Business Research Methods

Course Code – MGMT4013

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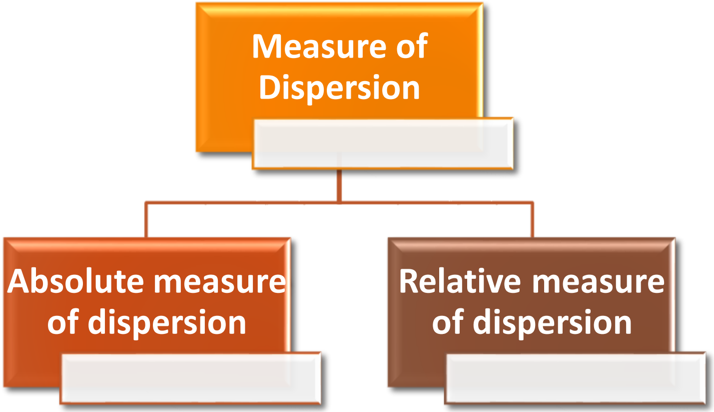
Content

- **Measures of Dispersion and their advantages.**

Measures of Dispersion

- The measure of dispersion shows the scatterings of the data.
- It tells the variation of the data from one another and gives a clear idea about the distribution of the data.
- The measure of dispersion shows the homogeneity or the heterogeneity of the distribution of the observations.

There are two kinds of measures of dispersion, namely



➢ **Absolute and Relative Measures of Dispersion**

Absolute measure of dispersion indicates the amount of variation in a set of values in terms of units of observations.

For example, when rainfalls on different days are available in mm, any absolute measure of dispersion gives the variation in rainfall in mm.

Relative measures of dispersion are free from the units of measurements of the observations. They are pure numbers. They are used to compare the variation in two or more sets, which are having different units of measurements of observations.

➢ Absolute and Relative Measures of Dispersion Cont…

The various absolute and relative measures of dispersion are listed below :

	Absolute Measures of Dispersion	Relative Measures of Dispersion
1	Range	Co-efficient of Range
2	Quartile deviation	Co-efficient of Quartile deviation
3	Mean deviation	Co-efficient of Mean deviation
4	Standard deviation	Co-efficient of variation

❖ Range and coefficient of Range:

Range: This is the simplest possible measure of dispersion and is defined as the difference between the largest and smallest values of the variable.

In symbols, Range = L – S.

Where, L = Largest value.
S = Smallest value.

Co-efficient of Range :

$$\text{Co-efficient of Range} = \frac{L - S}{L + S}$$

✓ Merits and Demerits of Range :

Merits	Demerits
It is simple to understand.	It is very much affected by the extreme items.
It is easy to calculate.	It is based on only two extreme observations.
In certain types of problems like quality control, weather forecasts, share price analysis, etc., range is most widely used.	It cannot be calculated from open-end class intervals.
	It is not suitable for mathematical treatment.
	It is a very rarely used measure.

❖ Quartile Deviation and Co efficient of Quartile

Quartile Deviation (Q.D) : Quartile Deviation is half of the difference between the first and third quartiles. Hence, it is called Semi Inter Quartile Range.

In Symbols, $Q.D = \frac{Q_3 - Q_1}{2}$. Among the quartiles Q_1, Q_2 and Q_3, the range $Q_3 - Q_1$ is called inter quartile range and $\frac{Q_3 - Q_1}{2}$, Semi inter quartile range.

Co-efficient of Quartile Deviation :

$$\text{Co-efficient of Q.D} = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

✓ Merits and Demerits of Quartile Deviation

Merits	Demerits
It is Simple to understand and easy to calculate	It is not based on all the items. It is based on two positional values Q1 and Q3 and ignores the extreme 50% of the items
It is not affected by extreme values.	It is not amenable to further mathematical treatment.
It can be calculated for data with open end classes also.	It is affected by sampling fluctuations.

❖ Mean Deviation and Coefficient of Mean Deviation:

Mean Deviation:

- Mean deviation is the arithmetic mean of the deviations of a series computed from any measure of central tendency; i.e., the mean, median or mode, all the deviations are taken as positive i.e., signs are ignored. According to Clark and Schekade,

Coefficient of mean deviation:

- Mean deviation calculated by any measure of central tendency is an absolute measure. For the purpose of comparing variation among different series, a relative mean deviation is required.

Coefficient of mean deviation: = $\dfrac{\text{Mean deviation}}{\text{Mean or Median or Mode}}$

If the result is desired in percentage,

the coefficient of mean deviation = $\dfrac{\text{Mean deviation}}{\text{Mean or Median or Mode}} \times 100$

✓ Computation of mean deviation – Individual Series :

Steps:

1. Calculate the average mean, median or mode of the series.
2. Take the deviations of items from average ignoring signs and denote these deviations by |D|.
3. Compute the total of these deviations, i.e., S |D|
4. Divide this total obtained by the number of items.

