DS & AI
CS & IT

Statistics - I

(Discrete Random Variable)

Lecture No. 04

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Recap of previous lecture

Topic

1. Geometric Distribution
2. Binomial "

Topics to be Covered

Topic

③ Difference b/w Hypergeometric & Binomial Dist.

④ POISSON DIST.

Thumb Rule of this Chapter → Try to avoid making Question by using following words;

"If, what if, AGAR, YADI, TOH, ..."

OR

Don't Try to develop Question (by your little mind until you have a complete understanding of the Chapter) & try to solve the Quest.

RECAP

Binomial Dist

Necessary Condⁿ for B.Dist → There are four N. Conditions;

① Number of Trials (R.Exp) should be finite i.e n = finite

② Each Trial (R.Exp) should be Independent.

③ Each Trial (R.Exp) has only two possible outcomes known as success / failure

i.e (Each Trial must be of Bernoullie Type)

④ The prob of success for each Trial (R.Exp) should be constant.

Shortcut → whenever we are not sure about the location of success, we can apply B.Dist.

IMPORTANT SLIDE

$p = P(H) = 1/2$

$q = P(T) = 1/2$

RECAP

PQ A coin is tossed 6 times then find

① $P(\text{getting } 1^{st} \text{ Head in } 5^{th} \text{ trial}) = ? = q^4 \cdot p \cdot (S \cdot O) = \left(\frac{1}{2}\right)^4 \left(\frac{1}{2}\right)(1)$

② $P(\text{only } 1^{st} \text{ two tosses produces Head}) = ? = P(HHTTTT) = \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^4$

③ $P(1^{st} \text{ two tosses produces Head}) = ?\ P(HH\ \underset{\sim}{SO}) = \left(\frac{1}{2}\right)^2 \cdot (1)^4$

④ $P(\text{exactly 2 tosses produces Head}) = ? = {}^6C_2 \cdot p^2 q^4 = {}^6C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^4$

⑤ $P(\text{getting } 2^{nd} \text{ Head in } 6^{th} \text{ toss}) = ?\ P(\text{exactly one H in 5 tosses}) \times P(\text{H in } 6^{th} \text{ toss})$

$= \left({}^5C_1 \cdot p^1 \cdot q^4\right) \times \frac{1}{2} = \left[{}^5C_1 \times \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)^4\right] \times \frac{1}{2}$

Def^n :→ Let X is Discrete Random Variable (DRV) such that it's Probability Mass function (p.m.f) is defined as;

RECAP

$$\boxed{P(X = r \text{ success}) = {}^nC_r \cdot p^r \cdot q^{n-r}}$$

where $q + p = 1$ → $p = P(\text{success})$, $q = P(\text{failure})$

Then X is Called Binomial Random Variable (B.R.V) & the distribution formed is Called B. Distribution with parameters n & p.

ie X Can be denoted as $X \sim B\{n, p\}$

① Parameters/Statistical Attributes → those Numerical Quantities which are necessary to apply Standard Result are Called Parameters

② $X = \{$which is Required should be assumed as X$\} \simeq \{$No of success$\}$

(3) Binomial Dist: RECAP

X:	0	1	2	3	4	....	$(n-1)$	n
$p(x)$:	p_0	p_1	p_2	p_3	p_4	....	p_{n-1}	p_n

where $p_i = P(X=i) = {}^nC_i\, p^i q^{n-i} \Rightarrow p_0, p_1, p_2 \text{---} p_n$ can be Calculated.

$$\sum p_i = \sum_{i=0}^{n}\left({}^nC_i\, p^i q^{n-i}\right) = (q+p)^n = (1)^n = 1^{\text{finite}} = 1$$

we Know that from 12^{th}, $\boxed{\sum_{r=0}^{n} {}^nC_r \cdot x^{n-r} \cdot a^r = (x+a)^n}$

(4) $\text{Mean}(X) = E(X) = \sum p_i X_i = p_0X_0 + p_1X_1 + p_2X_2 + \dots + p_nX_n = \text{-------} = np$

(5) $\text{Var}(X) = E(X^2) - (E(X))^2 = (\text{Do yourself}) - (np)^2 = \text{.........} = npq$

(6) $SD(\sigma) = +\sqrt{\text{Var}(X)} = +\sqrt{npq}$

(7) In B. Dist: Mean > Variance

If X is a discrete random variable that follows Binomial distribution, then which one of the following ~~response~~ relations is correct?

