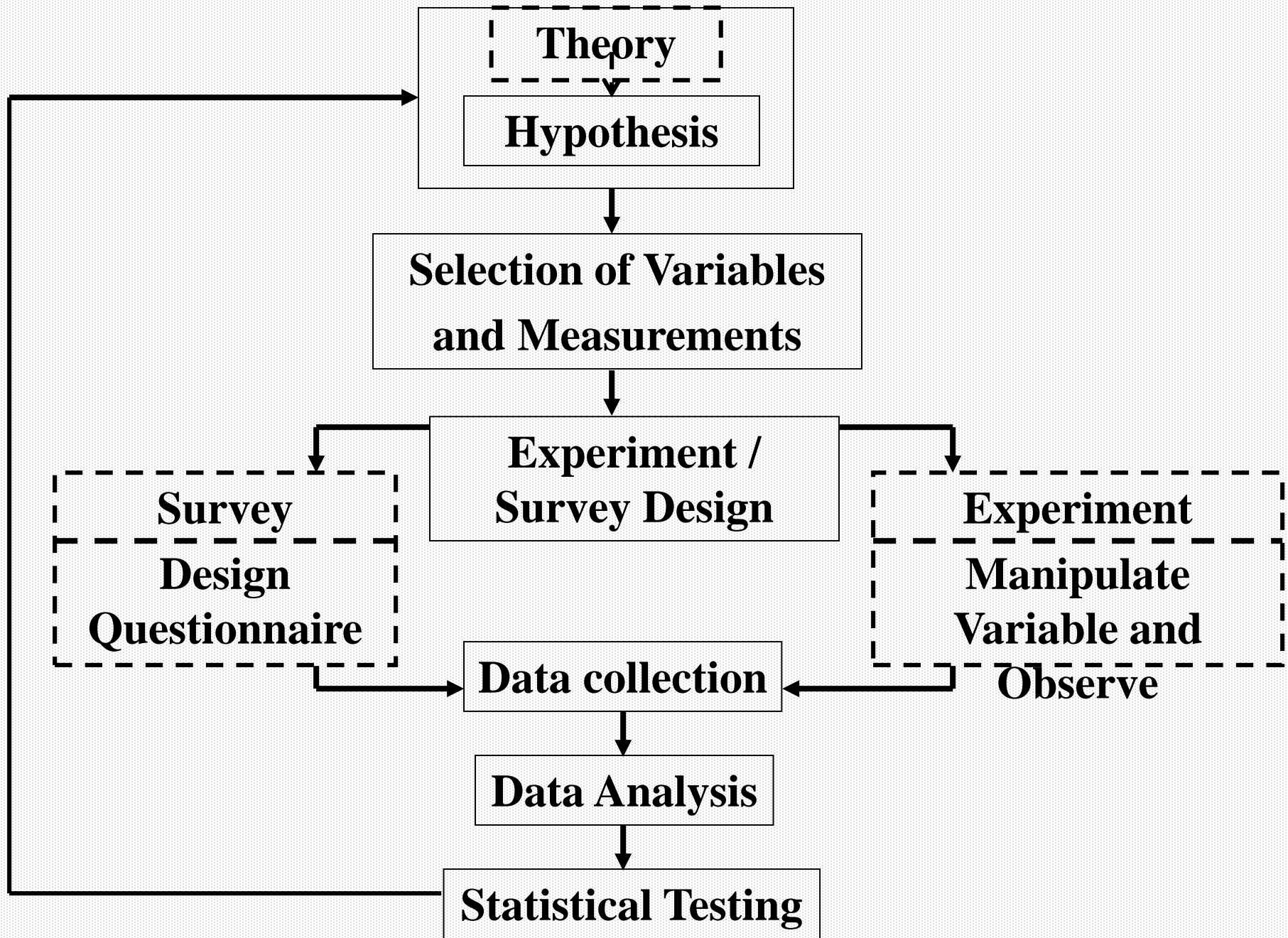


# Basic Statistics

# Qualitative and Quantitative Approaches

Qualitative	Quantitative
(Usually) Non-probability based sample	Typically a probability-based sample
Non-generalizable	Generalizable
Answers Why? How?	Answers How many? When? Where?
Researcher is the instrument	Various tools, instruments employed

# Quantitative Analysis Procedure



# Basics of Statistics

**Definition:** Science of collection, presentation, analysis, and reasonable interpretation of data. Statistics presents a rigorous scientific method for gaining insight into data.

