01-Statistics

Statistics

Posted on January 5, 2023
Last updated on January 5, 2023

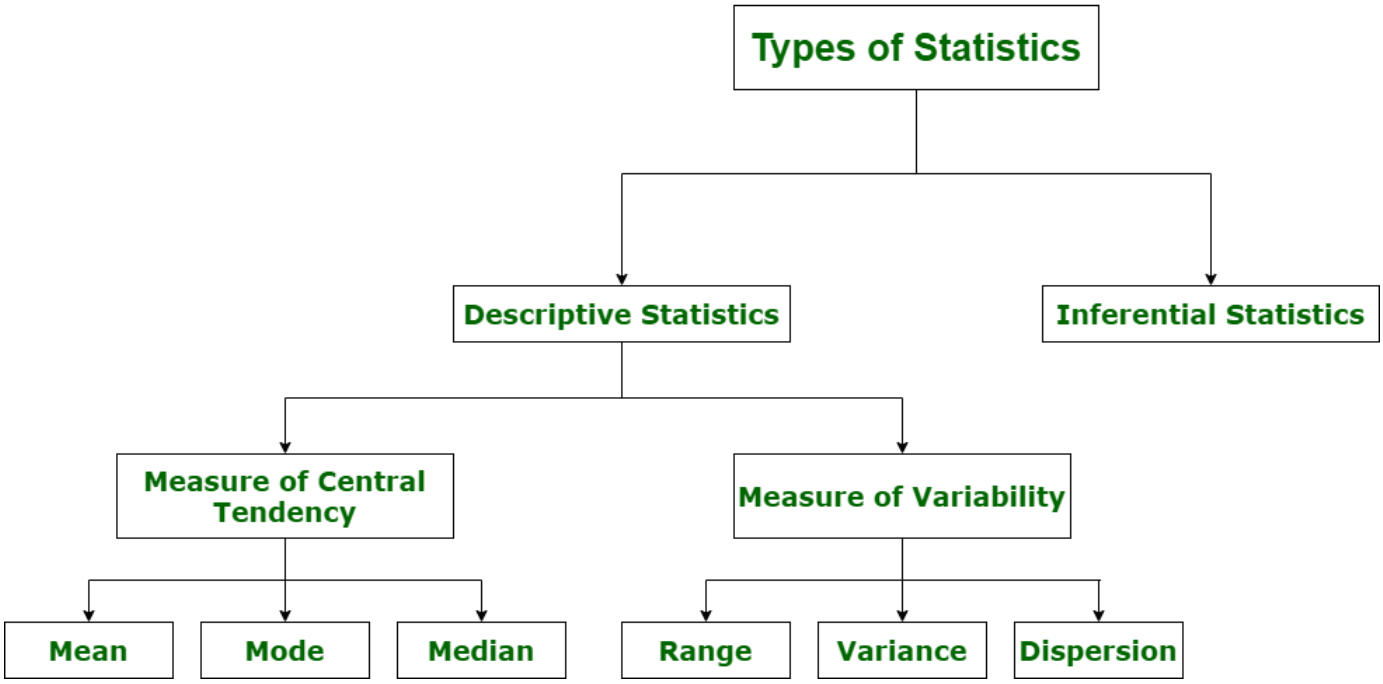
ALL Pdf Notes (https://github.com/amrit94/DataScience/tree/main/notes)

1.1 Statistics

- `Statistics` is the science of collecting, organizing and analyzing the data.
- Used for decision making process
- `Data` : facts or pieces of information

1.2 Types of Statistics

- **Descriptive stats**
  - It consists of `organizing and summarizing` the data.
- **Inferential stats**
  - It consists of using data you have measured to `form conclusion` .



1.2.1 Descriptive stats

Example

- Aveeage height of the student in a class (Mean)
- Most common height in the Class

Types

- Measure of Central Tendency
  - Mean, Median, Mode
- Measure of Variability
  - Range, Variance, Dispersion, Std
- Charts - Data distribution
  - Histogram, Bar charts

1.2.2 Inferential stats

Example

- Are the avg height of student in the class are similar to what you expect in the entire college
  - class – `Sample data`
  - entire college – `Population data`

