

# Chapter 4: Measures of Central Tendency

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Measures of central tendency describe the center point or typical value of a dataset. They summarize data by identifying a single value that represents the entire dataset. The three main measures of central tendency are **mean**, **median**, and **mode**.

## 1. Mean (Arithmetic Average)

The mean is the sum of all data points divided by the number of data points.

**Formula:**

Mean =  $\frac{\text{Sum of all values}}{\text{Number of values}}$

**Example:**

Given data: 5, 10, 15

Mean =  $\frac{5+10+15}{3} = 10$

**Key Points:**

- Sensitive to outliers (extreme values).
- Works best for symmetric distributions without significant outliers.

Weighted Arithmetic Mean

In calculating simple arithmetic mean it was assumed that all items are of equal importance. This may not be true always. When items vary in importance they must be assigned weights in proportion to their relative importance. Thus, a weighted mean is the mean of weighted items. The weighted arithmetic mean is sum of the product of the values and their respective weights divided by the sum of the weights.

Weighted Mean (WAM) =  $\frac{\sum w_i x_i}{\sum w_i}$

**Where:**

- $\sum w_i x_i$  is sum of multiple of individual frequency and its weight
- $\sum w_i$  is sum of weight

**Example:**

Subject	Marks (X)	Weightage (W)	XW
Math	60	1	60
Science	50	2	100
Economics	70	2	140
Accounts	80	1	80
Statistics	90	2	180
		8	560

$$(WAM) = \frac{\sum w_i x_i}{\sum w_i}$$

$$WAM = 560/8 = 70$$

### Geometric Mean

Geometric mean (GM) is the appropriate root (corresponding to the number of observations) of the product of observations. If there are n observations GM is the n<sup>th</sup> root of the product of n observations.

$$GM = \sqrt[n]{x_1 \times x_2 \times \dots \times x_n}$$

$$GM = \text{Anti log} \left( \frac{\sum \log x}{n} \right)$$

#### Example:

Calculate GM of 2, 4, 8

$$GM = \sqrt[3]{x_1 \times x_2 \times \dots \times x_n} = \sqrt[3]{2 \times 4 \times 8} = \sqrt[3]{64} = 4$$

## 2. Median

The median is the middle value when data points are arranged in ascending or descending order.

#### Steps to Calculate:

- Arrange the data in order.
- If the number of data points (nnn) is odd, the median is the middle value.
- If nnn is even, the median is the average of the two middle values.

#### Example:

- **Odd data points:** 3,8,12  
Median = 8 (middle value).

- **Even data points:** 3,8,12,2  
Median =  $(8+12)/2=10$

**Key Points:**

- Not affected by outliers.
  - Preferred measure for skewed distributions.
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### 3. Mode

The mode is the value(s) that occur most frequently in the dataset.

**Example:**

- Data: 2,4,4,6,8  
Mode = 4.
- Data: 1,2,2,3,3  
Modes = 2 and 3 (bimodal dataset).

**Key Points:**

- Useful for categorical data.
- A dataset may have no mode, one mode (unimodal), or multiple modes (bimodal/multimodal).

### Choosing the Right Measure

- **Mean** : Best for continuous, symmetric data without outliers.
- **Median**: Best for skewed data or when there are outliers.
- **Mode** : Best for categorical data or datasets with repeated values.

**Example Comparison:**

Dataset: 1,2,2,3,100

- **Mean** : 21.62 (influenced by the outlier 100).
- **Median**: 2 (not affected by outliers).
- **Mode** : 2 (most frequent value).