

# Assignment 5

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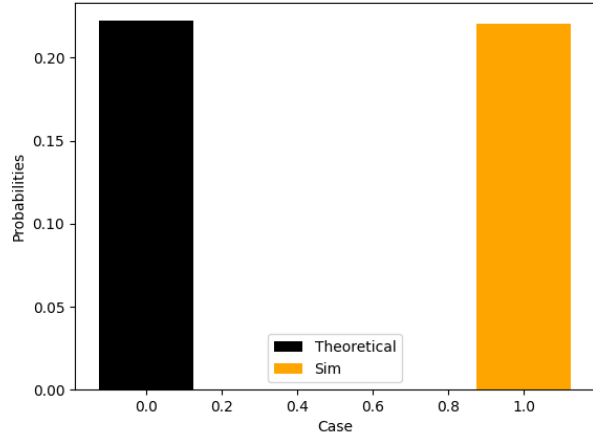
Download all python codes from

<https://github.com/cmapsi/AI1103-Probability-and-random-variables/tree/main/Assignment-5/codes>

and latex-tikz codes from

<https://github.com/cmapsi/AI1103-Probability-and-random-variables/blob/main/Assignment-5/main.tex>

The graph for theoretical result vs simulation is given below



## 1 PROBLEM

(GATE-XE-A 2017 Q.170) Two dice are thrown simultaneously. The probability that the product of the numbers appearing on the top faces of the dice is a perfect square is

- (A)  $\frac{1}{9}$  (B)  $\frac{2}{9}$  (C)  $\frac{1}{9}$  (D)  $\frac{4}{9}$

## 2 SOLUTION

Let  $X_i \in \{1, 2, 3, 4, 5, 6\}$ ,  $i = 1, 2$  be the random variables representing the outcomes of each die. The probability mass function is given below.

$$p_{X_i}(n) = \Pr(X_i = n) = \begin{cases} \frac{1}{6} & 1 \leq n \leq 6 \\ 0 & \text{otherwise} \end{cases} \quad (2.0.1)$$

Desired outcomes

$$X = X_1 \times X_2 = n^2 \quad (2.0.2)$$

We have the following expression for probability

$$p_X(n) = \sum_{k=1}^6 p_{X_1}\left(\frac{n}{k}\right) \times p_{X_2}(k) = \frac{1}{6} \sum_{k=1}^6 p_{X_1}\left(\frac{n}{k}\right) \quad (2.0.3)$$

Defining set  $S = \{1, 4, 9, 16, 25, 36\}$

$$\Pr(X \in S) = \sum_{k \in S} p_X(k) \quad (2.0.4)$$

Using (2.0.3) and (2.0.4)

$$\Pr(X \in S) = \frac{2}{9} \quad (2.0.5)$$