Recurrence

(HW)

(a) $P(r+1) = \frac{n-r}{r+1} P(r)$

(b) $P(r+1) = \frac{p}{q} P(r)$

(c) $P(r+1) = \frac{n+r}{r+1} \frac{p}{q} P(r)$

(d) $\boxed{P(r+1) = \frac{n-r}{r+1} \frac{p}{q} P(r)}$

$P(X=r+1) = {}^nC_{r+1} p^{r+1} q^{n-(r+1)}$ — (1)

& $P(X=r) = {}^nC_r p^r q^{n-r}$ — (2)

Now, $\frac{{}^nC_{r+1}}{{}^nC_r} = \frac{\frac{n!}{(r+1)!(n-r-1)!}}{\frac{n!}{r!(n-r)!}}$

$= \frac{\cancel{r!}\,.(n-r)\cancel{(n-r-1)!}}{(r+1)\cancel{r!}\cancel{(n-r-1)!}} = \frac{n-r}{r+1}$

So $\frac{P(X=r+1)}{P(X=r)} = \left(\frac{n-r}{r+1}\right) \frac{p.\cancel{p^r}.\cancel{q^{n-r-1}}}{\cancel{p^r}.q.\cancel{q^{n-r-1}}} = \left(\frac{n-r}{r+1}\right) \cdot \frac{p}{q}$

$$\boxed{P(X=r+1) = \left(\frac{n-r}{r+1}\right) \cdot \frac{p}{q} \cdot P(X=r)}$$

for $r=0$, $P(X=1) = (n)\frac{p}{q} P(X=0)$

for $r=1$, $P(X=2) = \left(\frac{n-1}{2}\right)\frac{p}{q} P(X=1)$ & so on....

A fair dice is tossed eight times. The probability that a third six is observed on the eight throw is ____

$X = \{$ Number of times six appeared $\}$ → success

$p = P(6) = 1/6$

$q = P(\bar{6}) = 5/6$

Req Prob $= P($getting exactly 2 six in 1^{st} 7 throws$) \times P(6$ in 8^{th} throw$)$

$= \begin{pmatrix} \text{Binomial for} \\ n = 7,\ r = 2 \end{pmatrix} \times \left(\frac{1}{6}\right)$

$= \left({}^7C_2\, p^2 q^5\right) \times \left(\frac{1}{6}\right) = \left[{}^7C_2 \times \left(\frac{1}{6}\right)^2 \left(\frac{5}{6}\right)^5\right] \times \frac{1}{6}$ Ans.

$= 0.039$

Q. Out of 1000 families with 5 children each, how many would you expect (i) having exactly 2 Boys (ii) having either 2B or 3B (iii) having all Girls

(a) 312
(b) 625
(c) 31
(d) 500

N = 1000 families, For Single family : X = { Number of Boys in Single Family }

(= success)

n = 5 kids, $p = P(B) = \frac{1}{2}$, $q = P(G) = \frac{1}{2}$

$$\boxed{P(X = r \text{ success}) = {}^nC_r \, p^r q^{n-r}}$$

(1) $P(X = 2B) = {}^5C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^3 = \frac{10}{32} = \frac{0.3125}{1} = \frac{312.5}{1000} \approx \frac{312}{1000}$

So No of Families are having exactly 2B = 312 families out of 1000 families

(2) $P(X = 2B \text{ or } 3B) = P(X=2B) + P(X=3B)$ {Add due to M.E Nature}

$$= {}^5C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^3 + {}^5C_3\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^2 = \frac{20}{32}$$

$$= \frac{0.625}{1} = \frac{625}{1000}$$ So Ans = 625 families.

(3) $P(\text{all Girls}) = P(\text{No Boy}) = P(X = 0B) = {}^5C_0\left(\frac{1}{2}\right)^0\left(\frac{1}{2}\right)^5 = \left(\frac{1}{2}\right)^5 = \frac{1}{32}$

$$= \frac{0.031}{1} = \frac{31}{1000}$$ So Ans = 31 families out of 1000 families

Note :- $X = \{\text{No. of Boys}\} = \{0, 1, 2, 3, 4, 5\} \simeq$ S.Space.

where S Space = $\{\underset{X=0}{(0B\,\&\,5G)}, \underset{X=1}{(1B\,\&\,4G)}, \underset{X=2}{(2B\,\&\,3G)}, \underset{X=3}{(3B\,\&\,2G)}, \underset{X=4}{(4B\,\&\,1G)}, \underset{X=5}{(5B\,\&\,0G)}\}$

ANALYSIS / PODCAST:- $X = \{\text{No. of Boys}\} = \{0, 1, 2, 3, 4, 5\}$

$$p_0 = P(X=0B) = {}^5C_0\left(\frac{1}{2}\right)^0\left(\frac{1}{2}\right)^5 = 0.03125$$

$$p_1 = P(X=1B) = {}^5C_1\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^4 = 0.15625$$

$$p_2 = P(X=2B) = {}^5C_2\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^3 = 0.31250$$

$$p_3 = P(X=3B) = {}^5C_3\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^2 = 0.31250$$

$$p_4 = P(X=4B) = {}^5C_4\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^1 = 0.15625$$

$$p_5 = P(X=5B) = {}^5C_5\left(\frac{1}{2}\right)^5\left(\frac{1}{2}\right)^0 = 0.03125$$

