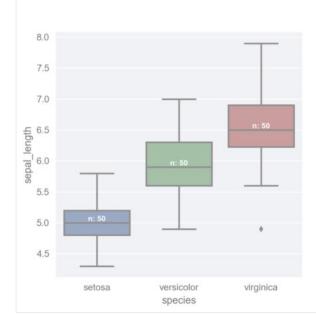
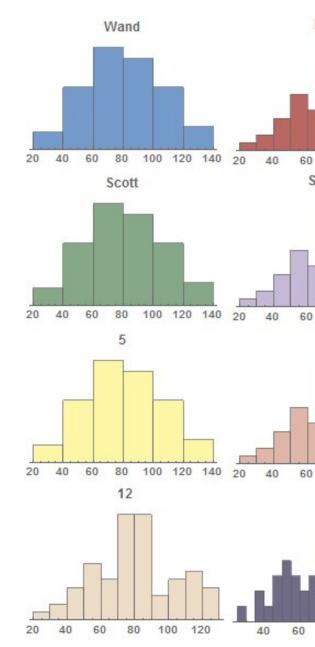


Benjamin Bach
http://benjbach.me
University of Edinburgh

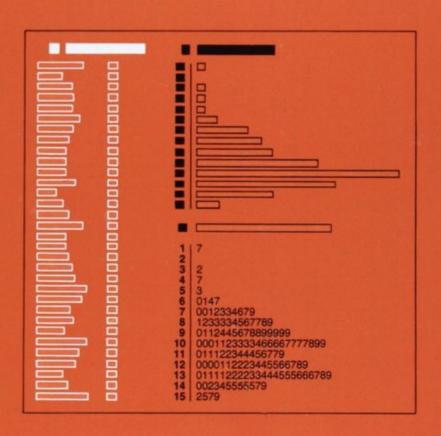


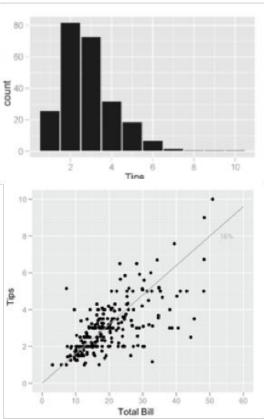


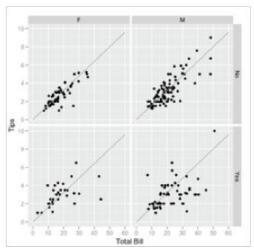


John W. Tukey

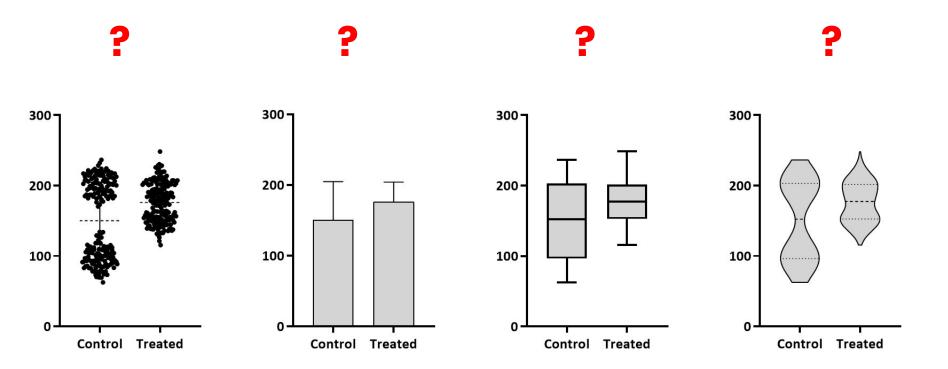
EXPLORATORY DATA ANALYSIS



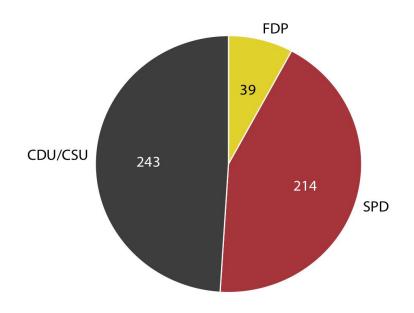


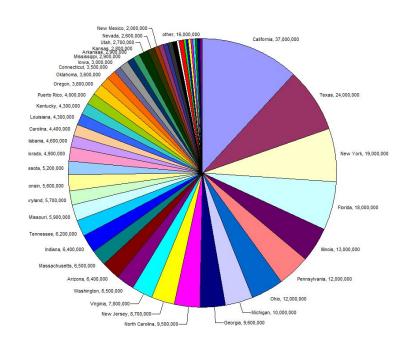


Basic Charts



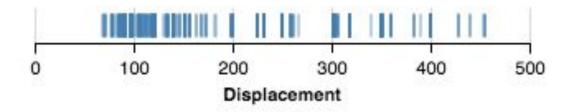
Basic Charts



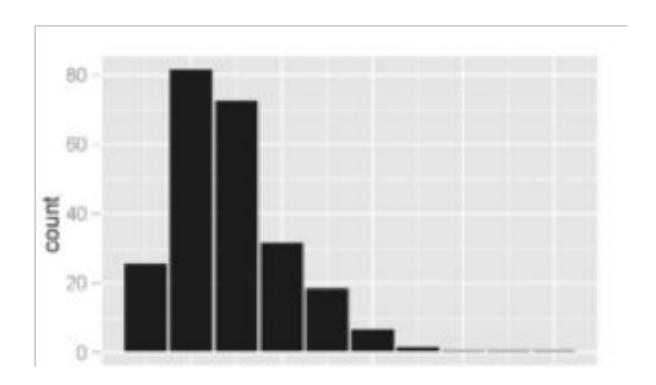


Outline

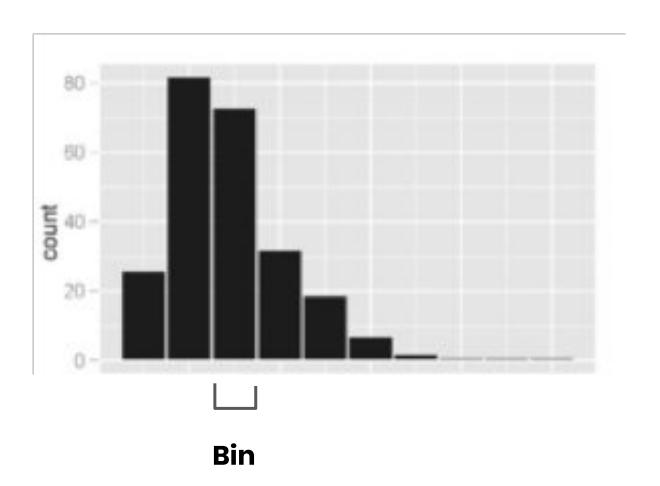
- Distributions & Histograms
- Mean, Mode, Average
- Chart types
- Uncertainty
- Pie Charts

