

AI1103-Assignment 1

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So we have finally,

$$\begin{aligned} Var(X) &= E(X^2) - E(X)^2 \\ &= 0.7 - 0.7^2 \\ &= 0.7 - 0.49 \\ &= 0.21 \end{aligned}$$

QUESTION

In a meeting, 70% of the members favour and 30% oppose a certain proposal. A member is selected at random and we take $X = 0$ if he opposed, and $X = 1$ if he is in favour. Find $E(X)$ and $Var(X)$.

SOLUTION

$E(X)$ is the expectation value (or mean) of random variable X .

Let probability that a randomly selected person is in favour be $\Pr(\text{Favour})$ and if he is in oppose is $\Pr(\text{oppose})$.

So we have that, 70% of people are in favour thus, $\Pr(\text{favour}) = 70/100$ and 30% are in oppose so $\Pr(\text{oppose}) = 30/100$.

$X=0$ if he opposed the proposal, and $X=1$ if he is in favour.

Therefore, we have

$$\begin{aligned} E(X) &= \sum P_i X_i \\ &= 0 \times \Pr(\text{oppose}) + 1 \times \Pr(\text{favour}) \\ &= 0 \times 30/100 + 1 \times 70/100 \\ &= 70/100 \\ &= 0.7 \end{aligned}$$

For calculating variance i.e. $Var(X)$

$$Var(X) = E(X^2) - E(X)^2$$

$X^2 = 0 \times 0 = 0$ if the person is in oppose and $X^2 = 1 \times 1 = 1$ if the person is in favour. So similarly we have,

$$\begin{aligned} E(X^2) &= \sum P_i X_i^2 \\ &= 0^2 \times \Pr(\text{oppose}) + 1^2 \times \Pr(\text{favour}) \\ &= 70/100 \\ &= 0.7 \end{aligned}$$

Therefore we have, $E(X) = 0.7$ and $Var(X) = 0.21$.

Note : The $E(X)$ and $Var(X)$ can also be calculated using the formulas $E(X) = n \times p$ and $Var(X) = n \times p \times (1 - p)$ where $n = 1$ as only one person is selected and p is the probability when the random variable X will be 1 which corresponds to the case of favour.