

# Chapter 3: Measures of Central tendency

## Part-1





# Learning Outcomes

After Completing the chapter ,you will able to :

- Compute the different types of mean, median and mode.
- Understand the applications of different types of measures of central tendency.



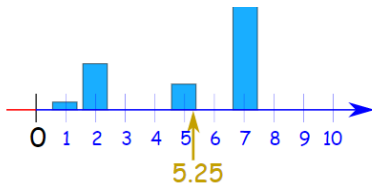
## Contents

### **From this lecture, you are going to learn...**

- What is measures of central tendency?
- Types of measures of central tendency
- Discussion of different types of Mean
- Examples, Uses and limitations

# What is measures of central tendency?

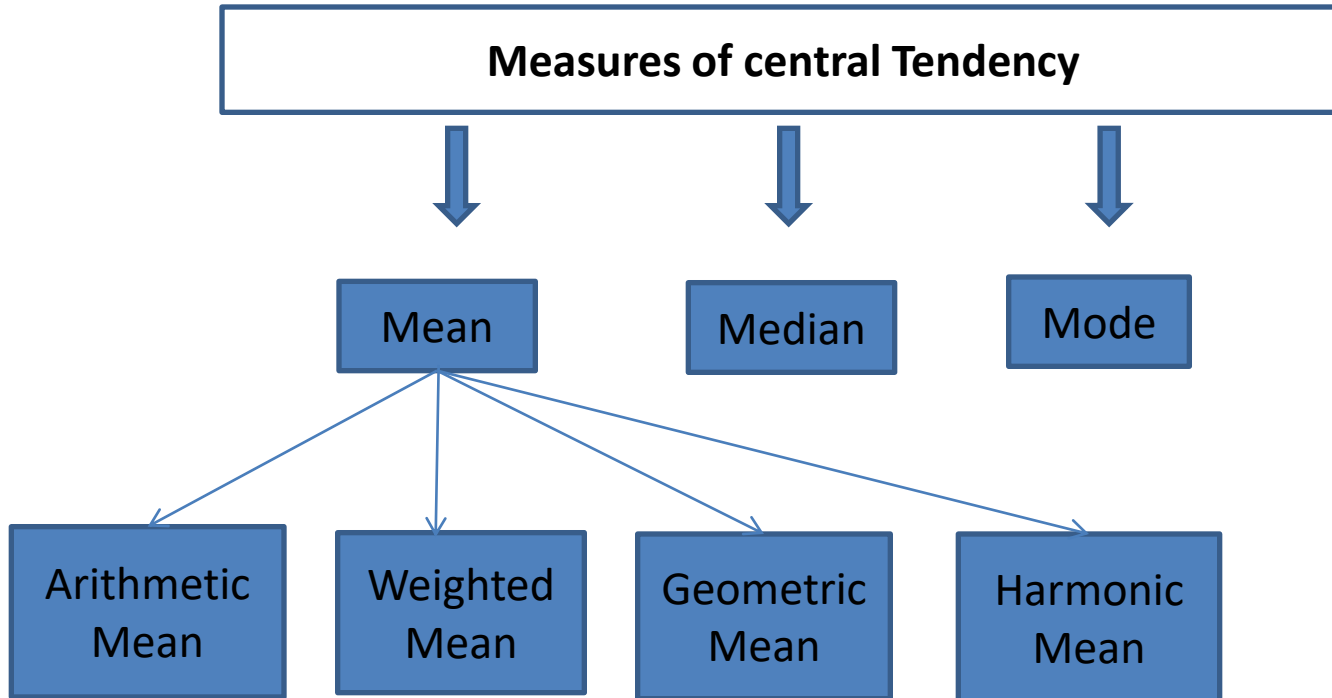
➔ A **measure of central tendency** is a summary statistic that attempts to describe a set of data by calculating the center point or typical value within that data set.



Average age to start schooling



# Types of measures of central tendency





## Arithmetic Mean(AM)

### Arithmetic Mean

The arithmetic mean is the sum of a set of observations, positive, negative or zero, divided by the number of observations. If we have “n” real numbers  $x_1, x_2, x_3, \dots, x_n$  their arithmetic mean, denoted by  $\bar{x}$ , can be expressed as:

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

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



## Example of Arithmetic Mean(AM)

**Example:** A sample of 5 student's marks from the previous semester in midterm exam has given: 14,15,17,16 and 15.Determine the average mark.

