

Vidyasagar University

Department of Library and Information Science

Paper No: BLI - 202

Paper Name - Management of Libraries and Information Centres – II

Unit – 4: Measurement of Central Tendency

Material No – 01

Central Tendency: One of the important objectives of statistical analysis is to determine various numerical measures which describe the inherent characteristics of a frequency distribution. The first of such measures is average is what is also called in statistics a measures of central tendency.

The averages are the measures which condense a huge unwieldy set of numerical data into single numerical values which are representative of the entire distribution.

Therefore, “An average is a single value selected from a group of values to represent them in some way, a value which is supposed to stand for whole group of which it is a part, as typical of all the values in the group” – A E Waugh.

Types: Popular types of averages are:

- 1 Mean
- 11 Arithmetic mean
- 12 Geometric mean
- 13 Harmonic mean
- 2 Median
- 3 Mode

Arithmetic mean (or simply mean)

Arithmetic mean of a set of observation is defined as their sum, divided by the number of observations. It is denoted by the symbol \bar{x} (say x bar).

If $x_1, x_2, x_3, \dots, x_n$ are of n number of observations, then

$$\text{Arithmetic Mean (AM)} = \bar{x} = \frac{x_1+x_2+x_3+\dots+x_n}{n}$$

$$\text{or } \bar{x} = \frac{\sum_{i=1}^n x_i}{n} \text{ or, simply } \frac{\sum x}{n} \dots\dots\dots (i)$$

Where, $x_1, x_2, x_3, \dots, x_n$ are the values of the variable

n = total number of observations

Weighted A M

If $x_1, x_2, x_3 \dots x_n$ be of n number of observations and $f_1, f_2, f_3 \dots f_n$ are their respective frequency then

$$\begin{aligned} \text{A M} = \bar{x} &= \frac{f_1x_1+f_2x_2+f_3x_3+\dots+f_nx_n}{f_1+f_2+f_3+\dots+f_n} \\ &= \frac{\sum_{i=1}^n fix_i}{N} \text{ or, simply } \frac{\sum fx}{N} \dots\dots\dots (ii) \end{aligned}$$

Where, $x_1, x_2, x_3 \dots x_n$ are the values of the variable

$f_1, f_2, f_3 \dots f_n$ are their respective frequency

N = Total number of frequency

So, required formulas to calculate arithmetic mean are:

a) Observations without frequency: $\bar{x} = \frac{\sum x}{n}$

b) Observations with respective frequency: $\bar{x} = \frac{\sum fx}{N}$

Important Properties of A M

- i) The total of a set of observations is equal to the product of their number and the arithmetic mean.

$$\sum xi = n\bar{x} \text{ or } \sum fix_i = N\bar{x}$$

- ii) The sum of the deviation of a set of observations from their A M is always zero.

$$\sum (xi - \bar{x}) = 0 \text{ where } \bar{x} = \frac{\sum xi}{n}$$

$$\sum fi(xi - \bar{x}) = 0 \text{ where } \bar{x} = \frac{\sum fix_i}{N}$$

Deviation of A from B is defined to be the quantity A – B (not B – A)

- iii) If a group of n_1 observations has A M \bar{x}_1 and another group of n_2 observations has A M \bar{x}_2 , then the A M (\bar{x}) of the composite group of $n_1 + n_2$ ($= N$, say) observations is given by $N\bar{x} = n_1 \bar{x}_1 + n_2 \bar{x}_2$

iv) If two variables x and y are so related that $y = \frac{x-c}{d}$ then,

$$\bar{x} = c+d\bar{y}, c = \text{origin}, d = \text{scale}$$

v) The sum of the squares of deviations of a set of observations has the smallest value, when deviations are taken from their A M.

Calculation of Arithmetic Mean

a) From simple data

Example 1: Calculate average price of a book of 10 books in a collection as given below:

Price per book (In Rs): 75, 80, 110, 125, 140, 90, 150, 100, 85, 135

Solution: Mean = $\bar{x} = \frac{\sum_{i=1}^n xi}{n} = \frac{\sum x}{n}$

Where, x is the values of the variable

n = total number of observations and which is 10

$$\begin{aligned}\text{So, } \bar{x} &= \frac{75+80+110+125+140+90+150+100+85+135}{10} \\ &= \frac{1090}{10} \\ &= 109\end{aligned}$$

Therefore, average price of a book is Rs 109.00

b) From simple frequency distribution

Example 2: The table given below shows the price and number of books holding of a library.

Find out average price of the books.

Price (Rs): 30 40 50 60 70 80 90 100 110 120 130 140 150

No of books: 5 8 12 15 20 25 45 40 30 20 15 10 5

Solution: Since the values of the variables have their respective frequency so the formula for calculating weighted A M should be followed:

Price/ book (Rs)	No of books	
(x)	(f)	(fx)
30	5	150
40	8	320
50	12	600

60	15	900
70	20	1400
80	25	2000
90	45	4050
100	40	4000
110	30	3300
120	20	2400
130	15	1950
140	10	1400
150	5	750

$$\sum f = N = 250 \quad \sum fx = 23220$$

$$A.M = \bar{x} = \frac{\sum fx}{N}$$

Where, x = values of the variable

f = frequency of the variable in each class

N = total number of frequency

$$\bar{x} = \frac{23220}{250} = \text{Rs } 92.88$$

Therefore, average price of a book in the library is Rs 92.88.

Example 3: The table given below shows the number of books issued per day for 28 days in the month of March, 2020 in a library. Find out average number of books issued per day in the library.

No of books issued/ day –	20	30	40	50	60	70	80
No of days	1	2	3	4	5	6	7

Solution: Since the values of the variables have their respective frequency so the formula for calculating weighted A.M should be applied here.

No of books issued per day	No of days of the month	
(x)	(f)	(fx)
20	1	20
30	2	60
40	3	120
50	4	200
60	5	300
70	6	420
80	7	560

$$\sum f = N = 28$$

$$\sum fx = 1680$$

$$A.M = \bar{x} = \frac{\sum fx}{N}$$

Where, x = values of the variable

f = frequency of the variable in each class

N = total number of frequency

$$\bar{x} = \frac{1680}{28} = 60 \text{ days}$$

So, average books issued per day in the library is 60.

Calculation of Arithmetic Mean from Group Frequency Distribution

Unlike simple frequency distribution, arithmetic mean may be calculated from group frequency distribution also. In that case value of the variable in a class should be the mid-value of that class.

Example 4: The table shows the number of books catalogued during a year in the cataloguing section of a library. Calculate average books catalogued per day in the library.

No of books catalogued/ day:	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60
No of days:	32	35	42	48	35	30	23	19	16

Solution:

No of books catalogued/ day (X)	Mid-value (x)	No of days (f)	(fx)
16-20	18	32	576
21-25	23	35	805
26-30	28	42	1176
31-35	33	48	1584
36-40	38	35	1330
41-45	43	30	1290
46-50	48	23	1104
51-55	53	19	1007
56-60	58	16	928

$$\sum f = N = 280$$

$$\sum fx = 9800$$

$$\text{Arithmetic mean} = \bar{x} = \frac{\sum fx}{N}$$

Where, x = mid-values of the classes

f = frequency of the variable in each class

N = total number of frequency

$$A M = \bar{x} = \frac{9800}{280} = 35 \text{ books}$$

Therefore, average books catalogued per day in the library is 35.

(For any discussion call - 9434342283)