IQRA NATIONAL UNIVERSITY
Phase II,Hayatabad peshawer

ID# 14486

Student: Hayat ahmad khan

Dept: BS (CS)

Final Term ①

paper: Probability & statistic

Q No: 1 :-

Answer :-

S = { (1,1), (1,2), (1,3), (1,4), (1,5), (1,6), (1,7), (1,8),
(2,1), (2,2), (2,3), (2,4), (2,5), (2,6), (2,7), (2,8),
(3,1), (3,2), (3,3), (3,4), (3,5), (3,6), (3,7), (3,8),
(4,1), (4,2), (4,3), (4,4), (4,5), (4,6), (4,7), (4,8),
(5,1), (5,2), (5,3), (5,4), (5,5), (5,6), (5,7), (5,8),
(6,1), (6,2), (6,3), (6,4), (6,5), (6,6), (6,7), (6,8),
(7,1), (7,2), (7,3), (7,4), (7,5), (7,6), (7,7), (7,8),
(8,1), (8,2), (8,3), (8,4), (8,5), (8,6), (8,7), (8,8) }

let A = { The sum is 7 }

B = { The sum is Even }

C = { The sum is greater then 8 }

and D = { The two die had the same outcomes }

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Then $A = \{(1,6), (2,5), (3,4), (5,2), (6,1) (4,3)\}$

$B = \{(1,1), (1,3), (1,5), (1,7), (2,2), (2,4), (2,6), (2,8),$
$(3,1), (3,3), (3,5), (3,7), (4,2), (4,4), (4,6), (4,8),$
$(5,1), (5,3), (5,5), (5,7), (6,2), (6,4), (6,6), (6,8),$
$(7,1), (7,3), (7,5), (7,7), (8,2), (8,4), (8,6), (8,8)\}$

$C = \{(1,8), (2,7), (2,8), (3,6), (3,7), (3,8), (4,5), (4,6),$
$(4,7), (4,8), (5,4), (5,5), (5,6), (5,7), (5,8), (6,3), (6,4)$
$(6,5), (6,6), (6,7), (6,8), (7,2), (7,3), (7,4), (7,5), (7,6)$
$(7,7), (7,8), (8,1), (8,2), (8,3), (8,4), (8,5), (8,6), (8,7)$
$(8,8)\}$

$D = \{(1,1), (2,2), (3,3), (4,4), (5,5), (6,6), (7,7), (8,8)\}$

$A \cap B = \phi$ $A \cap C = \{\}$ $A \cap D = \{\}$

$P(A) = \frac{6}{64}$, $P(B) = 32/64$

$P(C) = 36/64$, $P(D) = 8/64$

$P(A \cap B) = 0$, $P(A \cap C) = 0$, $P(A \cap D) = 0$

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Hence, $P(A|B) = \frac{P\ A \cap B}{P(B)} = 0 \times 32/6$

$P(A|B) = 0$

$P(A|C) = \frac{P(A \cap C)}{P(C)} = 0 \times 36/64$

$P(A|C) = 0$

$P(A|D) = \frac{P(A \cap D)}{P(D)} = 0 \times 8/64$

$P(A|D) = 0$

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-: Q2 :-

Answer:-

when we are rolling two dice there are 36 different combination. Counting these up. There are 15 possibilities less than 7: (1,1), (1,2), (1,3) (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (3,1), (3,2), (3,3) (4,1), (5,1). The probability of getting less than

$15/36 = 5/12$

There are 6 possible combination of getting a 7: (1,6), (2,5), (3,4), (4,3), (5,2), (6,1). which gives a probability of

$6/36 = 1/6$

This means that 21 possibilities account for getting less than or equal to 7, So there are 15 remaining possibilities of getting more than 7. This is the same as the probability of getting less than 7, so the probability must be 5/12 as well. In calculating this, we must assume that each combination is equally likely to roll as any other and therefore the dice are fair, or else the calculations don't work.

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-: Q3 :-

Answer:-

Given that $p = 2/3$ $n = 8$

$q = 1 - p$

$= 1 - 2/3$

$q = 1/3$

let "x" denotes the number of games won by A, then

(i) $P(x=4)$ $\binom{8}{4}\left(\frac{2}{3}\right)^4\left(1/3\right)^4$

$= \frac{1120}{6561}$

$= \boxed{0.1707}$

(ii) $P(x \geq 4)$

$1 - P(x < 4)$

$= \sum_{x=0}^{3}\binom{8}{x}\left(2/3\right)^x\left(1/3\right)^{8-x}$

$= \left[\left(1/3\right)^8 + 8\left(2/3\right)\left(1/3\right)^7 + 28\left(2/3\right)^2\left(1/3\right)^6 + 56\left(2/3\right)^3\left(1/3\right)^5\right]$

$= 1 - \frac{1}{6561}\left[1 + 16 + 112 + 448\right]$

$= 1 - \frac{577}{6561}$

$\Rightarrow \frac{6561 - 577}{6561}$

$\Rightarrow \frac{5984}{6561} \Rightarrow \boxed{0.9121}$

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(iii) $P(3 \leq X \leq 6)$

$$\sum_{x=3}^{6} \binom{8}{x} \left(\frac{2}{3}\right)^{x} \left(\frac{1}{3}\right)^{8-x}$$

$$= \binom{8}{3}\left(\frac{2}{3}\right)^3\left(\frac{1}{3}\right)^5 + \binom{8}{4}\left(\frac{2}{3}\right)^4\left(\frac{1}{3}\right)^4 + \binom{8}{5}\left(\frac{2}{3}\right)^5\left(\frac{1}{3}\right)^3 +$$

$$\binom{8}{6}\left(\frac{2}{3}\right)^6\left(\frac{1}{3}\right)^2$$

$$= \frac{8}{(3)^8}\left[56 + 140 + 224 + 224\right]$$

$$= \frac{8 \times 644}{6561}$$

$$= \frac{5152}{6561}$$

$$= \boxed{0.7852}$$

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-: Q4 :-

Answers :-

Proof :- Since the ci's from a partition of the sample space, we can apply the Law of total probability for $A \cap B$.

