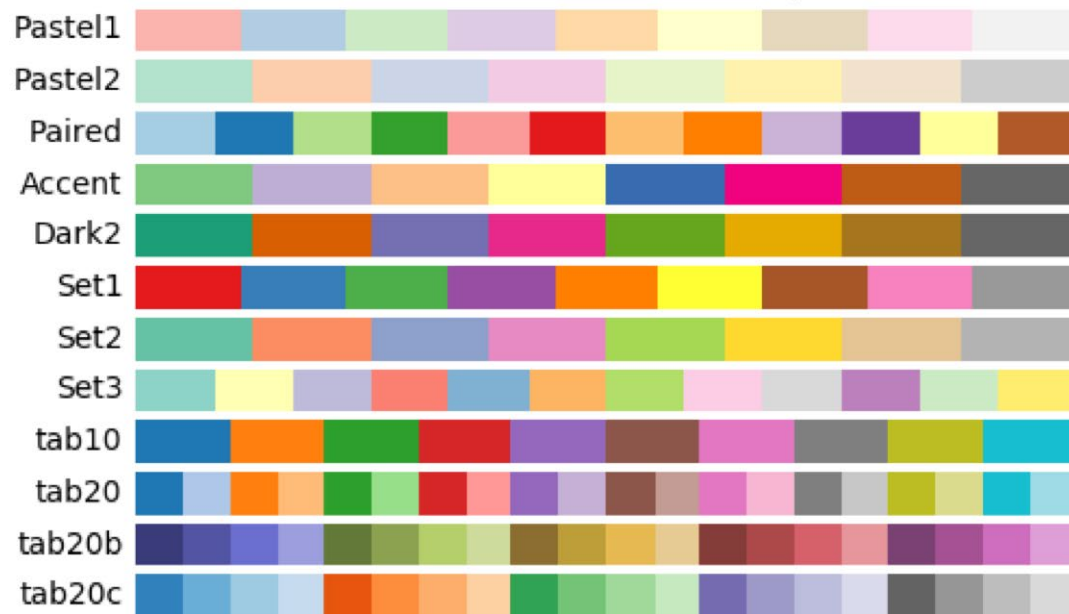


# Color Schemes

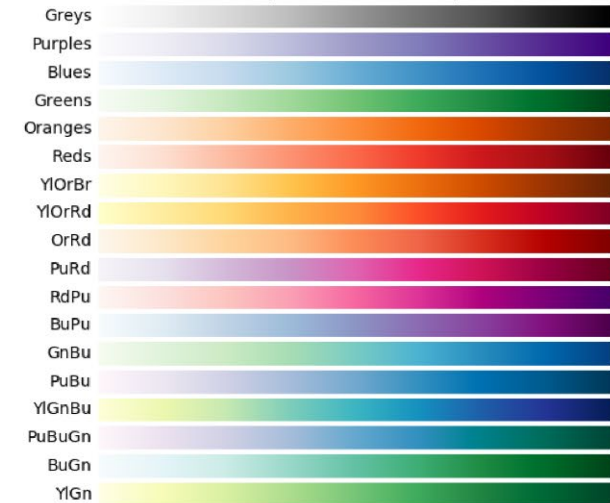
## Perceptually Uniform Sequential colormaps



