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Date ≠ 23-6-20

Question # 1
Answer

Solution:-

Let A be the event that the sum is 7. Let B the sum is add.
So.

$A = (1,6)\ (2,5)\ (3,4)\ (4,3)\ (5,2)\ (6,1).$

$B = (1,2)\ (1,4)\ (1,6)\ (2,1)\ (2,3)\ (2,5),$

$\vdots$

---- $(6,1)\ (6,3)\ (6,5)$ and.

$A \cap B = (1,6)\ (2,5)\ (3,4)\ (4,3)\ (5,2)\ (6,1)$

Now there are 36 outcomes in all tossing 2 Fair dice, Hence

$P(A) = 6/36 = 1/6$
$P(B) = 18/36 = 1/2$

and

$P(A \cap B) = 6/36 = 1/6$ So $P(A|B)$

$P(A \cap B) / P(B) = 1/3$ Answer

Question #2 :
Answer:-

Solution:-

Sum of 2 has 1 way 1,1
Sum of 3 has 2 way 1,2 & 2,1
Sum of 4 has 3 way 1,3; 2,2; 3,1
5 has 4 ways
6 has 5 ways
8 has 5 ways
9 has 4 ways
10 has 3 ways
11 has 2 ways
12 has 1 way

There are 15/36 for each side with a sum of 30/36. That leaves a 6/36 = 1/6 probability for a sum of 7.

Question # 3.

Answer:-

Solution:-

Given that $P = 2/3 \quad n = 8$

$$q = 1 - P$$

$$q = 1 - 2/3 \Rightarrow 1/3$$

(i) $P(x = 4)$

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

$$= \frac{1120}{6561} \Rightarrow \boxed{0.1707}$$

Ans.

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

$$1 - P(x < 4)$$

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

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

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

$$= 1 - \frac{577}{6561} \Rightarrow \frac{6561 - 577}{6561} \Rightarrow \boxed{0.9121}$$

Ans

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

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

$$= \binom{8}{3}\left(\frac{2}{3}\right)^3(1/3)^5 + \binom{8}{4}\left(\frac{2}{3}\right)^4(1/3)^4 + \binom{8}{5}\left(\frac{2}{3}\right)^5(1/3)^3 + \binom{8}{6}(2/3)^6(1/3)^2$$

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

$$= \frac{8 \times 644}{6561} = \frac{5152}{6561} = \boxed{0.7852}$$

Ans

Question # 4.

Answer:-

Proof:-

Since the C_i's form 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 & B are conditionally independant)

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

$\therefore$ (B is independent of all C_i is)

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

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

$\therefore$ law of total probability.

Hence A & B are independent.

Question # 5.

Answer:-

★ Mean & Variance of Binomial Random Variables:-

The probability ftn for the binomial random variable is

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

This is the probability of having x successess in a series of n independant trials when the probability of success in any one of the trials is p. If X is a random variable with this probability distribution.

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

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

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

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

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

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

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

The binomial theorem say that.

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

Setting $a = p$ & $b = 1 - p$

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

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

So that.

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

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

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

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

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

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

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

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

So the variance of X is

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

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

Question #6.
Answer:-

* **Bi-nomial frequency Distribution:-**

If the bi-nomial probability distribution is multiplied by N, the no. of experiments or sets, the resulting distribution is know as bi-nomial frequeny Distribution.

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

* **Bi-nomial Distribution:-**

A binomial Distribution can be though of as simply the probability of a success or failure outcome in an experiment or survey that is repeated multiple times

$$P(x-n)\ f(n) = {}^{n}C_{x}\, P^{x} q^{n-x}.$$

Question #7.

Answer:-

Coefficient of Variation:-

For Data Set A:-

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

$$CV = 3/45 \times 100 \Rightarrow \boxed{CV = 6.7}$$

For Data Set B:-

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

$$\boxed{CV = 18.3}$$

For Data set C:-

$$CV = 5/5\cancel{0} \times 1\cancel{0}\cancel{0}$$

$$\boxed{CV = 10}$$

For Data set D:-

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

$$\boxed{CV = 60}$$