Solution:  $\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$

$$\sum_{i=1}^5 x_i = 14 + 15 + 17 + 16 + 15 = 77$$

$$\bar{x} = \frac{77}{5}$$

## Weighted Mean(W.M)

**Weighted Mean (WM):** The Weighted mean of the positive real numbers  $x_1, x_2, \dots, x_n$  with

their weight  $w_1, w_2, \dots, w_n$  is defined to be, 
$$\bar{x} = \frac{\sum_{i=1}^n w_i x_i}{\sum_{i=1}^n w_i} .$$

$$\bar{x} = \frac{w_1 x_1 + w_2 x_2 + \dots + w_n x_n}{w_1 + w_2 + \dots + w_n}$$

**Example-1:** During a one hour period on a hot Saturday afternoon cabana boy Chris served fifty drinks. He sold five drinks for \$0.50, fifteen for \$0.75, fifteen for \$0.90, and fifteen for \$1.15. Compute the weighted mean of the price of the drinks.

$$\begin{aligned} \text{Sol: } \bar{X}_w &= \frac{5(\$0.50) + 15(\$0.75) + 15(\$0.90) + 15(\$1.15)}{5 + 15 + 15 + 15} \\ &= \frac{\$44.50}{50} = \$0.89 \end{aligned}$$

Drink type	$W_i$	$X_i(\$)$
1.	5	0.50
2.	15	0.75
3.	15	0.90
4.	15	1.15





## Geometric Mean(G.M)

Geometric Mean,

$$G.M. = (x_1 \cdot x_2 \cdot x_3 \dots x_n)^{\frac{1}{n}}$$

**Example:** Calculate the Geometric Mean of 5, 25 and 27

**Solution:** We know,

$$G.M. = (x_1 \cdot x_2 \cdot x_3 \dots x_n)^{\frac{1}{n}}$$

$$G.M. = (5 \times 25 \times 27)^{\frac{1}{3}}$$

$$=15$$



## Geometric Mean(G.M)

### Example:

Suppose the population growth rate from 2010 to 2013 were , 1.24, 1.26,1.29 and 1.31 respectively.

Find the geometric mean of these growth rates.

**Solution:** We know,

$$G.M. = (x_1 \cdot x_2 \cdot x_3 \dots x_n)^{\frac{1}{n}}$$

$$\begin{aligned} G.M. &= (1.24 \times 1.26 \times 1.29 \times 1.31)^{\frac{1}{4}} \\ &= 1.27 \end{aligned}$$

So, the average growth rate is, 1.27.

## Harmonic Mean(H.M)

**Harmonic Mean (HM):** The harmonic mean is the number of variables divided by the sum of the reciprocals of the variables.

The harmonic mean H.M of the positive real numbers  $x_1, x_2, \dots, x_n$  is defined to be

$$HM = \frac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \dots + \frac{1}{x_n}} = \frac{n}{\sum_{i=1}^n \frac{1}{x_i}}$$

- For example:
- One student spends on a solution of task  $\frac{1}{3}$  hours, the second student  $\frac{1}{5}$  hours and the third student  $\frac{1}{4}$  hours. Harmonic mean will be calculated:

**Solution:**

$$\bar{x} = \frac{n}{\sum \frac{1}{x}} = \frac{1+1+1}{\frac{1}{\frac{1}{3}} + \frac{1}{\frac{1}{5}} + \frac{1}{\frac{1}{4}}} = \frac{3}{3+5+4} = \frac{3}{12} = \frac{1}{4} (\text{hour})$$



## Harmonic Mean(H.M)

**Example:** A car travels 50 miles at 40 mph, 60miles at 50mph and 40 miles at 60mph.What is the average speed of the trip?

**Solution:** The distance is 50 miles, 60miles and 40 miles.

$$HM = \frac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \dots + \frac{1}{x_n}} = \frac{50 + 60 + 40}{\frac{50}{40} + \frac{60}{50} + \frac{40}{60}} = 48.13mph$$



## Uses and Limitations of A.M,G.M and H.M

Types of mean	Uses	Limitations
Arithmetic Mean(A.M)	It is easy to calculate and allow easy mathematical treatment. It has great application in Financial sectors.	Highly affected by extreme values.
Geometric Mean(G.M)	To find the averages percent increase in sales, production, growth etc.	All values must be positive and non zero.
Harmonic Mean(H.M)	It is appropriate for the situation when the average of fractions such as rates or multiples are desired. Less affected by extreme values	Cannot compute for one or more zero values.



*Thank  
you*

