MEASURE OF CENTRAL TENDENCY
ARITHMETIC MEAN-I

BY: Harmanu Paul
Department of Economics
Hans Raj Mahila Maha Vidyalaya,Jalandhar.

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Meaning

Central Tendency is a statistical measure that determines a single value that represents the entire distribution.

Definition

According to Croxton and Cowden, "An average is a single value within the range of the data that is used to represent all the values in the series. Since an average is somewhere within the range of data, it is sometimes called a measure of central value".

Main Objectives

- The main objectives of **Measure of Central Tendency are**
- **1) To condense data in a single value.**
- **2) To facilitate comparisons between data.**

Purpose, Importance and Function of Average

- Helpful in comparison
- Basis of statistical analysis
- Helpful in policy formulation
- Brief description
- Representative of universe
- Helpful in decision making

Characteristics / Requisites of good measures of Central Tendency or Average

- Easy to understand
- Familiar to common people
- Based on all values of a variable
- A good average should be rigidly defined
- A good average should be capable of further algebraic treatment

Continue.....

- Good measure should be graphically located
- A good average should not be affected by fluctuation of sampling
- A good average should not be affected by presence of extreme items
- A good average should be such that it is possible to find Central tendency even in open end class intervals
- A good average should not be affected by presence of skewness

Measure of Central Tendency

There are two types of Measure of Central Tendency :

Mathematical Measures
Positional Measures

Measure of Central Tendency

Mathematical measures

- Arithmetic Mean
  - Simple A.M
  - Weighted A.M
- Geometric Mean
- Harmonic Mean

Positional Measures

- Median
- Other Partitions
  - Quartiles (Q1,Q2,Q3)
  - Deciles (D1-D9)
  - Percentiles (P1-P99)
- Mode

Arithmetic Mean

Arithmetic Mean is only average which qualifies most of the essential requisites of a good average. Here each and every item has equal share in determining the Arithmetic Mean.

Arithmetic Mean is of Two Types:

- Simple A.M.
- Weighted A.M.

Simple Arithmetic Mean

Arithmetic Mean can be calculated with respect of different Statistical Series using different Methods

A.M. in case of Individual series

Individual series is that series in which only items or observation are given. Here all items have frequency equal to one.

Methods to determine A.M. in case of individual series

1.Direct Method

A.M= $\Sigma X / n$

Illustration 1.1

Find Mean Height of Seven Students

X: 158 160 162 164 166 168 170

Methods to determine A.M. in case of individual series

2. Short Cut Method

A.M = A + $\Sigma dx / n$

Illustration 1.2

Land Holding of Six farmers are given. Find A.M.

Land Holding(acres): 10 12 14 16 18 20

Methods to determine A.M. in case of individual series

3. Step Deviation Method

A.M = A + **$(\Sigma d'x / n) * c$**

Illustration 1.3

Find Mean Marks of Students.

Roll NO:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Marks:	20	30	40	50	55	60	70	80	90	100

A.M. in case of Discrete Series

- In this series X variable is discrete in nature and each item of the series is attached with their respective frequency. Here frequency is not equal to one as in case of individual series. Frequency is number of times the variable repeats by itself.

Methods to determine A.M. in case of Discrete series

1.Direct Method

A.M= **ΣfX / N or Σf**

Illustration 1.4

Find average of Wages.

Wages(₹ thousand):	**14**	**16**	**20**	**22**	**24**
No. of farmers:	**1**	**4**	**6**	**3**	**2**

Methods to determine A.M. in case of Discrete series

2. Short Cut Method

A.M = A + **Σfdx / Σf**

Illustration 1.5

Find Mean Marks:

Marks	**:**	**14**	**16**	**20**	**22**	**24**
No. of Students:		**1**	**4**	**6**	**3**	**2**

Methods to determine A.M. in case of Discrete series

3. Step Deviation Method

A.M = A + **(Σfd'x / Σf) * c**

Illustration 1.6

Find Mean Marks:

Marks	**:**	**14**	**16**	**20**	**22**	**24**
No. of Students:		**1**	**4**	**6**	**3**	**2**

A.M. in case of Continuous Series

In continuous Series the values of variable are given in form of Class interval with corresponding frequency. Here variable is continuous in nature and it can contain any value within the specified range.

