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

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.

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

Desired outcomes

$$X = X_1 \times X_2 = n^2 \tag{2.0.2}$$

We have the following expression for probability

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

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

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

Using (2.0.3) and (2.0.4)

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

The graph for theoretical result vs simulation is given below