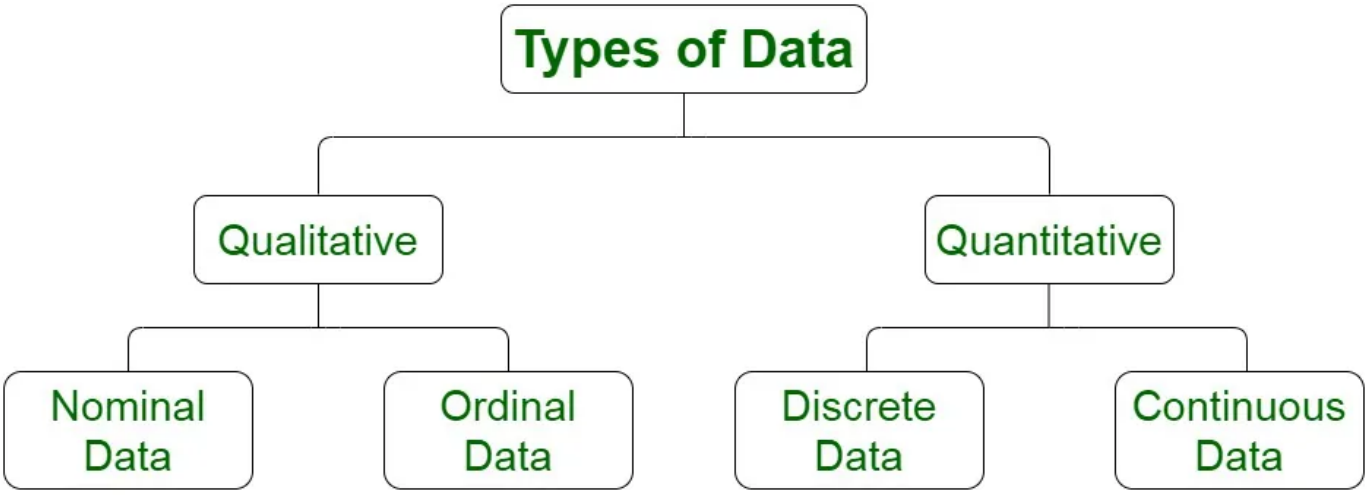
Types

- Z-test

- T-test
- Hypothesis testing, P value

1.3 Types of Data

```
* Quantitative Data
    * Discrete Data
    * Continuous Data
* Qualitative Data
    * Nominal Data
    * Ordinal Data
```



1.3.1 Quantitative/ Numerical Data

- Data is depicted in `numerical` terms.
- Can be shown in numbers and variables like ratio, percentage, and more.
- Example: 100%, 1:3, 123

Discrete Data

- The type of data that has `clear spaces between values` is discrete data.
- Whole number, Countable
- There are distinct or different values in discrete data.
- Depicted using bar graphs
- Ungrouped frequency distribution of discrete data is performed against a single value.
- Eg: No of bank acount, No of children

Continuous Data

- This information falls into a continuous series.
- Any Value(int, float), Measurable
- Every value within a range is included in continuous data.
- Depicted using histograms
- Grouped distribution of continuous data tabulation frequencies is performed against a value group.
- Eg: Weight, Height, Temperature

1.3.2 Qualitative/ Categorical Data

- Data is depicted in `non-numerical` terms.
- Could be about the behavioral attributes of a person, or thing.
- Example: loud behavior, fair skin, soft quality, and more.

Nominal Data

- Nominal data attributes `can't either be ordered or measured`

```
# Examples:
Gender (Women, Men)
Eye color (Blue, Green, Brown)
Hair color (Blonde, Brown, Brunette, Red, etc.)
Marital status (Married, Single)
Religion (Muslim, Hindu, Christian)
```

Ordinal Data

- Ordinal data is the specific type of data that `follows a natural order`.

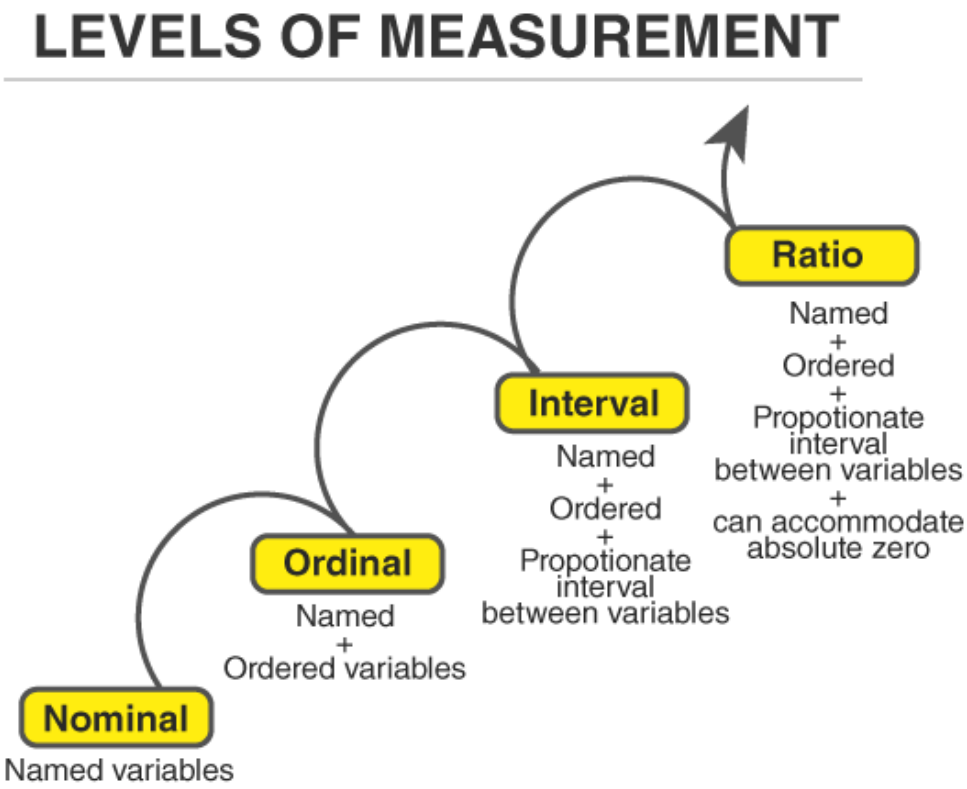
```
Examples:

Feedback is recorded in the form of ratings from 1-10.
Education level: elementary school, high school, college.
Economic status: low, medium, and high.
Letter grades: A, B, C, and etc.
```

1.4 Level of Measurement

- There are four different scales of measurement.
- The data can be defined as being one of the four scales.

```
Nominal Scale
Ordinal Scale
Interval Scale
Ratio Scale
```



1.4.1 Nominal Scale

- It is the 1st level of measurement scale
- It serve as `tags` or `labels` to classify or identify the objects.
- `Qualitative/Categorical` variable
- Order does-not matter
- Example:
    - Gender: M, F
    - Color: Red, Blue, Green