Methods to determine A.M. in case of continuous series

1. Direct Method

A.M= **ΣfX / N or Σf**

Illustration 1.7

Find Average Height.

Height(in cms)	No. of Students
150-152	4
152-154	6
154-156	1
156-158	2
158-160	1
160-162	3
162-164	3

Methods to determine A.M. in case of continuous series

2. Short Cut Method

A.M = A + **Σfdx / Σf**

Illustration 1.8

Find Average Height.

Height(in cms)	No. of Students
150-152	4
152-154	6
154-156	1
156-158	2
158-160	1
160-162	3
162-164	3

Methods to determine A.M. in case of continuous series

3. Step Deviation Method

A.M = A + **(Σfd'x / Σf) * c**

Illustration 1.9

Find Average Height.

Height(in cms)	No. of Students
150-152	4
152-154	6
154-156	1
156-158	2
158-160	1
160-162	3
162-164	3

Types of Continuous series

- Inclusive Class Interval

These are those series in which upper limit of first class is not equal to lower limit of second class and upper limit of second class is not equal to lower limit of third class and so on

Types of Continuous series

- Inclusive Class Interval

Illustration-1.10

Find mean

Plant Height(cms)	No. of Plants
60-62	5
63-65	18
66-68	42
69-71	27
72-74	8

To find arithmetic mean Inclusive series are not converted to exclusive series.

Types of Continuous series

- Unequal Class interval

Illustration- 1.11

Find A.M.

X	f
10-20	4
20-40	10
40-70	26
70-120	8
120-200	2

Given class interval are unequal. They are not made equal to find arithmetic mean.

Types of Continuous series

- Open End Class Interval Series

- Illustration 1.12

Find mean Weekly Wages

Weekly Wages	No. of Workers
Under 16	8
16-24	16
24-30	48
30-36	90
36-48	30
Above 48	8

Firstly we will obtain lower limit of first class and upper limit of last class.

Types of Continuous series

- Cumulative Frequency Series
- It is of Two Types:
  - ‘less than’ or ‘below’ cumulative frequency series
  - ‘more than’ or ‘above’ cumulative frequency series

Cumulative Frequency Series

- ‘less than’ or ‘below’ cumulative frequency series

Illustration – 1.13

Find Mean Age

Age(yrs)	No of Persons
Less than or equal to 10	18
Less than or equal to 20	34
Less than or equal to 30	49
Less than or equal to 40	61
Less than or equal to 50	71
Less than or equal to 60	76
Less than or equal to 70	78
Less than or equal to 80	79

Firstly we will convert cumulative frequency distribution into simple frequency distribution

Cumulative Frequency Series

- ‘more than’ or ‘above’ cumulative frequency series

Illustration – 1.14

Find Mean marks:

Marks : More than	10	20	30	40	50	60	70	80	90
No of students:	140	133	118	100	75	45	20	9	2

- Firstly we will convert cumulative frequency distribution into simple frequency distribution

A.M. in case of Mixed series

- Illustration- 1.15
- Calculate Arithmetic Mean

X	f
1	10
2	5
3	3
4-6	9
7-9	6
10-12	2
13-20	1
21-28	10
29-36	15

A.M. in case of Mid value series

- Illustration- 1.16
- Calculate Arithmetic Mean

X	f
5	2
10	5
15	8
20	18
25	22
30	13
35	8
40	4
45	3
50	1

Missing Frequency Series

- Case 1 One Missing Frequency

Age	Persons
4-8	11
8-12	13
12-16	16
16-20	14
20-24	x
24-28	9
28-32	17
32-36	6
36-40	4

Missing Frequency Series

- Case 2: Two Missing Frequency
- Illustration: 1.18 Given mean=35 and N=68

X	f
0-10	4
10-20	10
20-30	12
30-40	x
40-50	20
50-60	y

Determination of Class Intervals

- Illustration : 1.19
- Calculate different classes if A.M.=33 and Assumed mean=35

d'x	f
-3	5
-2	10
-1	25
0	30
1	20
2	10

Combined Mean

- If two or more than two series are given then we can find combined mean with the help of following formula

$$\overline{X}_{123.....n} = \frac{N_1\overline{X}_1 + N_2\overline{X}_2 + ... + N_n\overline{X}_n}{N_1 + N_2 + N_3 + ... + N_n}$$

Combined Mean

Illustration : 1.20

The mean height of 25 male workers in a factory is 61 inches and mean height of 35 female workers is 58 inches. Find the combined mean of 60 workers in the factory.