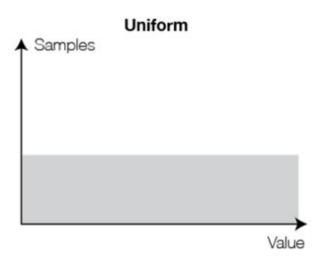


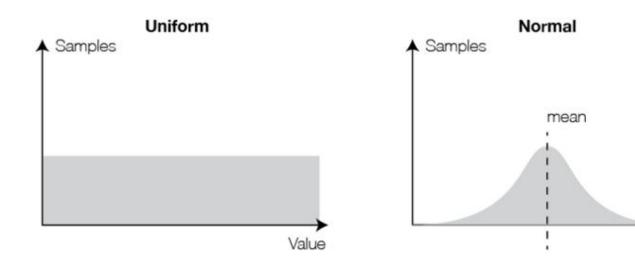
Distributions: Binning



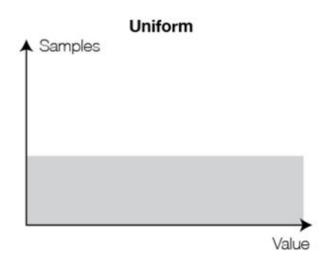
Distributions: Binning

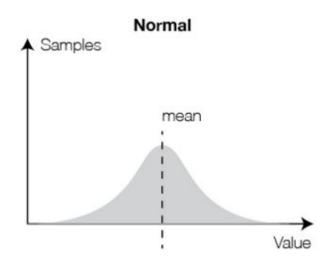


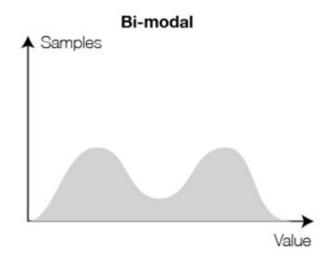


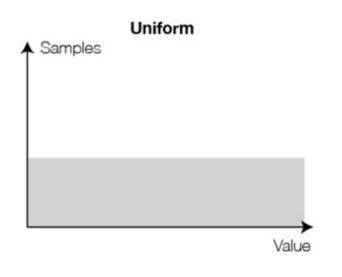


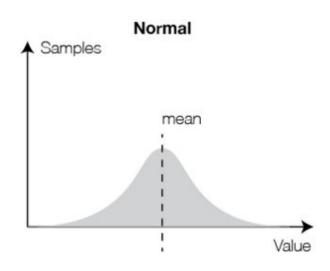
Value

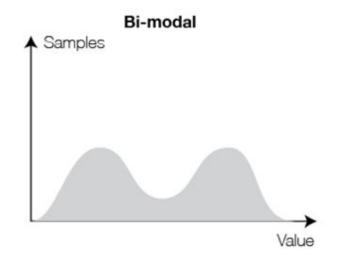


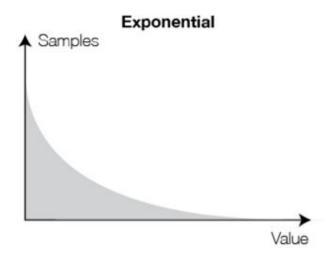




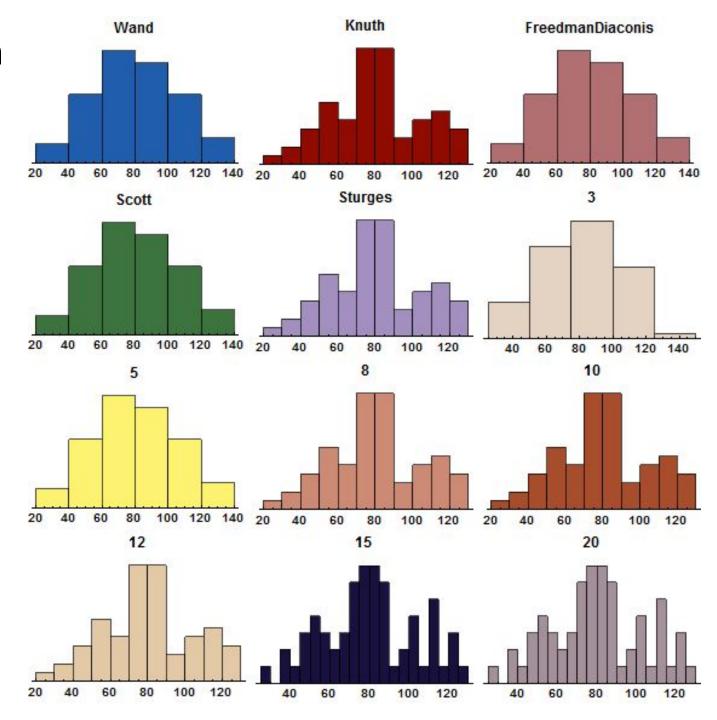




