# Assignment 5(CBSE 12 Example 35)

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May 21, 2022

# Outline

# Question

The probability of a shooter hitting a target is $\frac{3}{4}$. How many minimum number of times must he/she fire so that the probability of hitting the target at least once is more than 0.99?

# Solution

Let the shooter fire $n$ times. Obviously, $n$ fires are $n$ Bernoulli trials.
In each trial,
p = probability of hitting the target $=\frac{3}{4}$
q = probability of not hitting the target $=\frac{1}{4}$.
Let $X$ be the random variable whose probability distribution is $\mathrm{B}\left(n, \frac{3}{4}\right)$.
We know that,

$$\Pr\left(X = k\right) = \binom{n}{k} q^{n-k} p^k, k = 0, 1, 2, \dots n \tag{1}$$

$$= \binom{n}{k} \left(\frac{1}{4}\right)^{n-k} \left(\frac{3}{4}\right)^k \tag{2}$$

$$= \binom{n}{k} \frac{3^k}{4^n} \tag{3}$$

# Solution(contd)

Now, given that,

$$\Pr\left(\text{hitting the target at least once}\right) > 0.99 \tag{4}$$
$$\implies \Pr\left(X \geq 1\right) > 0.99 \tag{5}$$
$$\implies 1 - \Pr\left(X = 0\right) > 0.99 \tag{6}$$
$$\implies 1 - \binom{n}{0}\frac{3^0}{4^n} > 0.99 \tag{7}$$
$$\implies \binom{n}{0}\frac{1}{4^n} < 0.01 \tag{8}$$
$$\implies \frac{1}{4^n} < 0.01 \tag{9}$$
$$\implies 4^n > 100 \tag{10}$$

The minimum value of $n$ to satisfy the above inequality is 4.
Thus, the shooter must fire 4 times.

# PMF

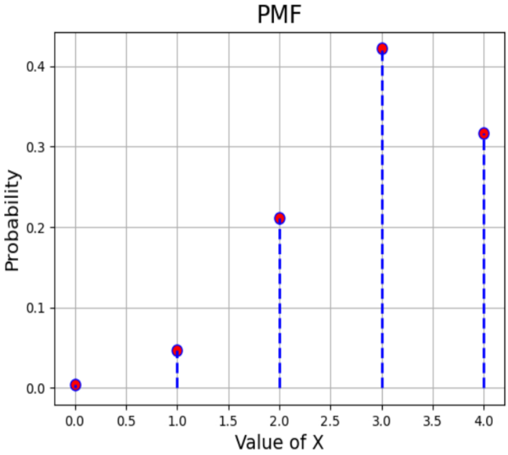


Figure: Plot of the PMF