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Subject :- probability
Samester :- 10th
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Program : BF (E)

Q:1: a): Data :

given : variance $= \sigma x^2 = 4$

Mean $= \mu x = 4$

Find/Required:- $n = ?$

$p = ?$

Sol:- $\mu = np = 4$ — (1)

$\sigma^2 = npq = 4$ — (2) } given

dividing (2) & (1)

$\frac{\cancel{np}q}{\cancel{np}} = \frac{4}{4} = \boxed{q = 1}$

As, $p + q = 1$

$p = 1 - q$

$p = 1 - 1$

$p = 0$

Now $np = 4$ (by equ (1))

$n = 4/p$

$n = 4/0$

$n = \infty$

Hence p is 0 & q is ∞

Q1: (b) Find: probability = ?

Sol. Mean $= \mu = np = 12$ — (1)

$SD = \sigma = \sqrt{npq} = 4$ — (2)

Dividing (1) & (2)

$\frac{\mu}{\sigma} = np/\sqrt{npq} = \cancel{12}^{3}/\cancel{4}_{1}$

squaring both sides

$\frac{(np)^2}{npq} = (3)^2$

$\Rightarrow \frac{\cancel{n^2} \cancel{p^2}}{\cancel{np}q} = 9$

$\Rightarrow np/q = 9$

$\Rightarrow np = 9q$ — (3)

Now $np = 12$ — (1)

Subtracting (3) & (1)

$np = 9q$

$\overset{-}{\oplus} np = \overset{-}{\oplus} 12$

$0 = 9q - 12$

$9q - 12 = 0$

$q = \frac{\cancel{12}^{4}}{\cancel{9}_{3}} = q = \frac{4}{3} > 1$

The Statement is incorrect as q can never be greater than 1.

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Q2: A): The bionomial distribution

$$P(X=x) = \binom{n}{x} p^x (1-p)^{n-x}$$

For $x = 0, 1, 2, \ldots n$

$\mu = np$, $\sigma^2 = np(1-p)$

$\downarrow$ $E(x)$ $\quad$ $\downarrow$ $Var(x)$

A burioulli random variable can be thought of as sum of n independent random variables, each with p mean variance $p(1-p)$

Let $v_1 \ldots v_n$ be independent Burioulli variables.

$E(4) = p$, $var(v_i) = p(1-p)$

$X = v_1 + \ldots + v_n$

$E(x) = E(v_1 + \ldots + v_n)$

$E(x) = E(v_1) + \ldots E(v_n)$

$E(v_1) = p$ $var(v_i) = p(1-p)$

$X = v_1 + \ldots + v_n$

$Var(x) = Var(v_1 + \ldots + v_n)$

$Var(x) = var(v_1) + \ldots + var(v_n)$

$= p(1-p) + \ldots + p(1-p)$

$= np(1-p)$

The bionomial Theoram

(4)

$$E(x) = \sum_{x} x\, p(x)$$

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

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

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

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

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

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

When $m = n-1$

then $y = x-1$

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

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

$$E(x) = np\,(p + (1-p))^{m} = np\,(1)$$

$\boxed{E(x) = np}$ → mean

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$$Var(X) = E[(X-\mu)^2]$$

$$= \sum_x [x-\mu]^2 \, p(x)$$

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

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

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

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

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

$$E[x(x-1)] = En(n-1)p^2$$

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

$$E(x^2) - Ex) = n(n-1)p^2$$

$$\boxed{E(x)^2 = n(n-1)p^2} \Rightarrow \text{variance}$$

Q2:- b)

Sol:- Let x denote no. of cars which are hired out per day.

Given = Poisson mean = $m = 1.5$

Now, $P(X=x) = \frac{e^{-m} \cdot m^x}{x!} = \frac{e^{-1.5} \cdot 1.5^x}{x!}$

(1) P(neither car used)

$P(x=0) = e^{-1.5} \cdot 1.5^0$

0.2231

(2) P(some demand refused) = P(demand is more than 2 cars per day).

$P(x>2)$

$= 1 - P(x \leq 2)$

$= 1 - [P(x=0) + P(x=1) + P(x=2)]$

$= 1 - \left\{ \frac{e^{-1.5} \cdot 1.5^0}{0!} + \frac{e^{-1.5} \cdot 1.5^1}{1!} + \frac{e^{-1.5} \cdot 1.5^2}{2!} \right\}$

$= 1 - e^{-1.5}\left[1 + 1.5 + \frac{2.25}{2}\right]$

$\boxed{= 0.1912}$

- Now proportion of days on which neither car used $= 0.2231 = 22.31\%$

- proportion of days on which some demand refused $= 0.1912 = 19.12\%$

Q3: A Set of 5 assembles of .... 15 Sub-groups.

Sol:-

Range : (40-93)

Smallest value = 40

largest value = 95

For 5 assembles chart is given:

Group No.	Range of defects	frequency.
1	40-50	4
2	51-60	3
3	61-70	2
4	71-80	3
5	81-95	3

- The maximum frequency has to deflects b/w 72-95.
- The group 4 & 5 have maximum No. of deflects repectively as shown in chart above.