Symbolically: M.D. = $\frac{\sum |D|}{n}$

✓ Computation of mean Deviation – Discrete series:

Steps:

1. Find out an average (mean, median or mode).
2. Find out the deviation of the variable values from the average, ignoring signs and denote them by |D|
3. Multiply the deviation of each value by its respective frequency and find out the total $\sum f|D|$.
4. Divide $\sum f|D|$ by the total frequencies N.

Symbolically, M.D. = $\frac{\sum f|D|}{N}$

✓ Computation of mean deviation-Continuous series:

Calculating mean deviation in a continuous series same as the discrete series.

In continuous series we have to find out the mid points of the various classes and take deviation of these points from the average selected.

$$\textbf{M.D} = \frac{\sum f\,|D|}{N}$$

Where, D = m - average
M = Mid point

✓ Merits and Demerits of Mean Deviation

Merits	Demerits
It is simple to understand and easy to compute.	It is not a very accurate measure of dispersion.
It is rigidly defined.	It is not suitable for further mathematical calculation.
It is based on all items of the series.	It is rarely used. It is not as popular as standard deviation.
It is not much affected by the fluctuations of sampling.	Algebraic positive and negative signs are ignored. It is mathematically unsound and illogical.
It is less affected by the extreme items.	
It is flexible, because it can be calculated from any average.	
It is better measure of comparison.	

❖ Standard Deviation and Coefficient of variation:

Standard Deviation :

It is defined as the positive square-root of the arithmetic mean of the Square of the deviations of the given observation from their arithmetic mean.

The standard deviation is denoted by the Greek letter σ (sigma)

✓ Calculation of Standard deviation-Individual Series :

There are two methods of calculating Standard deviation in individual Series :

a) Deviations taken from Actual mean

b) Deviation taken from Assumed mean

❖ Standard Deviation and Coefficient of variation Cont…

a) Deviation taken from Actual mean:

This method is adopted when the mean is a whole number.

Steps:

1. Find out the actual mean of the series (x)
2. Find out the deviation of each value from the mea $(x = X - \overline{X})$
3. Square the deviations and take the total of squared deviations åx2 .
3. Divide the total (åx2) by the number of observation $\left(\frac{\sum x^2}{n}\right)$

The square root of $\left(\frac{\sum x^2}{n}\right)$ is standard deviation.

Thus σ = $\sqrt{\left(\frac{\sum x^2}{n}\right)}$ or $\sqrt{\frac{\Sigma(x-\overline{x})^2}{n}}$

b) Deviations taken from assumed mean:

This method is adopted when the arithmetic mean is fractional value.

Taking deviations from fractional value would be a very difficult and tedious task. To save time and labour, We apply shortcut method; deviations are taken from an assumed mean.

The formula is: $$\sigma = \sqrt{\frac{\sum d^2}{N} - \left(\frac{\sum d}{N}\right)^2}$$

Where, d-stands for the deviation from assumed mean = (X-A)

Steps:

1. Assume any one of the item in the series as an average (A).
2. Find out the deviations from the assumed mean; i.e., X-A denoted by d and also the total of the deviations $\sum d$.
3. Square the deviations; i.e., d^2 and add up the squares of deviations, i.e., $\sum d^2$.

b) Deviations taken from assumed mean Cont…

4. Then substitute the values in the following formula:

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

Simplified Formula for Standard deviation :

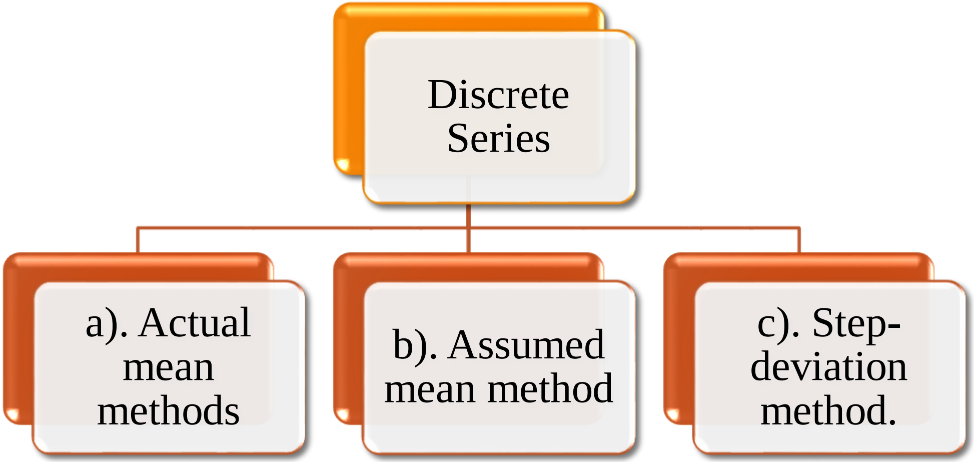
$$\sigma = \frac{1}{n}\sqrt{n\sum d^2 - \left(\sum d\right)^2}$$

