

High School Assignment

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1 2018-ICSE-10TH BOARD-PROBLEM

Problem 8(b): If the mean of the following distribution is 24, find the value of 'a'.

Marks	0-10	10-20	20-30	30-40	40-50
Number of students	7	a	8	10	5

Solution: Given, the mean of the following distribution is, $m = 24$.

We know that,

$$m = \frac{\mathbf{f}^T \mathbf{x}}{\mathbf{1}^T \mathbf{f}} \quad (1)$$

where, \mathbf{f} is the frequency vector and \mathbf{x} is the mid-value's vector. As per the question,

Intervals	Frequencies	Mid-Values
0-10	7	5
10-20	a	15
20-30	8	25
30-40	10	35
40-50	5	45

Therefore, from the above table we can deduce the following vectors,

$$\mathbf{f} = \begin{pmatrix} 7 \\ a \\ 8 \\ 10 \\ 5 \end{pmatrix}; \mathbf{x} = \begin{pmatrix} 5 \\ 15 \\ 25 \\ 35 \\ 45 \end{pmatrix} \quad (2)$$

To find the value of 'a', we can simplify the equation (1),

$$m = \frac{\mathbf{f}^T \mathbf{x}_{(i \neq a)} + \mathbf{f}^T \mathbf{x}_{(i=a)}}{\mathbf{1}^T \mathbf{f}_{(i \neq a)} + \mathbf{1}^T \mathbf{f}_{(i=a)}} \quad (3)$$

On substituting the following above values in the equation, we get

$$m = \frac{\begin{pmatrix} 7 \\ 8 \\ 10 \\ 5 \end{pmatrix} \cdot \begin{pmatrix} 5 \\ 25 \\ 35 \\ 45 \end{pmatrix} + (a) \cdot (15)}{\begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} 7 \\ 8 \\ 10 \\ 5 \end{pmatrix} + (1) \cdot (a)} \quad (4)$$

$$m = \frac{(35 + 200 + 350 + 225) + (15a)}{(7 + 8 + 10 + 5) + (a)} \quad (5)$$

$$m = \frac{810 + 15a}{30 + a} \quad (6)$$

$$24(30 + a) = 810 + 15a \quad (7)$$

$$720 + 24a = 810 + 15a \quad (8)$$

$$9a = 90 \quad (9)$$

$$\therefore a = 10 \quad (10)$$

Therefore, the required value(a) is 10.