

# Assignment 4

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**Abstract**—This document contains the solution to Question-23 of Exercise 15.1(Probability) in the Class 10 NCERT Textbook.

**Question:** A game consists of tossing a ₹1 coin 3 times and noting its outcome each time. Hanif wins if all the tosses give the same result i.e., 3 heads or 3 tails, and loses otherwise. Calculate the probability that Hanif will lose the game.

**Solution:**

- 1) Let the random variable  $Y \in \{0, 1\}$  denote the outcome of trial of tossing a coin once, where  $X = 0, 1$  denote the outcomes of getting Tail, Head respectively.

$$\Pr(Y = 1) = p = 0.5 \quad (1)$$

$$\Pr(Y = 0) = 1 - p = 0.5 \quad (2)$$

- 2) On considering 3 Bernoulli trials for tossing a coin, let  $X$  be a Binomial random variable for the trials, with parameters  $n$  and  $p$ , where

a)  $n$  = No.of trials = 3

b)  $p$  = probability with which it takes a favourable outcome(here say getting Head) = 0.5

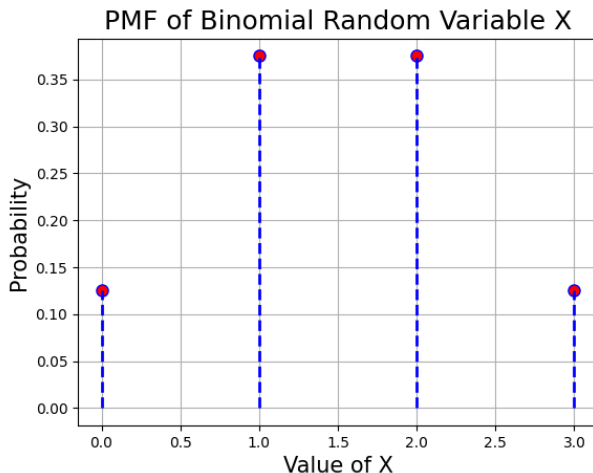


Fig. 1. Plot of the PMF

$$\Pr(X = k) = {}^nC_k (p)^k (1 - p)^{n-k} \quad (3)$$

where  $k = 0, 1, \dots, n$  which is/are the number of Heads in the  $n$  trials.

Now, Let the random variable  $Z \in \{0, 1\}$  denotes the outcome of the game such that :

Event	Description
$Z = 0$	Hanif losing the game
$Z = 1$	Hanif winning the game

TABLE I  
DESCRIPTION OF EVENTS

**Note:** The above 2 events are mutually exclusive and exhaustive.

$$\implies \Pr(Z = 0) + \Pr(Z = 1) = 1 \quad (4)$$

Hence, Probability of Hanif winning the game i.e., all the 3 tosses resulting in either 3 Heads or 3 Tails is:

$$\Pr(Z = 1) = \Pr(X = 0) + \Pr(X = 3) \quad (5)$$

From the equation- 3,

$$\Pr(Z = 1) = {}^3C_0 (0.5)^0 (0.5)^{3-0} + {}^3C_3 (0.5)^3 (0.5)^0 \quad (6)$$

On calculating, we get,

$$\Pr(Z = 1) = \frac{1}{8} + \frac{1}{8} = \frac{1}{4} \quad (7)$$

From the equations- 4 and 7, The probability of Hanif losing the game is:

$$\Pr(Z = 0) = 1 - \Pr(Z = 1) = 1 - \frac{1}{4} \quad (8)$$

$$\implies \Pr(Z = 0) = \frac{3}{4} \quad (9)$$

Hence, the probability that Hanif will lose the game is 0.75