

Chapter 5: MEASURES OF CENTRAL TENDENCY

Important Term and Concepts:

1. **Average:** It is a value which is typical or representative of a set of data. Averages are also called Measures of Central Tendency.
2. **Functions of Average:**
 - i] Presents complex data in a simple form.
 - ii] Facilitates comparison.
 - iii] Helps government to form policies.
 - iv] Useful in Economic analysis.
3. **Essentials of a good Average:**
 - i. Simple to calculate.
 - ii. It should be easy to understand.
 - iii. Rigidly defined.
 - iv. Based on all items of observation.
 - v. Least affected by extreme values.
 - vi. Capable of further algebraic treatment.
 - vii. Least affected by sampling fluctuation.
 - viii. Graphic measurement possible.
4. **Types of Averages:**
 - i. Arithmetic Mean
 - ii. Median
 - iii. Mode
 - iv. Quartiles
5. **Arithmetic Mean (X)**
 It is the most common type of measures of central tendency.
 It is obtained by dividing the sum of all observation in a series by the total number of observation.
6. **Calculation of Arithmetic Mean:**

| | Individual Series | Continuous Series |
|-----------------------|-------------------------------------|---|
| Direct Method | $X = \frac{\sum X}{N}$ | $X = \frac{\sum fx}{\sum f}$ |
| Assumed Mean Method | $X = A + \frac{\sum X}{N}$ | $X = A + \frac{\sum fd}{\sum f}$ |
| Step Deviation Method | $X = A + \frac{\sum d \times i}{N}$ | $X = A + \frac{\sum fd}{\sum f} \times i$ |

7. **Merits of Arithmetic Mean:**

- 1] Easy to calculate
- 2] Simple to understand
- 3] Based on all observations
- 4] Capable of further mathematical calculations.

Demerits:

- 1] Affected by extreme values.
- 2] Cannot be calculated in open-end series.
- 3] Cannot be graphically ascertained.
- 4] Sometimes misleading or absurd result.

8. **Weighted Arithmetic Mean:**

Values to be arranged are given varying importance.

$$\bar{X}_W = \frac{\sum WX}{\sum W}$$

Where \bar{X}_W = Weighted Arithmetic Mean

W = Weight

X = Values of the variables

9. **Median (M)**

It is defined as the middle value of the series, when the data is arranged in ascending or descending order.

Calculation of Median

For Individual & Discrete Series

$$M = \text{Size of } \frac{(N+1)}{2} \text{th item}$$

Continuous series

Median Item = size of $(N/2)^{\text{th}}$

$$\text{item. } M = L_1 + \frac{N/2 - c.f}{f} \times i$$

Merits

1. Easy to understand and easy to compute.
2. Not underlay affected by extreme observation.
3. It can be located graphically.
4. Appropriate average in case of open end classes.

Demerits:

1. Not based on all observations.
2. It requires arrangement of data.
3. Not capable o further algebraic treatment.

11.Mode (Z)

It is the value which occurs the most frequently in a series.

Calculation of Mode

- i. Individual Series :
- ii. By observation identify the value that occurs most frequently in a series.
- iii. By conversion into discrete series and then identify the value corresponding to which there is highest frequency.

Discrete Series:

- i. By Inspection Method.
- ii. Grouping Method: By preparing Grouping Table and then preparing Analysis table.

Continuous Series:

- i. Determination of Modal class by Inspection Method or Grouping table and Analysis table.
- ii. Applying the formula

$$Z = L_1 + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times i$$

OR

$$Z = L_1 + \frac{D_1}{D_1 + D_2} \times i$$

Merits of Mode

- i. It is easy to understand and simple to calculate.
- ii. Not affected by extreme values.
- iii. Can be located graphically.
- iv. Easily calculated in case of open-end classes.

Demerits of Mode

- i. Not rigidly defined.
- ii. If mode is ill defined, mathematical calculation is complicated.
- iii. Not based on all items.
- iv. Not suited to algebraic treatment.

12. Relationship between Mean Median and Mode

- i. In case of symmetrical distribution

$$\text{Mean} = \text{Median} = \text{Mode}$$

- ii. In case of asymmetrical distribution

$$\text{Mode} = 3 \text{ Median} - 2 \text{ Mean}$$

MCQ/1 mark conceptual questions

1. The single value which represents the entire universe is called
(a.) Central tendency (b.) Range
(c.) Index Number (d.) Histogram
2. In calculation of _____, all items are given equal importance.
(a.) Simple arithmetic means (b.) Weighted arithmetic mean
(c.) Median (d.) Mode
3. To calculate arithmetic mean by direct method in individual series, we use _____ formula.
(a.) $\Sigma X / N$ (b.) $\Sigma fX / N$
(c.) $\Sigma fm / N$ (d.) $A + \Sigma fd / N$
4. Total of given variables is given by _____.
(a.) ΣfX (b.) $\Sigma X / N$ (c.) Σfd (d.) Σfm
5. Which average is the most suitable in the case of calculating average Intelligence of students in a class?
(a.) Mode (b.) Mean
(c.) Median (d.) Median and Mode
6. Which average is affected by extreme values?
(a.) Mean (b.) Mode
(c.) Median (d.) None of the above
7. The values which has the greatest frequency in a series is called
(a.) Quartile (b.) Median (c.) Mode (d.) Mean
8. The value which divides a series into 4 equal parts
(a.) Median (b.) Quartile
(c.) Decile (d.) Percentile

