



Statistics

Question1

Consider a data consisting of 10 observations $x_1, x_2, \dots, x_{10}$, whose mean is 5 and variance is 7. If the mean and the variance of the first 8 observations $x_1, x_2, \dots, x_8$ are 4 and 3.5, respectively, and $x_9 < x_{10}$, then the value of $3x_9 + 2x_{10}$ is _____.

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Answer: 44

Solution:

We know the mean of 10 observations is 5. So, the total sum of the 10 observations is:

$$\frac{x_1 + x_2 + x_3 + \dots + x_8 + x_9 + x_{10}}{10} = 5$$

Multiplying both sides by 10 gives:

$$x_1 + x_2 + x_3 + \dots + x_8 + x_9 + x_{10} = 50$$

The mean of the first 8 observations is 4, so their total sum is:

$$\frac{x_1 + x_2 + \dots + x_8}{8} = 4$$

Therefore,

$$x_1 + x_2 + \dots + x_8 = 32$$

Subtracting, we get:

$$x_9 + x_{10} = 50 - 32 = 18$$

Next, we use the formula for variance of the 10 observations:

$$\text{Variance} = \frac{\sum_{i=1}^{10} x_i^2}{10} - (\text{mean})^2$$

Substitute the given values to find the total of squares:

$$\frac{\sum_{i=1}^{10} x_i^2}{10} - 25 = 7$$

$$\sum_{i=1}^{10} x_i^2 = 320$$

Similarly, for the first 8 observations:

$$\frac{\sum_{i=1}^8 x_i^2}{8} - 16 = 3.5$$

$$\sum_{i=1}^8 x_i^2 = 156$$

Now, subtract the two results:

$$x_9^2 + x_{10}^2 = 320 - 156 = 164$$

We already know:

$$x_9 + x_{10} = 18$$

Expanding $(x_9 + x_{10})^2$, we get:

$$x_9^2 + x_{10}^2 + 2x_9x_{10} = 324$$

Substitute $x_9^2 + x_{10}^2 = 164$:

$$164 + 2x_9x_{10} = 324$$

$$x_9x_{10} = 80$$

Now, we have two equations:

$$x_9 + x_{10} = 18$$

$$x_9x_{10} = 80$$

Solving the quadratic $t^2 - 18t + 80 = 0$, we get $t = 8$ and 10 . Given $x_9 < x_{10}$, so $x_9 = 8$ and $x_{10} = 10$.

Finally,

$$3x_9 + 2x_{10} = 3(8) + 2(10) = 44$$

Question2

Consider the following frequency distribution:

Value	4	5	8	9	6	12	11
Frequency	5	f_1	f_2	2	1	1	3

Suppose that the sum of the frequencies is 19 and the median of this frequency distribution is 6.

For the given frequency distribution, let α denote the mean deviation about the mean, β denote the mean deviation about the median, and σ^2 denote the variance.

Match each entry in List-I to the correct entry in List-II and choose the correct option.

List – I	List – II
(P) $7f_1 + 9f_2$ is equal to	(1) 146
(Q) 19α is equal to	(2) 47
(R) 19β is equal to	(3) 48
(S) $19\sigma_2$ is equal to	(4) 145
	(5) 55

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Options:

A.

(P) $\rightarrow$ (5) (Q) $\rightarrow$ (3) (R) $\rightarrow$ (2) (S) $\rightarrow$ (4)

B.

(P) $\rightarrow$ (5) (Q) $\rightarrow$ (2) (R) $\rightarrow$ (3) (S) $\rightarrow$ (1)

C.

(P) $\rightarrow$ (5) (Q) $\rightarrow$ (3) (R) $\rightarrow$ (2) (S) $\rightarrow$ (1)

D.

$$(P) \rightarrow (3) \quad (Q) \rightarrow (2) \quad (R) \rightarrow (5) \quad (S) \rightarrow (4)$$

Answer: C

Solution:

