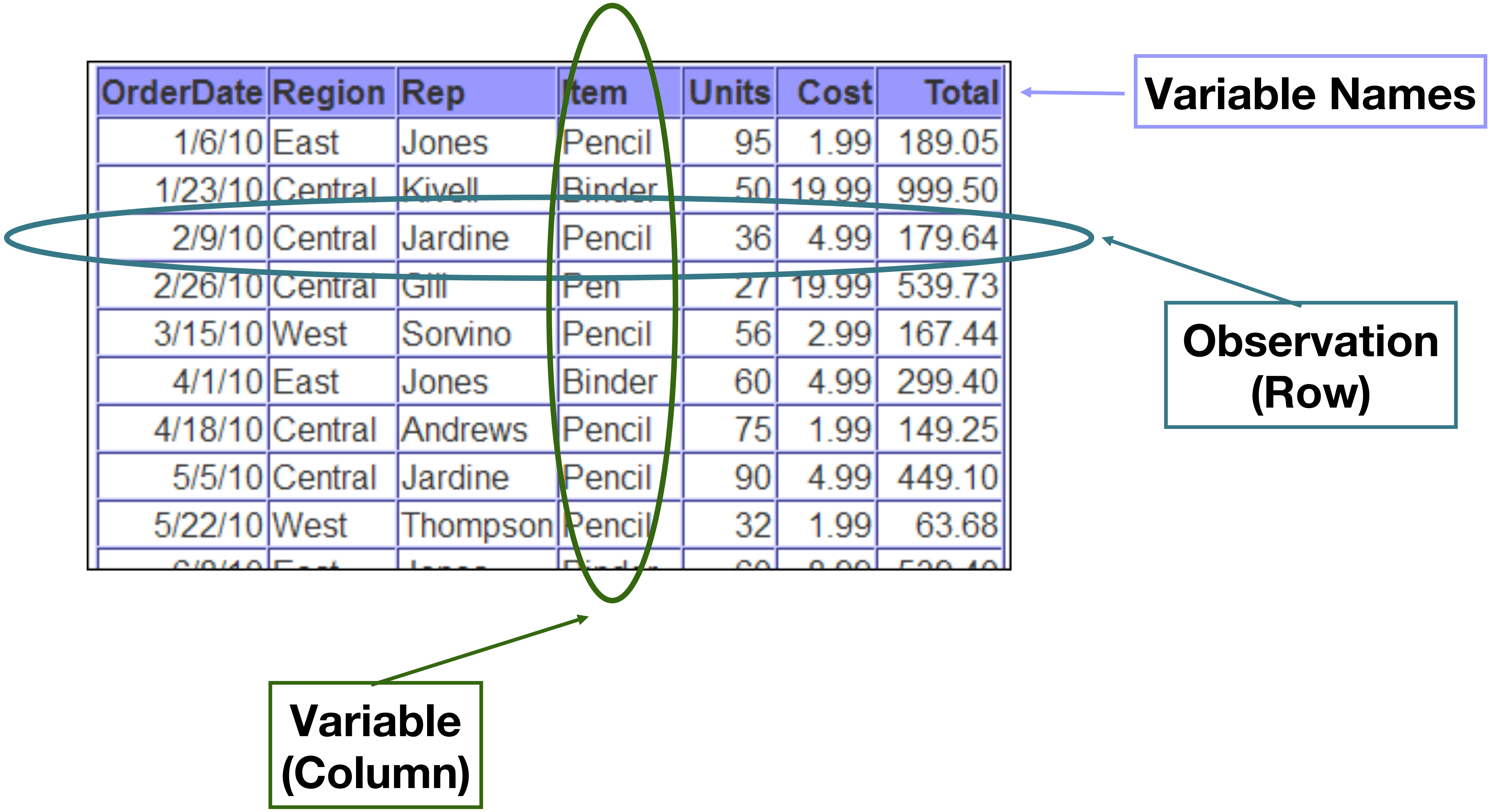
Data Organization

Data is stored in the form of a ***<u>Data Matrix</u>***



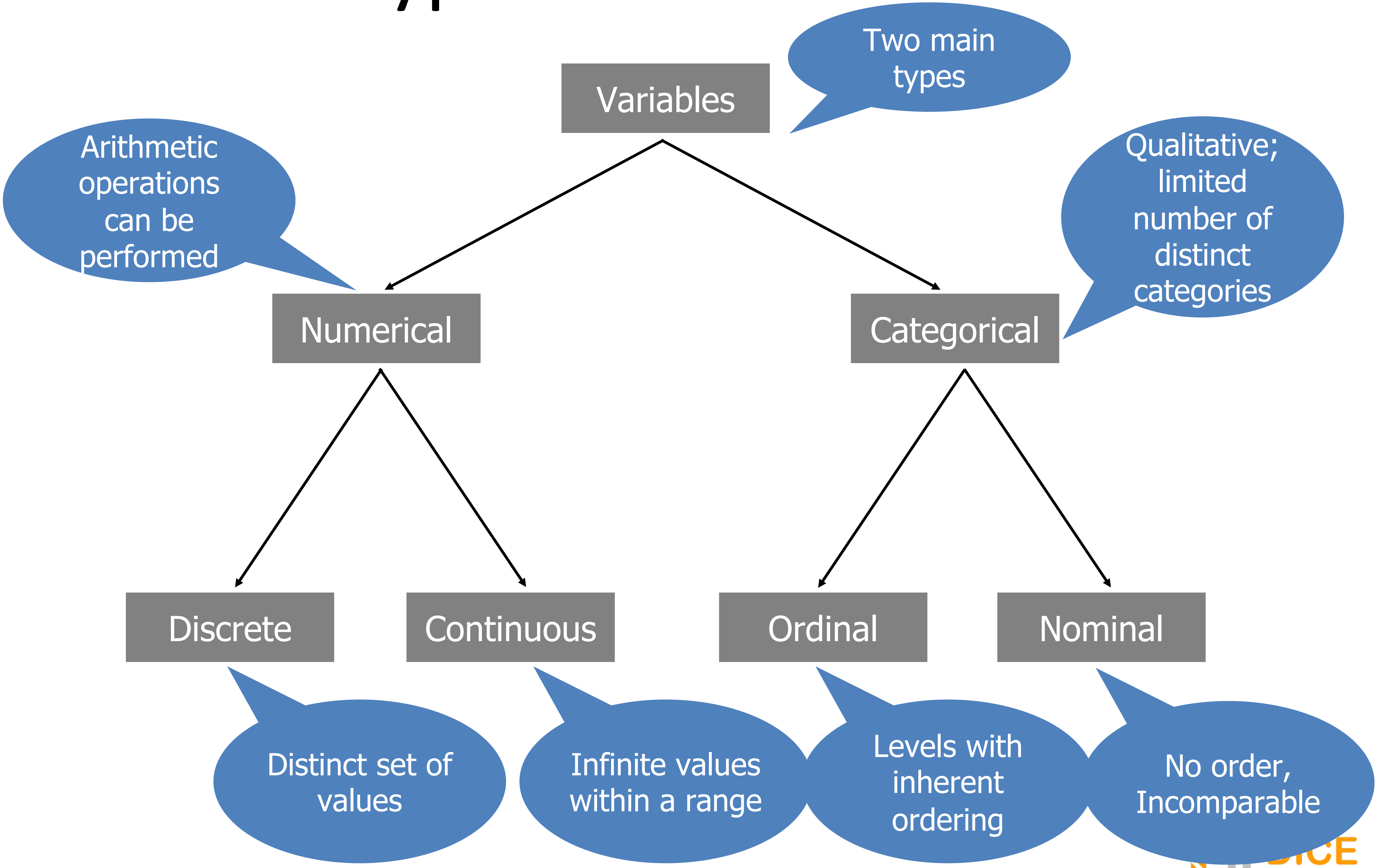
OrderDate	Region	Rep	Item	Units	Cost	Total
1/6/10	East	Jones	Pencil	95	1.99	189.05
1/23/10	Central	Kivell	Binder	50	19.99	999.50
2/9/10	Central	Jardine	Pencil	36	4.99	179.64
2/26/10	Central	Gill	Pen	27	19.99	539.73
3/15/10	West	Sorvino	Pencil	56	2.99	167.44
4/1/10	East	Jones	Binder	60	4.99	299.40
4/18/10	Central	Andrews	Pencil	75	1.99	149.25
5/5/10	Central	Jardine	Pencil	90	4.99	449.10
5/22/10	West	Thompson	Pencil	32	1.99	63.68

Variable Names

Observation (Row)

Variable (Column)

Types of Variables



Variables

Two main types

Numerical

Arithmetic operations can be performed

Categorical

Qualitative; limited number of distinct categories

Discrete

Distinct set of values

Continuous

Infinite values within a range

Ordinal

Levels with inherent ordering

Nominal

No order, Incomparable

Types of Variables

http://www.statisticshowto.com/types-variables/

https://statistics.laerd.com/statistical-guides/types-of-variable.php

Types of Variables

- *Response Variable*: It is the focus of a question in a study or experiment. It is the variable we want to predict or observe. It is the dependent variable.

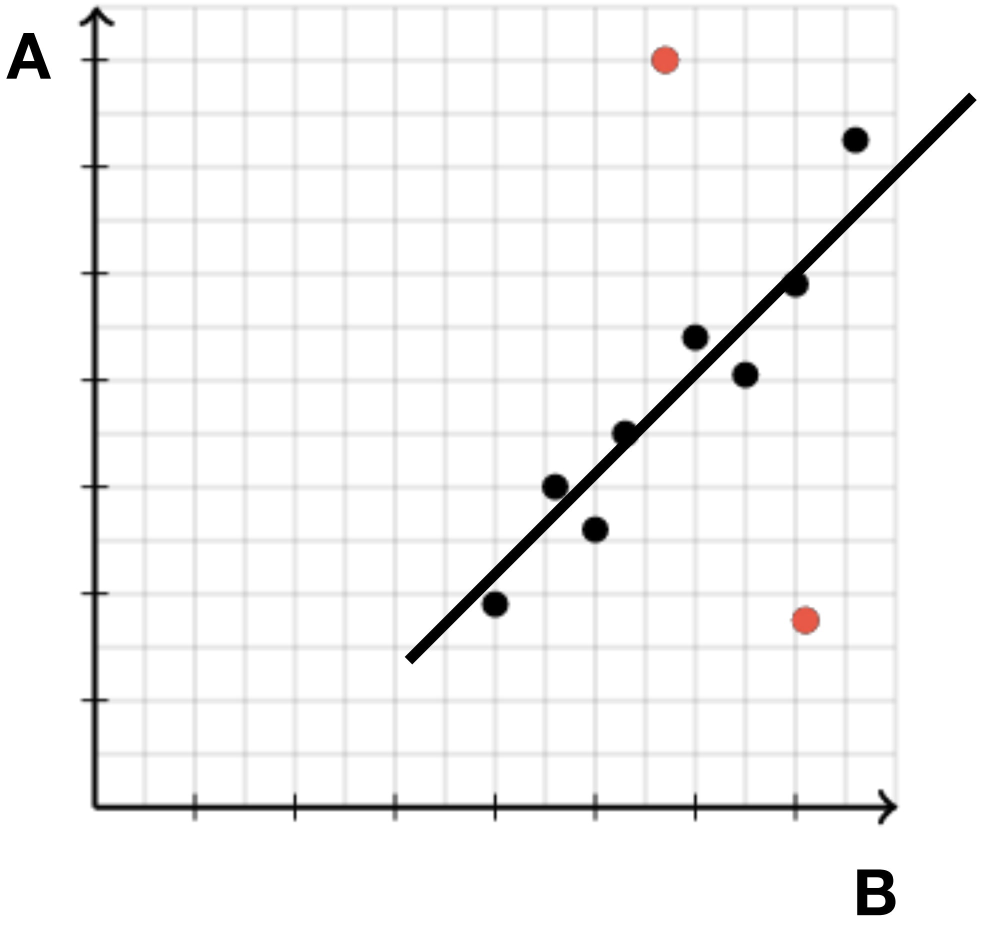
- *Explanatory Variable*: It is the variable on whom the response variable depends, or the variable which ‘explains’ the response variable. It is assumed to be independent variable.

