

CHAPTER 14

Statistics

Step – Deviation method:

This method will be apply when all the d_i 's ($x_i - a$) have a common factor.

$$\text{Mean } (\bar{x}) = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

Where, a = Assumed mean on class mark (x_i)

$$u_i = \frac{d_i}{h} = \frac{x_i - a}{h}$$

Note:

- If the class sizes are equal, then the common factor (h) is nothing but the class size.
- If the class sizes are unequal, the above formula can still be applied by taking ' h ' to be a suitable divisor of all the d_i 's.
- The assumed mean method and step – deviation method are just simplified forms of the direct method.
- The mean obtained by all the three methods is same.

Example:

The mean of the following frequency is 50. But the frequencies f_1 and f_2 in class 20 – 40 and 60 – 80 are missing. Find the missing frequencies.

Class – Interval	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	Total
Frequency	17	f_1	32	f_2	19	120

Procedure to find mean by step – deviation method:

Step – I:

Write the given data in columns. In first column, write class – intervals; in second column, write their given corresponding frequencies.

Step – II:

Obtain the mid value (x_i) of each class to prepare column III of the table.

Step – III:

Take an assumed mean (a) from amongst the mid values, as a figure, which is in the middle of the series or any one of the two middle values if the number of x_i 's is even.

Step – IV:

Calculate the deviations d_i of all the mid – values from the

assumed mean 'a' i.e. $d_i = x_i - a$ and $u_i = \frac{d_i}{h} = \frac{\mu_i - a}{h}$ to get column IV of the table.

Step – V:

Multiply the respective frequencies of each class in column II by the deviations in column IV and obtain the column V of $f_i u_i$.

Step – VI:

Find the total of $f_i u_i$ of column V to get $\sum f_i u_i$.

Step – VII:

Find the total of frequencies of column II and denote it by $\sum f_i$.

Step – VIII:

Find $\bar{x}$ using formula,

$$\bar{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i} \right) \times h$$

Sol.

Let us construct the following table for the given data.

Class – Interval	Frequency (f _i)	Class – Mark (x _i)	$u_i = \frac{x_i - a}{h}$	f _i u _i
0 – 20	17	10	- 2	17 × - 2 = -34
20 – 40	f ₁	30	- 1	f ₁ × -1 = -f ₁
40 – 60	32	50	0	0
60 – 80	f ₂	70	1	f ₂ × 1 = f ₂
80 – 100	19	90	2	19 × 2 = 38
Total	$\sum f_i = 68 + f_1 + f_2$			$\sum f_i u_i = 4 - f_1 + f_2$

Here, $h = 20$, $\bar{x} = 50$, $a = 50$

$$\text{Class Mark } (x_i) = \frac{\text{Lower limit} + \text{Upper limit}}{2} = \frac{0 + 20}{2} = \frac{20}{2} = 10$$

$$\sum f_i = 120 \Rightarrow 68 + f_1 + f_2 = 120 \Rightarrow f_1 + f_2 = 52 \dots (1)$$

Mean = 50 (Given)

$$\Rightarrow a + h \left[\frac{\sum f_i u_i}{\sum f_i} \right] = \text{Mean}$$

$$\Rightarrow 50 + \left[\frac{4 - f_1 + f_2}{120} \right] \times 20 = 50$$

$$\Rightarrow 50 + \frac{4 - f_1 + f_2}{6} = 50$$

$$\Rightarrow \frac{4 - f_1 + f_2}{6} = 0$$

$$\Rightarrow 4 - f_1 + f_2 = 0$$

$$\Rightarrow -f_1 + f_2 + 4 = 0 \quad \dots (2)$$

Solve (1) & (2), we get

$$\mathbf{f_1 = 28 \text{ and } f_2 = 24}$$