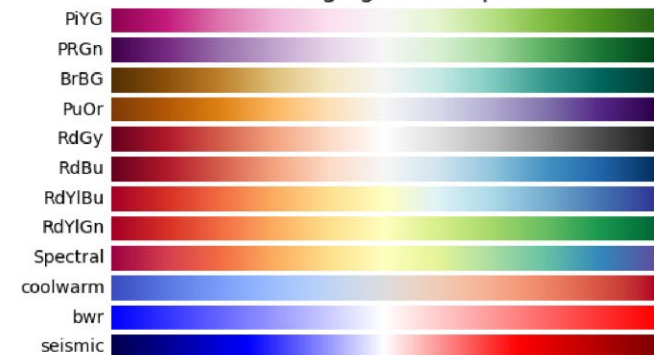
## Qualitative colormaps



## Sequential colormaps

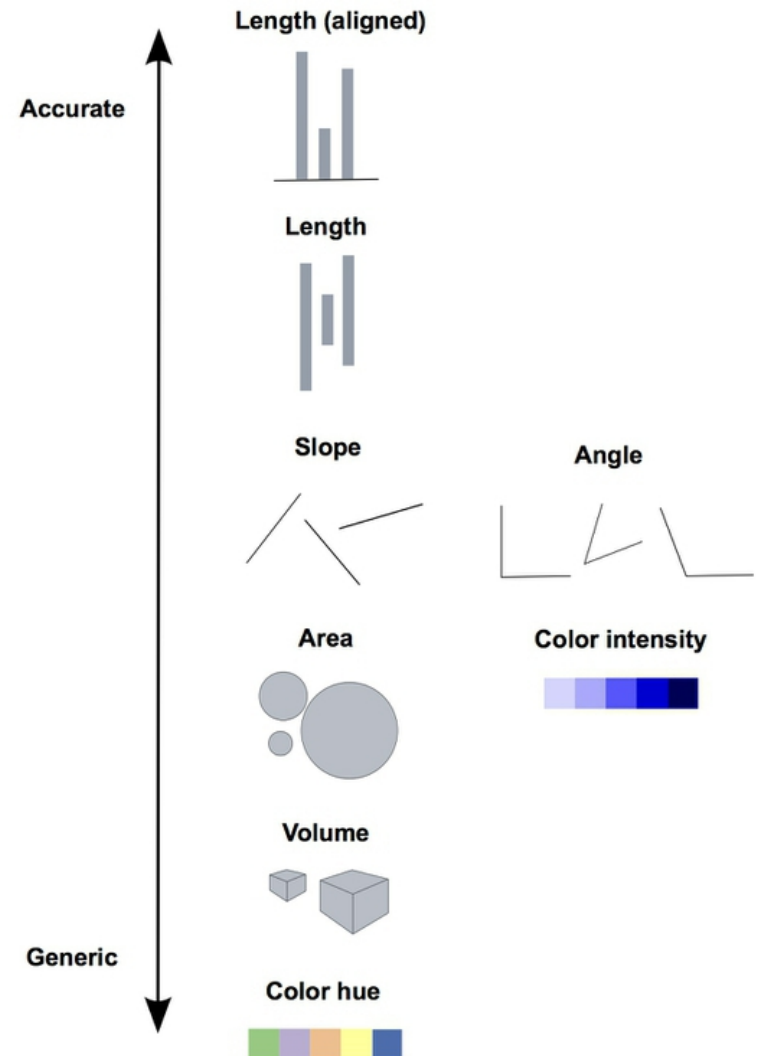


## Diverging colormaps



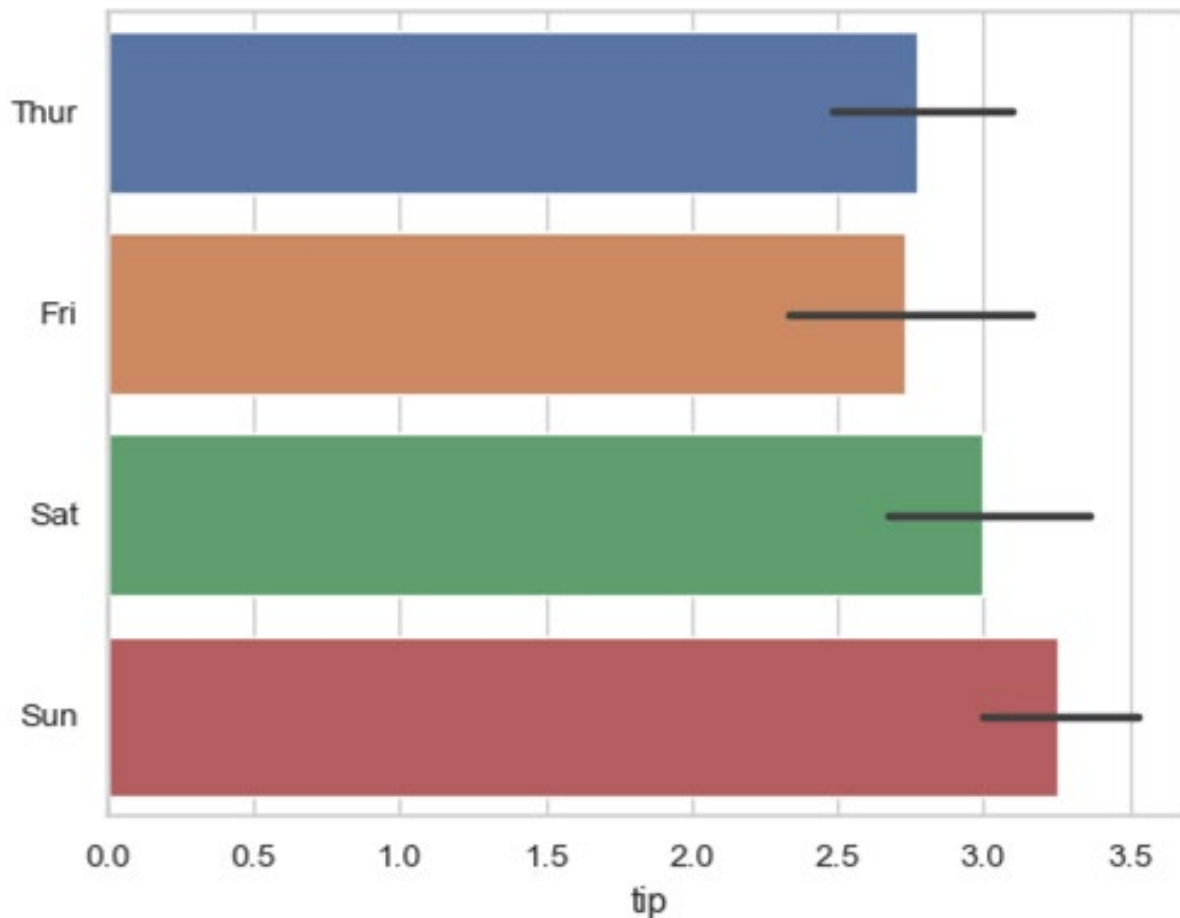
# Not all Marks are Good!

