

Assignment 2

Vaddamani Saketh - CS20BTECH11054

Download all python codes from

https://github.com/CS20BTECH11054/AI1103/blob/main/Assignment_2/codes/Assignment_2.py

and latex-tikz codes from

https://github.com/CS20BTECH11054/AI1103/blob/main/Assignment_2/Assignment_2.tex

1 PROBLEM

(Prob, 5.30) Find the variance of the number obtained on a throw of an unbiased die

2 SOLUTION

Let $X \in \{1, 2, 3, 4, 5, 6\}$, be the random variable representing outcome of the die. The probability mass function (pmf) can be expressed as

$$p_X(n) = P(X = n) = \begin{cases} \frac{1}{6} & 1 \leq n \leq 6 \\ 0 & \text{otherwise} \end{cases} \quad (2.0.1)$$

The variance ($\text{Var}(X)$) of this distribution can be found by definition,

$$\text{Var}(X) = E(X^2) - (E(X))^2 \quad (2.0.2)$$

where,

$$E(X) = \sum_{k=1}^{k=6} k p_X(k) \quad (2.0.3)$$

$$E(X) = \frac{1}{6} \sum_{k=1}^{k=6} k \quad (2.0.4)$$

$$E(X) = \frac{1}{6} \times \frac{6 \times 7}{2} \quad (2.0.5)$$

$$E(X) = \frac{7}{2} \quad (2.0.6)$$

$$E(X^2) = \sum_{k=1}^{k=6} k^2 p_X(k) \quad (2.0.7)$$

$$E(X^2) = \frac{1}{6} \sum_{k=1}^{k=6} k^2 \quad (2.0.8)$$

$$E(X^2) = \frac{1}{6} \times \frac{6 \times 7 \times 13}{6} \quad (2.0.9)$$

$$E(X^2) = \frac{91}{6} \quad (2.0.10)$$

Therefore, substituting values from Eq.(2.0.6) and Eq.(2.0.10), we get

$$\text{Var}(X) = E(X^2) - (E(X))^2 \quad (2.0.11)$$

$$\text{Var}(X) = \frac{91}{6} - \frac{49}{4} \quad (2.0.12)$$

$$\text{Var}(X) = \frac{70}{12} \quad (2.0.13)$$

$$\text{Var}(X) = 2.9167 \quad (2.0.14)$$

Therefore, the variance of the number obtained on a throw of an unbiased die is **2.9167**.