For the frequency distribution :

$$\sigma = \frac{c}{N}\sqrt{N\sum fd^2 - \left(\sum fd\right)^2}$$

✓ Calculation of Standard deviation - Discrete Series:

There are three methods for calculating standard deviation in discrete series:



(a) Actual mean method:

Steps:

1. Calculate the mean of the series.
2. Find deviations for various items from the means i.e., x- *x* = d.
3. Square the deviations (= d2) and multiply by the respective frequencies(f) we get fd2.
4. Total to product (åfd2).

Then apply the formula: $\sigma = \sqrt{\frac{\sum fd^2}{\sum f}}$

If the actual mean in fractions, the calculation takes lot of time and labour; and as such this method is rarely used in practice.

(b) Assumed mean method:

Here deviation are taken not from an actual mean but from an assumed mean. Also this method is used, if the given variable values are not in equal intervals.

(b) Assumed mean method Cont…

Steps:

1. Assume any one of the items in the series as an assumed mean and denoted by A.
2. Find out the deviations from assumed mean, i.e, X-A and denote it by d.
3. Multiply these deviations by the respective frequencies and get the $\sum fd$.
4. Square the deviations (d^2).
5. Multiply the squared deviations (d^2) by the respective frequencies (f) and get $\sum fd^2$.
6. Substitute the values in the following formula:

$$\sigma = \sqrt{\frac{\sum fd^2}{\sum f} - \left(\frac{\sum fd}{\sum f}\right)^2}$$

Where, $d = X - A$, $N = \sum f$.

(c) Step-deviation method:

If the variable values are in equal intervals, then we adopt this method.

Steps:

1. Assume the center value of the series as assumed mean A.
2. Find out d = $\frac{x - A}{C}$, where C is the interval between each value
3. Multiply these deviations d' by the respective frequencies and get $\sum fd$
4. Square the deviations and get d^2
5. Multiply the squared deviation (d^2) by the respective frequencies (f) and obtain the total $\sum fd^2$
6. Substitute the values in the following formula to get the standard deviation.

$$\sigma = \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times C$$

✓ Calculation of Standard Deviation –Continuous series:

In the continuous series the method of calculating standard deviation is almost the same as in a discrete series.

But in a continuous series, mid values of the class intervals are to be found out.

The step- deviation method is widely used.

The formula is,

$$\sigma = \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times C$$

$$d = \frac{m - A}{C}$$, C- Class interval.

✓ Calculation of Standard Deviation –Continuous series Cont…

Steps:

1. Find out the mid-value of each class.
2. Assume the center value as an assumed mean and denote it by A.
3. Find out d = $\frac{m - A}{C}$
4. Multiply the deviations d by the respective frequencies and get Σfd.
5. Square the deviations and get d 2.
6. Multiply the squared deviations (d 2) by the respective frequencies and get ∑fd 2.
7. Substituting the values in the **following formula** to get the standard deviation.

$$\sigma = \sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2} \times C$$

- ✓ **Combined Standard Deviation:**

If a series of N1 items has mean $\overline{X_1}$ and standard deviation s1 and another series of N2 items has mean $\overline{X_2}$ and standard deviation s2 , we can find out the combined mean and combined standard deviation by using the formula.

$$\overline{X}_{12} = \frac{N1\,\overline{X}_1 + N_2\,\overline{X}_2}{N_1 + N_2}$$

$$\sigma_{12} = \sqrt{\frac{N_1\,\sigma_1^2 + N_2\,\sigma_2^2 + N_1 d_1^2 + N_2 d_2^2}{N_1 + N_2}}$$

Where $d_1 = \overline{X}_1 - \overline{X}_{12}$

$$d_2 = \overline{X}_2 - \overline{X}_{12}$$

✓ Merits and Demerits of Standard Deviation:

Merits	Demerits
It is rigidly defined and its value is always definite and based on all the observations and the actual signs of deviations are used.	It is not easy to understand and it is difficult to calculate.
As it is based on arithmetic mean, it has all the merits of arithmetic mean.	It gives more weight to extreme values because the values are squared up.
It is the most important and widely used measure of dispersion.	As it is an absolute measure of variability, it cannot be used for the purpose of comparison.
It is possible for further algebraic treatment.	
It is less affected by the fluctuations of sampling and hence stable.	
It is the basis for measuring the coefficient of correlation and sampling.	

- ✓ **Coefficient of Variation**

The coefficient of variation is obtained by dividing the standard deviation by the mean and multiply it by 100.

Symbolically,

Coefficient of variation (C.V) = $\frac{\sigma}{\overline{X}} \times 100$

❑ Sources

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