Prob Dist is :

X:	0	1	2	3	4	5
$P(X)$:	p_0	p_1	p_2	p_3	p_4	p_5

$$\because \sum p_i = 0.03125 + 0.15625 + 0.31250 + 0.31250 + 0.15625 + 0.03125$$

$$= 1$$

Wah

In 1000 families having 5 kids each, various cases are as follows ;→

$$(0B \,\&\, 5G) \text{ or } (1B \,\&\, 4G) \text{ or } (2B \,\&\, 3G) \text{ or } (3B \,\&\, 2G) \text{ or } (4B \,\&\, 1G) \text{ or } (5B \,\&\, 0G) = \text{Total Cases.}$$

$$0.03125 + 0.15625 + 0.31250 + 0.31250 + 0.15625 + 0.03125 = 1.$$

$$31.25 + 156.25 + \underbrace{312.50 + 312.50}_{\text{exactly } 2B \text{ or } 3B} + 156.25 + 31.25 = 1000$$

$$\underbrace{156.25 + 312.50 + 312.50 + 156.25 + 31.25}_{\text{At least one Boy.}}$$

$$P(X=2B \,\&\, X=3B) = P(2B \cap 3B) = 0.$$
$(\because$ Both are ME$)$

For 1 Lakh families, Data will be as follows,

$$(3125) + (15625) + (31250) + (31250) + (15625) + (3125) = 100000$$

Q. In a Bike Race, the probability of a Motorist being killed in a accident in $\frac{1}{2400}$ then Find the prob that, in a Race having 200 motorist,

(i) there will be No Fatal accident

(ii) " " " at least one Fatal accident.

M-I

$X = \{\text{Number of Deaths in a Single Race}\} = \{\text{No. of F.A in a Single Race}\}$ → Success.

$n = 200, \quad p = P(FA) = \frac{1}{2400}, \quad q = 1 - \frac{1}{2400} = \frac{2399}{2400}$

$$\boxed{P(X = r/\text{success}) = {}^nC_r\, p^r q^{n-r}}$$

(i) $P(X = 0\,FA) = {}^{200}C_0\, p^0 q^{200} = \left(\frac{2399}{2400}\right)^{200} = \frac{0.92}{1}$

i.e In 100 Race of above type, No of Race when No one will be killed = 92 Race.

(ii) $P(X \geq 1) = 1 - P(X = 0)$

$= 0.08 = \frac{8}{100}$

i.e In 8 Race, At least one person will be killed.

Using Common Sense →

M-II $P(\text{killed}) = \frac{1}{2400}$, $P(\text{not killed}) = \frac{2399}{2400}$

$$P(\text{No one will be killed}) = ? = \underbrace{\left(\frac{2399}{2400}\right) \times \left(\frac{2399}{2400}\right) \times \left(\frac{2399}{2400}\right) \times \cdots \cdots \times \left(\frac{2399}{2400}\right)}_{200 \text{ Bikers}}$$

(Multi is just becoz of Independency of Bikers)

$$= \left(\frac{2399}{2400}\right)^{200} = 0.92$$

M III Using POISSON DIST $\rightarrow$

will be discussed in next chapter

i.e in POISSON DIST

ANALYSIS OF HYPERGEOMETRIC & BINOMIAL DIST

- If we are performing R.Exp one by one w/o Replacement then we can also use the concept of Hypergeometric Dist.
- If we are performing R.Exp one by one with Replacement then we can also use the concept of Binomial Distribution

Q: A Box contains 4 R and 3 B Marbles and we want to draw 3. Marbles one by one (without) Replacement then Find the probability of drawing 1R & 2 B Marbles?

(M-I) By Making Cases →

Req Prob $= P(RBB \text{ or } BRB \text{ or } BBR)$

$$= \left(\frac{4}{7}\frac{3}{6}\frac{2}{5}\right) + \left(\frac{3}{7}\frac{4}{6}\frac{2}{5}\right) + \left(\frac{3}{7}\frac{2}{6}\frac{4}{5}\right)$$

$$= \left(\frac{4}{7}\times\frac{3}{6}\times\frac{2}{5}\right)\times 3$$

(M-II) Using Hypergeometric Distribution

7 Marbles

4R → 1R

3M

3B → 2B

$$\text{Req Prob} = \frac{\text{Fav}}{\text{Total}} = \frac{{}^4C_1 \times {}^3C_2}{{}^7C_3} = \frac{4 \times \frac{3\times 2}{2\times 1}}{\left(\frac{7\times 6\times 5}{3\times 2\times 1}\right)} = \left(\frac{4}{7}\times\frac{3}{6}\times\frac{2}{5}\right)\times 3$$

Q: A Box Contains 4 R and 3 B Marbles and we want to draw 3 Marbles one one by one with Replacement then Find the probability of drawing 1R & 2 B Marbles?