1.4.2 Ordinal Scale

- The ordinal scale is the 2nd level of measurement
- `Ordering` and ranking matters
- Difference cannot be measured

```
# Example
Totally agree
Agree
Neutral
Disagree
Totally disagree

# It has ranking and can't calculate difference
```

1.4.3 Interval Scale

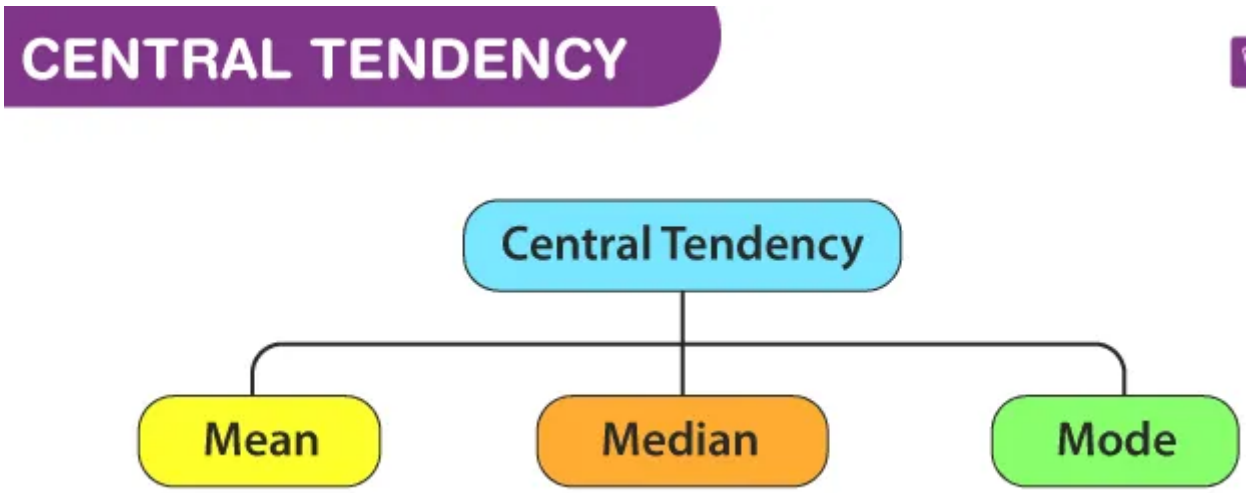
- The interval scale is the 3rd level of measurement scale, which is quantitative.
- Order and Rank matters
- Difference can be measured(excluding ratio)

1.4.4 Ratio Scale

- The ratio scale is the 4th level of measurement scale, which is quantitative
- Order and Rank matters
- Difference and ratio can be measured

1.5 Measure of Central Tendency

- The central tendency is the descriptive summary of a data set



Mean

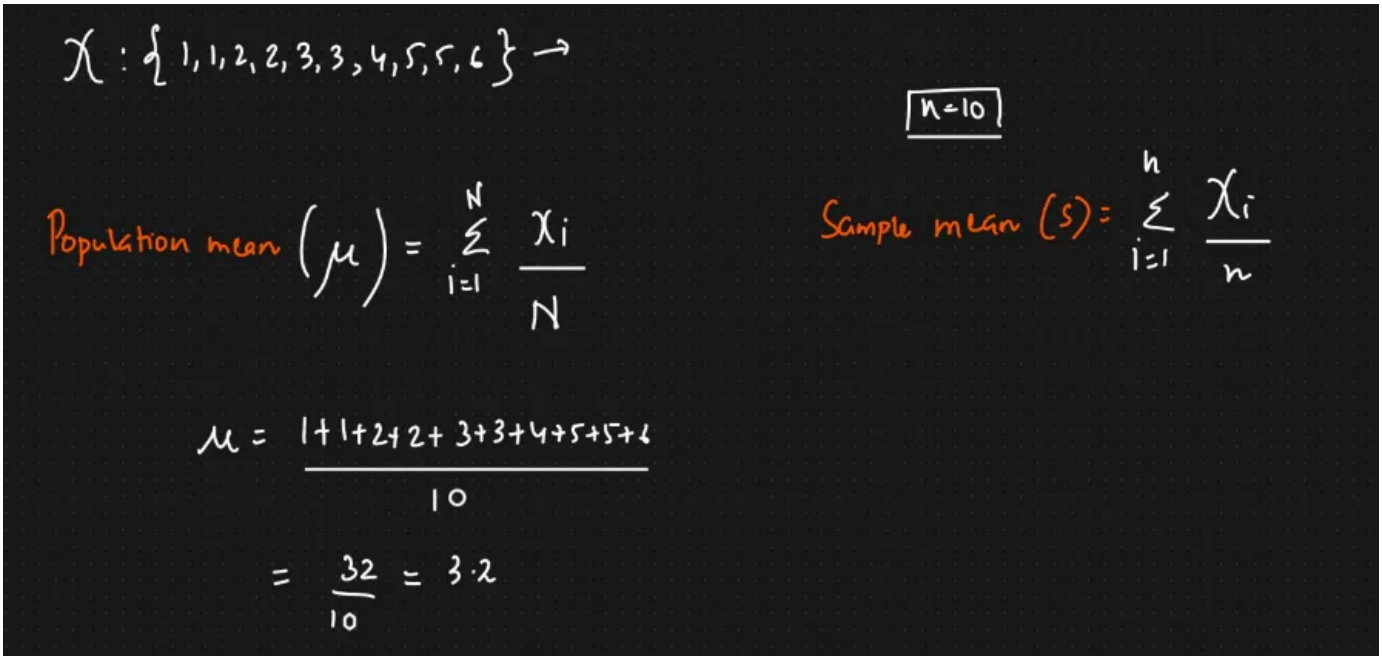
- The mean represents the average value of the dataset.
- It can be calculated as the sum of all the values in the dataset divided by the number of values.

