

# Assignment 2

**Yash R Ramteke**  
**bt21btech11006**

**Question:** Determine the binomial distribution where mean is 9 and standard deviation is  $\frac{3}{2}$ . Also, find the probability of obtaining at most one success.

**Solution:** For binomial distribution :

Given, Mean = 9 and Standard Deviation(S.D) =  $\frac{3}{2}$

$$\text{Mean} = np = 9 \quad (1)$$

$$\text{Variance} = (\text{S.D.})^2 = npq = \frac{9}{4} \quad (2)$$

By substituting equation(1) in equation(2):

$$q = \frac{1}{4} \quad (3)$$

Since,  $p = 1 - q$

$$p = 1 - \frac{1}{4} = \frac{3}{4} \quad (4)$$

Using equation (4) in equation (1):

$$n = \frac{9}{p} = \frac{4 \times 9}{3} = 12 \quad (5)$$

Thus distribution is:

Let  $X \in 0, 1$

$$P(X) = \sum_{i=0}^k P(i, k-i) \quad (6)$$

$$\sum_{i=0}^k \binom{n}{i} p^i (1-p)^{n-i} \binom{m}{k-i} p^{k-i} (1-p)^{m-k+i} \quad (7)$$

$$= p^k (1-p)^{n+m-k} \sum_{i=0}^k \binom{n}{i} \binom{m}{k-i} \quad (8)$$

$$= \binom{n+m}{k} p^k (1-p)^{n+m-k} \quad (9)$$

$$P(k=r) = {}^{12}C_r (p)^r (q)^{12-r} \quad (10)$$

$$P(k=r) = {}^{12}C_r \left(\frac{3}{4}\right)^r \left(\frac{1}{4}\right)^{12-r} \quad (11)$$

$$r = 0, 1, 2, 3, \dots$$

$$P(\text{at most one success}) = P(k=0) + P(k=1)$$

$$= {}^{12}C_0 \left(\frac{3}{4}\right)^0 \left(\frac{1}{4}\right)^{12} + {}^{12}C_1 \left(\frac{3}{4}\right)^1 \left(\frac{1}{4}\right)^{11} \quad (12)$$

$$= \left(\frac{1}{4}\right)^{12} + 36 \left(\frac{1}{4}\right)^{12} = \frac{37}{4^{12}} \quad (13)$$