

# AI1103 - Assignment 3

Monika Kharadi - CS20BTECH11026

## PROBLEM :

3. The mean and variance, respectively of a binomial distribution for n independent trials with the probability of success as p, are

- (A)  $\sqrt{np}$ ,  $np(1-2p)$
- (B)  $\sqrt{np}$ ,  $\sqrt{np(1-p)}$
- (C) np, np
- (D) np, np(1-p)

We can add  $\text{Var}(X_i)$  to get  $\text{Var}(X)$  as these are independent trials

$$\begin{aligned}\text{Var}(X) &= \sum_{i=1}^n \text{Var}(X_i) \\ \text{Var}(X) &= n(p - p^2) \\ \text{Var}(X) &= np(1 - p)\end{aligned}\quad (6)$$

Variance of a binomial distribution for n independent trials is **np(1-p)**.

## SOLUTION

Let  $X_1, X_2, X_3, \dots, X_n$  be the random variable for n independent trials such that

$$X = X_1 + X_2 + X_2 + X_3 + \dots + X_n$$

where p = success (1) and 1 - p = failure (0)

Hence, (D) is correct option.

Expected Value for n trials :

$$\begin{aligned}E(X_i) &= X_i \cdot p_i \\ E(X_i) &= p\end{aligned}\quad (1)$$

We know that,

$$\begin{aligned}E(X) &= \sum_{i=1}^n E(X_i) \\ E(X) &= np\end{aligned}\quad (2)$$

Mean of a binomial distribution for n independent trials is **np**.

Now,

$$\begin{aligned}E(X_i^2) &= X_i^2 \cdot p_i \\ E(X_i^2) &= p\end{aligned}\quad (3)$$

For variance,

$$\text{Var}(X_i) = E(X_i^2) - E(X_i)^2 \quad (4)$$

$$\text{Var}(X_i) = p - p^2 \quad (5)$$