QUANTITATIVE METHODS

MODULE CODE: BIT 125

WELCOME

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COURSE CONTENTS

CHAPTER 06

MEASURE OF DISPERSION

- ☐ Absolute and relative measures
- ☐ The range
- ☐ Inter-quartile range
- ☐ Quartile deviation
- ☐ Mean deviation
- ☐ Standard deviation
- ☐ Coefficient of variation
- ☐ Skewness and Kurtosis

5 Lecture Hours

MEASURE OF DISPERSION

The measure of dispersion indicates the scattering of data. It explains the disparity of data from one another delivering a precise view of the distribution of data. The measure of dispersion displays and gives us an idea about the variation and central value of an individual item.

In other words, Dispersion is the extent to which values in a distribution differ from the average of the distribution.

It gives us an idea about the extent to which individual items vary from one another and from the central value.

For Example:

Players	I Innings	II Innings	Mean
Player 1	0	100	50
Player 2	40	60	50

Comparing the averages of the two players we may come to the conclusion that they were playing alike. But player 1 scored 0 runs in I innings and 100 in II innings. Player 2 scored nearly equal runs in both the innings. Therefore it is necessary for us to understand data by measuring dispersion.

MEASURE OF DISPERSION

Types of Measures of Dispersion

1. Absolute Measures

Absolute measures of dispersion are expressed in the unit of Variable itself. Like Kilograms, Rupees, Centimeters, Marks etc.

- Range
- Interquartile Range
- Quartile Deviation
- Mean Deviation
- Standard Deviation
- Lorenz Curve

MEASURE OF DISPERSION

Types of Measures of Dispersion

2. Relative Measures

Relative measures of dispersion are obtained as ratios or percentages of the average. These are also known as ‘Coefficient of dispersion’. These are pure numbers or percentages totally independent of the units of measurements.

- Coefficient of Range
- Coefficient of Quartile Deviation
- Coefficient of Mean Deviation
- Coefficient of Standard Deviation
- Coefficient of Variation

MEASURE OF DISPERSION

Characteristics of a Good Measure of Dispersion

- It should be easy to calculate & simple to understand.
- It should be based on all the observations of the series.
- It should be rigidly defined.
- It should not be affected by extreme values
- It should not be unduly affected by sampling fluctuations.
- It should be capable of further mathematical treatment and statistical analysis

MEASURE OF DISPERSION

Objectives of Computing Dispersion

1. Comparative Study

Measures of dispersion give a single value indicating the degree of consistency or uniformity of distribution. This single value helps us in making comparisons of various distributions.

The smaller the magnitude (value) of dispersion, higher is the consistency or uniformity and vice-versa.

2. Reliability of an Average

A small value of dispersion means low variation between observations and average. It means the average is a good representative of observation and very reliable.

A higher value of dispersion means greater deviation among the observations. In this case, the average is not a good representative and it cannot be considered reliable.

MEASURE OF DISPERSION

3. Control the Variability

Different measures of dispersion provide us data of variability from different angles and this knowledge can prove helpful in controlling the variation.

Especially, in the financial analysis of business and Medical, these measures of dispersion can prove very useful.

4. Basis for Further Statistical Analysis

Measures of dispersion provide the basis further statistical analysis like, computing Correlation, Regression, Test of hypothesis, etc.

RANGE

Range is defined as difference between the largest and smallest observation in the data set.

Formula to Calculate Range:

Range = Largest value in the data set (L) – Lowest value in the data set (S)

$$Coefficient\ of\ Range = \frac{L-S}{L+S}$$

Example 5.1:

The following data relates to the heights of 10 students (in cms) in a class.

158, 164, 168, 170, 142, 160, 154, 174, 159, 146

Calculate the range and coefficient of range.

RANGE

Solution:

L=174

S=142

Range = L – S

= 174 – 142

= 32

Coefficient of range = (L-S)/(L+S)

=(174-142)/(174+142)

= 32/316

= 0.101

RANGE

Example 5.2

Calculate the range and the co-efficient of range for the marks obtained by 100 students in a school

Marks	60-63	63-66	66-69	69-72	72-75
No. of students	5	18	42	27	8

Solution:

L = Upper limit of highest class = 75

S = lower limit of lowest class = 60

Range = L-S

= 75-60

= 15

Coefficient of range = (L-S)(L+S)

=15/(75+60)

= 0.111

RANGE

Merits:

- It is very easy to calculate and simple to understand.
- No special knowledge is needed while calculating range.
- It takes least time for computation.
- It provides the broad picture of the data at a glance.