Relationship b/w Variables

- Two variables that show connection with each other are called ***Associated/Correlated (Dependent)***

- Two variables that do not show connection with each other are called ***Independent***

- An observation that is away that is not close to majority of data is called ***Outlier***



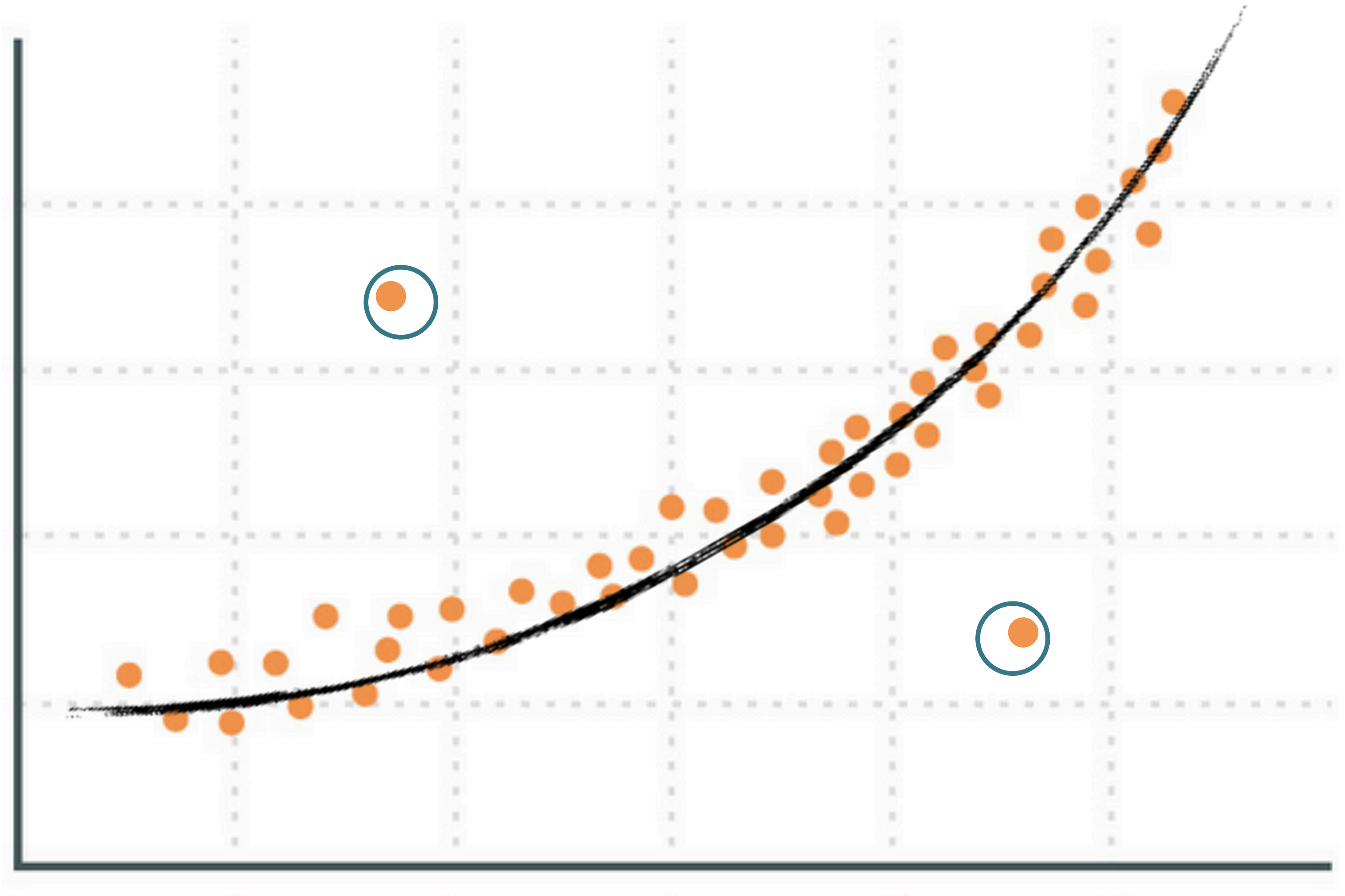
Data Visualisation

DICE
ANALYTICS

Visualising Numerical Data

DICE ANALYTICS

Scatterplot



Income

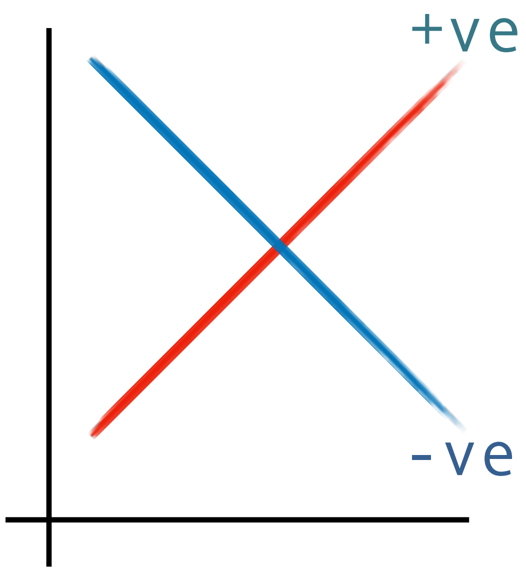
Response Variable

Age

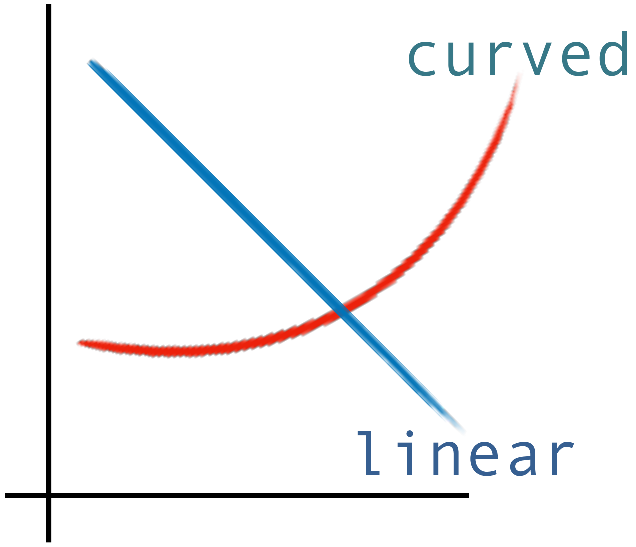
Explanatory Variable

Characteristics of Relationship

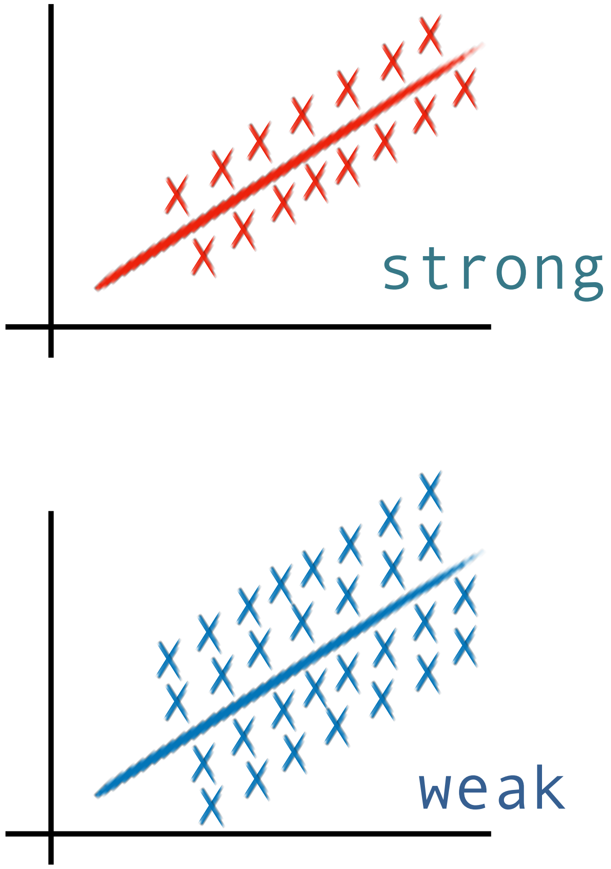
Direction



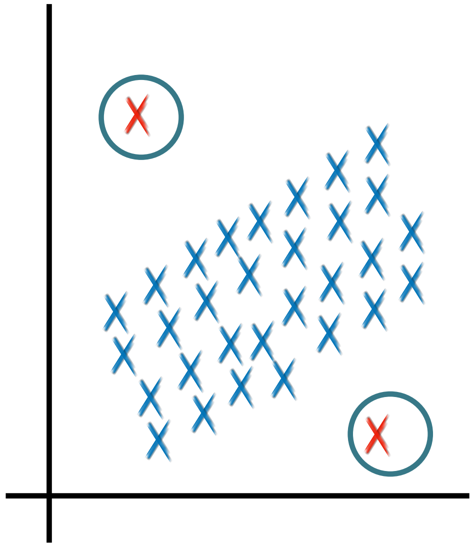
Shape



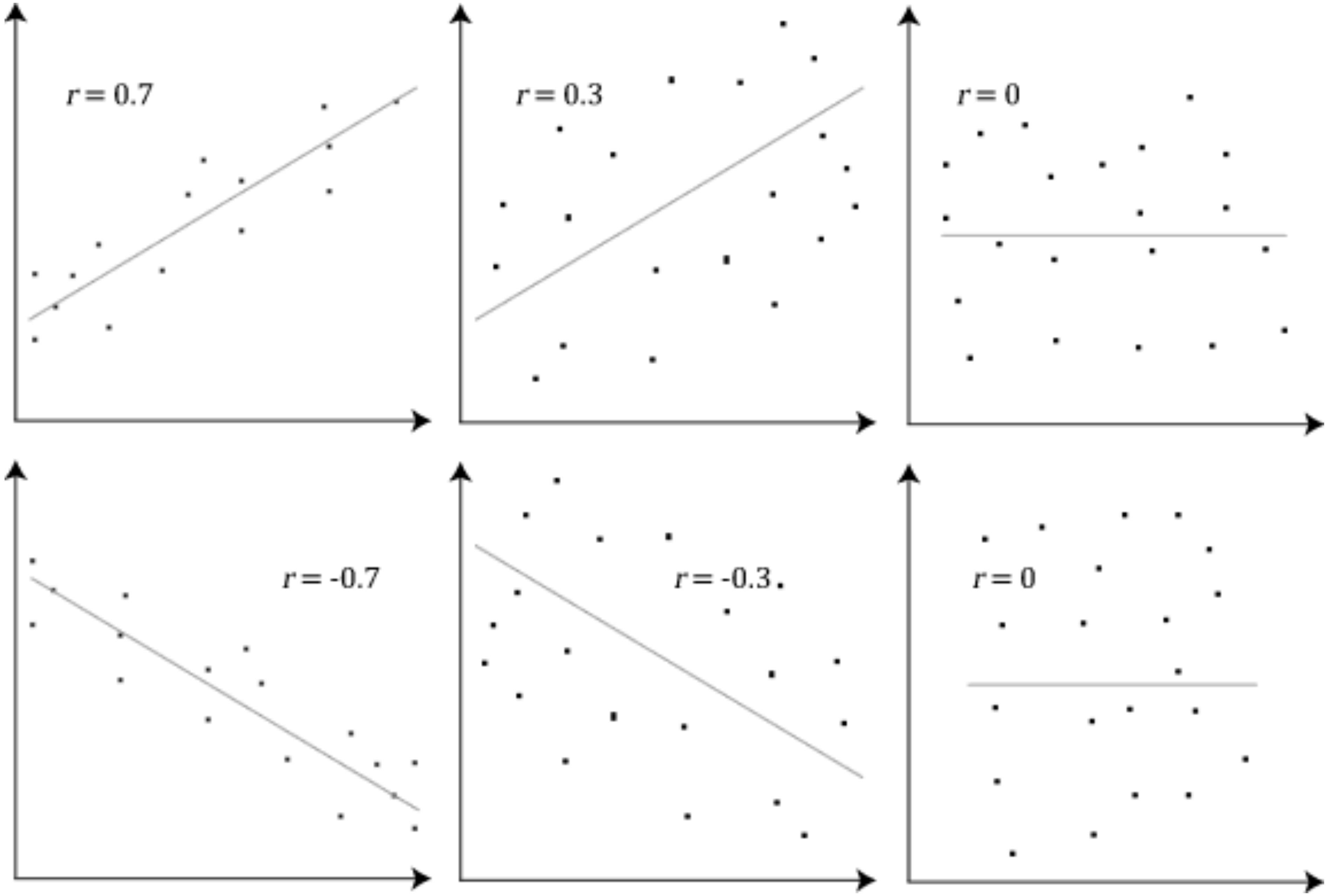
Strength



Outliers



Correlation (example)

