**Measures of Dispersion**

**Dispersion:** Literal meaning of dispersion is scatteredness. Dispersion is the degree of the scatter or variation of the variables about a central value.

The measurement of the scatterness of the values of a data set around a central value is called a measure of dispersion.

**Measures of Dispersion:** Following are the measures of dispersion:

1. Absolute measures
2. Range
3. Mean deviation
4. Standard deviation
5. Quartile deviation
6. Relative measures
7. Coefficient of range
8. Coefficient of mean deviation
9. Coefficient of variation
10. Coefficient of quartile deviation

**Range:** The range is the simplest measure of dispersion. This is defined as the difference between the highest and lowest values in a data set.

(Ungrouped data)

(Grouped data), where  is lower limit of the first class and is the upper limit of the last class.

**Example**

The following are the wages of 8 workers of a factory. Find the range of variation.

Wages in Tk.

1400 1450 1520 1380 1485 1495 1575 1440

**Solution:**

Range 

Where, Largest value and  Smallest value

Hence,  and 

Range  =Tk.195

**Example # 2**

Calculate range from the following data:

|  |  |
| --- | --- |
| Profits (Tk. lakhs) | No. of Companies. |
| 10-20 | 8 |
| 20-30 | 10 |
| 30-40 | 12 |
| 40-50 | 8 |
| 50-60 | 4 |

**Solution:**

In a frequency distribution, range is calculated by taking the difference between the lower limit of the lower class and the upper limit of the highest class.

Range == 60-10 =50

**Mean Deviation:** Let  be n observations of a variable with mean, then mean deviation is defined as:

 (Ungrouped data)

 (Grouped data), where be the mid-values and  be their corresponding frequencies.

**Standard deviation**: Let  be n observations of a variable with mean, then standard deviation is defined as

S.D. = σ = **(**Ungrouped data)

S.D. = σ = (Grouped data), where be the mid-values and  be their corresponding frequencies.

**Variance**: The square of the standard deviation is the variance.

**(**Ungrouped data)

(Grouped data)

**Example:**

The following are the percentages of ash content in 12 samples of coal found in close proximity:

9.2 14.1 9.8 12.4 16.0 12.6 22.7 18.9 21.0 14.5 20.4 16.9

**Solution**

We know that,

S.D. = σ =

By using calculator we get,

, n=12

So that,

σ = == =4.209

**Quartile deviation:** If Q1 is the first quartile and Q3 is third quartile, then the quartile deviation is defined as: 

**Coefficient of Variation:**

The coefficient of variation is defined by:

whereis the standard deviation and is the mean.

**Example:**

Measurements made with one micrometer of the diameter of a ball bearing have a mean of 3.92 mm and a standard deviation of 0.0152 mm, whereas measurements made with another micrometer of the unstretched length of a spring have a mean of 1.54 inches and a standard deviation of 0.0086 inch. Which of these measuring instruments is relatively more precise?

**Solution:**

We know that,

The coefficient of variation is

Now for the 1st measurement,

C.V.1= = where, and 3.92

Now for the 2st measurement,

C.V.2= = where, and 1.54

Thus, the measurements made with the first micrometer are relatively more precise.

Why does coefficient of variation (CV) important?

* We know that cv is unit free. So, when two sets of data are in different units, to compare them we use the cv.
* It is also suitable for comparing the homogeneity and uniformity of two or more distribution.

[If we want to compare the variability of two or more series, we can use this method. The series or groups of data for which the coefficient of variation is greater, indicates that the group is more variable, less stable, less uniform, less consistent or less homogeneous. On the other hand, if the coefficient of variation is less, it indicates that the group is less variable, more stable, more uniform, more consistent or more homogeneous.]

**Example**

The prices of a Tea company shares in Dhaka and Chittagong Markets during the least ten months are recorded below:

|  |  |  |
| --- | --- | --- |
| **Month** | **Dhaka** | **Chittagong** |
| January | 105 | 108 |
| February | 120 | 117 |
| March | 115 | 120 |
| April | 118 | 130 |
| May | 130 | 100 |
| June | 127 | 125 |
| July | 109 | 125 |
| August | 110 | 120 |
| September | 104 | 110 |
| October | 112 | 135 |

Determine the arithmetic mean and standard deviation of the prices of shares. In which market are the shares prices stable?

**Solution**

For determining in which market prices of shares are more stable we shall compare the co-efficient of variation. Let prices in Dhaka and Chittagong are denoted by  and  respectively:

**Dhaka:**

****

= **=**8.33

C.V.1= = 7.24%

**Chittagong:**

****

= **=**10.089 = 10.09

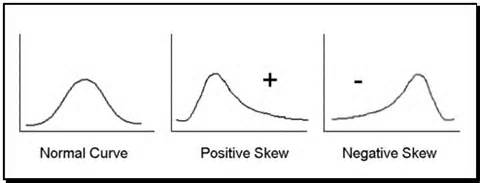
C.V.2= = 8.478 = 8.48%

Since the co-efficient of variation is less in Dhaka, hence the share price in the Dhaka market shows greater stability.

**Skewness and Kurtosis:** Skewness and Kurtosis are known as the shape characteristics of a frequency distribution, because they throw light on the shape of a distribution.Skewness is the degree of asymmetry, or departure from symmetry, of a distribution. The degree of peakness or flatness of a distribution relative to a normal distribution is called kurtosis.

**Measure of skewness and kurtosis:** The measure of skewness is given by where,  and 

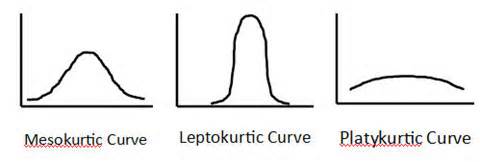
In a skewed distribution, when the curve has a longer tail to the right side, then the distribution is said to be positively skewed and in the reverse case the distribution is said to be negatively skewed.



The measure of kurtosis is given by where,  and There are three types of kurtosis.

If the value of is greater than 3, the curve is more peaked than symmetric curve that is leptokurtic.

If the value of is less than 3, the curve is less peaked than symmetric curve that is platykurtic. If the value of is equal to 3, the curve is then symmetric curve and it is mesokurtic.



Question:

What is skewness? What are the types of skewness? Distinguish them.

**Skewness:**

Skewness is a measure that refers to the lack of symmetry of a distribution.

Skweness is of two types.

1. Positive skewness.
2. Negative skewness.

Based on the skewness,the distribution can be classified in 3 categories.

|  |  |  |
| --- | --- | --- |
| Positively skewed | Negatively skewed | Symmetric |
| 1. If the long tail lies on the right (i.e. presence of extreme values at the positive end of the distribution) of a distribution so that the mean is pulled in a positive direction, is called positively skewed distribution. | 1. If the long tail lies on the left (i.e. presence of extreme values at the negative end of the distribution) of a distribution so that the mean is pulled in a negative direction, is called negatively skewed distribution. | 1. When there exist no lack of symmetry or skewness then the distribution is called symmetric distribution. |
| skew6.gif - 2.2 K  Mean>Median>Mode | 2.  skew7.gif - 2.2 K  Mean<Median<Mode | 2.  skew1.gif - 2.7 K  Mean=Median=Mode |
| 1. Since ; if , then the distribution is positively skewed. | 1. If , then the distribution is negatively skewed. | 1. If , then the distribution is skewness. |