Demerits

- It is a crude measure because it is only based on two extreme values (highest and lowest).
- It cannot be calculated in case of open-ended series.
- Range is significantly affected by fluctuations of sampling i.e. it varies widely from sample to sample.

DEVIATION

Interquartile Range

It is defined as the difference between the Upper Quartile and Lower Quartile of a given distribution.

$$\textit{Interquartile Range} = \textit{Upper Quartile } (Q_3) - \textit{Lower Quartile}(Q_1)$$

Quartile Deviation

It is known as Semi-Inter-Quartile Range i.e. half of the difference between the upper quartile and lower quartile.

$$\textit{Quartile Deviation} = \frac{Q_3 - Q_1}{2}$$

Coefficient of Quartile Deviation

$$\text{Coefficient of QD} = = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

QUARTILE DEVIATION

Merits:

- It is also quite easy to calculate and simple to understand.
- It can be used even in case of open-end distribution.
- It is less affected by extreme values so, it a superior to ‘Range’.
- It is more useful when dispersion of middle 50% is to be computed.

Demerits

- It is not based on all the observations.
- It is not capable of further algebraic treatment or statistical analysis.
- It is affected considerably by fluctuations of sampling.
- It is not regarded as very reliable measure of dispersion because it ignores 50% observations.

MEAN DEVIATION

Mean deviation is a measure of variability/dispersion. We can calculate it from Arithmetic Mean, Median or Mode. It shows us how far are all the observations from the middle, on average? Each deviation is an absolute deviation as it is an absolute value which implies that we ignore the negative signs. Also, the deviations on both the sides of the Mean shall be equal. Let us start learning the mean deviation formula in detail.

- Mean Deviation from Mean (M.D) $= \frac{\sum |X-\bar{X}|}{N}$ (Individual Series)

  Mean Deviation from Mean (M.D) $= \frac{\sum f|X-\bar{X}|}{N}$ (Discrete/Continuous Series)

  Coefficient of M.D from Mean $= \frac{M.D}{\bar{X}}$

- Mean Deviation from Median (M.D) $= \frac{\sum |X-M_d|}{N}$ (Individual Series)

  Mean Deviation from Median (M.D) $= \frac{\sum f|X-M_d|}{N}$ (Discrete/Continuous Series)

  Coefficient of M.D from Median $= \frac{M.D}{M_d}$

MEAN DEVIATION

- Mean Deviation from Mode (M.D) $= \frac{\sum |X-Mode|}{N}$ (Individual Series)

  Mean Deviation from Mode (M.D) $= \frac{\sum f|X-Mode|}{N}$ (Discrete/Continuous Series)

  Coefficient of M.D from Mode $= \frac{M.D}{Mode}$

QUARTILE DEVIATION

Merits

- It is based on all the observations of the series and not only on the limits like Range and QD.
- It is simple to calculate and easy to understand.
- It is not much affected by extreme values.
- For calculating mean deviation, deviations can be taken from any average.

Demerits

- Ignoring + and – signs is bad from the mathematical viewpoint.
- It is not capable of further mathematical treatment.
- It is difficult to compute when mean or median are in fraction.
- It may not be possible to use this method in case of Open ended series.

STANDARD DEVIATION

Standard deviation is the positive square root of average of the deviations of all the observation taken from the mean. It is denoted by σ (Sigma).