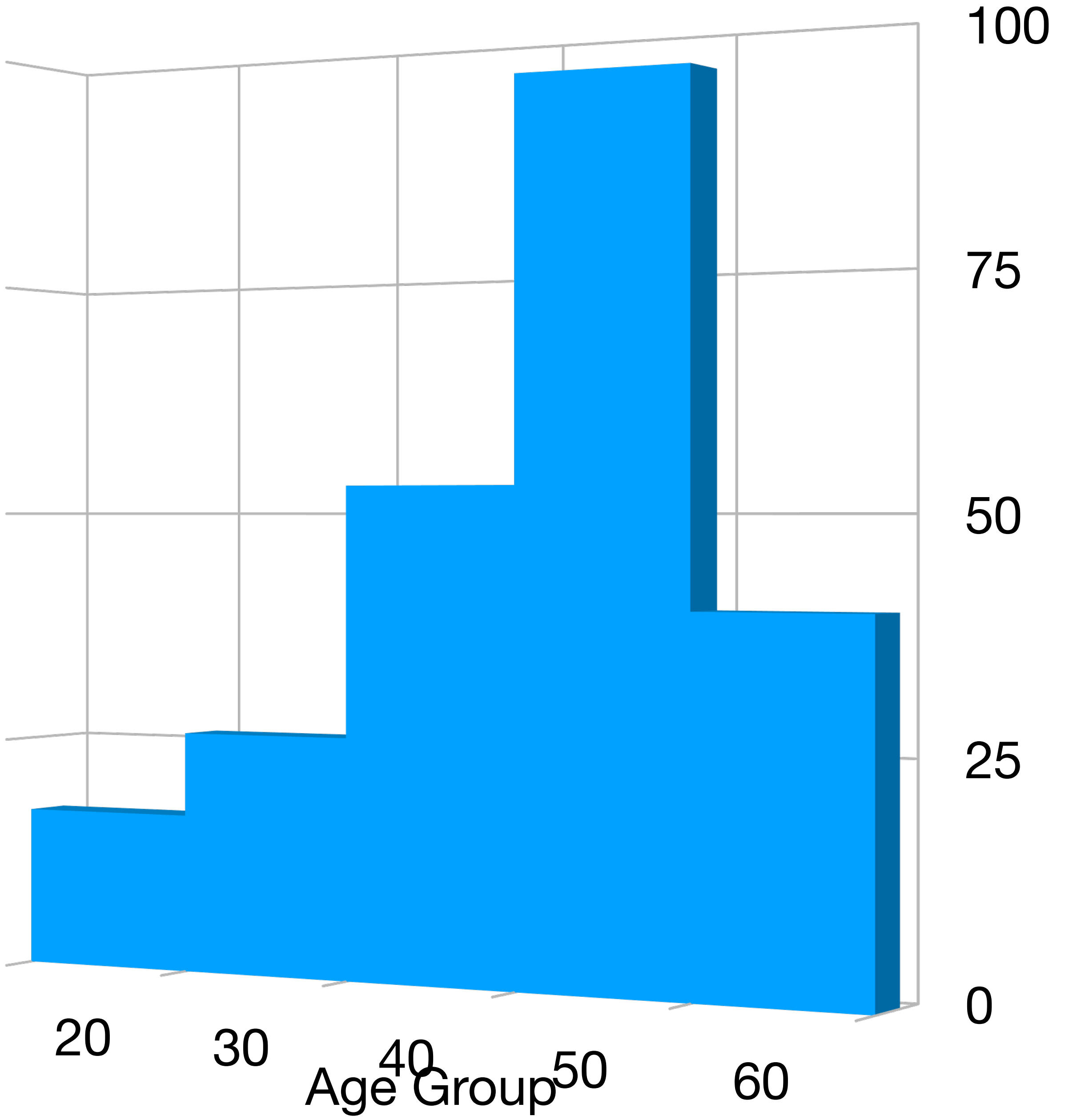


Histograms

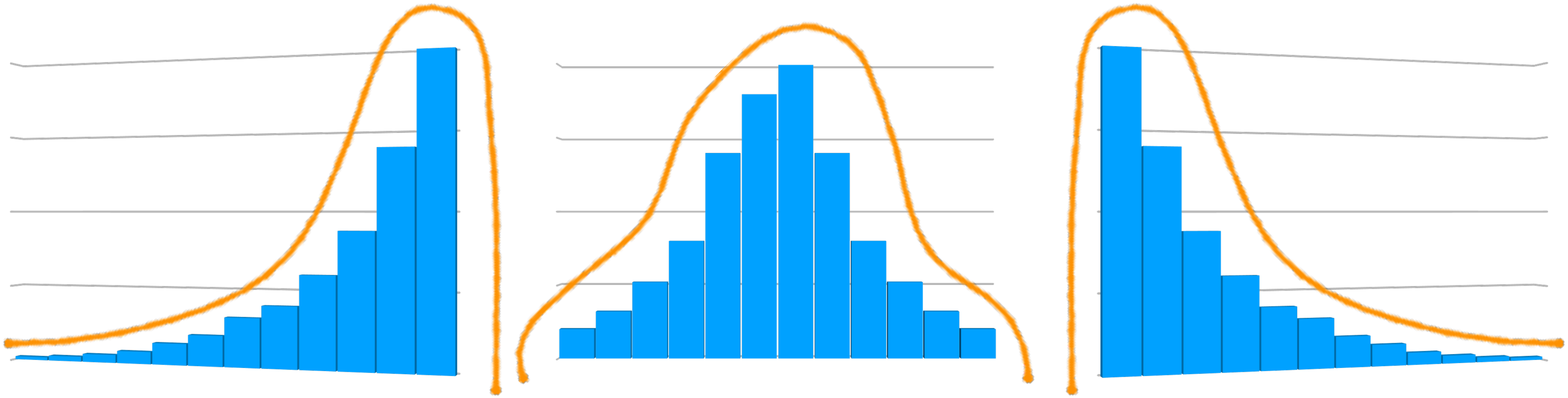
- Help to view ***data density***

- Help to see ***shape of distribution***

1) Skewness
2) Modality



Skewness



Left Skewed

Symmetric

Right Skewed

-ve Skewness

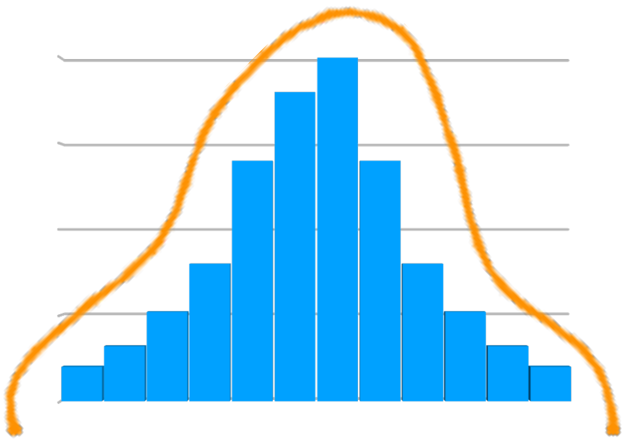
Zero Skewness

+ve Skewness

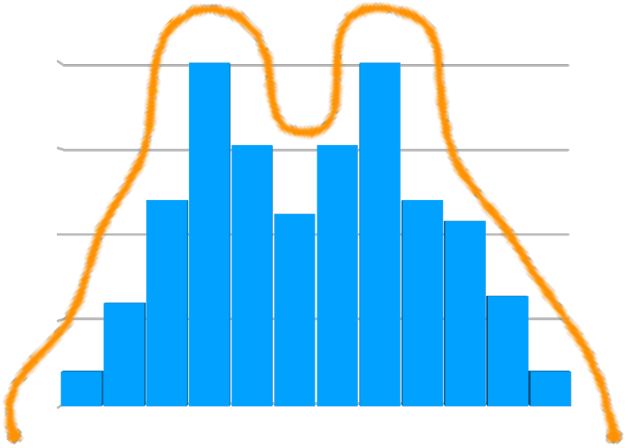
- Draw a smooth curve to see skewness
- Don’t rely on jagged edges

Modality

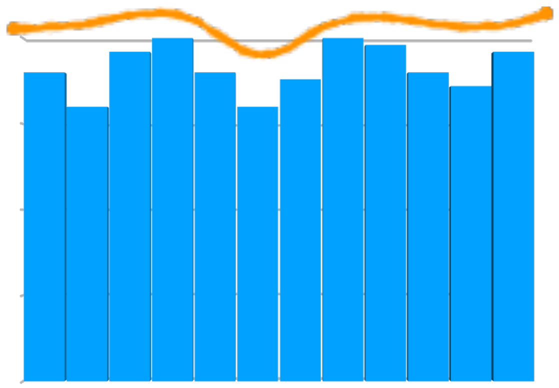
unimodal



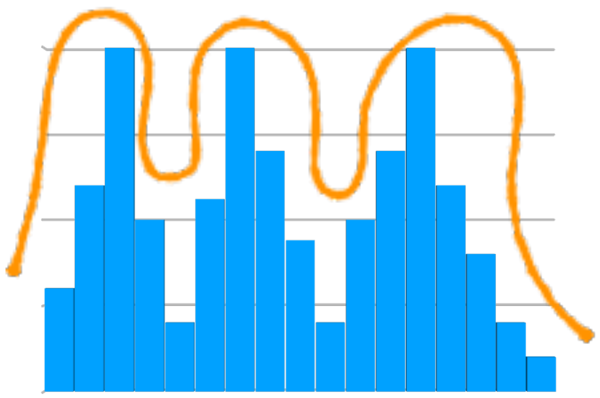
bimodal



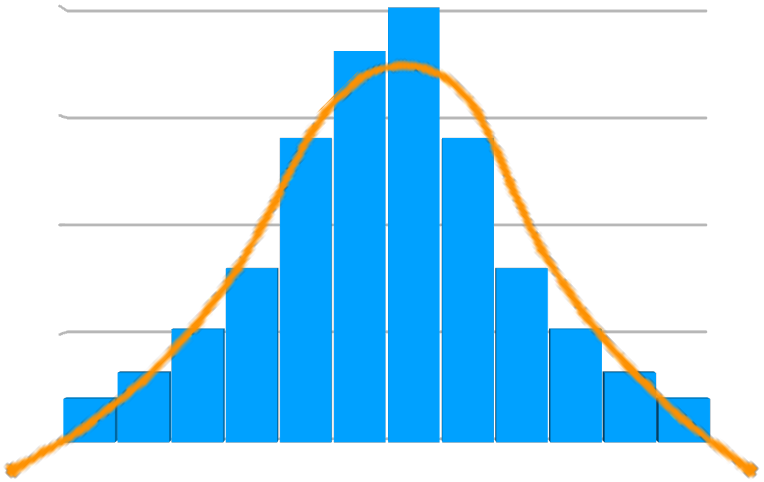
uniform



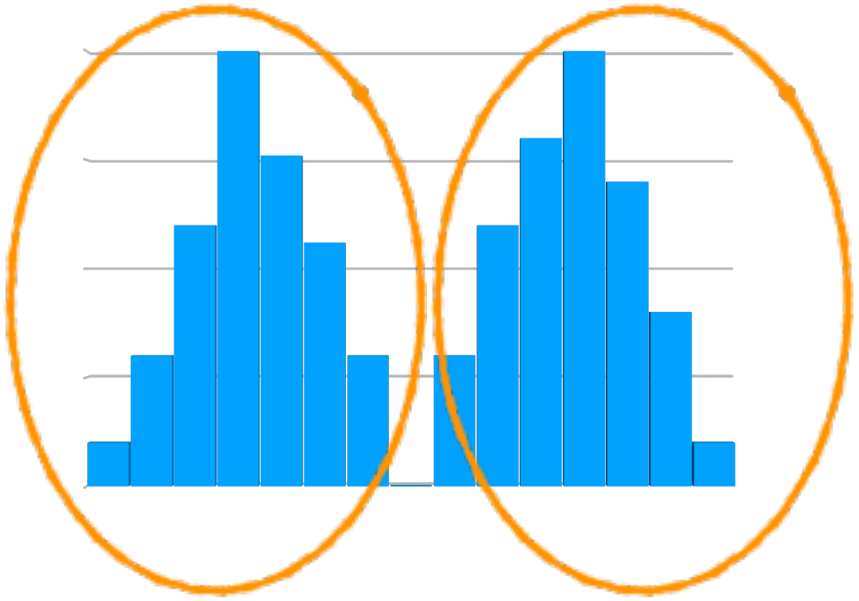
multimodal



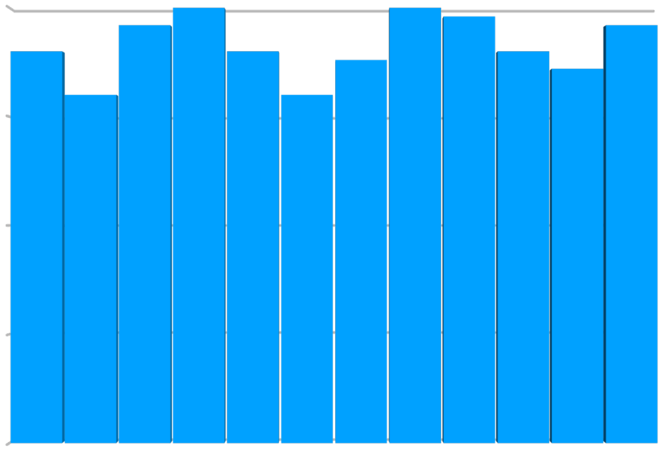
Modality (Example)



