

# Assignment 5

## Probability and Random Variables

Swati Mohanty (EE20RESCH11007)

### I. PROBLEM

In a game, a man wins a rupee for a six and loses a rupee for any other number when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a six. Find the expected value of the amount he wins / loses.

### II. SOLUTION

Let  $X$  denote the random variable of winning/losing in the game.

$P(X = 1) = P(\text{win}) = \text{getting a 6 on rolling a fair die.}$

$P(X = 0) = P(\text{loss}) = \text{getting a 6 on rolling a fair die.}$

$$P(X = 1) = p = \frac{1}{6} = 0.167$$

$$P(X = 0) = 1 - p = \frac{5}{6} = 0.833$$

Let  $Y$  denote the random variable of winning the game in  $N$ th trial, there can be 4 possible cases with the following probability:

(i) Wins in first throw:

$$P(Y = 1) = p = 0.167 \quad (1)$$

(ii) Wins in the second throw :

$$P(Y = 2) = (1 - p) \times p = 0.139 \quad (2)$$

(ii) Wins in the third throw :

$$P(Y = 3) = (1 - p) \times (1 - p) \times p = 0.107 \quad (3)$$

(ii) Does not win in any throw :

$$P(Y = 3) = (1 - p) \times (1 - p) \times (1 - p) = 0.596 \quad (4)$$

$$\text{Net amount} = P(Y=1) \times 1 + P(Y = 1) \times (-1 + 1) + P(Y = 1) \times (-1 - 1 + 1) + P(Y = 1) \times (-1 - 1 - 1) = -1.73$$

The probabilities were simulated using the python code.

**Download python code from here**

```

Simulated results
0.167073
0.13918
0.13918
0.833175
-2.471632
Theoretical results
0.165
0.132
0.107
0.596
-1.7299999999999998

```

Figure 1: Simulation for tossing a fair coin

[https://github.com/Swati-Mohanty/AI5002/blob/main/Assignment\\_5/codes/die.py](https://github.com/Swati-Mohanty/AI5002/blob/main/Assignment_5/codes/die.py)

**Download latex code from here-**

[https://github.com/Swati-Mohanty/AI5002/blob/main/Assignment\\_5/codes/assignment5.tex](https://github.com/Swati-Mohanty/AI5002/blob/main/Assignment_5/codes/assignment5.tex)