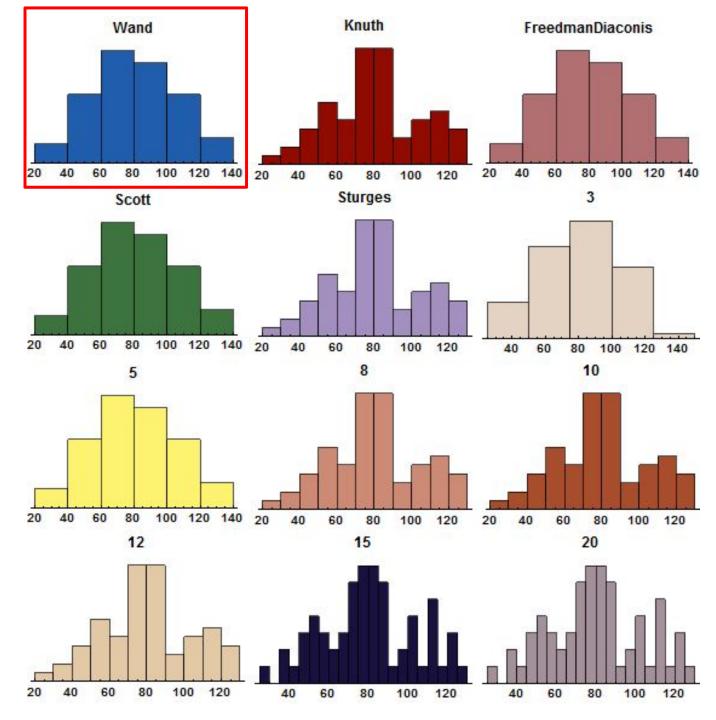




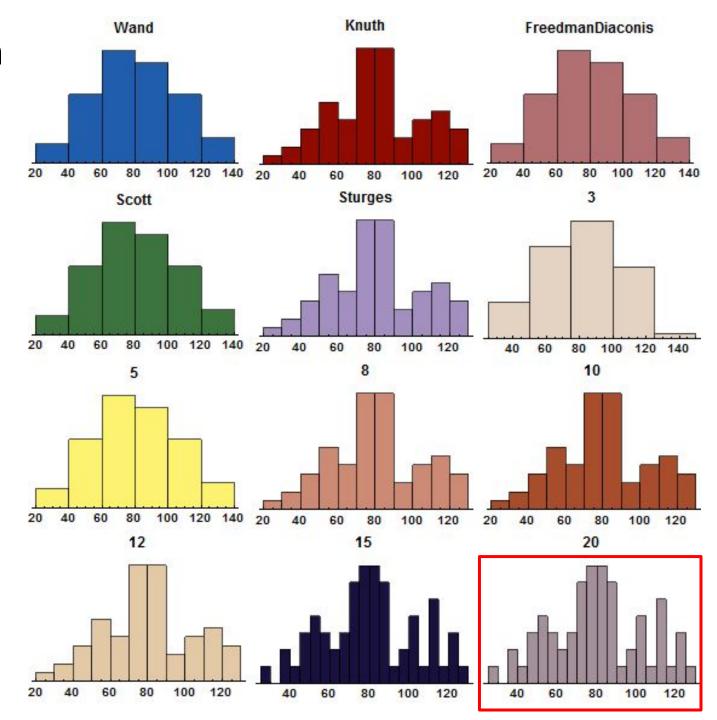
Histogram Binning

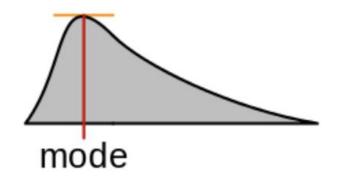


Histogram Binning

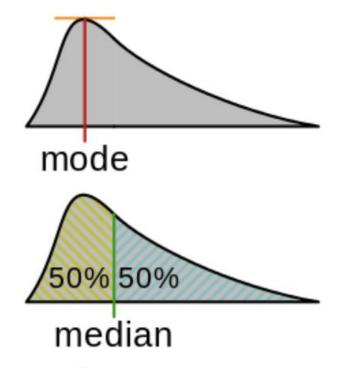


Histogram Binning



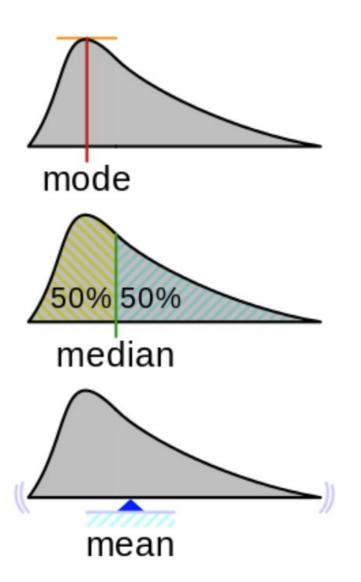


Mode: Most frequent value in data



Mode: Most frequent value in data

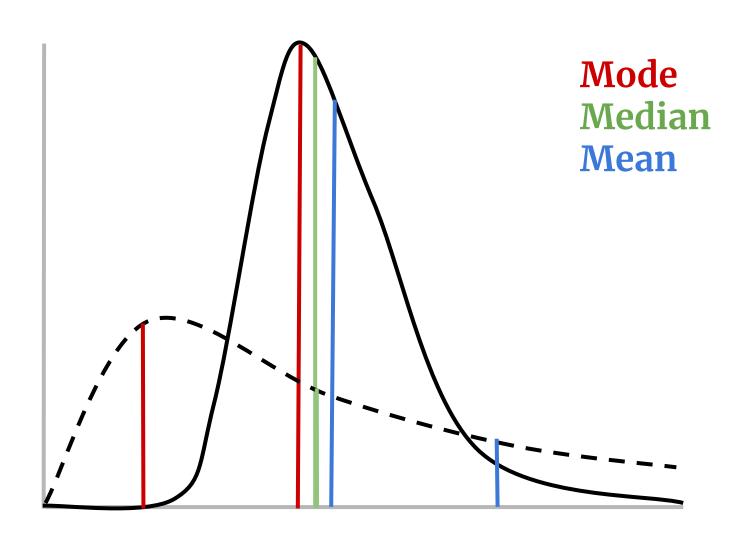
Median: splits samples in two equally sized sets (50:50)