Normal Distribution

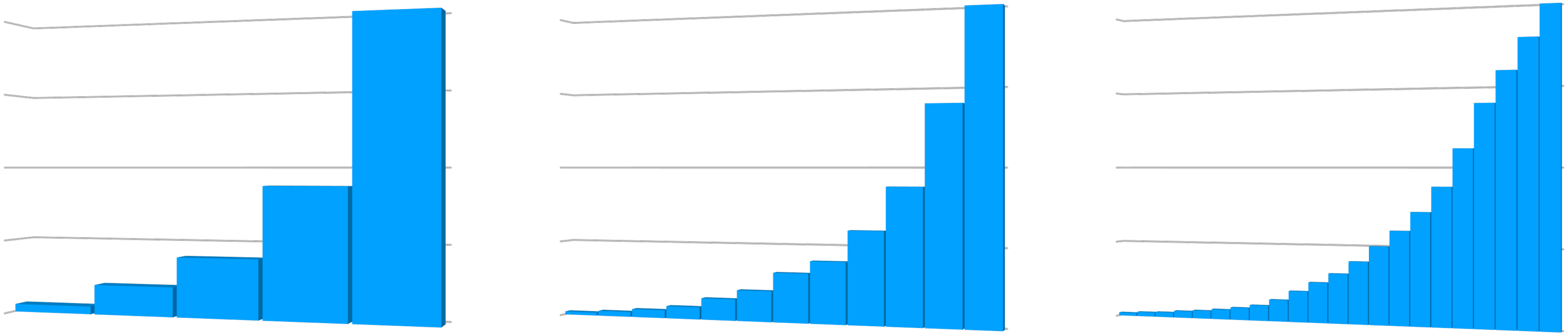


Two separate groups



No trend

Binwidth



Measures of Center

Data : 56, 87, 34, 65, 77, 62, 90, 45, 77, 79

Mean

Arithmetic Average

$$\text{Mean} = \frac{56 + 87 + 34 + 65 + 77 + 62 + 90 + 45 + 77 + 79}{10}$$

Mean = 67.2

Mode

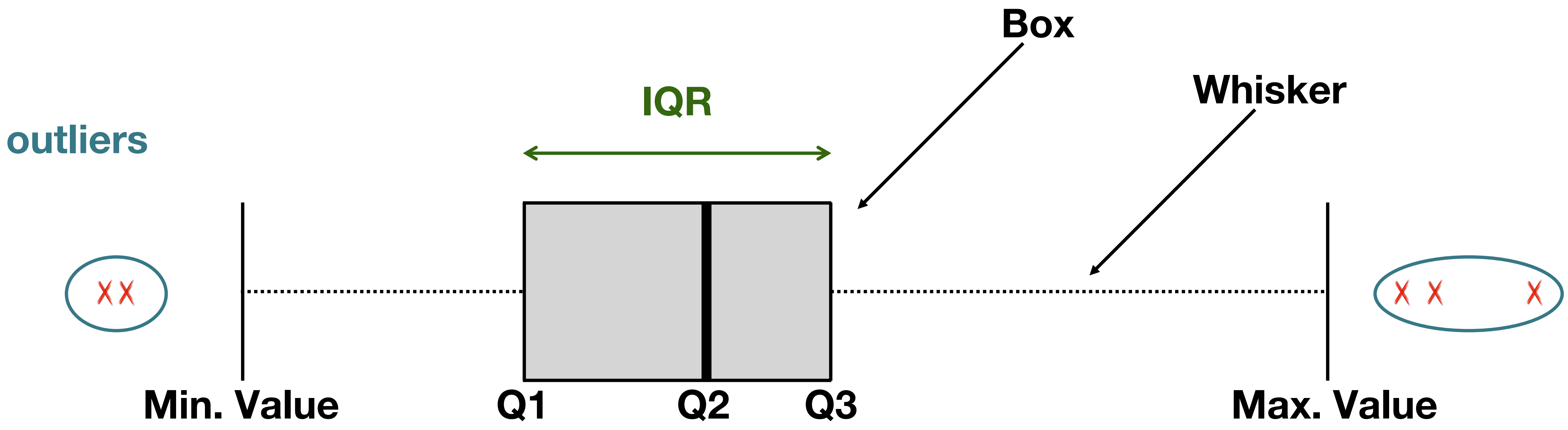
Most frequent value/observation
Mode = 77

Median

Midpoint of distribution (50th percentile)

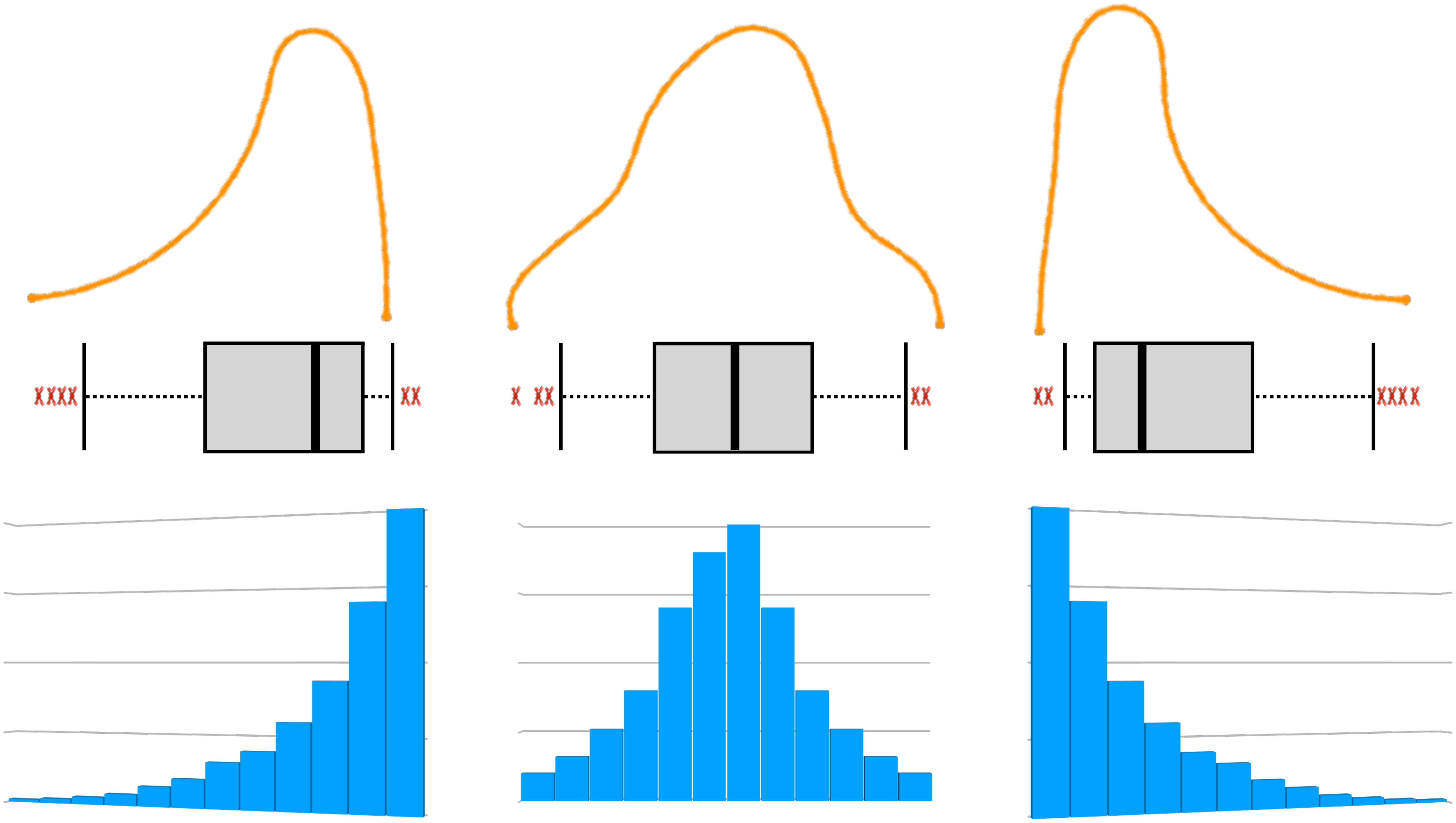
$$\text{Median} = \frac{77 + 62}{2} = 69.5$$

Box Plots



Min. Value :Lower Extreme (that's not an outlier)
Q1 :Lower Quartile (25% of observations)
Q2 :Median (50% of observations)
Q3 :Upper Quartile (75% of observations)
Max. Value :Upper Extreme (that's not an outlier)
IQR :Inter-Quartile Range = Q3 - Q1 (middle 50% of observations)

