

# Probability Assignment 1

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**Question :** Suppose  $X$  is a binomial distribution  $B\left(6, \frac{1}{2}\right)$ . Show that  $X = 3$  is the most likely outcome. (Hint :  $P(X = 3)$  is the maximum among all  $P(x_i), x_i = 0, 1, 2, 3, 4, 5, 6$ )

**Solution:** Given that,  $X$  is a binomial distribution with parameters

Here, we can conclude that  $P(X = 3)$  is the highest and hence proved that

$$X = 3 \quad (18)$$

is the most likely outcome.

$$n = 6 \quad p = 0.5 \quad (1)$$

the probability of getting exactly  $k$  successes in  $n$  trials is given by

$$P(X = k) = \binom{n}{k} \cdot p^k \cdot (1 - p)^{n-k} \quad (2)$$

From (2), We can conclude that

$$\text{For } x_i = 0 : \quad (3)$$

$$P(X = 0) = \binom{6}{0} \cdot (0.5)^0 \cdot (0.5)^6 \approx 0.016 \quad (4)$$

$$\text{For } x_i = 1 : \quad (5)$$

$$P(X = 1) = \binom{6}{1} \cdot (0.5)^1 \cdot (0.5)^5 \approx 0.094 \quad (6)$$

$$\text{For } x_i = 2 : \quad (7)$$

$$P(X = 2) = \binom{6}{2} \cdot (0.5)^2 \cdot (0.5)^4 \approx 0.234 \quad (8)$$

$$\text{For } x_i = 3 : \quad (9)$$

$$P(X = 3) = \binom{6}{3} \cdot (0.5)^3 \cdot (0.5)^3 \approx 0.313 \quad (10)$$

$$\text{For } x_i = 4 : \quad (11)$$

$$P(X = 4) = \binom{6}{4} \cdot (0.5)^4 \cdot (0.5)^2 \approx 0.234 \quad (12)$$

$$\text{For } x_i = 5 : \quad (13)$$

$$P(X = 5) = \binom{6}{5} \cdot (0.5)^5 \cdot (0.5)^1 \approx 0.094 \quad (14)$$

$$\text{For } x_i = 6 : \quad (15)$$

$$P(X = 6) = \binom{6}{6} \cdot (0.5)^6 \cdot (0.5)^0 \approx 0.016 \quad (16)$$

$$(17)$$