# Frequency Distribution

Consider a data set of 26 children of ages 1-6 years. Then the frequency distribution of variable 'age' can be tabulated as follows:

## Frequency Distribution of Age

Age	1	2	3	4	5	6
Frequency	5	3	7	5	4	2

## Grouped Frequency Distribution of Age:

Age Group	1-2	3-4	5-6
Frequency	8	12	6

# Data Presentation

Two types of statistical presentation of data - **graphical and numerical.**

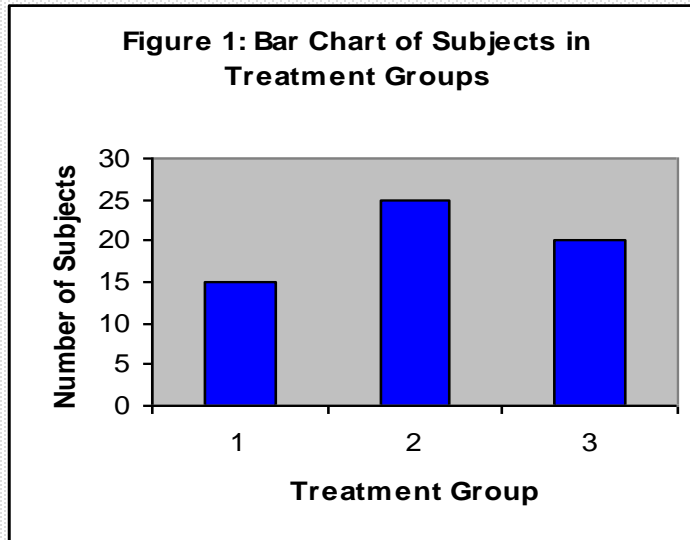
Graphical Presentation: We look for the overall pattern and for striking deviations from that pattern. Overall pattern usually described by shape, center, and spread of the data. An individual value that falls outside the overall pattern is called an *outlier*.

Bar diagram and Pie charts are used for categorical variables.

Histogram, Box-plot are used for numerical variable.

# Data Presentation –Categorical Variable

**Bar Diagram:** A **bar diagram** (or a bar graph) is a rectangular bar shaped statistical graphic which is divided into several bar to illustrate numerical proportion.

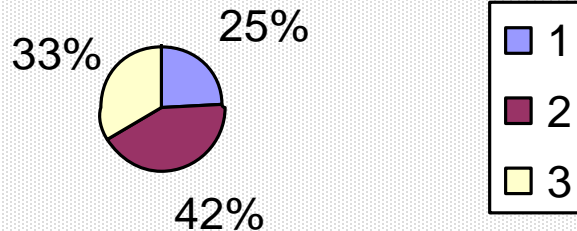


Treatment Group	Frequency
red	15
black	25
blue	20
Total	60

# Data Presentation –Categorical Variable

**Pie Chart:** A **pie chart** (or a circle **chart**) is a circular statistical graphic which is divided into slices to illustrate numerical proportion.