- Accuracy of judgements depend on type of mark.
- Aligned lengths most accurate
- Color least accurate



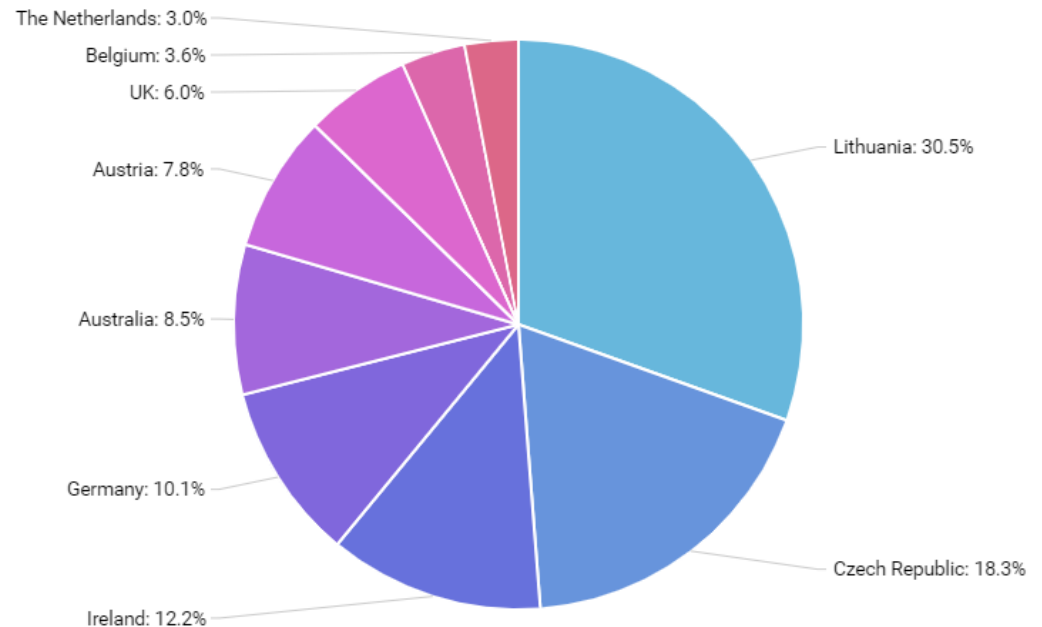
# Lengths are Easy to Understand

- People can easily distinguish between two different lengths, e.g., height of bars in bar chart



# Angles are Hard to Understand

- Avoid pie charts!
- Angle judgements are inaccurate
- In general, underestimate size of larger angle.





# Areas are Hard to Understand

- Avoid area charts
- Area judgements are inaccurate
- In general, underestimate size of larger area

## African Countries by GDP

### TOP COUNTRIES BY GDP IN U.S. \$ BILLIONS

Gross domestic product (GDP) refers to the market value of all final goods and services produced within a country in a given period (2005 - 2008).

### GDP CALCULATION

private consumption + gross investment + government spending + (exports - imports)



# References

- Tufte Books
- Wilke, Fundamentals of Data Visualization
  - <https://clauswilke.com/dataviz/>
  - Written in R Markdown, you can see R source code for images