`Population mean (Mu)`

$$\mu = \sum_{i=1}^{N} \frac{X_i}{N}$$

`Sample Mean (s)`

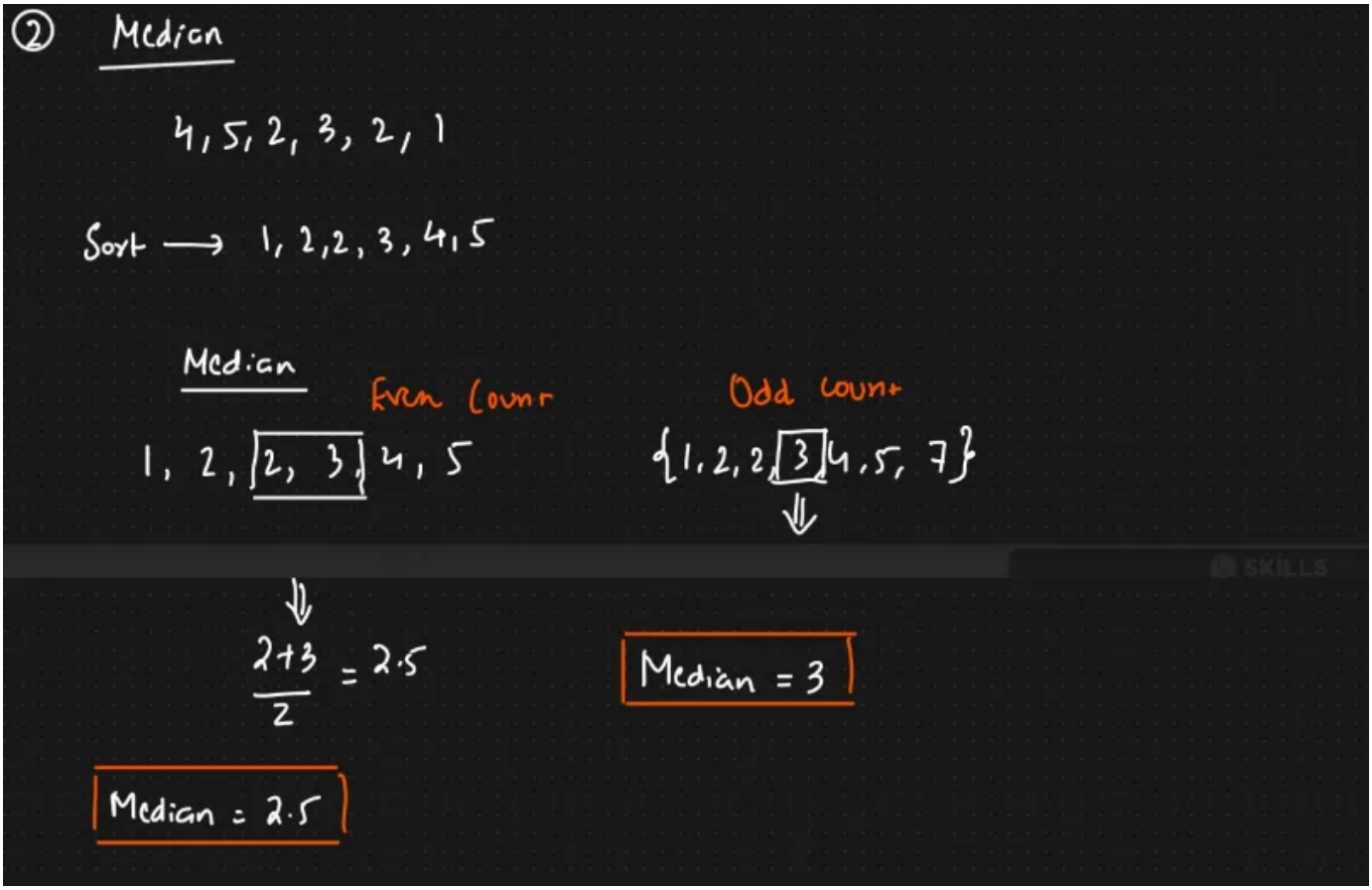
$$s = \sum_{i=1}^{n} \frac{X_i}{n}$$



Median

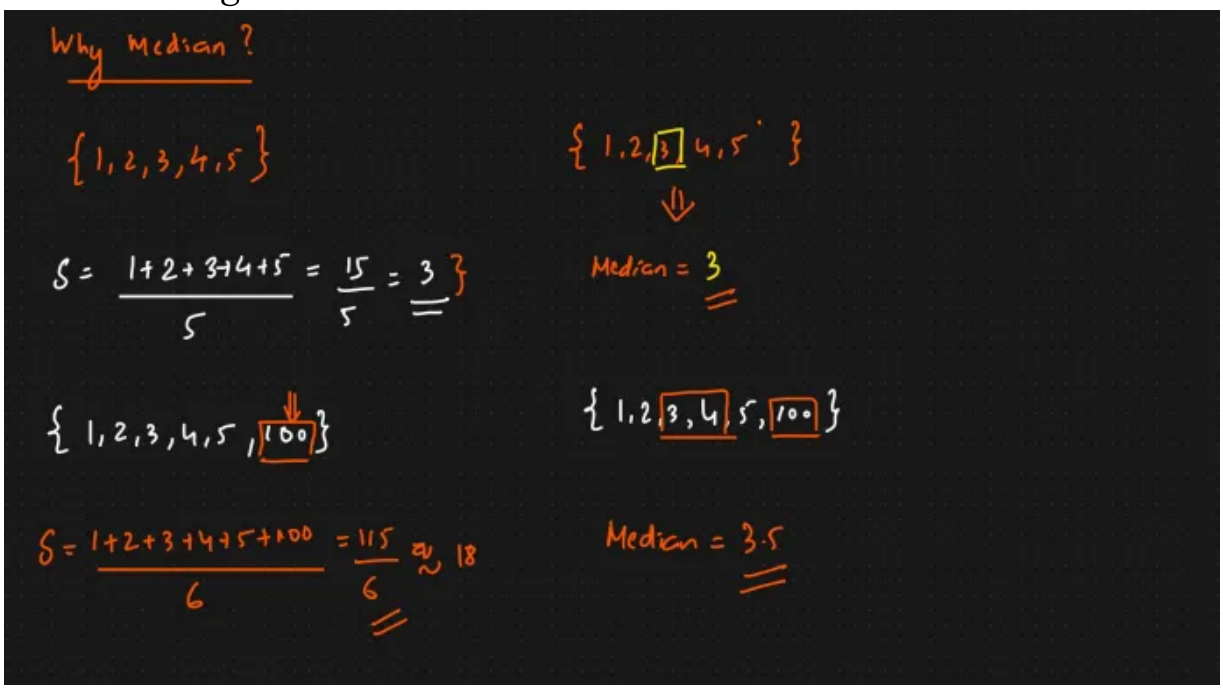
Median is the `middle value` of the dataset in which the dataset is arranged in the ascending order or in descending order.