Figure 2: Pie Chart of Subjects in Treatment Groups

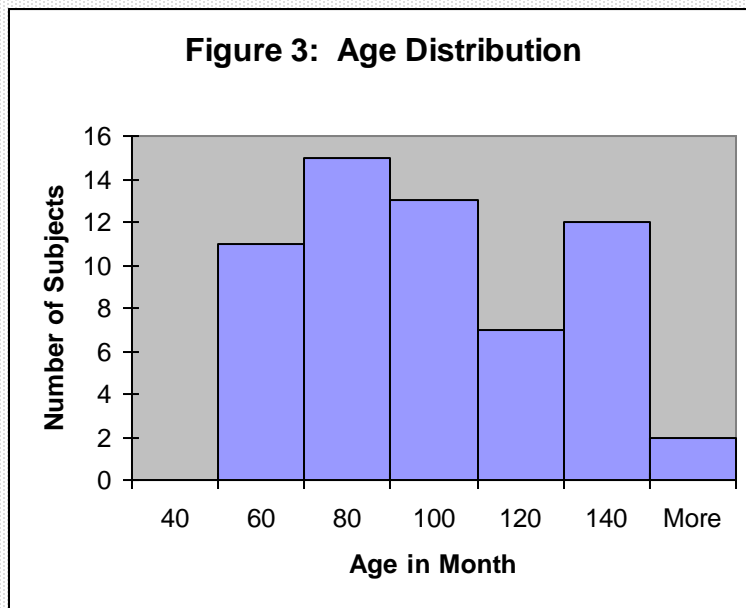


Treatment Group	Frequency	Proportion	Percent (%)
1	15	$(15/60)=0.25$	25.0
2	25	$(25/60)=0.333$	41.7
3	20	$(20/60)=0.417$	33.3
Total	60	1.00	100



# Graphical Presentation – Numerical Variable

**Histogram** is a graphical representation of the distribution of numerical data. Overall pattern can be described by its **shape**, **center**, and **spread**. The following age distribution is **right skewed**. The **center** lies between **80 to 100**. **No outliers**.



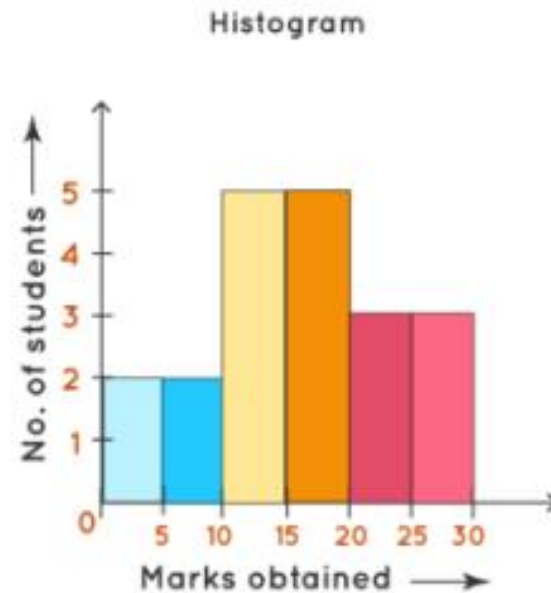
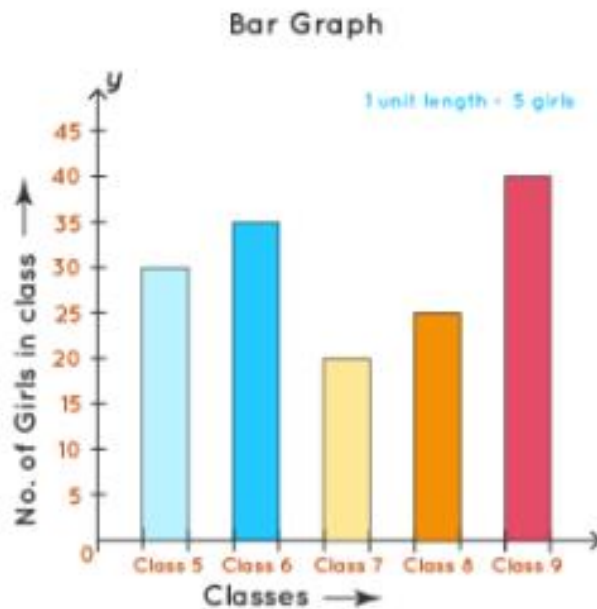
Age	Frequency
40-60	11
60-80	15
80-100	13
100-120	7
120-140	12
More	2

# Bar Graph vs Histogram

The main differences between a bar chart and a histogram are as follows:

Bar Graph	Histogram
Equal space between every two consecutive bars.	No space between two consecutive bars. They should be attached to each other.
The x-axis can represent anything.	The x-axis should represent only continuous data that is in terms of numbers.