Combined Mean

- Illustration – 1.21

- The A.M. of marks of Economics in the class of 30 students was 52. The top 6 students had an average of 80 marks whereas the bottom 10 students had an average of 31 marks. Determine the average marks of remaining students.

Correcting Incorrect Mean

- Illustration :1.22

The mean wage of 100 workers per day was found to be 80. later on it was found that wages of two workers 93 and 59 was misread as 39 and 95. Find the correct mean per day.

Correcting Incorrect Mean

- Illustration :1.23

The mean, mode and median of 75 observation was calculated to be 27,34 and 29 resp. Later on it was found that one observation was wrongly read as 43 instead of correct value 53. Examine to what extent the calculated values of the three averages will be affected by this error.

Correcting Incorrect Mean

- Illustration : 1.24

Following table shows the marks obtained by 100 students in Economics.

Marks:	5-10	10-15	15-20	20-25	25-30	30-35	35-40
Freq.:	1	8	18	36	20	10	7

Later on some mistakes were found which are as follows:

Student:	A	B	C	D	E	F
Correct Marks:	41	23	36	16	33	21
Incorrect6 Marks:	36	28	34	06	17	26

Revise the frequency table and find correct A.M.

Properties Of Arithmetic Mean

- The sum of the deviations, of all the values of x, from their arithmetic mean, is zero. Mathematically:

$$\Sigma(X-\bar{X}) = 0$$

- Sum of squares of deviation from arithmetic mean is always minimum. Mathematically:

$$\Sigma(X-\bar{X})^2 < \Sigma(X-A)^2$$

Where A is any assumed mean other than actual mean

Properties Of Arithmetic Mean

- If all the items in the series are increased, Decreased , Multiply or divided by some constant say ‘a’ then mean will also changed accordingly.
- Combined mean can be calculated

$$\overline{X}_{123.....n} = \frac{N_1\overline{X}_1 + N_2\overline{X}_2 + ... + N_n\overline{X}_n}{N_1 + N_2 + N_3 + ... + N_n}$$

Properties Of Arithmetic Mean

- If X and Y are two variable then

Mean(X+Y)= Mean(X)+Mean(Y)

Mean(X-Y)= Mean(X)-Mean(Y)

- If a and b are constant and X is a variable then

Mean(aX+b)=a * Mean(X)+b

- **ΣX=n*Mean(X)**

Weighted Arithmetic Mean

- Simple A.M. give equal importance to all the items of the series. But if different items of the series are to be given unequal importance the we use weighted A.M.

$$\bar{X}_w = \Sigma WX / \Sigma W$$

Weighted Arithmetic Mean

- Illustration- 1.25

A student of B.Com got the following marks

English	75%
Punjabi	90%
Accounts	70%
Economics	80%
Bus. Comm	60%

Find out weighted mean if weights are 1,1,3,2,3 resp.

Merits and Demerits of A.M

- **Merits**
- It is rigidly defined. Its value is always definite.
- It is easy to calculate and easy to understand. Hence it is very popular.
- It is based on all the observations; so that it becomes a good representative.
- It can be easily used for comparison.
- It is capable of further algebraic treatment such as finding the sum of the values of the observations, if the mean and the total number of the observations are given; finding the combined arithmetic mean when different groups are given etc.
- It is not affected much by sampling fluctuations.

Demerits

- **Demerits**
- It is affected by outliers or extreme values. For example, the average (A.) mean of 10, 15, 25 and 500 is 137.5 Now observe first three values whose A.mean is 16.67

  Due to the outlier 500 the A. mean of the four numbers is raised to 137.5. In such a case A. mean is not a good representative of the given data.
- Many a times it gives absurd results like 4.4 children per family.
- It is not possible to take out the averages of ratios and percentages.