9. The following values can be located through graph:

(a.) Mode

(b.) Mean

(c.) Weighted mean

(d.) Combined mean

Answers:

1. (a) 2. (a) 3. (a) 4. (b) 5. (c) 6. (a) 7. (c) 8. (b) 9. (a)

Conceptual Questions:

1. Give the meaning of central tendency.

Ans. It is the single value which represents the characteristics of the entire Universe.

2. Define arithmetic mean.

Ans. It is defined as the sum of the values of all observations divided by the number of observations

3. Name three most commonly used averages

Ans. These are: Arithmetic mean, median and mode

4. Name two positional measures of central tendency.

Ans. (a) Median (b) Mode

5. Define median.

Ans. It is the values which divides a series into more than two equal parts. The partition values are : quartiles, deciles and percentiles.

6. Define quartiles, deciles and percentiles.

Ans. Quartiles. These divide the series into 4 equal parts. There are three quartiles; Q1, Q2 and Q3. Q2 are same as median.

Deciles. These divide the series into 10 equal parts. There are 9 deciles; D1, D2 and D9. D5 are same as median.

Percentiles. These divide the series into 100 equal parts. There are 99 percentiles; P1, P2 and P99. P50 are same as median.

7. Define mode.

Ans. Mode is defined as that value which occurs most frequently in the distribution.

8. What is the relationship between Mean, median and mode?

Ans. Mode = 3Median – 2Mean

3/4 marks questions (FAQ)/VALUE BASED

1. Two companies using arithmetic mean give their average profits as Rs. 3 Lakh for the same year. A statistical expert intends to rate their performance. Which qualitative values will help him in his task?

Ans. Though statistically correct, only qualitative data may not be sufficient to rate a company's performance. Qualitative aspects such as **honesty, cleverness, enterprising nature, business ethics** etc. cannot be measured quantitatively using arithmetic mean. Hence he should also consider the above qualitative aspects as well as to rate the performance.

2. Following table give distribution of income in a factory:

| Income (Rs.) | 0-1000 | 1000-2000 | 2000-3000 | 3000-4000 | 4000-5000 |
|----------------|--------|-----------|-----------|-----------|-----------|
| No. of workers | 10 | 20 | 45 | 22 | 3 |

Which average do you suggest to study the data given on income distribution? Which values does the average exhibit?

Ans. In such cases, where income distribution is unequal, middle value or median is the most **trusted average**. Median is the most representative figure as half the income earners must be **earning at least the median income**. Values which are exhibited by median are exhibited by median are justice, study of qualitative aspects like **equality, inclusiveness** etc.

HOTS questions

1. How is arithmetic mean calculated in specific cases?

Ans. Other than regular class – intervals (continuous series), there are specific cases in which arithmetic mean is calculated as discussed under:

1. **When mid values are given.** There is no need to convert the mid-values in continuous series. We will calculate arithmetic mean as usual.
2. **When inclusive class intervals are given.** We may/may not convert inclusive series into exclusive series, to calculate mean. (However it is advisable to convert into exclusive series, to be in practice).
3. **When Cumulative series are given.** When values of the variables are given in „Less than“ or „More than“ types, we need to convert these into a simple frequency series.

4. *When unequal class-intervals are given.* In such cases, arithmetic mean is calculated in the usual manner after finding mid-values of each class-interval.

5. *When open-end class intervals are given.* Mean can be calculated after finding missing class limits which are assumed after studying the pattern of class intervals.

2. What is the meaning of term “Central tendency”? How is it useful?

Ans. It is a value around which values of a variable concentrate. It is the value which is capable to represent the series. Central tendency is very useful in statistical analysis because:

1. It represents the entire group.
2. It can be used to facilitate statistical analysis.
3. It helps in comparing one set of data with another set of data.
4. It helps in decision making and formulating plans in various areas of business activities, economic planning etc.

Q-3 “Mode is the most commonly used measure” why?

Ans. Mode has practical utility. It is very useful to traders as it helps them in decision making regarding modal wage, size etc. When we need to use average income, average wages, average size of shoes, average per capita expenditure, we refer to most frequently used item i.e. mode. Now a days, modal output, imports, exports etc. are determined by mode. Mode is also used to forecast rainfall, temperature etc. That is why we say that mode is the most commonly used measure.