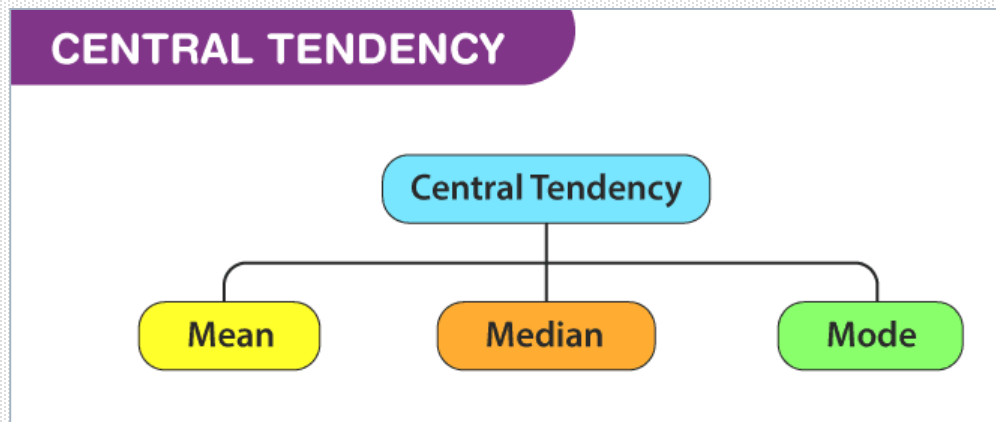
# Bar Graph vs Histogram



## Central Tendency

Central tendency is defined as “the statistical measure that identifies a single value as representative of an entire distribution or sample.”

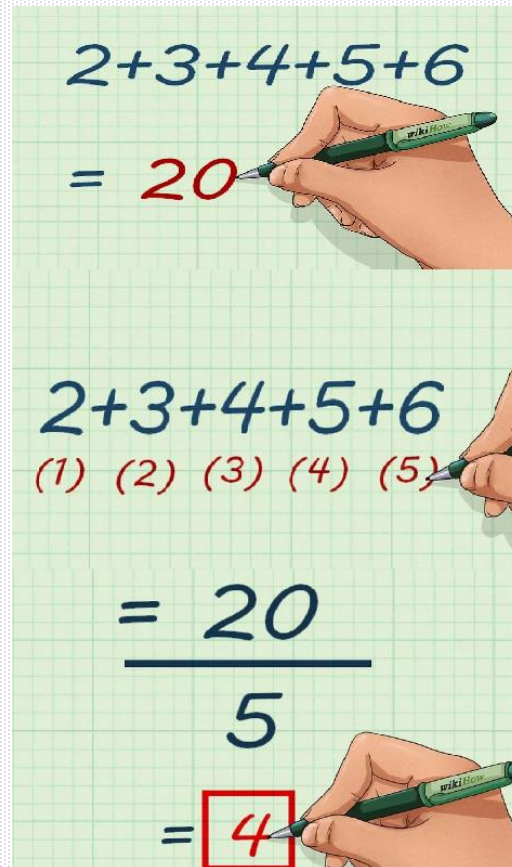
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## Mean (গড়)

The mean is the mathematical average of a set of two or more numbers.

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The illustration shows the calculation of the mean for the numbers 2, 3, 4, 5, and 6. It is divided into three parts:

- Top part:** The numbers are summed:  $2+3+4+5+6 = 20$ . The number 20 is written in red.
- Middle part:** The numbers are listed with indices below them:  $2+3+4+5+6$  with  $(1) (2) (3) (4) (5)$  underneath. The indices are written in red.
- Bottom part:** The sum is divided by the count of numbers: 
$$\begin{array}{r} = 20 \\ \hline 5 \\ = 4 \end{array}$$
 The final result, 4, is written in red and enclosed in a red square.

# Mean

---

## Use:

- To know the overall result
- To determine the skewness and standard deviation
- To determine T-Score, Z-Score

## Merits:

- Easy to determine
- Observation has equal weightage
- Most reliable Central Tendency

# Mean

---

## Limitations:

- Value of mean will be changed even if one data point is changed
- Mean cannot be determined if data is qualitative
- Mean is affected by extreme score (Outlier)
- It cannot be computed accurately if any item is missing
- It cannot be calculated graphically

