Assignment 1

Suraj - CS20BTECH11050

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PROBLEM 4.11

Two dice are thrown simultaneously. If X denotes the number of sixes, find the expectation of X

SOLUTION :

When 2 fair dice are thrown simultaneously we know that each die has 6 possible outcomes and outcome of one dice is independent of the outcome of other dice.

$\therefore$ Total possible outcomes are $^6C_1 \times {}^6C_1 = 36$

Let us assume P(X) = probability of obtaining X number of 6's as there are only 2 dice X can take values 0,1,2

$P(X_1) = $ Probability of outcome 6 for dice 1 $\quad = \dfrac{1}{6}$

$P(X_2) = $ Probability of outcome 6 for dice 2 $\quad = \dfrac{1}{6}$

Note that X_1 and X_2 are independent events as outcome of one dice do not depend on other

Then,

$$
\begin{aligned}
P(X = 0) &= P(\overline{X_1} \ and \ \overline{X_2}) \\
&= P(\overline{X_1}) \cdot P(\overline{X_2}) \\
&= (1 - P(X_1)) \cdot (1 - P(X_2)) \\
&= \frac{5}{6} \times \frac{5}{6} \\
P(X = 0) &= \frac{25}{36}
\end{aligned}
$$

$$
\begin{aligned}
P(X = 1) &= P(\overline{X_1} \ and \ X_2) + P(X_1 \ and \ \overline{X_2}) \\
&= P(\overline{X_1}) \cdot P(X_2) + P(X_1) \cdot P(\overline{X_2}) \\
&= \frac{5}{6} \times \frac{1}{6} + \frac{1}{6} \times \frac{5}{6} \\
P(X = 1) &= \frac{10}{36}
\end{aligned}
$$

$$
\begin{aligned}
P(X = 2) &= P(X_1 \ and \ X_2) \\
&= P(X_1) \cdot P(X_2) \\
&= \frac{1}{6} \times \frac{1}{6} \\
P(X = 2) &= \frac{1}{36}
\end{aligned}
$$

The probability distribution table is

x	0	1	2
P(X)	$\dfrac{25}{36}$	$\dfrac{10}{36}$	$\dfrac{1}{36}$

$$
\begin{aligned}
E(X) &= \sum XP(X) \\
&= 0 \times \frac{25}{36} + 1 \times \frac{10}{36} + 2 \times \frac{1}{36} \\
&= \frac{12}{36} \\
&= \frac{1}{3}
\end{aligned}
$$

$$
\therefore E(X) = \frac{1}{3}
$$

Hence Expectation value of $X = \dfrac{1}{3} = 0.33$