Standard Deviation $(\sigma) = \sqrt{\frac{\sum fx^2}{n} - \left(\frac{\sum fx}{n}\right)^2}$

STANDARD DEVIATION

Merits:

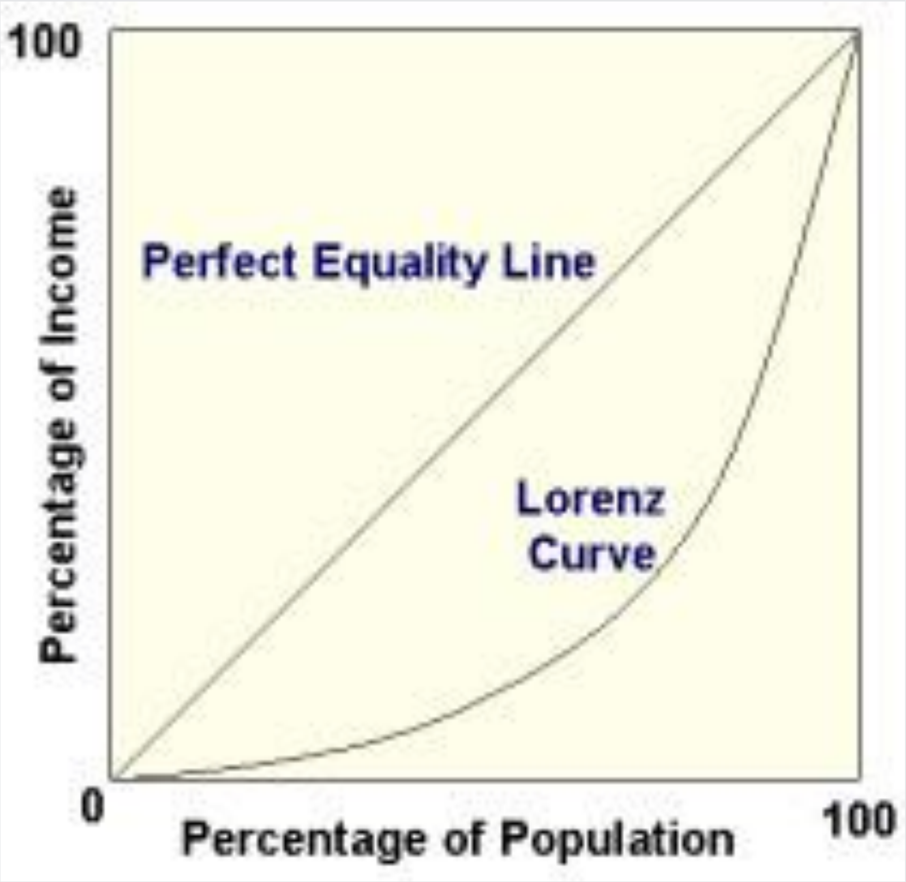
- The value of standard deviation is based on every observation in a set of data.
- It is less affected by fluctuations of sampling.
- It is the only measure of variation capable of algebraic treatment.

Demerits:

- Compared to other measures of dispersion, calculations of standard deviation are difficult.
- While calculating standard deviation, more weight is given to extreme values and less to those near mean.
- It cannot be calculated in open intervals.
- If two or more data set were given in different units, variation among those data set cannot be compared.

LORENZ'S CURVE

Lorenz's curve is the graphical method of studying variations in the distribution. This method was for the first time used by American Economist Max. O. Lorenz in 1905 for measuring the variation in the distribution of incomes and wealth. Now a days it is used in business to the distributions of profits, wages, production etc. The graph plots percentiles of the population on the horizontal axis according to income or wealth and cumulative income or wealth on the vertical axis.



LORENZ'S CURVE

Steps to draw Lorenz's Curve

- Find the cumulative values of the size of items (variables values) as well as the frequencies.
- Express these cumulative values as percentages by taking the grand total for each as 100.
- Represent the percentage of the cumulative frequencies on the x-axis starting the scale from 100 to 0.
- Represent the percentages of cumulated values of the variable on the y-axis starting the scale from 0 to 100.
- Draw a diagonal line joining the 0 on the x-axis with 100 on the y-axis.
  This is called the **Line of Equal Distribution.**
- Plot the percentages of cumulative values of the variable (y) against the percentages of corresponding cumulative frequencies (x) and join these points with a smooth free hand curve to obtain the Lorenz's curve for the given distribution.

Less the distance of the curve from the line of equal distribution, less will be the variability and greater the distance greater will be the variability.

LORENZ’S CURVE

Merits:

- Lorenz’s curve is a visual aid system of finding dispersion. The variability of two distributions can easily be compared by this method;
- It is appropriate method of studying distributions of wealth and income in a community.

Demerits:

- It does not give a quantitative measure of dispersion.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