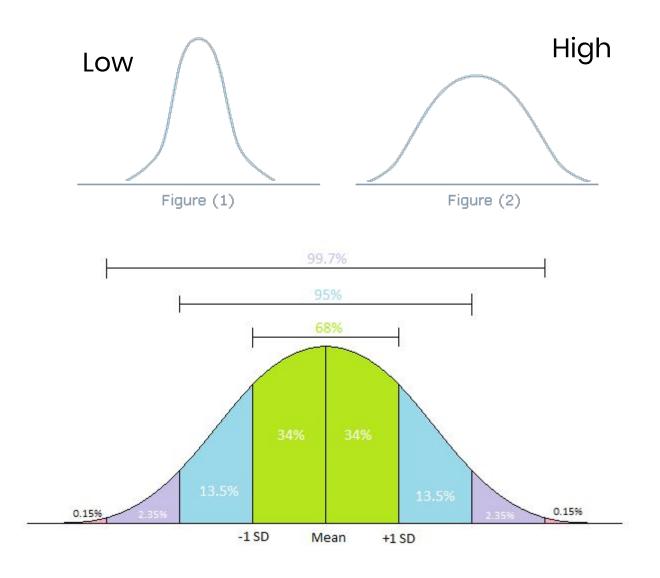
Mode: Most frequent value in data

Median: splits samples in two equally sized sets (50:50)