Box Plots & Skewness



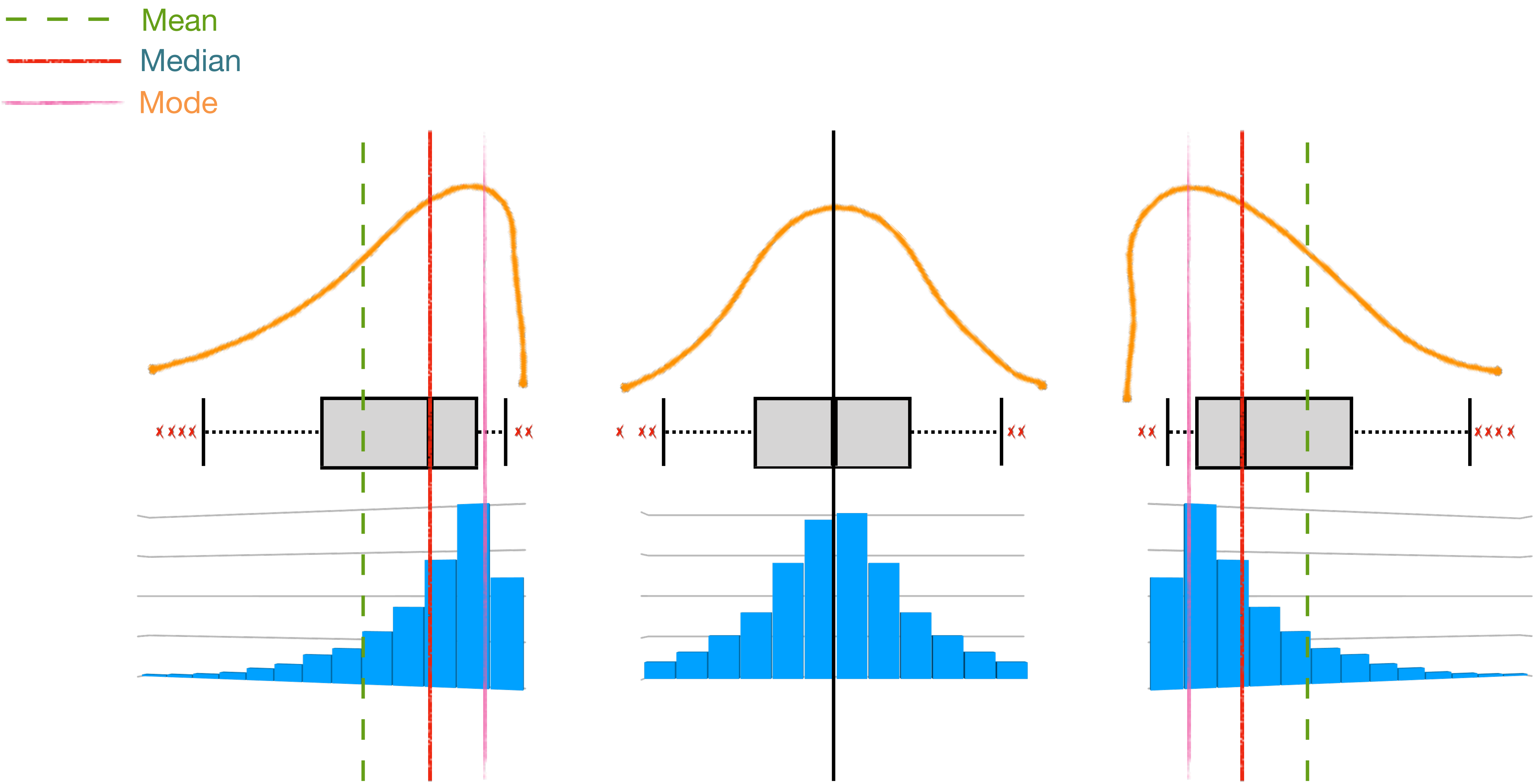
Left Skewed

Symmetric

Right Skewed

DICE
ANALYTICS

Skewness vs Measures of Center



Mean < Median < Mode

Left Skewed

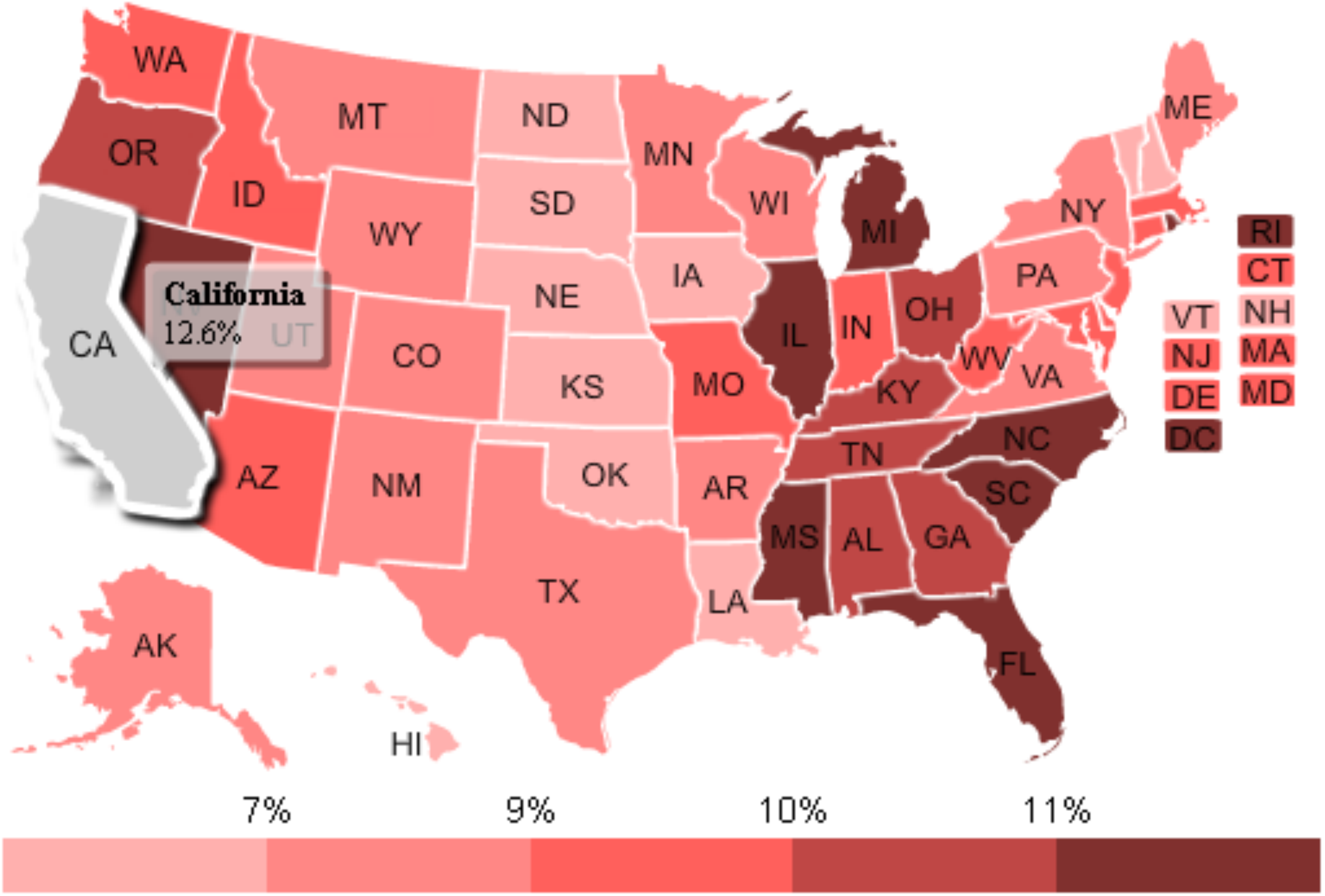
Mean = Median = Mode

Symmetric

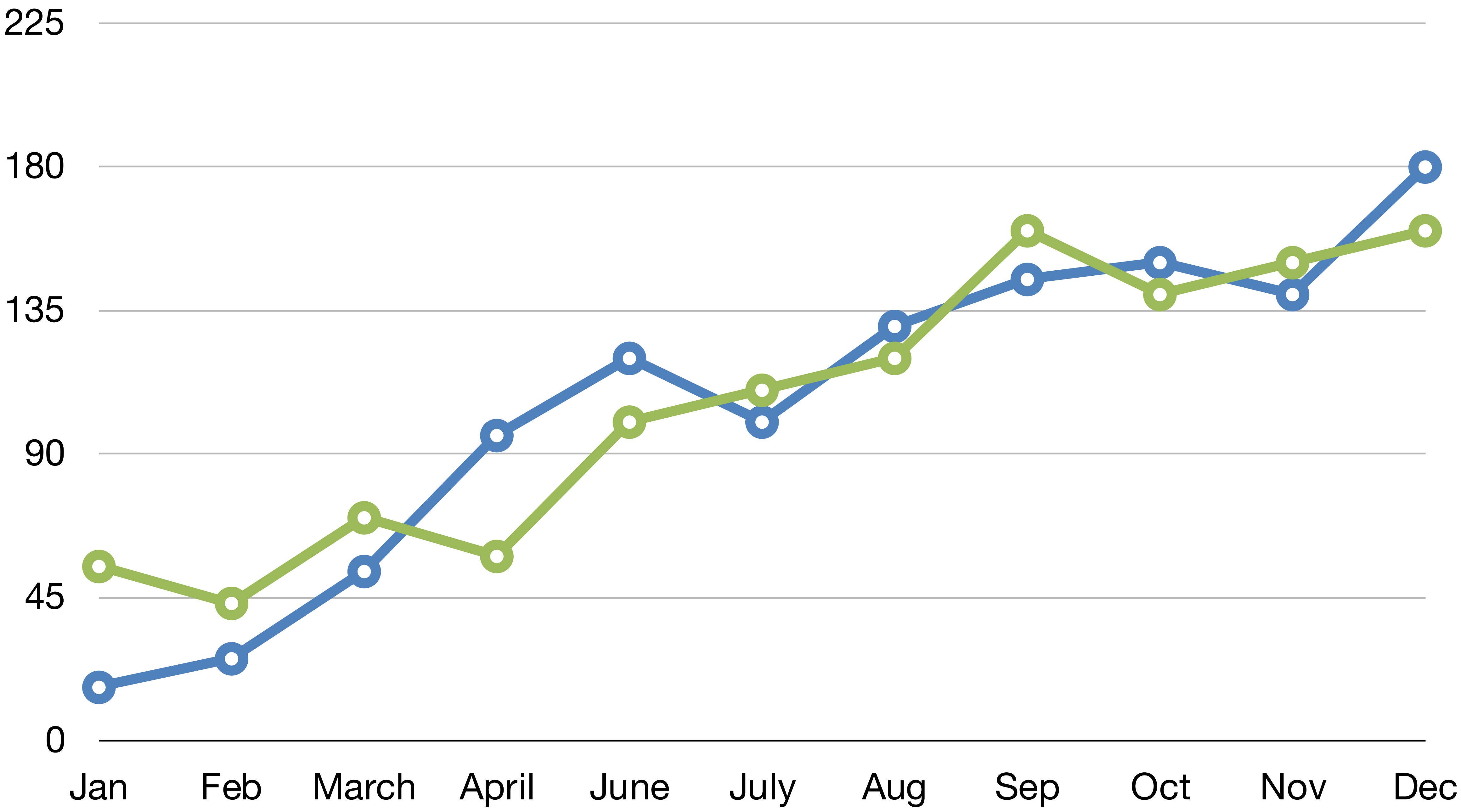
Mean > Median > Mode

Right Skewed

Intensity/Heat Maps



Time Plots


225
180
135
90
45
0
Jan
Feb
March
April
June
July
Aug
Sep
Oct
Nov
Dec

Measures of Spread

Range	Variance
Standard Deviation	Inter-quartile Range

Range

- Range = Max. Value - Min. Value
- **Data : 56, 87, 34, 65, 77, 62, 90, 45, 77, 79**
- Range = 90 - 34 = 56

Variance

- A measure of how much data (a variable) varies; how spread out a data set is about the mean.
- Average squared deviation from mean; has squared units of the variable
- Sample Variance

$$s^2 = \frac{\sum (X - \overline{X})^2}{N - 1}$$

- Population Variance

$$\sigma^2 = \frac{\sum (x - \mu)^2}{N}$$

Variance (Example)

- **Data : 56, 87, 34, 65, 77, 62, 90, 45, 77, 79**

$$s^2 = \frac{\sum (X - \bar{X})^2}{N - 1} = \frac{(56 - 67.2)^2 + (87 - 67.2)^2 + \ldots\ldots + (79 - 67.2)^2}{10-1}$$

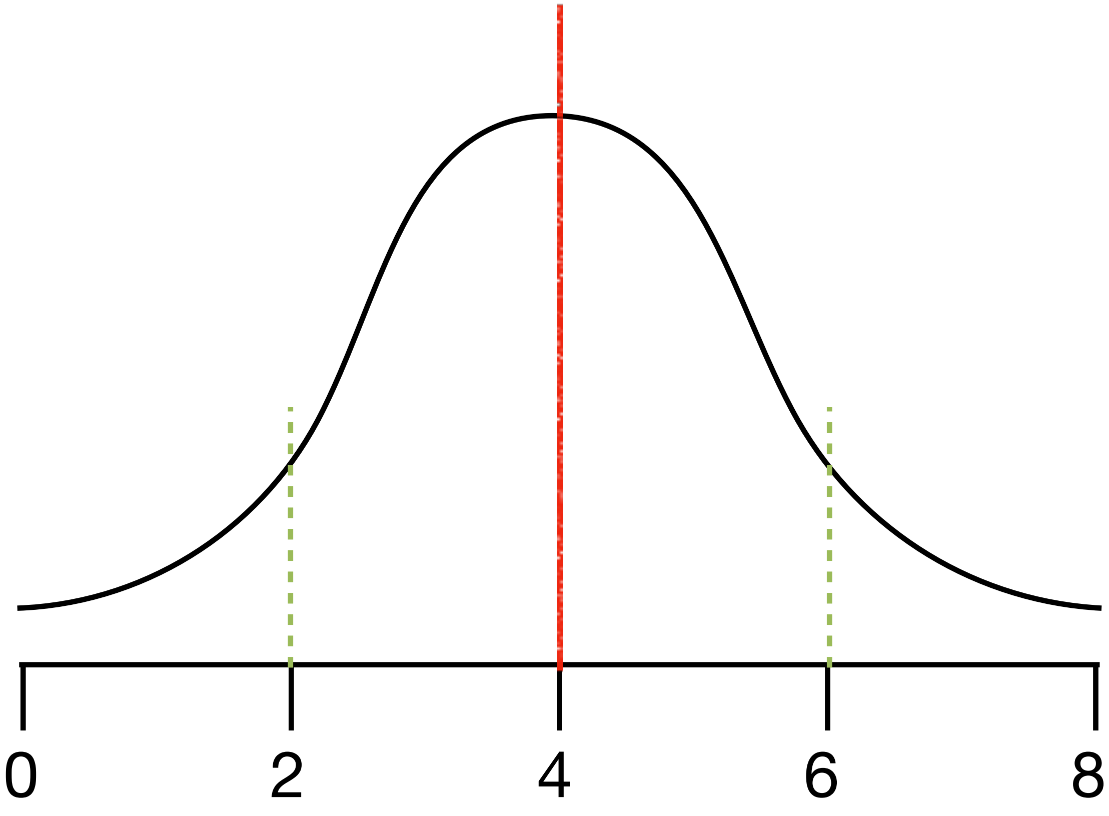
$$= \frac{2995.6}{9}$$

$$= 332.8$$

Sum of Squares

Why Square The Differences?

- Get rid of negatives, so that the negatives and positives do not cancel each other during addition.
- Increase larger deviations more than smaller ones so that they are weighed more heavily.



(2-4) + (6-4) = -2 + 2 = 0

Standard Deviation (SD)

- Square root of Variance
- It has the same units as the variable, which makes it useful in comparisons and calculations