When the dataset contains an `even` number of values, then the median value of the dataset can be found by taking the mean of the `middle two values`.



Why Median?

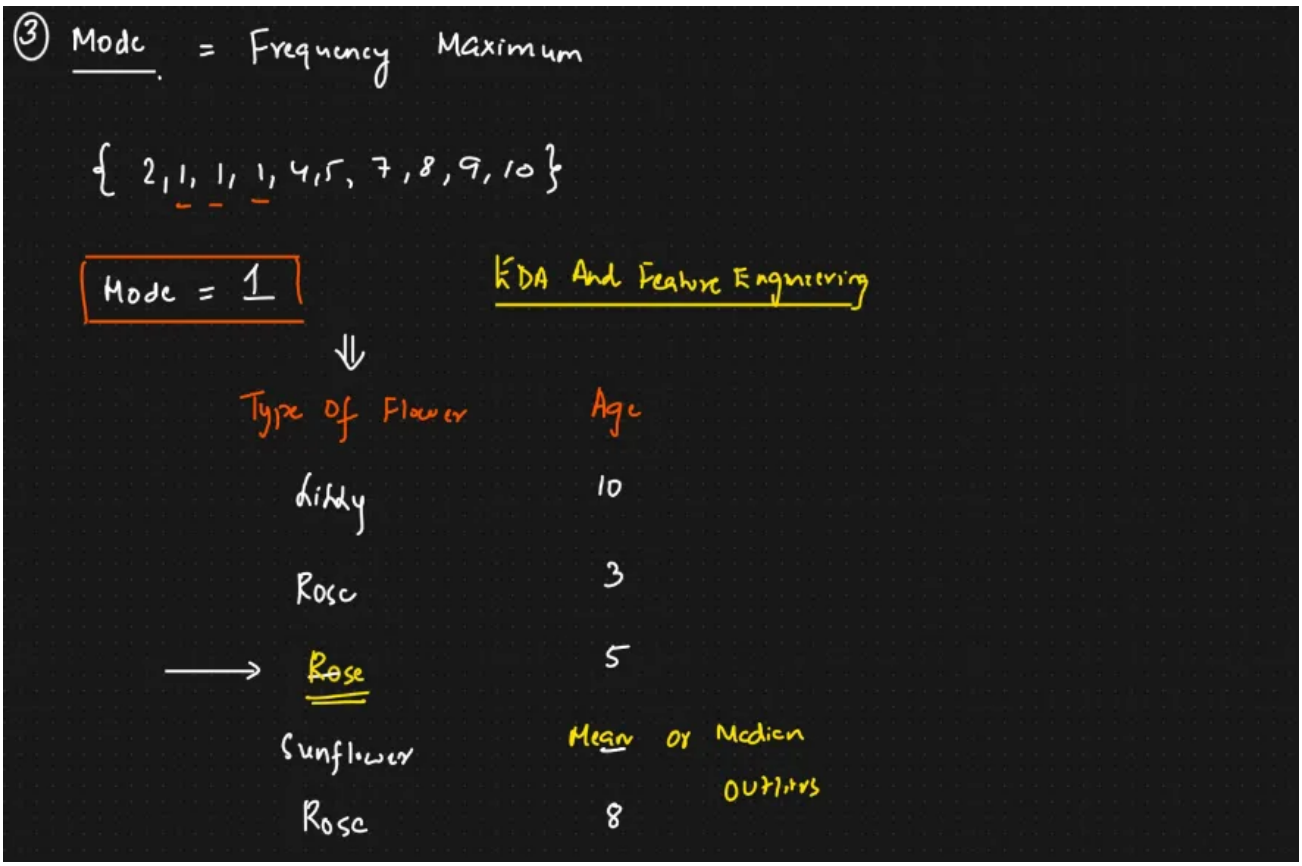
- In case on any outlier in the distribution the
  - mean - huge affect
  - meadian - slight devitaed



Mode

- The mode represents the `frequently occurring value` in the dataset.