Value (x_i)	f_i	cf	$f_i x_i$
4	5	5	20
5	f_1	$5 + f_1$	20
6	1	$6 + f_1$	6
8	f_2	$6 + f_1 + f_2$	24
9	2	$8 + f_1 + f_2$	18
11	3	$11 + f_1 + f_2$	33
12	1	$12 + f_1 + f_2$	12
$12 + f_1 + f_2$			$\Sigma f_i x_i = 133$

$$\text{Given } 12 + f_1 + f_2 = 19$$

$$\text{Median} = 6$$

$$\Rightarrow f_1 + f_2 = 7$$

$$\text{Median} = \left(\frac{N+1}{2}\right)^{\text{th}} \text{ term} = \left(\frac{19+1}{2}\right)^{\text{th}} \text{ term} = 10^{\text{th}} \text{ term}$$

$$\Rightarrow 6 + f_1 = 10 \Rightarrow f_1 = 4 \text{ and } f_2 = 3$$

$$\therefore 7f_1 + 9f_2 = 7 \times 4 + 9 \times 3$$

$$= 55 \Rightarrow P \rightarrow 5$$

$$\text{Mean } (\bar{X}) = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{133}{19} = 7$$

$$\begin{aligned} \text{Mean deviation about mean } (\alpha) &= \frac{\Sigma f_i |x_i - \bar{x}|}{\Sigma f_i} \\ &= \frac{5(3) + 4(2) + 1(1) + 3(1) + 2(2) + 3(4) + 1(5)}{19} = \frac{48}{19} \end{aligned}$$

$$\Rightarrow 19\alpha = 48 \quad Q \rightarrow 3$$

$$\text{Mean deviation about median } (\beta)$$

$$= \frac{\sum f_i |x_i - M|}{\sum f_i}$$

$$= \frac{5(2) + 4(1) + 1(0) + 3(2) + 2(3) + 3(5) + 1(6)}{19}$$

$$= \frac{47}{19}$$

$$19\beta = 47 \quad R \rightarrow 2$$

$$\text{Variance } (\sigma^2) = \frac{\sum f_i f_i^2}{\sum f_i} - (\bar{X})^2$$

$$= \frac{5 \times 16 + 4 \times 25 + 1 \times 36 + 3 \times 64 + 2 \times 81 + 3 \times 121 + 1 \times 144}{19} - (7)^2$$

$$= \frac{1077}{19} - 49 = \frac{146}{19}$$

$$\Rightarrow 19\sigma^2 = 146$$

$$S \rightarrow 1$$

$$P \rightarrow 5, Q \rightarrow 3, R \rightarrow 2, S \rightarrow 1$$

Question3

Consider the given data with frequency distribution

x_i	3	8	11	10	5	4
f_i	5	2	3	2	4	4

Match each entry in List-I to the correct entries in List-II.

List - I	List - II
(P) The mean of the above data is	(1) 2.5
(Q) The median of the above data is	(2) 5
(R) The mean deviation about the mean of the above data is	(3) 6
(S) The mean deviation about the median of the above data is	(4) 2.7
	(5) 2.4

The correct option is:

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Options:

A. $(P) \rightarrow (3) \ (Q) \rightarrow (2) \ (R) \rightarrow (4) \ (S) \rightarrow (5)$

B. $(P) \rightarrow (3) \ (Q) \rightarrow (2) \ (R) \rightarrow (1) \ (S) \rightarrow (5)$

C. $(P) \rightarrow (2) \ (Q) \rightarrow (3) \ (R) \rightarrow (4) \ (S) \rightarrow (1)$

D. $(P) \rightarrow (3) \ (Q) \rightarrow (3) \ (R) \rightarrow (5) \ (S) \rightarrow (5)$

Answer: A

Solution:

x_1	f_i	$f_i x_i$	$f_i x_i - \bar{x} $	$f_i x_i - N $
3	5	15	15	10
4	4	16	8	4
5	4	20	4	0
8	2	16	4	6
10	2	20	8	10
11	3	33	15	18
	$\Sigma f_i = 20$	$\Sigma f_i x_i = 120$	sum = 54	sum = 48

(P) $\text{Mean} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{120}{20} = 6$

(Q)

$$\begin{aligned}\text{Median} &= \frac{(10^{\text{th}} + 11^{\text{th}}) \text{ observation}}{2} \\ &= \frac{5 + 5}{2} = 5\end{aligned}$$

(both observation are same)

(R) Mean deviation

$$\begin{aligned}&= \frac{\sum f_i |x_i - \bar{x}|}{\sum f_i} = \frac{54}{20} \\ &= 2.7\end{aligned}$$

(S) Mean deviation about median

$$\begin{aligned}&= \frac{\sum f_i |x_i - M|}{\sum f_i} = \frac{48}{20} \\ &= 2.4\end{aligned}$$