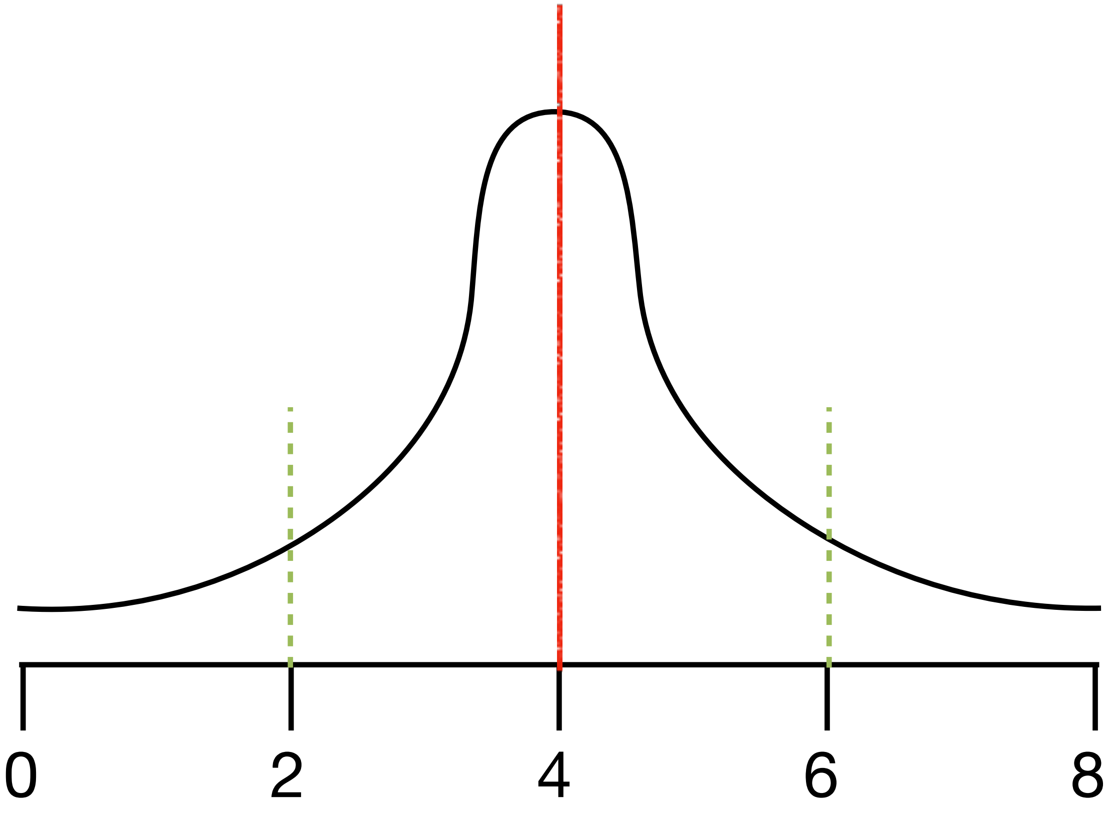
- Sample SD

$$s = \sqrt{s^2} = \sqrt{\frac{\sum (X-\bar{X})^2}{N-1}}$$

- Population SD

$$\sigma = \sqrt{\sigma^2} = \sqrt{\frac{\sum (x-\mu)^2}{N}}$$

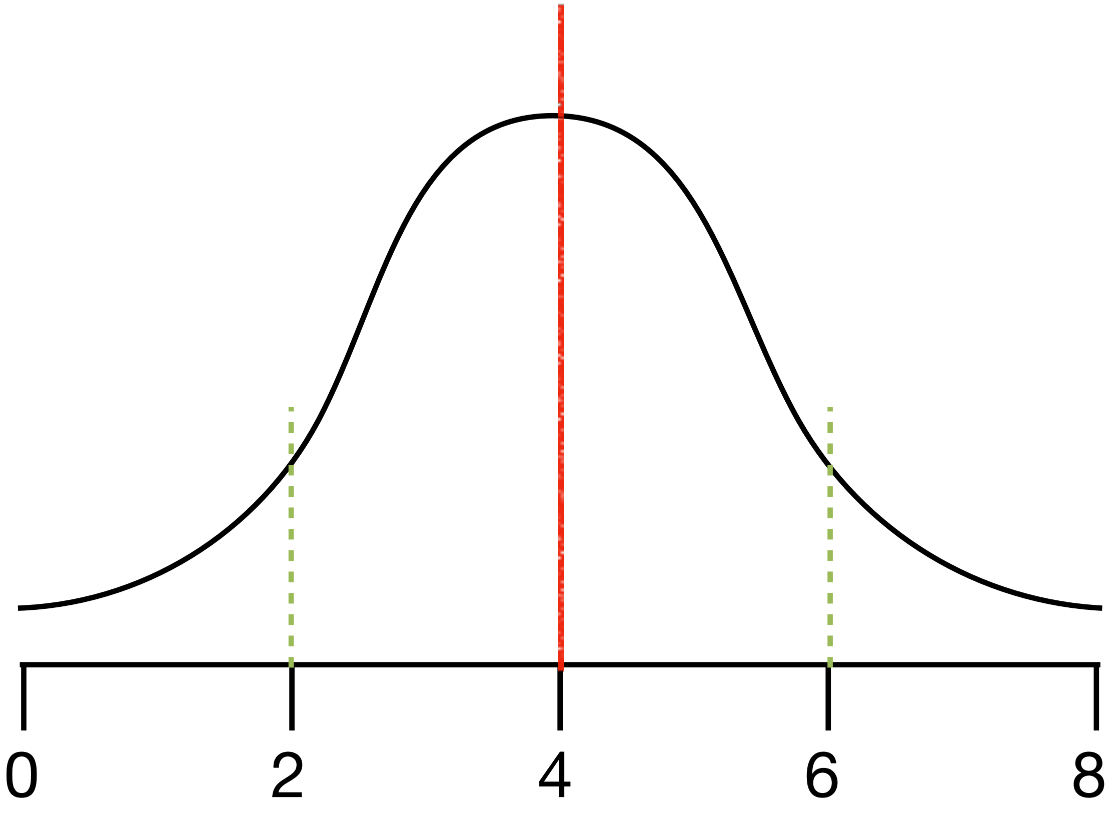
Spread



Less Spread

Low Variance

Low Deviation



More Spread

High Variance

High Deviation

Robust Statistics

- Measures on which extreme observations or outliers have little effect

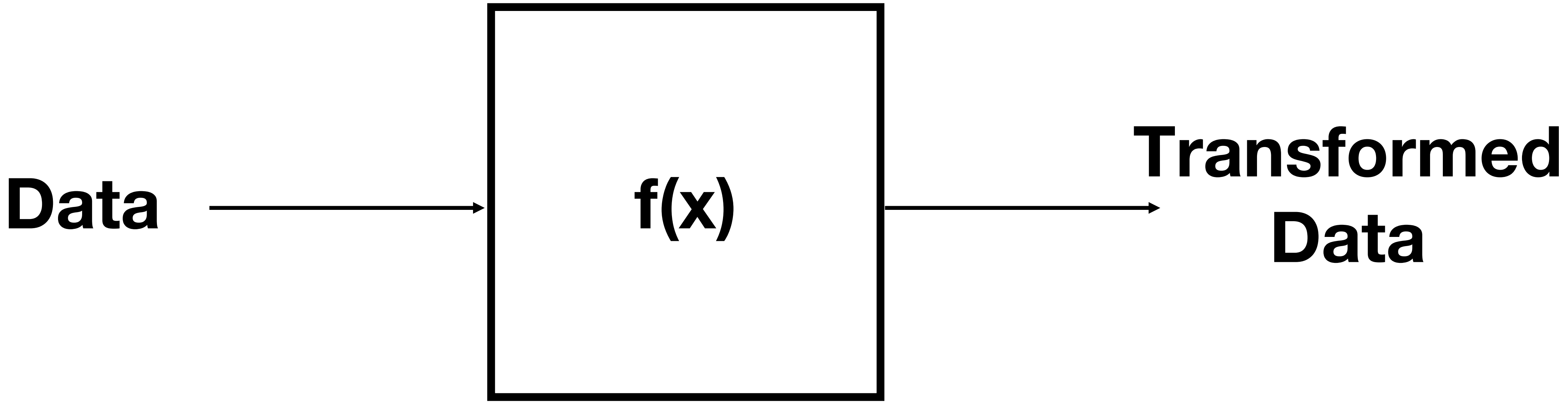
	Robust	Non-Robust
Spread	IQR	SD, Range
Center	Median	Mean

Skewed

Symmetric

Data Transformations

- Applying a Function f(x) to adjust scales of data.
- Done usually when data is skewed, so that it becomes easier to perform *modelling.*
- Done to convert non-linear relationship into a linear relationship.



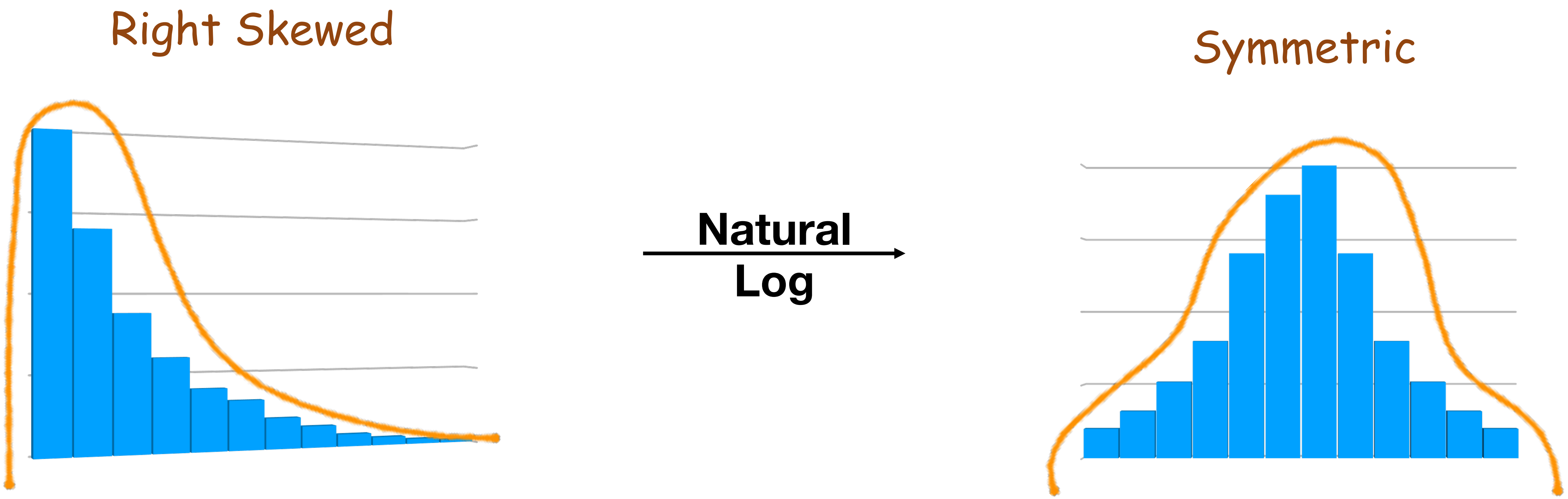
Data

f(x)

Transformed Data

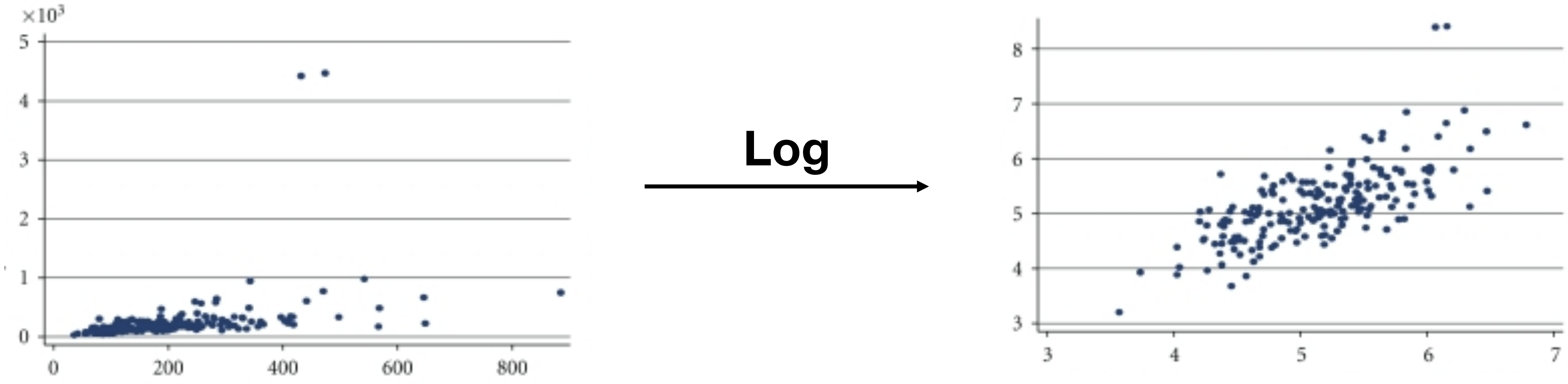
(Natural) Log Transformation

- To transform data that is positively skewed
- Usually done when data is concentrated near Zero (relative to the few large values in data)



Log Transformation

- To make the relationship between two variable more linear
- Most of the simple methods for modelling work only when relationship is linear