# Mean

---

$$\text{Mean} = \frac{\text{Sum of Data Points}}{\text{Number of Data Points}}$$

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n}$$

Data Set: 6, 4, 10, 3, 7

$$\bar{x} = \frac{6 + 4 + 10 + 3 + 7}{5} = \frac{30}{5} = 6$$



# Mean

---

$$\mu = \frac{\sum_{i=1}^n x_i}{n}$$

$\sum x_i \longrightarrow x_1 + x_2 + x_3 + \dots + x_n$

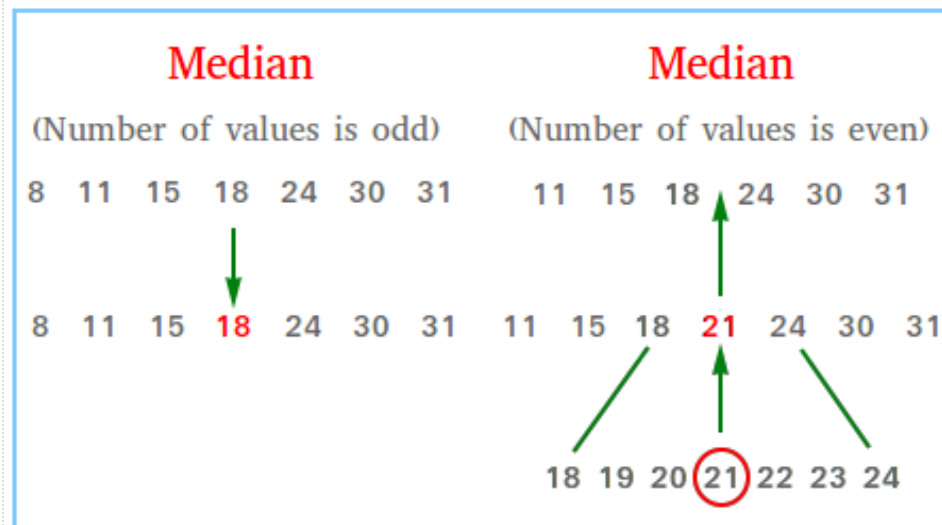
$n \longrightarrow$  Total number of elements in a group

$\mu \longrightarrow$  Mean

## Median(মধ্যমা/মধ্যক)

The median is the value that's exactly in the middle of a dataset when it is ordered. It's a measure of central tendency that separates the lowest 50% from the highest 50% of values.

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# Median

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## Use

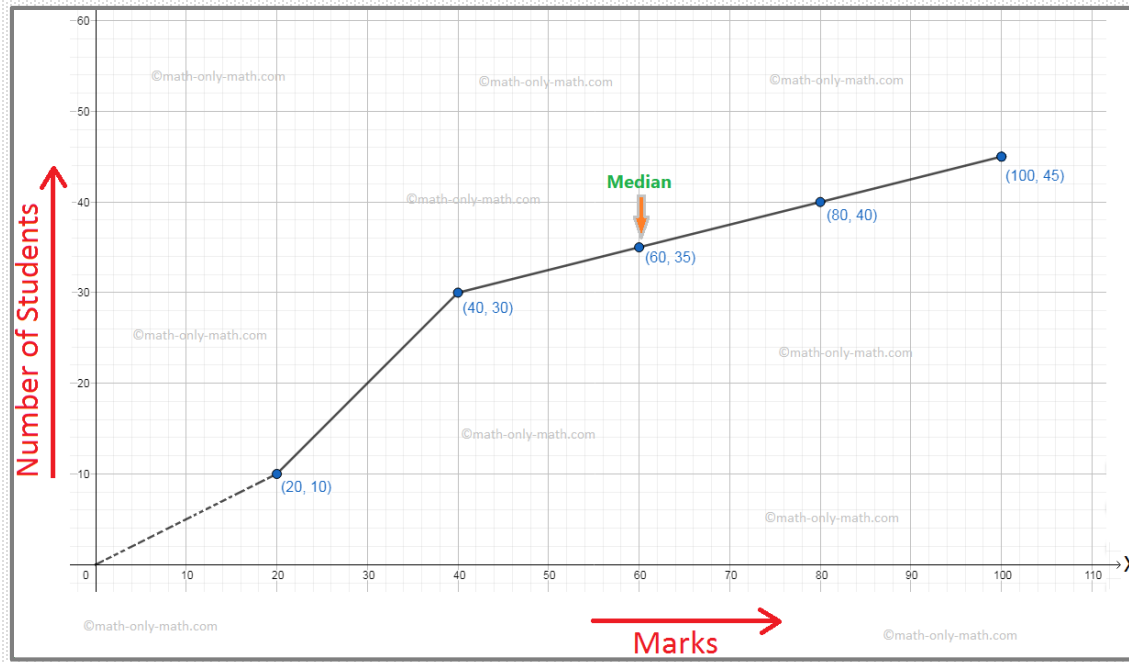
- When we want to know the exact mid point
- When the distribution is skewed.
- To find skewness
- When the distribution contains outliers.
- Also it can be used for the qualitative value

