# 12.13.3.25

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The probability distribution of a random variable X is given below:

| X | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| P(X) | $k$ | $\frac{k}{2}$ | $\frac{k}{4}$ | $\frac{k}{8}$ |

1) Determine the value of $k$.
2) Determine P(X $\leq$ 2) and P(X > 2).
3) Find P(X $\leq$ 2) + P (X > 2).

**Solution:**

1) **Value of $k$:** We know that sum of probability of all the random variables is 1, i.e.,

$$\sum_{i=-\infty}^{\infty} P(i) = 1 \tag{1}$$

$$\implies P(0) + P(1) + P(2) + P(3) = 1 \tag{2}$$

$$\implies k + \frac{k}{2} + \frac{k}{4} + \frac{k}{8} = 1 \tag{3}$$

$$\implies \frac{15k}{8} = 1 \tag{4}$$

$$\implies k = \frac{8}{15} \tag{5}$$

Hence, the value of k is $\frac{8}{15}$. This makes the data given in the question as follows,

$$P(k) = \begin{cases} \frac{8}{15} & \text{if } k = 0 \\ \frac{4}{15} & \text{if } k = 1 \\ \frac{2}{15} & \text{if } k = 2 \\ \frac{1}{15} & \text{if } k = 3 \\ 0 & \text{Otherwise} \end{cases} \tag{6}$$

2) **Value of P(X $\leq$ 2) and P(X > 2):**

a) **Value of P(X $\leq$ 2):** P(X $\leq$ 2) translates to sum of probabilities of all random variables less than or equal to 2, i.e.,

$$P(X \leq 2) = \sum_{i=-\infty}^{2} P(i) \tag{7}$$

$$\implies P(X \leq 2) = P(0) + P(1) + P(2) \tag{8}$$

$$\implies P(X \leq 2) = \frac{8}{15} + \frac{4}{15} + \frac{2}{15} \tag{9}$$

$$\implies P(X \leq 2) = \frac{14}{15} \tag{10}$$

b) **Value of P(X > 2):** P(X > 2) translates to sum of probabilities of all random variables greater than 2, i.e.,

$$P(X > 2) = \sum_{i=3}^{\infty} P(i) \tag{11}$$

$$\implies P(X > 2) = P(3) \tag{12}$$

$$\implies P(X > 2) = \frac{1}{15} \tag{13}$$

3) **Value of P(X $\leq$ 2) + P (X > 2):** From (10) and (13) we can easily say that,

$$P(X \leq 2) + P(X > 2) = \frac{14}{15} + \frac{1}{15} \tag{14}$$

$$\implies P(X \leq 2) + P(X > 2) = 1 \tag{15}$$

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