CLASS NOTES

Class: XI	**Topic: CHAPTER: MEASURES OF DISPERSION**
Subject: ECONOMICS: STATISTICS FOR ECONOMICS	**Basic concepts: MEANING AND TYPES OF DISPERSION STANDARD DEVIATIION.**

Dispersion

Dispersion is a measure of the variation of the items from central value.

"Dispersion is the measure of the variation of the item".

". According to Spiegel, 'The degree to which numerical data tend to spread about an average value is called the variation or dispersion of the data".

The measures of **dispersion** is important to compare uniformity, consistency and reliability amongst variables / series. ... Relative measures are expressed in ratios or percentage of average, also known as coefficients of **dispersion**

Different methods of measuring dispersion are

- Range
- Quartile deviation
- Mean deviation
- Standard deviation

Standard Deviation

Standard deviation is the square root of the arithmetic mean of the squares of deviations of the items from their mean values.

In statistical analysis, the standard deviation is considered to be a powerful tool to measure dispersion. The standard deviation is extensively used to measure deviation and is preferred over other measures of dispersion.

It is the square root of the arithmetic mean of the squares of deviations of observations from their mean value. It is generally denoted by sigma i.e. σ.

Calculation of Standard Deviation

σ for Individual Series

There exist three methods of calculating SD for individual series which are:

Direct method

In this method, at first, the arithmetic mean is calculated using the formula-

$\sum X/N$.

Then deviations of all observations from this mean value are calculated using D= X-mean. In the next step, these deviations, x, are squared and their summation is divided by the number of observations. Lastly, the square root of the above calculation results in the derivation of standard deviation. The formula is mentioned below:

$$\sigma = \sqrt{[\sum D^2/N]}$$

Here, D= Deviation of an item relative to mean, calculated as D= X- mean

N= The number of observations

Short-cut method

This method works on the idea of the assumption of any random value for calculation of deviation. The value is generally assumed such that it lies around the middle of the range of values because if an extreme value is chosen the deviations would be large and hence it will render calculations tedious. The formula is as follows:

$$\sigma = \sqrt{[(\sum D^2/N) - (\sum D/N)^2]}$$

Step-deviation method

The step deviation method is an extension of the shortcut method. Further, it simplifies the shortcut method by selecting a common factor among deviations such that when divided by this factor, all the deviation values get reduced. As a result, this reduction makes the calculation simpler. The common factor is generally referred to as C. The formula is mentioned below:

$$\text{Standard deviation}(\sigma) = \sqrt{[(\sum D'^2/N) - (\sum D'/N)^2]} \times C$$

Here, D'= Step-deviation of observations relative to an assumed mean, calculated as D'= (X-A)/C

C= Common factor chosen

DISCRETE SERIES

σ for Discrete Series

The standard deviation is calculated by four methods

Actual Mean Method

In this method the deviations are taken from the actual mean: The formula to calculate Standard deviation $(\sigma)= \sqrt{(\sum fD^2)/N)}$

Short-cut method

The formula for calculation of standard deviation using the short-cut method is mentioned below:

$$\text{Standard deviation}(\sigma)= \sqrt{[(\sum fD^2/N) - (\sum fD/N)^2]}$$

Direct Method

The formula to calculate standard deviation by Direct Method is

$$\text{Standard deviation}(\sigma)= \sqrt{(\sum fX^2)/N) - (\bar{X})^2}$$

Where $\sum fX^2$= Sum total of the Squared observations multiplied by Frequency

Step-deviation Method

The formula is given below

$$(\sigma)= \sqrt{[(\sum fD'^2/N) - (\sum fD'/N)^2]} \times C$$

CONTINUOUS SERIES

σ for Continuous Series

Actual mean method

$$\sigma = \sqrt{\frac{\sum fx^2}{N}}$$

$\sum \boldsymbol{fx^2}$ = ***sum total of the squared deviations multiplied by frequency***, N= no.of observations

Direct Method

The direct method for calculation of standard deviation for frequency distribution is pretty much the same as for discrete series. The only difference occurs when using the values of observations. The mid values of the classes are derived dividing the sum of upper and lower value of class and this value is used for calculations. The formula is:

$$\text{Standard deviation}(\sigma)= \sqrt{\frac{\sum fm^2}{N} - -(\overline{X})^2}$$

Here, $\sum fm^2$=Sum total of the squared mid-points multiplied by frequency

N= Number of observations

Step-deviation Method

The formula is given below:

$$\text{Standard deviation}(\sigma)=\sqrt{[(\sum fD'^2/N) - (\sum fD'/N)^2]} \times C$$

Here, D'= Step-deviation of observations relative to an assumed value, calculated as D'= (Xi-A)/C

N= The summation of frequency

C= Common factor chosen

Short-cut method

The formula for calculation of standard deviation using the short-cut method is mentioned below:

Standard deviation(σ)= √[(∑fD²/N) – (∑fD/N)²]

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