14.6   MEASURES OF CENTRAL TENDENCY

The commonly used measure of central tendency are -

(i) Mean

(ii) Median

(iii) Mode

(a) Mean :

The mean of a number of observation is the sum of the values of all the observations divided by the total number of observations. It is denoted by the symbol $\bar{x}$, read as x bar.

(i) **properties of mean :**

(a) If a constant real number 'a' is added to each of the observation than new mean will be $\bar{x} + a$.

(b) If a constant real number 'a' is subtracted from each of the observation then new mean will be $\bar{x} - a$

(c) If a constant real number 'a' is multiplied with each of the observation then new mean will be $\bar{x}$

(d) If each of the observation is dived by a constant no 'a' then new mean will be $\dfrac{\bar{x}}{a}$.

(ii) Mean of ungrouped data : If $x_1, x_2, x_3, \dots , x_n$ are then n values (or observations) then A.M. (Arithmetic mean) is

$$\bar{x} = \frac{x_1 + x_1 + \dots + x_n}{n} = \frac{\sum_{i-1}^{n} x_i}{n}$$

$$n\bar{x} = \text{Sum of observation} = = \sum_{i-1}^{n} x_i$$

i.e. product of means & no. of items given sum of observation.

Ex.9   Find the mean of the factors of 10

Sol.   factors of 10 are 1,2,5 & 10.

$$\bar{x} = \frac{1 + 2 + 5 + 10}{4} = \frac{18}{4} = 4.5$$

Ex.10   If the mean of 6,4,7 P and 10 is 8 find P.

Sol. $8 = \dfrac{6 + 4 + 7 + P + 10}{5} \Rightarrow P = 13 \Rightarrow P = 13$

(iii) Method for Mean of ungrouped frequency distribution.

x_i	f_i	$f_i x_i$

x_1	f_1	f_1x_1
x_2	f_2	f_2x_2
x_3	f_3	f_3f_3
.	.	.
.	.	.
.	.	.
x_n	f_n	f_nx_n
	$\sum f_i =$	$\sum f_ix_i =$

Then mean $\bar{x} = \dfrac{\sum f_ix_i}{\sum f_i}$

(iv) Method for Mean of grouped frequency distribution.

Ex.11 **(1) Direct Method : for finding mean**

Marks	No. of students fi	mid values xi	fixi
10 – 20	6	15	90
20 – 30	8	25	200
30 – 40	13	35	455
40 – 50	7	45	315
50 – 60	3	55	165
60 – 70	2	65	130
70 - 80	1	75	75
	$\sum f_1 = 40$		$\sum f_ix_i = 40$

$\bar{x} = \dfrac{\sum f_ix_i}{\sum f_i} \dfrac{1430}{40} = 35.75$

(v) Combined Mean :
$$\bar{x} = \frac{n_1\bar{x_1} + n_2 + \bar{x_2} + ...}{n_1 + n_2 + ...}$$

(vi) Uses of Arithmetic Mean

(A) It is used for calculating average marks obtained by a student.

(B) It is extensively used in practical statistics.

(C) It is used to obtain estimates.

(D) It is used by businessman to find out profit per unit article, output per machine, average monthly income and expenditure etc.

(b) Median :

Median of a distribution is the value of the variable which divides the distribution into two equal parts.

(i) Median or ungrouped data

(A) Arrange the data in ascending order.

(B) Count the no. of observations (Let there be 'n' observations)

(C) If n is odd then median = value of $\left(\dfrac{n+1}{2}\right)^{th}$ observation.

(D) If n is even the median = value of mean of $\left(\dfrac{n}{2}\right)^{th}$ observation and $\left(\dfrac{n}{2}+1\right)^{th}$ observation.

Ex.12 Find the median of the following values :

37, 31, 42, 43, 46, 25, 39, 45, 32

Sol. Arranging the data in ascending order, we have

25, 31, 32, 37, 39, 42, 43, 45, 46

Here the number of observations n = 9 (odd)

$\therefore$ Median   = Value of $\left(\dfrac{9+1}{2}\right)^{\text{th}}$ observation

                = Value of 5th observation

                = 39.

Ex.13 The median of the observation 11, 12, 14, 18, x + 2, x + 4, 30, 32, 35, 41 arranged in ascending order is 24. Find the value of x.

Sol. Here, the number of observations n = 10. Since n is even, therefore

Median $= \dfrac{\left(\dfrac{n}{2}\right)^{\text{th}} \text{conservation} + \left(\dfrac{n}{2}+1\right)^{\text{th}} \text{observation}}{2}$

$\Rightarrow$ $24 = \dfrac{5^{\text{th}} \text{ observation} + 6^{\text{th}} \text{ observation}}{2}$

$\Rightarrow$ $24 = \dfrac{(x+2)+(x+4)}{2}$

$\Rightarrow$ $24 = \dfrac{2x+6}{2} \Rightarrow 24 = x + 3 \Rightarrow x = 21.$

Hence, x = 21

(ii) Uses of Median :
(A) Median is the only average to be used while dealing with qualitative data which cannot be measured quantitatively but can be arranged in ascending or descending order or magnitude.
(B) It is used for determining the typical value in problems concerning wages, distribution of wealth etc.
(c) Mode :
(i) Mode or ungrouped data (By inspection only) : Arrange the data in an array and then count the frequencies of each variate. The variate having maximum frequency is the mode.

Ex.13 Find the mode of the following array of an individual series of scores 7, , 10, 12, 12, 12, 11, 13, 13, 17.

Number	7	10	11	12	13	17
Frequency	2	1	1	3	2	1

$\therefore$ Mode is 12

(ii) Uses of Mode : Mode is the average to be used to find the ideal size, e.g., in business forecasting, in manufacture of ready-made garments, shoes etc.
(c) Empirical Relation between Mode, Median & Mean :
Mode = 3 Median - 2 Mean