- Sometimes the dataset may contain `multiple` modes and in some cases `no mode` at all.



1.6 Measure of Dispersion

- In statistics, the measures of dispersion help to interpret the `variability of data` i.e. to know how much homogenous or heterogeneous the data is.
- In simple terms, it shows how `squeezed or scattered` the variable is.

1.6.1 Variance

- Spread of data

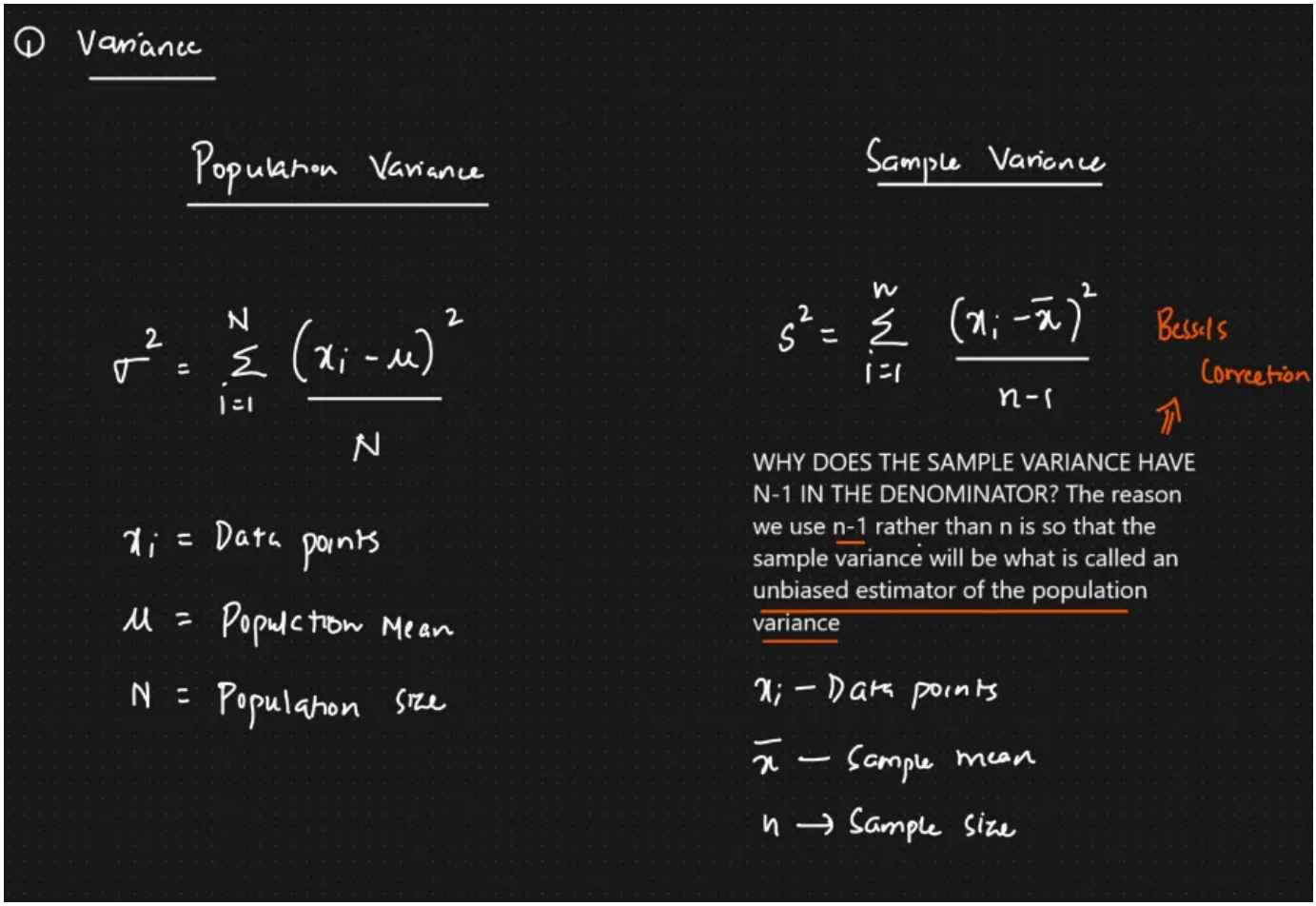