## Merits

- It is not at all affected by extreme values (Outliers)
- Median can be determined even any data is missing
- It can be located graphically
- It is easily understood and is easy to calculate. In some cases it can be located merely by inspection.

## Median (মধ্যমা/মধ্যক)

Median can be located graphically



# Median

---

## Limitations:

- While calculating median, all the data should be arranged in ascending or in descending order. In case of large number of items, it becomes tedious and time consuming.
- Median provides correct result in case of odd observation. When the number of observations is even it fails to obtain accurate result.
- It does not use all the data/score

# Median

## How to find the Median:

---

If 'n' is odd:  $\text{Median} = \left(\frac{n+1}{2}\right)^{\text{th}} \text{ term}$

If 'n' is even:  $\text{Median} = \frac{\left(\frac{n}{2}\right)^{\text{th}} \text{ term} + \left(\frac{n}{2} + 1\right)^{\text{th}} \text{ term}}{2}$

## How to find the Median:

### For Odd Number

Find the median of this set of data values.

47 35 37 32 38 39 36  
34 35

*Solution:*

Lowest value to the highest value:

32 34 35 35 36 37 38  
39 47

The number of values,  $n$ , in the data set = 9

$$\begin{aligned}\text{Median} &= \frac{1}{2}(9+1) \text{ th value} \\ &= 5\text{th value} \\ &= 36\end{aligned}$$

### For Even Number

Find the median of the following data set:

12 18 16 21 10 13 17 19

*Solution:*

Arrange the data values in order from the lowest value to the highest value:

10 12 13 16 17 18 19 21

The number of values in the data set is 8, which is even.

$$\begin{aligned}\therefore \text{Median} &= \frac{4\text{th data value} + 5\text{th data value}}{2} \\ &= \frac{16+17}{2} \\ &= \frac{33}{2} \\ &= 16.5\end{aligned}$$

## Mode(প্রচুরক )

The mode is the value that appears most frequently in a data set.

---

Example:

In  $\{6, 3, 9, 6, 6, 5, 9, 3\}$  the Mode is 6, as it occurs most often.





## Mode(প্রচুরক )

---

### Use

- The mode represents the value(s) that occurs most often in a dataset.
- The mode tells us the most common value in categorical data when the mean and median can't be used.

### Merits

- It can be determined by observation
- It is not affected by outliers
- Also it can be used for the qualitative value
- It can be presented graphically

## Mode(প্রচুরক )

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### Limitations:

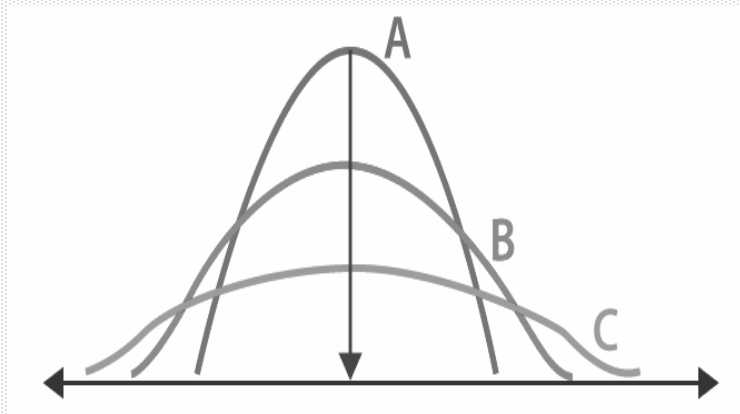
- We cannot find the mode of the equal series
- Mode may not be exist
- Sometime there are more than one mode
- Mode gives us an idea of where the “center” of a dataset is located, but it can be misleading compared to the mean or median.