Mean: average value

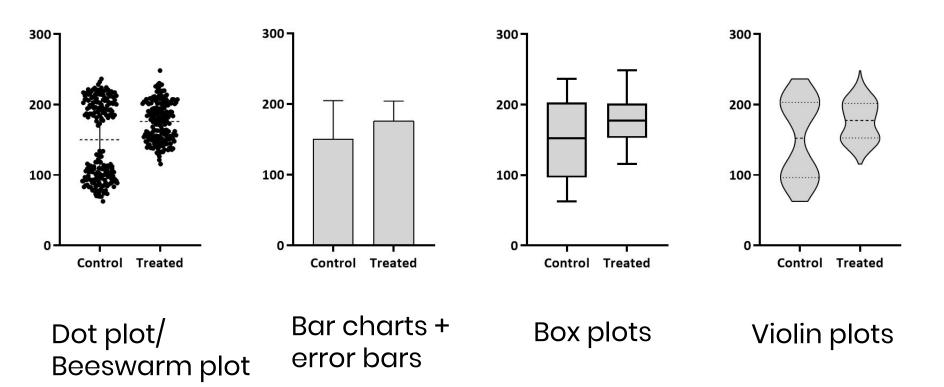


Standard deviation

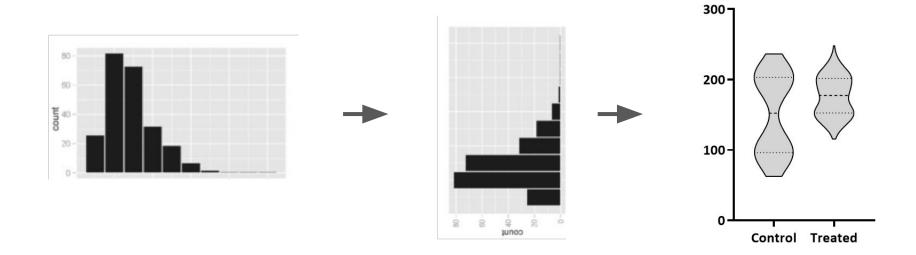


Visualizing Distributions

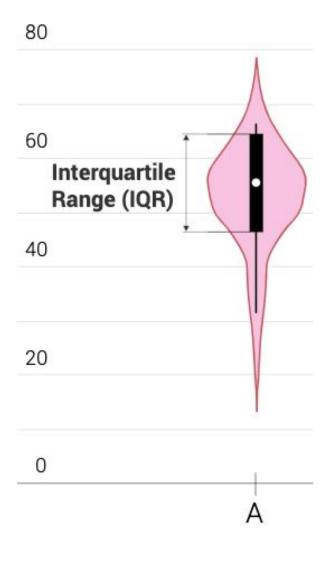
Plotting Distributions



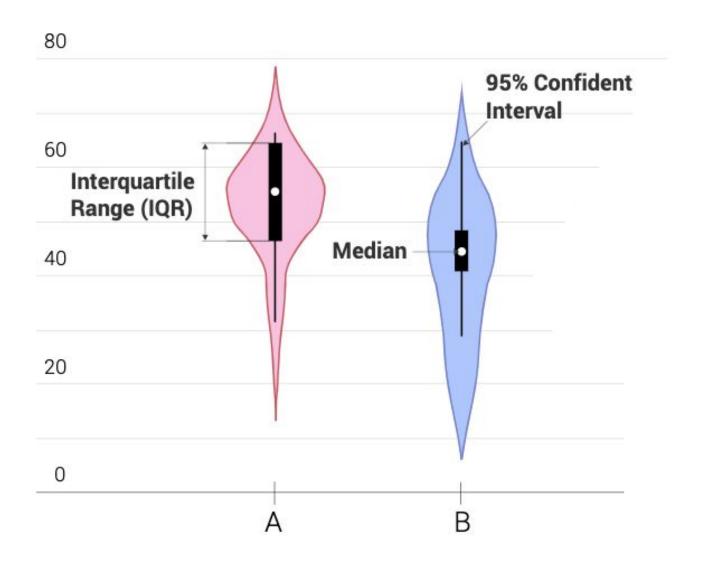
Violin plots



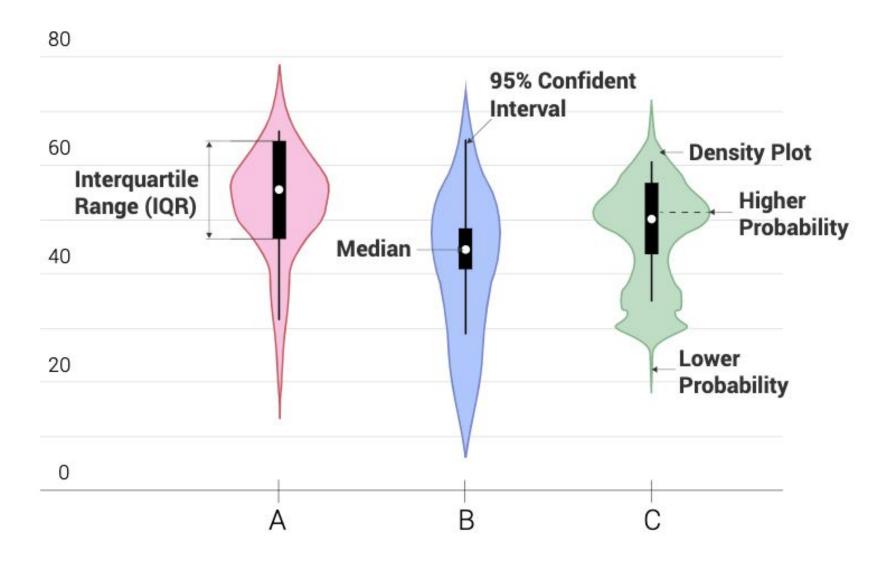
Violin plots: measures



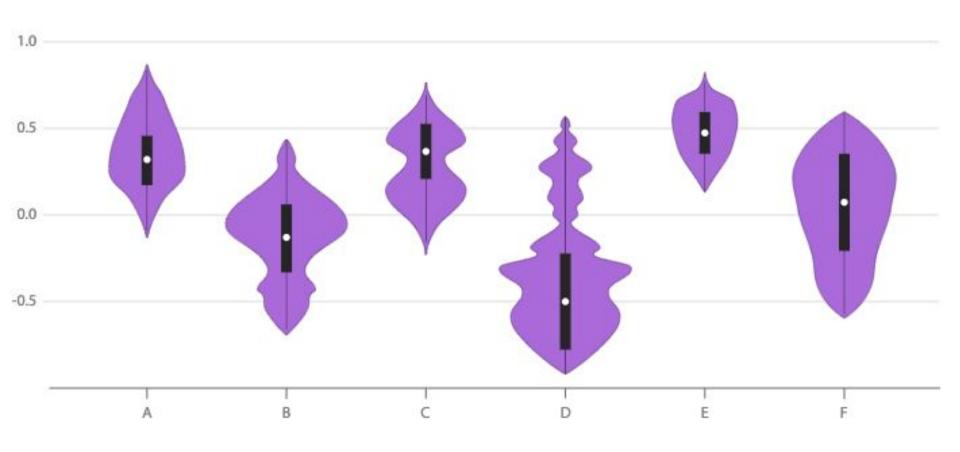
