

# Assignment 2

Taha Adeel Mohammed - CS20BTECH11052

Download all latex-tikz codes from

<https://github.com/Taha-Adeel/AI1103/tree/main/Assignment2>

(D) 2 and 5

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

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

## 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

## 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

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

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

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