# Measures of Dispersion

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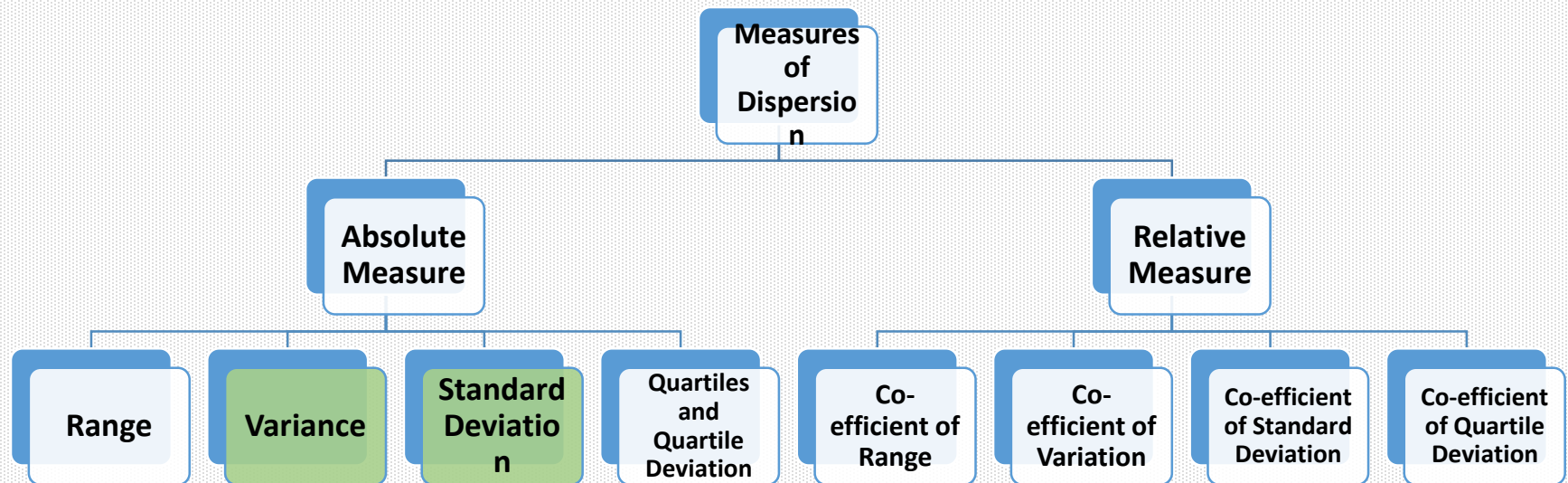
Literal meaning of dispersion is scatter ness. Dispersion is the degree of the scatter ness or deviation of each value in the data set from a measure of central tendency usually the mean.

- The more similar the scores are to each other, the lower Measures of Dispersion will be
- The less similar the scores are to each other, the higher Measures of Dispersion will be



