327.5th item lies in 10–15 which is the median class.

$$M = l + \frac{\frac{N}{2} - C}{f} i$$

where l stands for lower limit of median class,

N stands for the total frequency,

C stands for the cumulative frequency just proceeding the median class,

i stands for class interval

f stands for frequency for the median class.

$$\text{Median} = 10 + \frac{\frac{655}{2} - 224}{241} \times 5$$

$$= 10 + \frac{103.5 \times 5}{241} = 10 + 2.15 = 12.15$$

39.7 MODE

Mode is defined to be the size of the variable which occurs most frequently.

Example 7. *Find the mode of the following items :*

0, 1, 6, 7, 2, 3, 7, 6, 6, 2, 6, 0, 5, 6, 0.

Solution. 6 occurs 5 times and no other item occurs 5 or more than 5 times, hence the mode is 6.

Ans.

For grouped data,
$$\text{Mode} = l + \frac{f - f_{-1}}{2f - f_{-1} - f_1} \cdot i$$

where l is the lower limit of the modal class, f is the frequency of the modal class, i is the width of the class, f_{-1} is the frequency before the modal class and f_1 is the frequency after the modal class.

Emperical formula

$$\textbf{Mean} - \textbf{Mode} = 3\,[\textbf{Mean} - \textbf{Median}]$$

Example 8. *Find the mode from the following data:*

Age	0–6	6–12	12–18	18–24	24–30	30–36	36–42
Frequency	6	11	25	35	18	12	6

Solution.

Age	*Frequency*	*Cumulative frequency*
0–6	6	6
6–12	11	17
12–18	$25 = f_{-1}$	42
$\boxed{18\text{–}24}$	$35 = f$	77
24–30	$\boxed{18} = f_1$	95
30–36	12	107
36–42	6	113

$$\text{Mode} = l + \frac{f - f_{-1}}{2f - f_{-1} - f_1} \times i$$

$$= 18 + \frac{35 - 25}{70 - 25 - 18} \times 6$$

$$= 18 + \frac{60}{27} = 18 + 2.22 = 20.22$$ **Ans.**

39.8 GEOMETRIC MEAN

If $x_1, x_2, x_3, \ldots\ldots, x_n$ be n values of variates x, then the geometric mean

$$G = (x_1 \times x_2 \times x_3 \times x_4 \times \ldots \times x_n)^{1/n}$$

Example 9. *Find the geometric mean of 4, 8, 16.*

Solution. $$G.M. = (4 \times 8 \times 16)^{1/3} = 8.$$ **Ans.**

39.9 HARMONIC MEAN

Harmonic mean of a series of values is defined as the reciprocal of the arithmetic mean of their reciprocals. Thus if H be the harmonic mean, then

$$\frac{1}{H} = \frac{1}{n}\left[\frac{1}{x_1} + \frac{1}{x_2} + \ldots\ldots + \frac{1}{x_n}\right]$$

Example 10. *Calculate the harmonic mean of 4, 8, 16.*

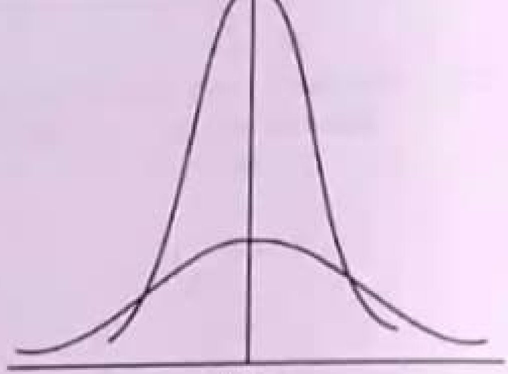
Solution.

$$\frac{1}{H} = \frac{1}{3}\left[\frac{1}{4}+\frac{1}{8}+\frac{1}{16}\right] = \frac{7}{48}$$

$$H = \frac{48}{7} = 6.853$$

21.9. DISPERSION

A measure of central tendency by itself can exhibit only one of the important characteristics of distribution. It can represent a series only 'as best as a single figure can'. It is inadequate to give us a complete idea of the distribution. It must be supported and supplemented by some other measures. One such measure is **Dispersion.**



Two or more frequency distributions may have exactly identical averages but even then they may differ markedly in several ways. Further analysis is, therefore, essential to account for these differences. Consider the following example :

Distribution A	:	75	85	95	105	115	125
Distribution B	:	10	20	30	70	180	290

A.M. of each distribution is $\frac{600}{6} = 100$. In distribution A, the values of the variate differ from 100 but the difference is small. In distribution B, the items are widely scattered and lie far from the mean. Although the A.M. is the same, yet the two distributions widely differ from each other in their formation.

Therefore, while studying a distribution, it is equally important to know how the variates are clustered around or scattered away from the point of central tendency. Such variation is called *dispersion or spread or scatter or variability*. Thus, *dispersion is the extent to which the values are dispersed about the central value.*

values are dispersed about the central value.

21.10. MEASURES OF DISPERSION

The following are the measure of dispersion :

(*a*) Range

(*b*) Quartile deviation or Semi-inter-quartile range

(*c*) Average (or mean) deviation

(*d*) Standard deviation.

(*a*) **Range.** Range is the difference between the extreme values of the variate.

$$\text{Range} = L - S, \text{ where } L = \text{Largest and } S = \text{Smallest}$$

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