Violin plots: measures



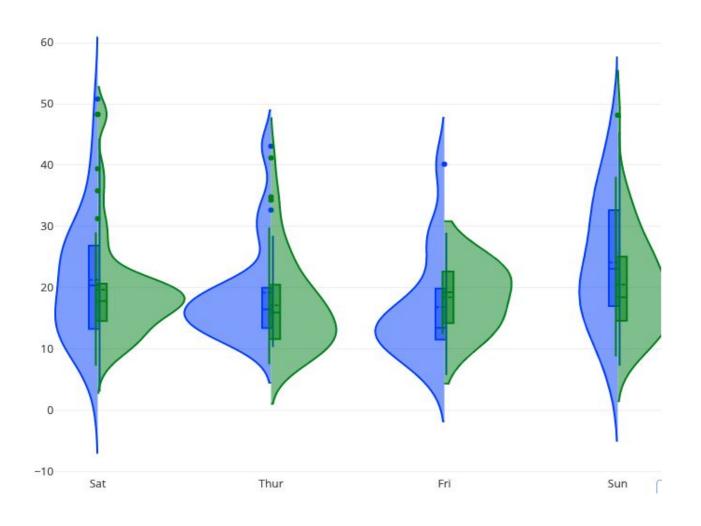
Violin plots: measures



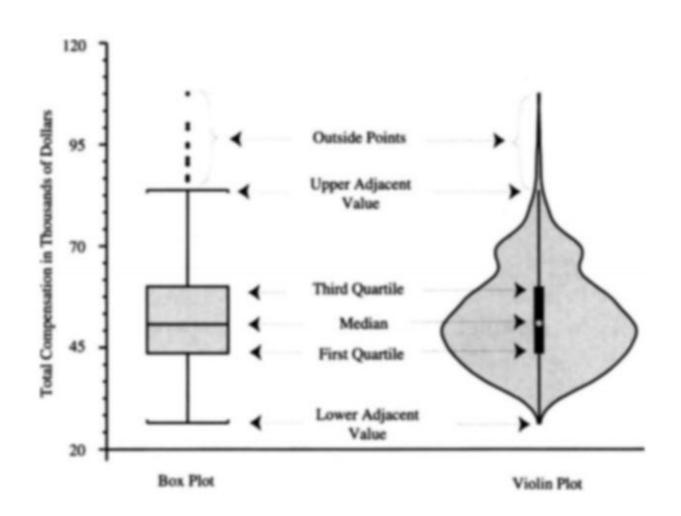
Violin plots: example shapes

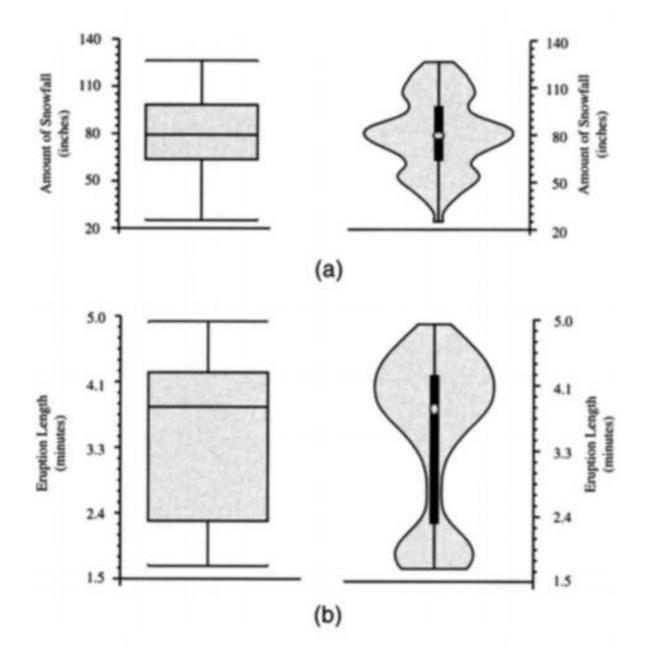


Violin plots for comparison

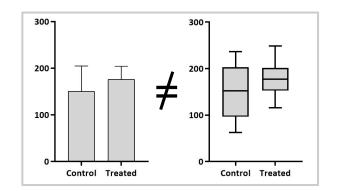


Box plots

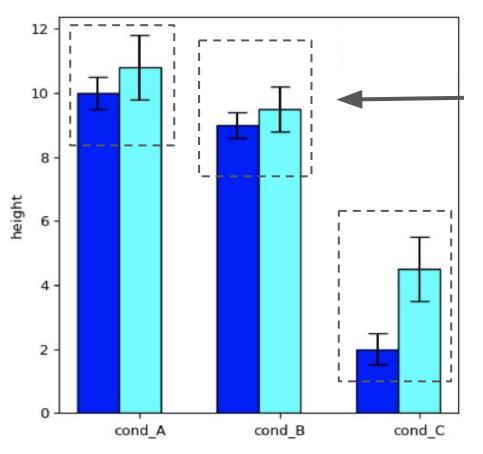




Bar plots + Error bars



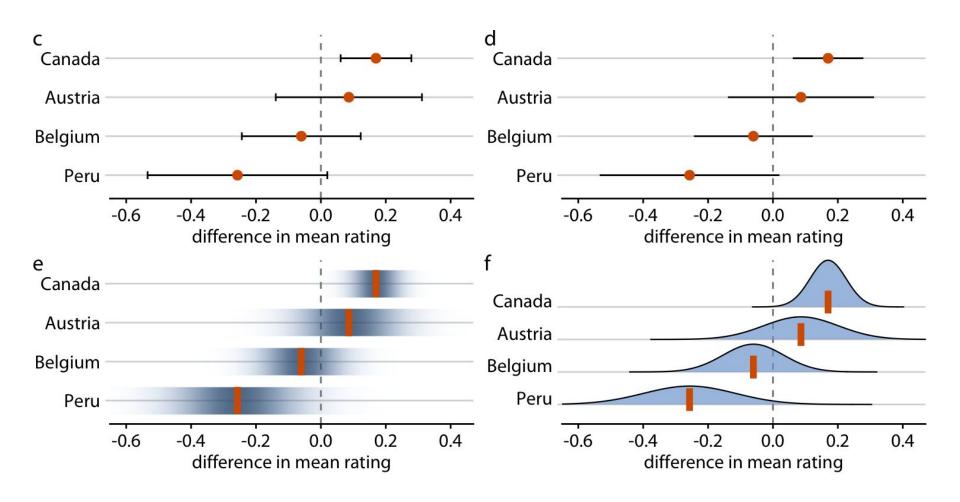
?