# Measures of Dispersion

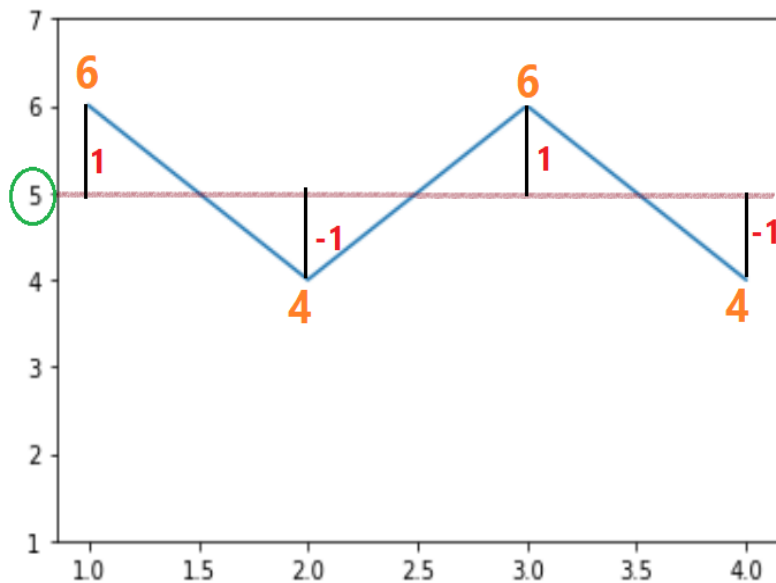
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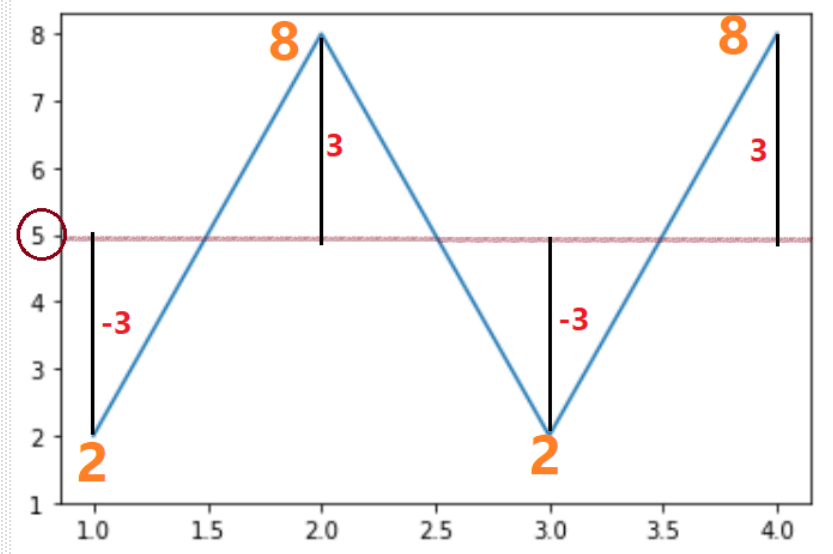
# Variance

The variance is a measures that indicates how much data scatter around the mean.

**6, 4, 6, 4** Mean = 5



**2, 8, 2, 8** Mean = 5



# Variance

**6, 4, 6, 4** Mean = 5

---

**Total Distance = (6-5) + (4-5) + (6-5) + (4-5) = 0** **X**

**Total Distance**  $(6-5)^2 + (4-5)^2 + (6-5)^2 + (4-5)^2 = 4$

**Variance**  $\frac{(6-5)^2 + (4-5)^2 + (6-5)^2 + (4-5)^2}{4} = 1$

# Variance

**2, 8, 2, 8**    Mean = 5

---

**Variance**

$$\frac{(2-5)^2 + (8-5)^2 + (2-5)^2 + (8-5)^2}{4}$$

**= 9**

# Variance

**Population Data** **x1, x2, .....**  $x_n$

**Mean =**  $\mu$

**Variance**

$$\sigma^2 = \frac{(x_1 - \mu)^2 + (x_2 - \mu)^2 + \dots + (x_n - \mu)^2}{n}$$

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

**Sample Data**

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



## Standard Deviation (আদর্শ বিচ্যুতি)

			(Mean)				
Result	38	44	45	50	55	44	74

From which number we can say it is Good or Bad result ?

Mean plus or minus standard deviation is optimum result  
but beyond this is either good or bad

Suppose  $SD = 2$

Then optimum number is  $50 + 2 = 52$  or  $50 - 2 = 48$

## Standard Deviation (আদর্শ বিচ্যুতি)

A	B		A	B		A	B
6	7			7		9	7
7	9		7	4		7	4
8	3			3		1	5
9	2		9	2		2	6
2	8			3		8	4
5	4			4		3	4
37	33		16	23		30	30

Mean= 8      3.83

# Standard Deviation (আদর্শ বিচ্যুতি)

## How to calculate the Standard Deviation

$$\begin{array}{c} 2, 8, 2, 8 \quad \text{Mean} = 5 \\ \hline \sigma^2 \text{ Variance} = \frac{(2-5)^2 + (8-5)^2 + (2-5)^2 + (8-5)^2}{4} = 9 \end{array}$$

$$\sigma = \sqrt{\sigma^2}$$

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

$$\sigma = \sqrt{9} = 3$$