Assignment 2

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Download all latex-tikz codes from

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

(B) 2 and 3

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

(D) 2 and 5

2 Solution (80)

The variance of a distribution is given by

$$\sigma = E[X^2] - E[X]^2 \tag{2.0.1}$$

As variance is always positive,

$$E[X^2] - E[X]^2 \geq 0 \tag{2.0.2}$$

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

$$\implies E[X^2] - E[X]^2 = 1 - 0^2 = 1 \geq 0 \tag{2.0.3}$$

(B) 2 and 3

$$\implies E[X^2] - E[X]^2 = 3 - 2^2 = -1 \leq 0 \tag{2.0.4}$$

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

$$\implies E[X^2] - E[X]^2 = \frac{1}{3} - \frac{1}{2}^2 = \frac{1}{12} \geq 0 \tag{2.0.5}$$

(D) 2 and 5

$$\implies E[X^2] - E[X]^2 = 5 - 2^2 = 1 \geq 0 \tag{2.0.6}$$

$\therefore$ $E[X]$ and $E[X^2]$ cannot attain the values 2 and 3 respectively. (**Option B**) (As then the variance would be negative (Refer (2.0.4)))