`Population Variance (sigma sq)`

$$\sigma^2 = \sum_{i=1}^{N} \frac{(x_i - \mu)^2}{N}$$

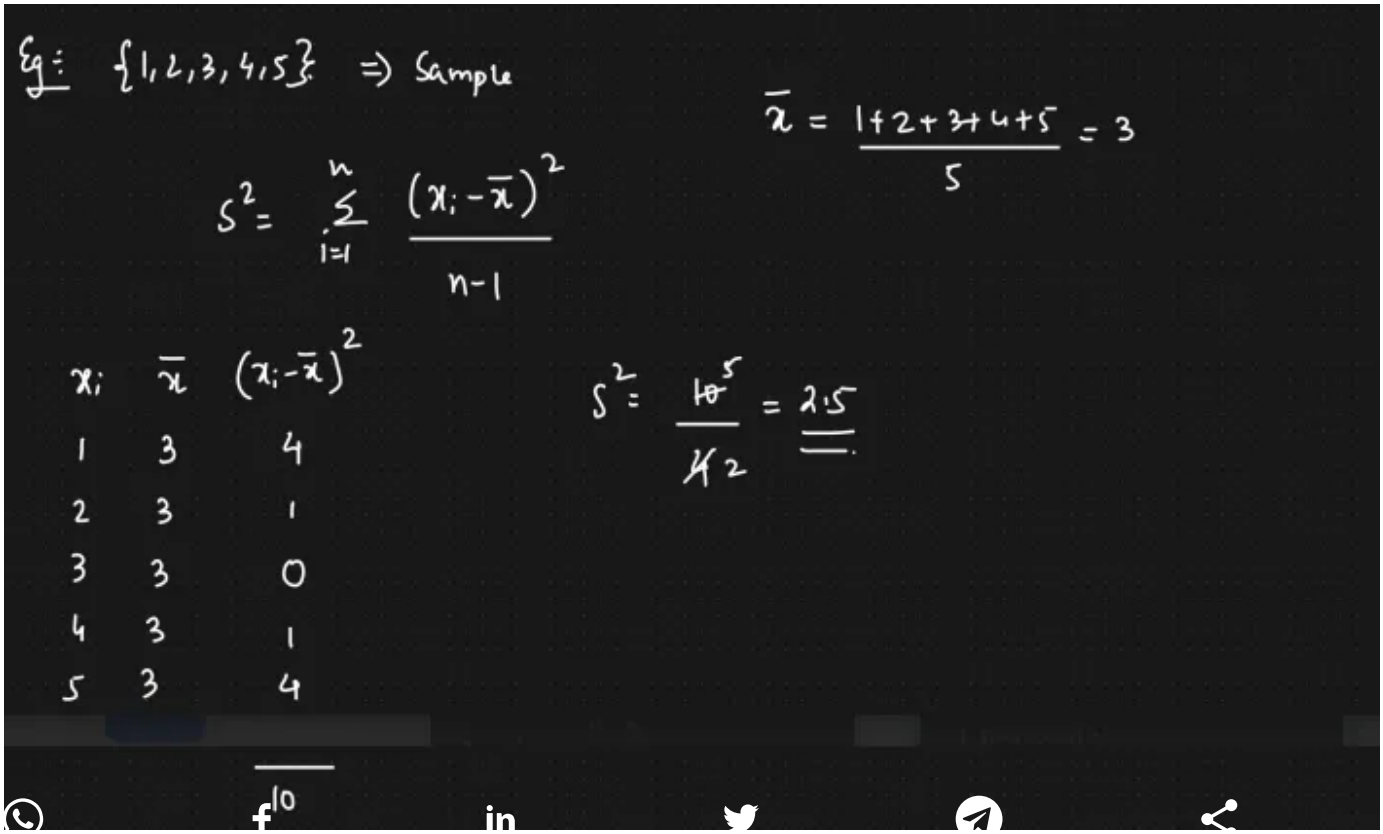
`Sample Variance (s sq)`

$$s^2 = \sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1}$$

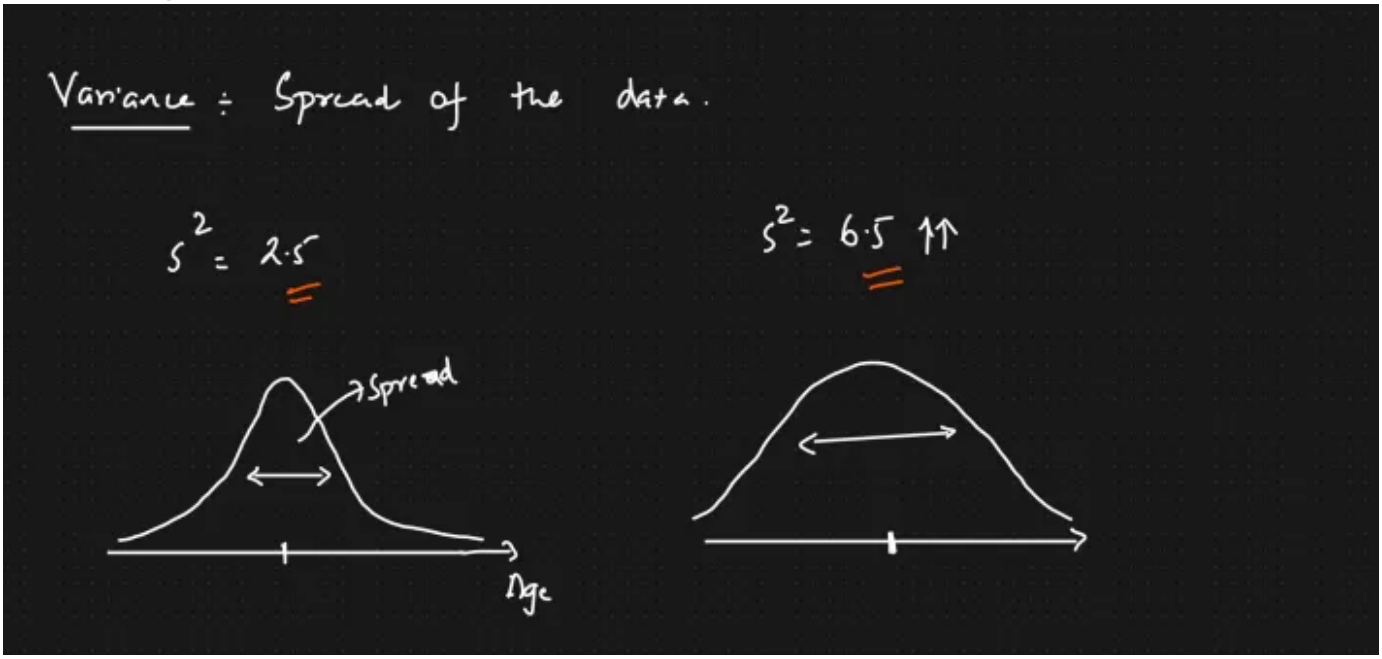
We use `(n-1) rather than n` so that the sample variance will be what is called an unbiased estimator of the population variance - `Bessels Correction`



