

# Assignment 3

## AI1110: Probability and Random Variables

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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:** Let us define the random variables X and Y:

Parameter	Value	Description
X	{0,1,2}	Number of Heads in two coin tosses
Y	{1,2,3,4,5,6}	Number appearing on a Die throw
n	2	Number of coin tossed
p	$\frac{1}{2}$	Probability of getting heads on a coin

PMF of X:

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

$$\Pr(X = i) = \binom{n}{i} \times p^i \times (1 - p)^{n-i} = \binom{2}{i} \times \frac{1}{2^2} \quad (2)$$

PMF OF Y:

$$\Pr(X = i) = \frac{1}{6}, i = 1, 2, 3, 4, 5, 6 \quad (3)$$

- 1) There are 3 possible outcomes i.e  $X = 0, 1, 2$   
For 1st outcome (Two Heads)  $X=2$ ,

$$\Pr(X = 2) = \binom{2}{2} \times \frac{1}{2^2} = \frac{1}{4} \quad (4)$$

For 2nd outcome (Two Tails)  $X=0$ ,

$$\Pr(X = 0) = \binom{2}{0} \times \frac{1}{2^2} = \frac{1}{4} \quad (5)$$

For 3rd outcome (One Head and One Tail)  $X=1$ ,

$$\Pr(X = 1) = \binom{2}{1} \times \frac{1}{2^2} = 2 \times \frac{1}{4} = \frac{1}{2} \quad (6)$$

From (4), (5) and (6), the probabilities are not equal to  $\frac{1}{3}$ . Hence, the statement is false.

- 2) There are 2 possible outcomes i.e  $Y=\text{Odd, Even}$

$$\Pr(Y = \text{Odd}) = \Pr(Y = 1) + \Pr(Y = 3) + \Pr(Y = 5) = \frac{1}{2} \quad (7)$$

Hence, the statement is true.