

# Assignment 1

## AI1110: Probability and Random Variables

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CS22BTECH11046

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**10.15.1.25: Question.** Which of the following arguments are correct and which are not correct? Give reasons for your answer.

- 1) If two coins are tossed simultaneously, there are three possible outcomes - two heads, two tails, or one of each. Therefore, for each of these outcomes, the probability is  $\frac{1}{3}$ .
- 2) If a die is thrown, there are two possible outcomes - an odd number or an even number. Therefore, the probability of getting an odd number is  $\frac{1}{2}$ .

**Solution:**

- 1) X is a random variable which denotes the number of heads obtained when n coins are tossed simultaneously,  $p$  = probability of getting head .

$$X \sim \text{Bin}(n, p) \quad (1)$$

then,

$$p_X(r) = {}^nC_r p^r (1-p)^{n-r} \quad (2)$$

Here  $n = 2$  and  $p = \frac{1}{2}$ ,

$$p_X(1) = {}^2C_1 \times \frac{1}{2^2} = \frac{1}{2} \quad (3)$$

Therefore,

|    |                     |               |
|----|---------------------|---------------|
| 0: | Getting two tails   | $p_X(0)=0.25$ |
| 1: | Getting one of each | $p_X(1)=0.50$ |
| 2: | Getting two heads   | $p_X(2)=0.25$ |

**Reason:** For  $X=1$ , it contains two mutually exclusive events (H, T), (T, H). Therefore, the probability of getting one of each is  $\frac{1}{2}$  and not  $\frac{1}{3}$ . So, the above statement is incorrect.

- 2) Here, X is a random variable which denotes the number of success in getting odd number. Sample space  $\Omega = \{1, 2, 3, 4, 5, 6\}$  ,Probability of getting each number= $\frac{1}{6}$

$$X = \begin{cases} 0 & \text{if no success,} \\ 1 & \text{if success.} \end{cases}$$

$$\begin{aligned} p_X(1) &= \Pr(1) + \Pr(3) + \Pr(5) \\ &= \frac{1}{6} + \frac{1}{6} + \frac{1}{6} \\ &= \frac{3}{6} \\ &= 0.5 \end{aligned}$$

|    |                     |               |
|----|---------------------|---------------|
| 0: | Getting even number | $p_X(0)=0.50$ |
| 1: | Getting odd number  | $p_X(1)=0.50$ |

**Reason:** Event of getting an odd number and Event of getting an even number are equally likely and they together forms an exhaustive event. Hence,

$$p_X(0) = \frac{1}{2} \quad (4)$$

$$p_X(1) = \frac{1}{2} \quad (5)$$

So the above statement is correct.