

Assignment 6 CBSE class 12

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Question

Find the variance of the number obtained on a throw of an unbiased die.

Solution

The sample space of the die experiment is $S = \{1, 2, 3, 4, 5, 6\}$. Let X denote the number obtained on the throw. Then X is a random variable which can take values 1, 2, 3, 4, 5, or 6.

$$\therefore \Pr(X = 1) = \Pr(X = 2) = \Pr(X = 3) = \Pr(X = 4) = \Pr(X = 5) = \Pr(X = 6) = \frac{1}{6}$$

Therefore the probability distribution of X is:-

X	1	2	3	4	5	6
Pr(X)	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

Table

Now, $E(X)$ = Expected value

$$E(X) = \sum_{i=1}^n x_i p(x_i) \quad (1)$$

$$\text{Here, } E(X) = \sum_{i=1}^6 i \left(\frac{1}{6} \right) \quad (2)$$

$$= \frac{1}{6} \times \left(\sum_{i=1}^6 i \right) \quad (3)$$

$$= \frac{1}{6} \times \frac{6(6+1)}{2} \quad (4)$$

$$= \frac{1}{6} \times \frac{42}{2} \quad (5)$$

$$= \left(\frac{21}{6} \right) \quad (6)$$

$$E(X^2) = \sum_{i=1}^n x_i^2 p(x_i) = \sum_{i=1}^6 i^2 \left(\frac{1}{6}\right) \quad (7)$$

$$= \frac{1}{6} \times \left(\sum_{i=1}^6 i^2 \right) \quad (8)$$

$$= \frac{1}{6} \times \frac{6(6+1)(12+1)}{6} \quad (9)$$

$$= \left(\frac{91}{6}\right) \quad (10)$$

$$\therefore \text{Var}(X) = E(X^2) - (E(X))^2 \quad (11)$$

$$= \frac{91}{6} - \left(\frac{21}{6}\right)^2 \quad (12)$$

$$= \frac{91}{6} - \frac{441}{36} = \left(\frac{35}{12}\right) \quad (13)$$