

Assignment 1

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Download all python codes from

<https://github.com/Taha-Adeel/AI1103/tree/main/Assignment%201/codes>

and latex-tikz codes from

<https://github.com/Taha-Adeel/AI1103/tree/main/Assignment%201>

(C) $\frac{1}{2}$ and $\frac{1}{3}$

$$\Rightarrow E[X^2] - E[X]^2 = \frac{1}{3} - \frac{1^2}{2} = \frac{1}{12} \geq 0 \quad (2.0.6)$$

(D) 2 and 5

$$\Rightarrow E[X^2] - E[X]^2 = 5 - 2^2 = 1 \geq 0 \quad (2.0.7)$$

1 PROBLEM (80)

Suppose X is a real-valued random variable. Which of the following values CANNOT be attained by $E[X]$ and $E[X^2]$, respectively?

(A) 0 and 1 (C) $\frac{1}{2}$ and $\frac{1}{3}$

(B) 2 and 3 (D) 2 and 5

$\therefore E[X]$ and $E[X^2]$ cannot attain the values 2 and 3
(Option B) (As then the variance would be negative (Refer (2.0.5)))

2 SOLUTION (80)

The variance of a distribution is given by

$$\sigma^2 = \sum_{X \in \mathbb{R}} ((E[X] - X))^2 \Pr(X) \quad (2.0.1)$$

$$= E[X^2] - E[X]^2 \quad (2.0.2)$$

As variance is always positive (We can easily see that from (2.0.1)),

$$E[X^2] - E[X]^2 \geq 0 \quad (2.0.3)$$

is a necessary condition for any real valued random variable. Computing the value of $E[X^2] - E[X]^2$ for the options, we have

(A) 0 and 1

$$\Rightarrow E[X^2] - E[X]^2 = 1 - 0^2 = 1 \geq 0 \quad (2.0.4)$$

(B) 2 and 3

$$\Rightarrow E[X^2] - E[X]^2 = 3 - 2^2 = -1 \leq 0 \quad (2.0.5)$$