Example



Variance graph



1.6.2 Standard Deviation

Population std (sigma)

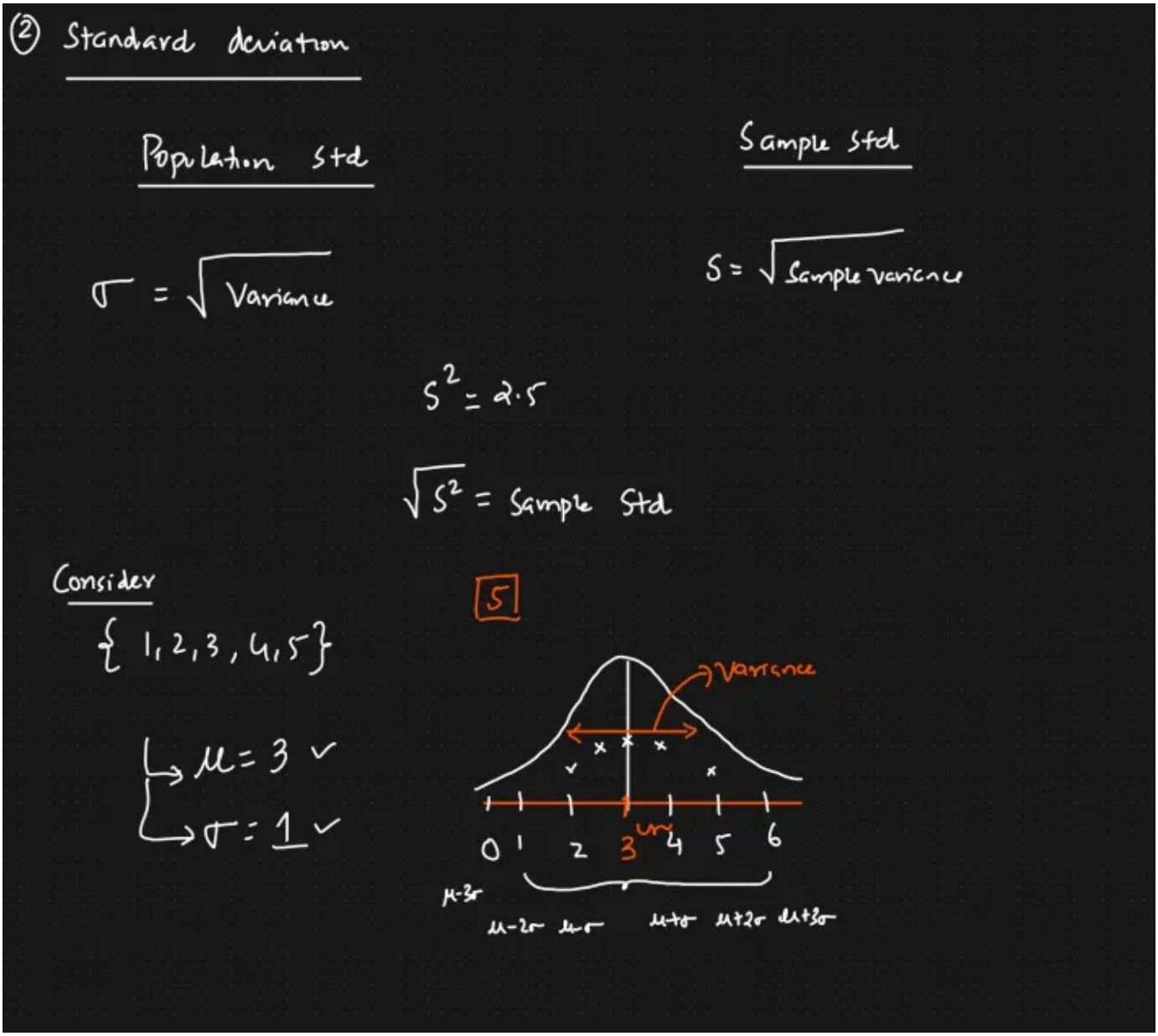
$$\sigma = \sqrt{Variance}$$

$$\sigma = \sqrt{\sum_{i=1}^{N} \frac{(X_i - \mu)^2}{N}}$$

Sample std (s)

$$s = \sqrt{SampleVariance}$$

$$s = \sum_{i=1}^{n} \frac{(X_i - \bar{X})^2}{n-1}$$



1.6.3 Random Variable

- Random variable is a process of mapping the output of a random process pr expriment to a number
- Eg:
  - Tossing a coin
  - Roling a dice

Below - `Value of x, y if fixed i.e x=2 and y=8`

$$x + 5 = 7, x + y = 10$$

Below - `the value of x is not fixed` , it depends on the output

$$X = \begin{cases} 0 & \text{if } H \\ 1 & \text{if } T \end{cases}$$

Quantifying a Random Process

$$Y = \{ \text{Sum of the rolling of dice 7 times} \}$$

$$\{4, 5, 6, 1, 2, 2\} = 20$$