$$P(A \cap B) = \sum_{i=1}^{m} P(A \cap B | C_i)\, P(C_i)$$

$$P(A \cap B) = \sum_{i=1}^{m} P(A/C_i)\, P(B|C_i)\, P(C_i)$$

$\therefore$ (A and B are Conditionally independant).

$$P(A \cap B) = \sum_{i=1}^{m} P(A|C_i)\, P(B)\, P(C_i)$$

$\therefore$ (B is independant of all Ci's)

$$P(A \cap B) = P(B) \sum_{i=1}^{m} P(A|C_i)\, P(C_i)$$

$$P(A \cap B) = P(B)\, P(A)$$

$\therefore$ (Law of total probability)

Hence A and B are independent.

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-: Q5 :-

Answers:- The probability function for a binomal random variable is

$$b(x;n,p) = \binom{n}{x} p^x q^{n-x}$$

$$b(x;n,p) = \binom{n}{x} p^x (1-p)^{n-x} \quad \because q = 1-p$$

This is the probability of having x sucesses in a series of n independent trails when the probability of success in any or of the trials is p. if x is a random variable with this probability distribution

$$E(x) = \sum_{x=0}^{n} x\binom{n}{x} p^x (1-p)^{n-x}$$

$$= \sum_{x=0}^{n} x \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$$

$$= \sum_{x=0}^{n} \frac{n!}{(x-1)!(n-x)!} p^x (1-p)^{n-x}$$

Since $x=0$ term vanishes. Let $y = x-1$ and $m = n-1$. Subbing $n = y+1$ and $n = m+1$ into the last sum.

$$E(x) = \sum_{y=0}^{m} \frac{(m+1)!}{y!(m-y)!} p^{y+1} (1-p)^{m-y}$$

$$= (m+1)p \sum_{y=0}^{m} \frac{m!}{y!(m-y)!} p^y (1-p)^{m-y}$$

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$$= np \sum_{y=0}^{m} \frac{m!}{y!\,(m-y)!} p^y (1-p)^{m-y}$$

By binomial theorem

$$(a+b)^m = \sum_{y=0}^{m} \frac{m!}{y!\,(m-y)!} a^y b^{m-y}$$

Set $a = p$ and $b = 1-p$

$$\sum_{y=0}^{m} \frac{m!}{y!\,(m-y)!} p^y (1-p)^{m-y}$$

$$\sum_{y=0}^{m} \frac{m!}{y!\,(m-y)!} a^y b^{m-y}$$

$$= (a+b)^m$$

$$= (p+1-p)^m$$

$= 1$ so that

$$\boxed{E(x) = np}$$

Similarly but this time using $y = x-2$ and $m = n-2$

$$E(x(x-1)) = \sum_{x=0}^{n} x(x-1)\binom{n}{x} p^x (1-p)^{n-x}$$

$$= \sum_{x=0}^{n} x(x-1) \frac{n!}{x!\,(n-x)!} p^x (1-p)^{n-x}$$

$$= \sum_{x=2}^{n} \frac{n!}{(x-2)!\,(n-x)!} p^x (1-p)^{n-x}$$

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$$= n(n-1)p^2 \sum_{x=2}^{n} \frac{(n-2)!}{(x-2)!(n-x)!} p^{x-2} (1-p)^{n-x}$$

$$= n(n-1)p^2 \sum_{y=0}^{m} \frac{m!}{y!(m-y)!} p^y (1-p)^{m-y}$$

$$= n(n-1)p^2 (p + (1-p))^m$$

$$= n(n-1)p^2$$

So the variance of x is

$$E(x^2) - E(x)^2 = E(x(x-1)) + E(x) - E(x)^2 =$$

$$n(n-1)p^2 + np - (np)^2$$

$$= \boxed{np(1-p)}$$

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-: Q6 :-

Binomial Distribution:-

Many experiments consist of repeated independent trials each trial having two possible outcomes. (eg) The two possible outcomes of a trial may head and tail, sucess and Failure, True and False etc.

Formula:-

$$P(X=x)\ f(x) = {}^{n}C_{x}\ p^{x}\ q^{n-x}$$

Binomial Frequency Distribution:-

if the binomial probability distribution is multiplied by N, then the number of experiments or sets, the resulting distribution is known as the bi-nomial frequency distribution.

Formula:-

$$N \binom{n}{x} p^{x}\ q^{n-x}$$

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-: Q7 :-

Answers:-

Coefficient of variation:-

For Data Set A:-

$$CV = \frac{\sigma}{\mu} * 100$$

$$CV = \frac{3}{45} \times 100$$

$$\boxed{CV = 6.7}$$

For Data Set B:-

$$CV = 11/60 \times 100$$

$$\boxed{CV = 18.3}$$

For Data Set C:-

$$CV = 5/50 \times 100$$

$$\boxed{CV = 10}$$

For Data Set D:-

$$CV = 15/25 \times 100$$

$$\boxed{CV = 60}$$