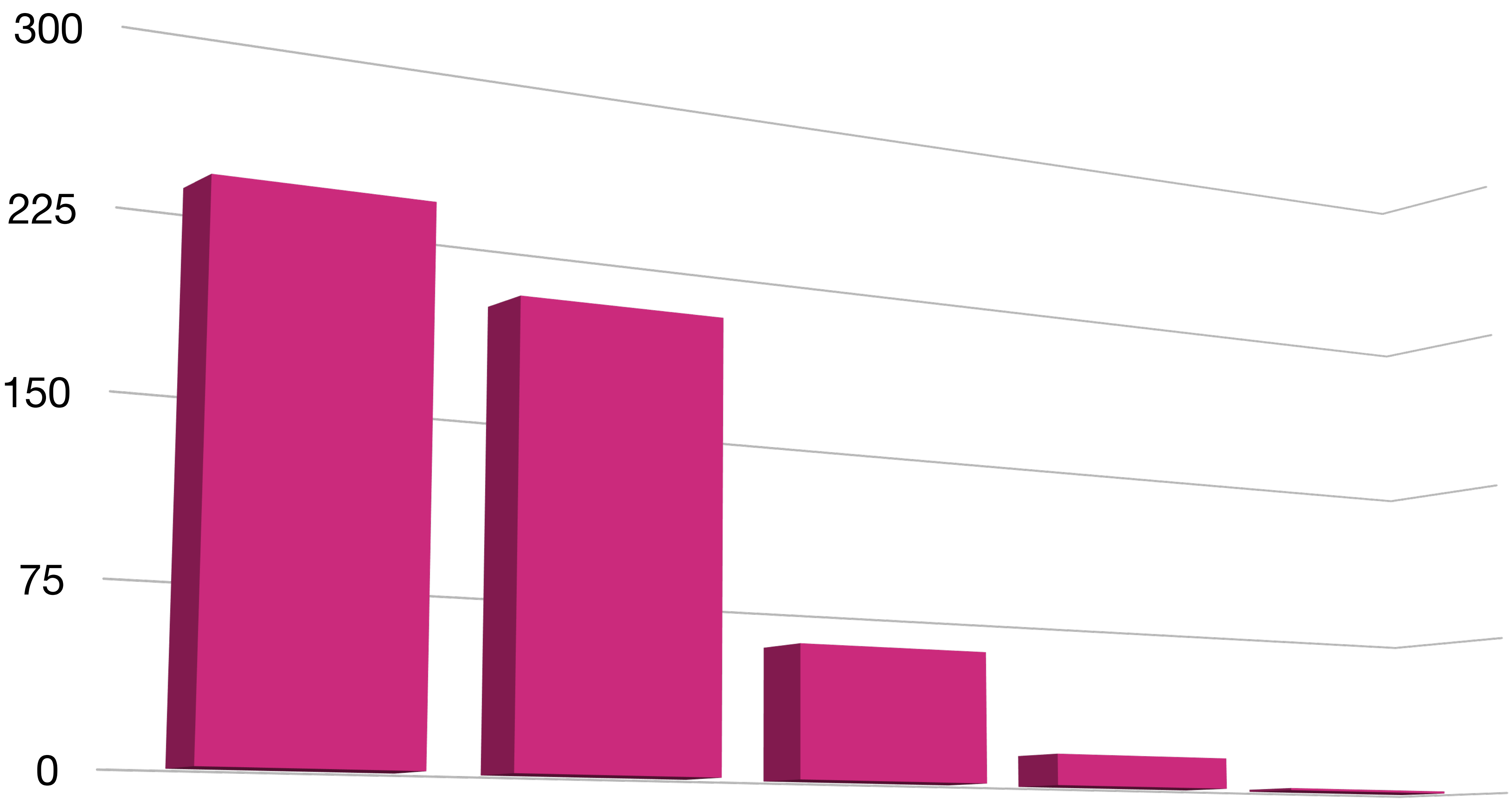
Log

Other Transformation

- You may use other transformations or create of your own
- For instance: Square Root, Square, Inverse

Visualising Categorical Data

Bar Plot

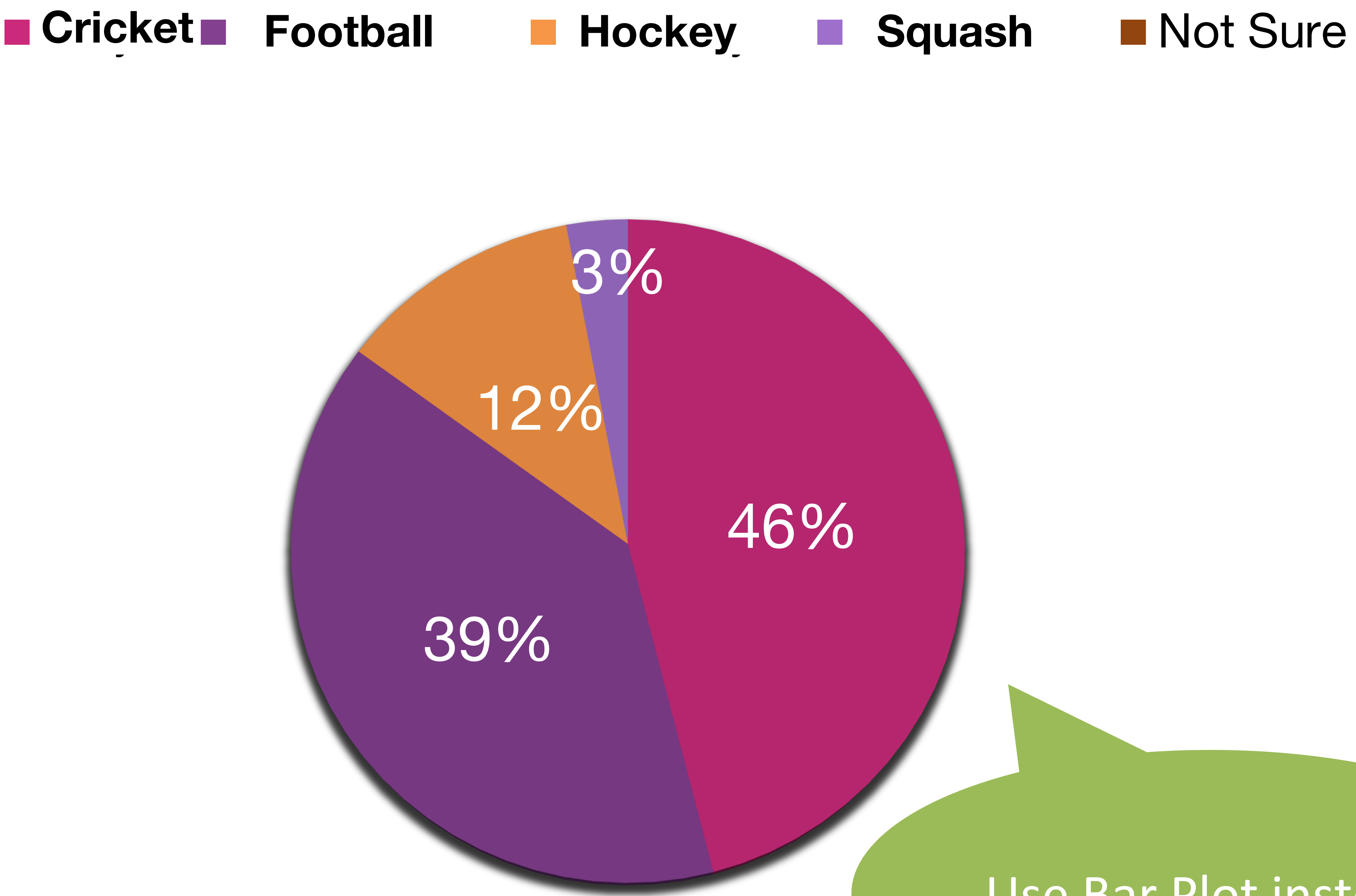


Frequency

Bar Plot vs Histogram

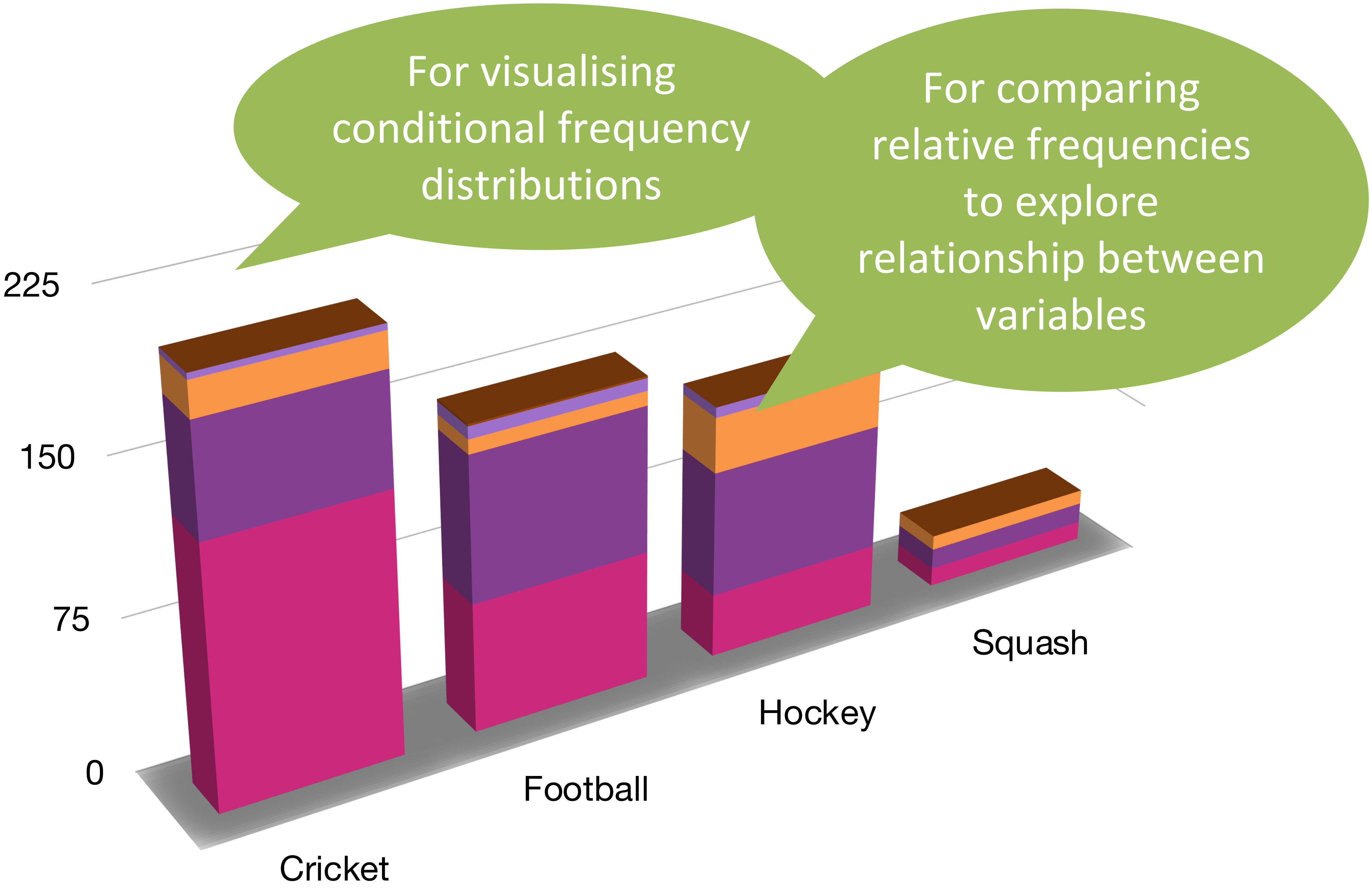
- Bar Plot for Categorical Variables, Histogram for Numerical Variables
- X-axis in Histogram must be a Number Line
- Ordering of bars is not interchangeable in Histogram as compared to Bar Plot

