# MEASURES OF CENTRAL TENDENCY

## Introduction:-

The word average is one of the most commonly used in day to day conversation. For example , Average strength of the class , Average score in Cricket , Average Height , Average Income , Average Price…. Average is a single value that represents a group of values. Averages are generally the central part of the distribution and therefore ,they are also called measures of central tendency. Averages are the values which lie between the two extreme observations of the distribution

**"Average is an attempt to find one single figure to describe whole of figures"**

## Characteristics of a Good Average:-

- Easy to Under stand
- It should be simple to calculate
- It should be rigidly defined
- It should be based on all the observations
- It should not be affected much by extreme observations
- Capable of further algebraic treatment
- Sampling stability

## Types of Averages:-

The following are the important types of averages:

1. Arithmetic Mean
2. Geometric Mean
3. Harmonic Mean
4. Median
5. Mode

# 1. Arithmetic Mean

## a) Arithmetic Mean - Raw Data

Arithmetic Mean is defined as the sum of all the observations in the distribution divided by number of observations. If a variable ' x ' takes the values $x_1, x_2, x_3, ...,x_n$, then its Arithmetic Mean ( $\bar{x}$ ) is defined as

$$\bar{x} = \frac{X1 + X2 + X3 + ……+ Xn}{n}$$

$$\bar{x} = \frac{\sum X}{n}$$

## Illustration .1

Q 1)  The ages of participants in a swimming competition were as follows. Calculate  the arithmetic mean of the

ages .
   Ages in years : 26 , 24 , 27 , 27 , 30 , 29 , 25 , 28 .

## Solutions :-

Given that ,  Ages in years : 26 , 24 , 27 , 27 , 30 , 29 , 25 , 28 .

Let x :  26 , 24 , 27 , 27 , 30 , 29 , 25 , 28 .

Arithmetic Mean $\bar{x} = \dfrac{\Sigma x}{n}$

$$\bar{x} = \dfrac{26+24+27+27+30+29+25+28}{8} = \dfrac{216}{8} = 27$$

## Illustration .2

Q2) Calculate Arithmetic mean of heights of 10 students in a BCom class

| Roll No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Height(cms) | 160 | 157 | 162 | 155 | 158 | 161 | 154 | 159 | 152 | 156 |

## Solutions :-

Given that, height of the students: 160,157,162,155,158,161,154,159,152,156

let x : 160,157,162,155,158,161,154,159,152,156 and n = 10

Arithmetic Mean $\bar{x} = \dfrac{\Sigma x}{n}$

$$\bar{x} = \dfrac{160+157+162+155+158+161+154+159+152+156}{10} = \dfrac{1574}{10} = 157.4 Cms$$

## b) Arithmetic Mean - Discrete Data

If a variable x takes values $x_1$, $x_2$, $x_3$,.....,$x_n$ with corresponding frequencies $f_1$, $f_2$, $f_3$,..., $f_n$ then the  Arithmetic mean is defined as ,

$$\bar{x} \quad = \quad \frac{f_1 x_1 + f_2 x_2 + f_3 x_3 + .. + f_n x_n}{f_1 + f_2 + f_3 + .. + f_n}$$

$$= \quad \frac{\Sigma f\, x}{N} \quad \left(\frac{\Sigma f x}{\Sigma f}\right)$$

Where $\Sigma f$ = N = Total number of observations (total frequency)

## Illustration .1

Q1) Find the averages of variable x taking values as follows.

| x | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|
| Frequency | 12 | 30 | 42 | 28 | 18 |

## Solutions :-

| x | f | fx |
|---|---|---|

| | | |
|---|---|---|
| 50 | 12 | 600 |
| 60 | 30 | 1800 |
| 70 | 42 | 2980 |
| 80 | 28 | 2240 |
| 90 | 18 | 1620 |
| | $\sum f = 130$ | $\sum fx = 9200$ |

$$\text{Arithmetic mean } \bar{x} = \frac{\sum fx}{\sum f} = \frac{9200}{130} = 70.77$$

## Illustration .2

Q2) Calculate the mean value of income per month of families in a town from the following data.

| Income(Rs'000) | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|
| No. of Families | 3 | 6 | 9 | 14 | 10 | 8 |

### Solutions :-

| x | f | f x |
|---|---|---|
| 25 | 3 | 75 |
| 26 | 6 | 156 |
| 27 | 9 | 243 |
| 28 | 14 | 392 |
| 29 | 10 | 290 |
| 30 | 8 | 240 |
| | $\sum f = 50$ | $\sum f x = 1396$ |

$$\text{Arithmetic mean } \bar{x} = \frac{\sum fx}{\sum f} = \frac{1396}{50} = 27.92$$

# c)Arithmetic Mean - Continuous Data

For a continuous distribution, the observations are in the form of class intervals and the values taken by x are the midpoints of the class intervals. Arithmetic Mean for the Continuous data is defined as,

$$\bar{x} = \frac{f_1 x_1 + f_2 x_2 + f_3 x_3 + .. + f_n x_n}{f_1 + f_2 + f_3 + .. + f_n}$$

$$\bar{x} = \frac{\sum f x}{N} \left( \frac{\sum fx}{\sum f} \right)$$

Here $x_1$ , $x_2$, $x_3$, .... , $x_n$ are the class marks or mid values of the class interval and $f_1$, $f_2$, $f_3$, ..., $f_n$ are corresponding class frequencies.

## Illustration .1

Q1) Calculate Arithmetic mean of the following

| Production in tonnes | 20 -30 | 30 -40 | 40 -50 | 50 -60 | 60 -70 | 70 - 80 | 80 - 90 |
|---|---|---|---|---|---|---|---|

| No. of factories | 15 | 14 | 17 | 22 | 20 | 18 | 14 |

**Solutions :-**

| Production C - I | No.of factories f | Class mark x | fx |
|---|---|---|---|
| 20 - 30 | 15 | 25 | 375 |
| 30 - 40 | 14 | 35 | 490 |
| 40 - 50 | 17 | 45 | 765 |
| 50 - 60 | 22 | 55 | 1210 |
| 60 - 70 | 20 | 65 | 1300 |
| 70 - 80 | 18 | 75 | 1350 |
| 80 - 90 | 14 | 85 | 1190 |
| | $\sum f = N = 120$ | | $\sum fx = 6680$ |

$$\text{Arithmetic mean} = \bar{X} = \frac{\sum fx}{N} = \frac{6680}{120} = 55.7 \; tonnes$$

The mean production of the factories is 55.7 tonnes.

## Illustration .2

Q2) The following data give the yield of milk in litres per day in a certain dairy. Find the arithmetic mean

| Yield of milk in litres | 10 -15 | 15 -20 | 20 -25 | 25 - 30 |
|---|---|---|---|---|
| No of cows | 80 | 100 | 270 | 50 |

**Solutions :-**

| Yield of Milk C - I | No.of factories f | Class mark x | fx |
|---|---|---|---|
| 10 - 15 | 80 | 12.5 | 1000 |
| 15 - 20 | 100 | 17.5 | 1750 |
| 20 - 25 | 270 | 22.5 | 6075 |
| 25 - 30 | 50 | 27.5 | 1375 |
| | $\sum f = N = 500$ | | $\sum fx = 10200$ |

$$\text{Arithmetic mean} = \bar{X} = \frac{\sum fx}{N} = \frac{10200}{500} = \underline{20.4}$$