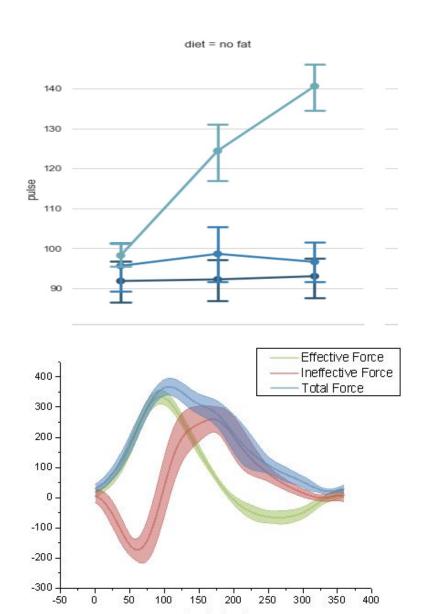
No significant difference

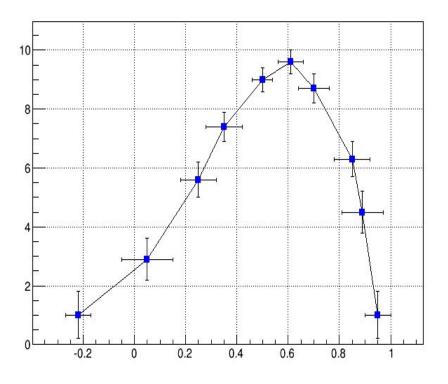
Significance difference

Uncertainty

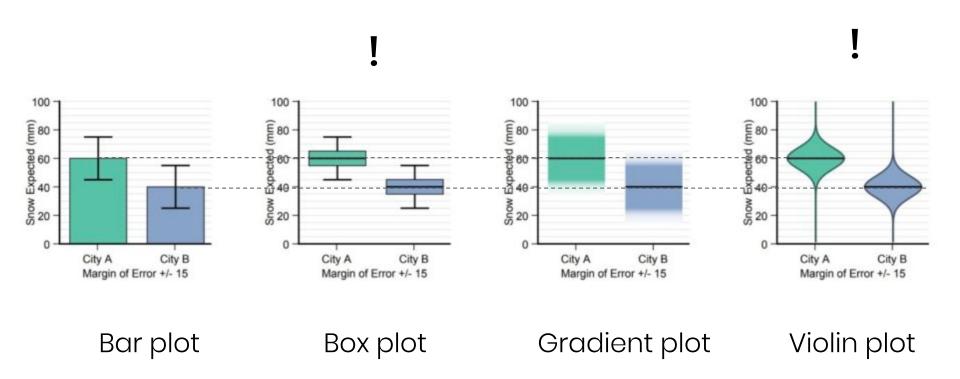


Uncertainty



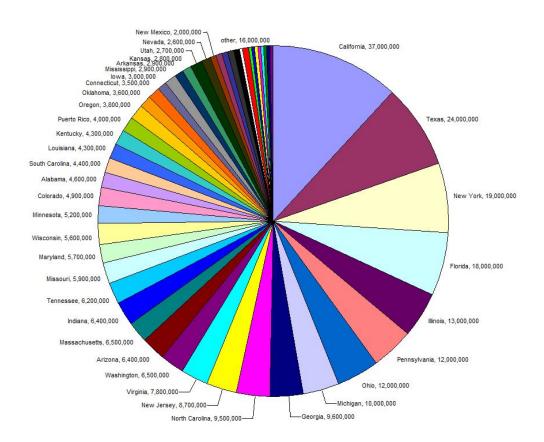


Comparing plots



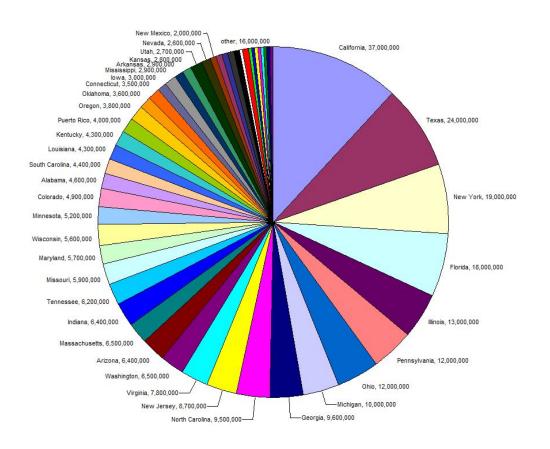
A word on pie charts...

Bad Pie Charts



- Too many values
 Differences hard to understand
- Distribution?
- (Confusing colors)

Bad Pie Charts

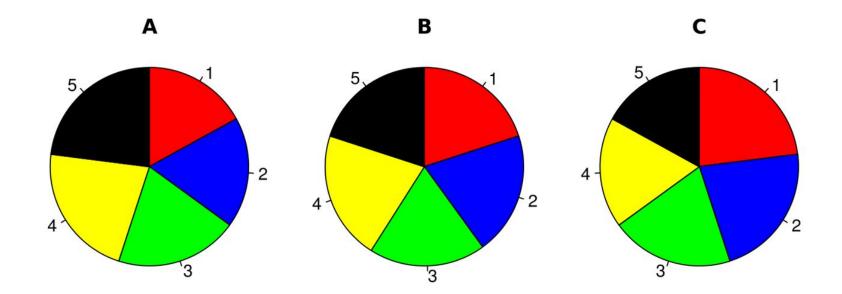




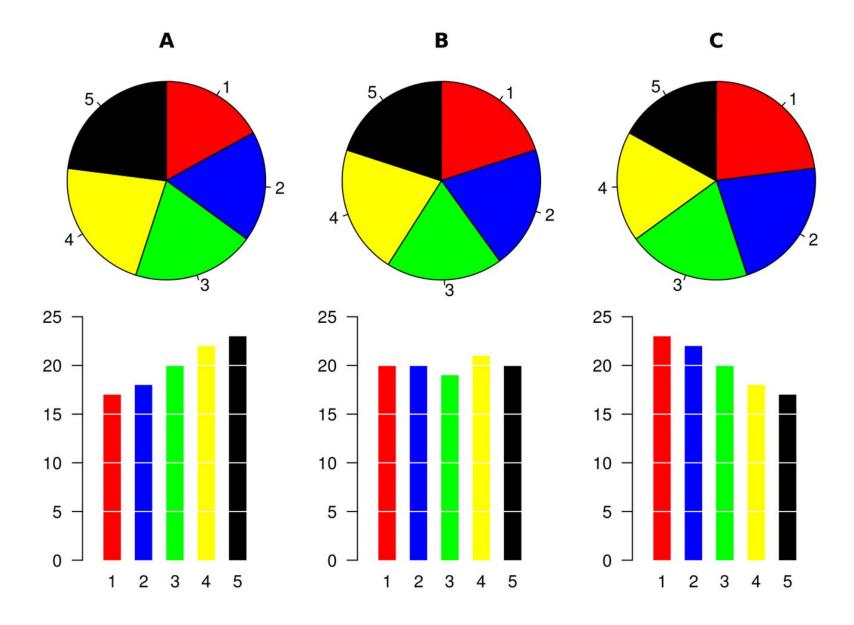
- Too many values
 Differences hard to understand
- Distribution?
- (Confusing colors)

Not adding up to 100%

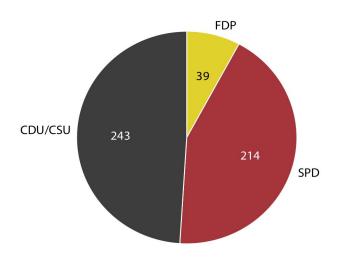
Pie Charts



Pie Charts



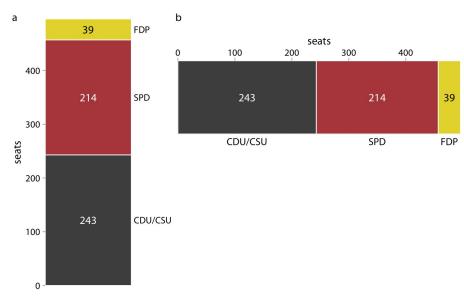
Alternatives?



Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019.

Pie chart

Stacked bars



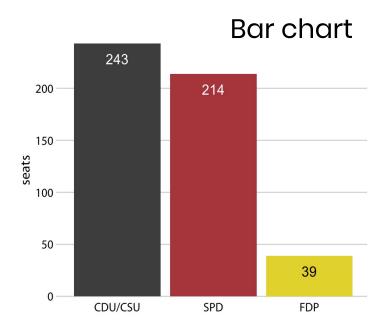


Table 10.1: Pros and cons of common approaches to visualizing proportions: pie charts, stacked bars, and side-by-side bars.

	Pie chart	Stacked bars	Side-by-side bars
Clearly visualizes the data as proportions of a whole	~	V	×

Table 10.1: Pros and cons of common approaches to visualizing proportions: pie charts, stacked bars, and side-by-side bars.

	Pie chart	Stacked bars	Side-by-side bars
Clearly visualizes the data as proportions of a whole	V	~	×
Allows easy visual comparison of the relative proportions	×	×	~

Table 10.1: Pros and cons of common approaches to visualizing proportions: pie charts, stacked bars, and side-by-side bars.

	Pie chart	Stacked bars	Side-by-side bars
Clearly visualizes the data as proportions of a whole	V	~	*
Allows easy visual comparison of the relative proportions	×	×	~
Visually emphasizes simple fractions, such as 1/2, 1/3, 1/4	~	×	×

Table 10.1: Pros and cons of common approaches to visualizing proportions: pie charts, stacked bars, and side-by-side bars.

	Pie chart	Stacked bars	Side-by-side bars
Clearly visualizes the data as proportions of a whole	~	~	*
Allows easy visual comparison of the relative proportions	*	×	~
Visually emphasizes simple fractions, such as 1/2, 1/3, 1/4	~	×	*
Looks visually appealing even for very small datasets	~	×	~

Table 10.1: Pros and cons of common approaches to visualizing proportions: pie charts, stacked bars, and side-by-side bars.

	Pie chart	Stacked bars	Side-by-side bars
Clearly visualizes the data as proportions of a whole	V	~	×
Allows easy visual comparison of the relative proportions	×	×	~
Visually emphasizes simple fractions, such as 1/2, 1/3, 1/4	V	×	×
Looks visually appealing even for very small datasets	~	×	~
Works well when the whole is broken nto many pieces	×	×	~

Table 10.1: Pros and cons of common approaches to visualizing proportions: pie charts, stacked bars, and side-by-side bars.

	Pie chart	Stacked bars	Side-by-side bars
Clearly visualizes the data as proportions of a whole	~	~	*
Allows easy visual comparison of the relative proportions	*	×	~
Visually emphasizes simple fractions, such as 1/2, 1/3, 1/4	~	×	×
Looks visually appealing even for very small datasets	~	×	~
Works well when the whole is broken into many pieces	×	×	~
Works well for the visualization of many sets of proportions or time series of proportions	×	V	×

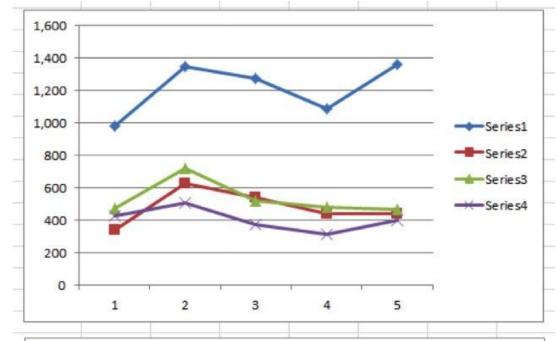
Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019.

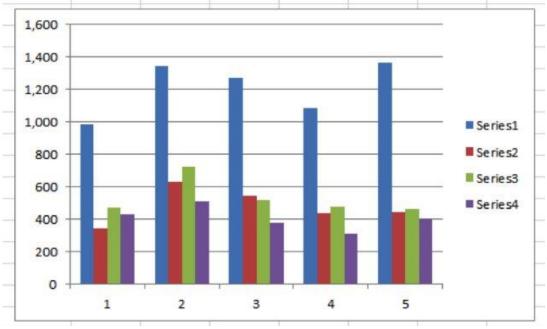
Line Charts vs. Bar Charts

Line Charts vs. Bar Charts?

Continuous values e.g., time series

Discrete values e.g., countries





https://online-behavior.com/analytics/data-visualization

Wrap up

- Choose appropriate bin-sizes
- violin plots for compare distributions
- Label error bars
- Don't confound box plots and error bars
- Avoid pie charts
- Line charts for continuous data

Further Readings

- Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019.
 - https://serialmentor.com/dataviz/visualizing-proportions.htm
 - https://serialmentor.com/dataviz/histograms-density-plots.htmll
 - https://serialmentor.com/dataviz/boxplots-violins.html
- Hullman, Jessica, Paul Resnick, and Eytan Adar. "Hypothetical outcome plots outperform error bars and violin plots for inferences about reliability of variable ordering." *PloS one* 10.11 (2015).
- Skau, Drew, and Robert Kosara. "Arcs, angles, or areas: Individual data encodings in pie and donut charts." Computer Graphics Forum. Vol. 35. No. 3. 2016.
- Cairo, Alberto. **The truthful art: data, charts, and maps for communication**. New Riders, 2016.
 - Chapter 6: Exploring Data with Simple Charts
 - Chapter 7: Visualizing Distributions