Pie Chart



Use Bar Plot instead

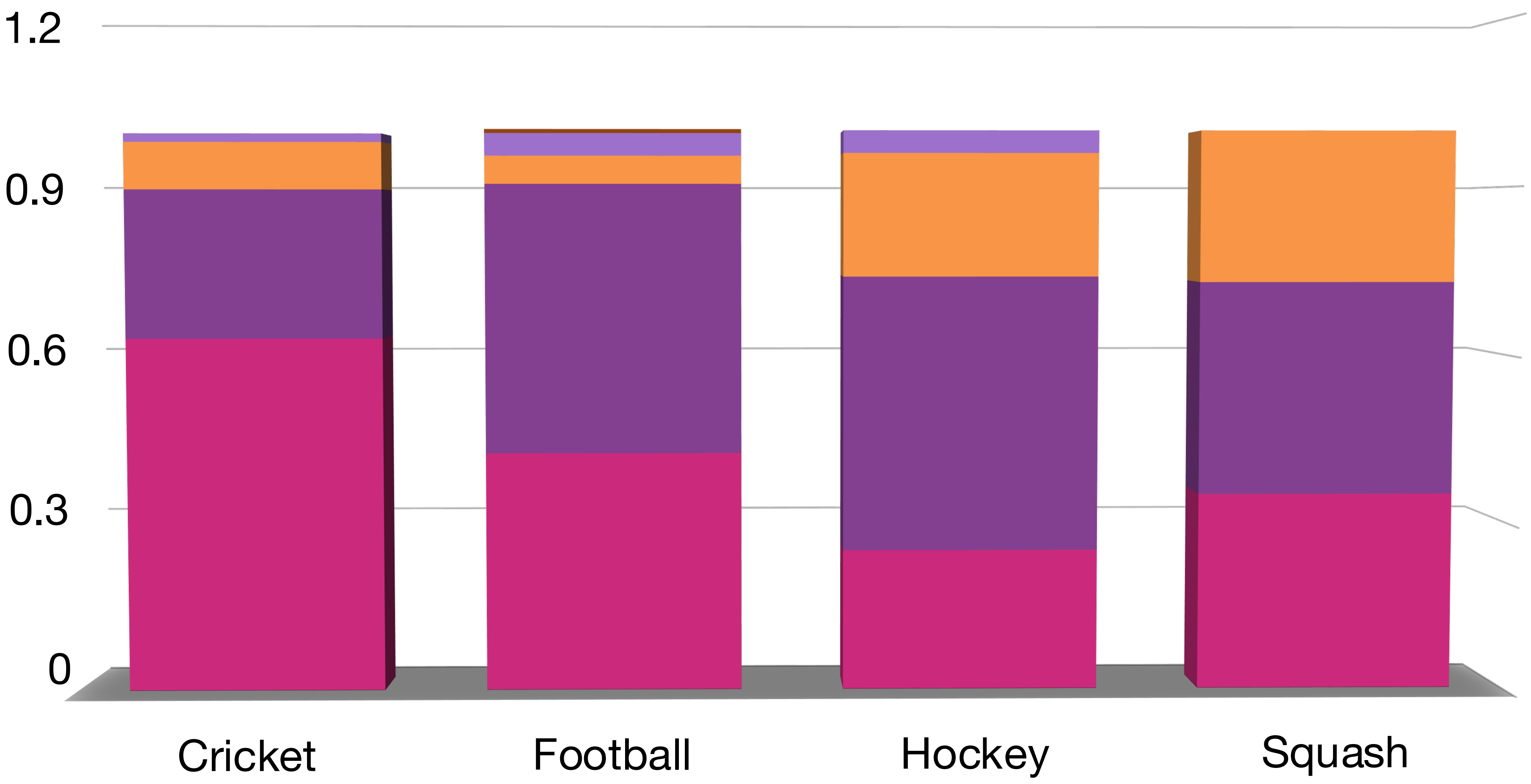
Segmented Bar Plot



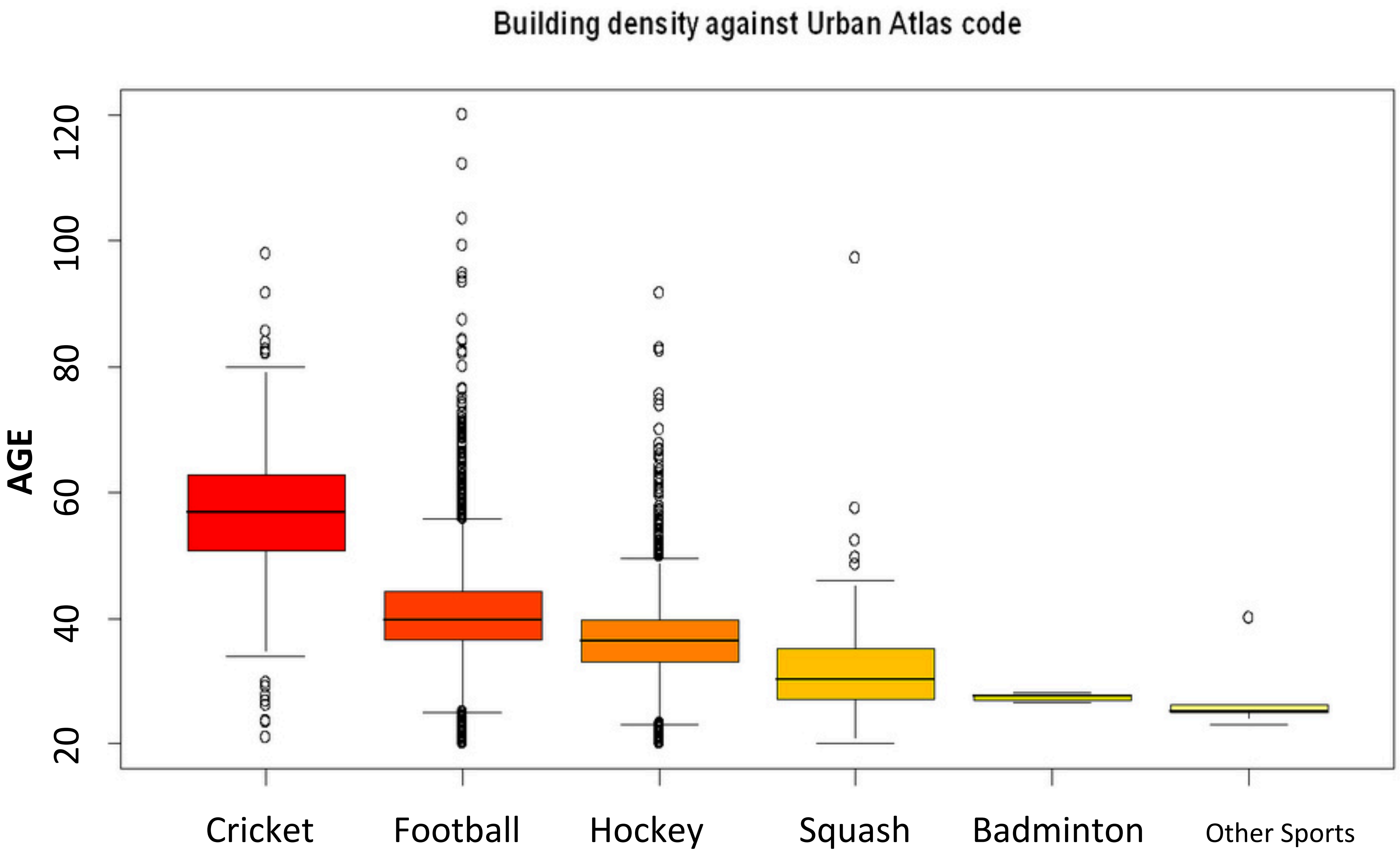
For visualising conditional frequency distributions

For comparing relative frequencies to explore relationship between variables

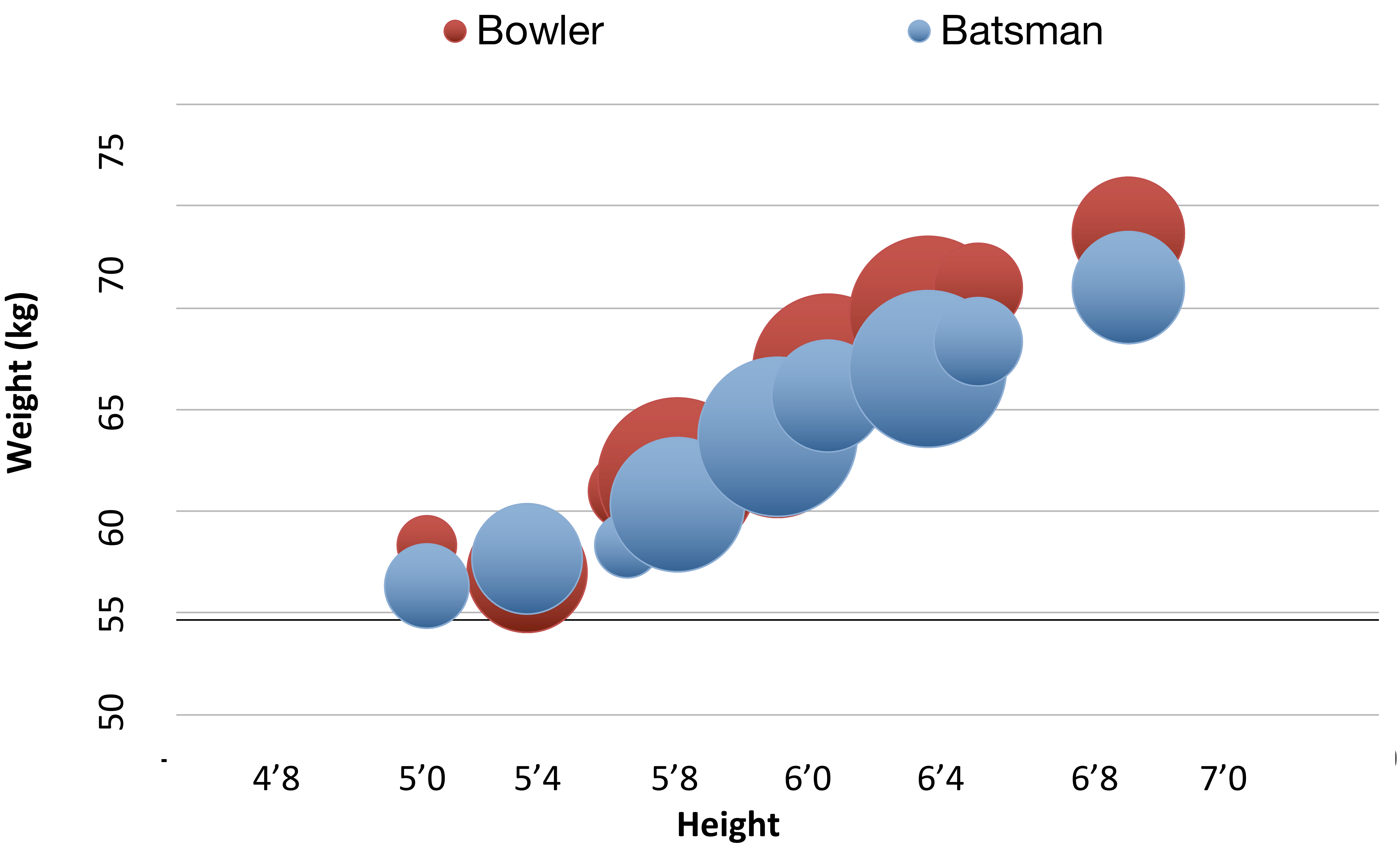
Relative Frequency Segmented Bar Plot



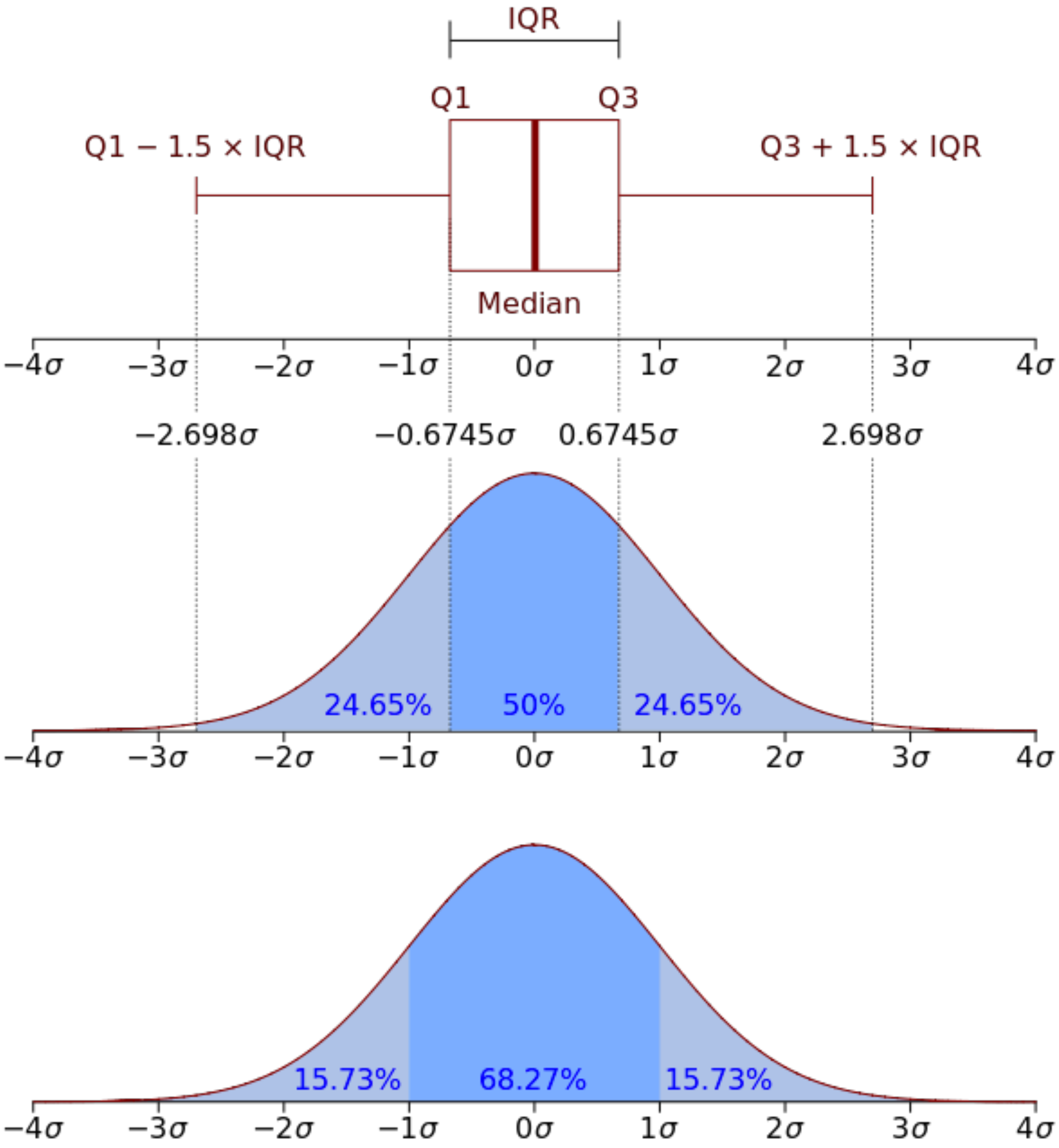
Side-by-Side Box Plots



Bubble Plot


● Bowler
● Batsman
Weight (kg)
75
70
65
60
55
50
4’8
5’0
5’4
5’8
6’0
6’4
6’8
7’0
Height

Outliers



DICE ANALYTICS

Why do EDA

- To understand data properties
- To find patterns in data
- To suggest modelling strategies
- To "debug" analyses
- To communicate results

(From JHU)

Why do EDA

https://www.youtube.com/watch?v=jbkSRLYSojo