M-I By Making Cases :→

Req Prob $= P(RBB \text{ or } BRB \text{ or } BBR)$

$$= \left(\frac{4}{7}\cdot\frac{3}{7}\cdot\frac{3}{7}\right) + \left(\frac{3}{7}\cdot\frac{4}{7}\cdot\frac{3}{7}\right) + \left(\frac{3}{7}\cdot\frac{3}{7}\cdot\frac{4}{7}\right)$$

$$= \left(\frac{4}{7}\times\frac{3}{7}\times\frac{3}{7}\right)\times 3$$

M-II Using Binomial Distribution :→

$X = \{\text{Number of Red Balls}\} \rightarrow$ success,

$n = 3$, $p = P(RB) = \frac{4}{7}$, $q = P(BB) = \frac{3}{7}$

4R
3B

$$\boxed{P(X = r/\text{success}) = {}^nC_r\, p^r q^{n-r}}$$

$$P(X = 1RB) = {}^3C_1 \left(\frac{4}{7}\right)^1 \left(\frac{3}{7}\right)^2$$

$$= 3 \times \left(\frac{4}{7}\right) \times \left(\frac{3}{7}\times\frac{3}{7}\right)$$

(*) If We are drawing Balls one by one without Replacement then

$$\boxed{\begin{matrix}4R\\3B\end{matrix}} \xrightarrow{1R} \boxed{\begin{matrix}3R\\3B\end{matrix}}$$

$$\underbrace{p = P(R) = \frac{4}{7} \;\nearrow\; p = P(R) = \frac{3}{6} = \frac{1}{2}}$$

we can't apply B. Dist

$\because$ It voilates 4^{th} condition.

Q: There are 10 Calci on a Table in which 6 are Defective & 4 are Non Def. & we want to draw three Calci one by one w/o Replacement then find the Prob that there will be exactly one Defective ?

M-I By Making Cases →

Req Prob = P(DNN or NDN or NND)

already discussed in last lect of Prob.

M-II using Hypergeometric Dist →

10 Calci

6 Def → 1 Def

3 Calci

4 N.Def. → 2 N.Def.

Req Prob $= \frac{f}{T}$ = already discussed in lec 6 of Prob.

Q. There are 10 Calci on a Table in which 6 are Defective & 4 are Non Def. & we want to draw three Calci one by one with Replacement then find the prob that there will be exactly one Defective?

6 D
4 N.D.

M-I By Making Cases →

Req Prob = P(DNN or NDN or NND)

$$= \left(\frac{6}{10}\frac{4}{10}\frac{4}{10}\right) + \left(\frac{4}{10}\frac{6}{10}\frac{4}{10}\right) + \left(\frac{4}{10}\frac{4}{10}\frac{6}{10}\right)$$

$$= \left(\frac{6}{10}\times\frac{4}{10}\times\frac{4}{10}\right)\times 3$$

M-II (using Binomial Dist) →

X = {Number of Def. Calci} → success

$n = 3$, $p = P(\text{Def}) = \frac{6}{10}$, $q = P(\text{N.D}) = \frac{4}{10}$

$$P(X = 1\ \text{Def}) = {}^{3}C_{1}\, p^{1} q^{2} = 3 \times \left(\frac{6}{10}\right)\left(\frac{4}{10}\right)^{2}$$

$$= 3 \times \frac{6}{10} \times \frac{4}{10} \times \frac{4}{10} \quad \text{Ans}$$

POISSON DISTRIBUTION

It is a particular case of Binomial Dist under following conditions;

① $n \to \infty$ (very large)
② $p \to 0$ (very small)
③ $np \to \lambda$ (i.e constant)

These 3 conditions will be taken as Necessary conditions for Poisson Dist.

Shortcut: → whenever we are not sure about n, But we can find it's Average Value (λ) then we can apply Poisson Dist.

Important Conclusion :- if (Quest is Based on Binomial Dist) (n & p are given) $\Rightarrow$ $\not\Leftarrow$ (then it can also be solved by Poisson) ($\lambda = np$ = can be calculated)

But take care; if n is small, use B. Dist & if n is large use P. Dist.

Def^n: Let X is D.R.V s.t it's p.m.f is defined as

$$\boxed{P(X = r \text{ success}) = \frac{e^{-\lambda} \cdot \lambda^{r}}{r!}}$$

then X is called Poisson Random Variable with parameter λ & it is denoted as $X \sim P\{\lambda\}$

Note ① $X = \{\text{which is Required}\}$ success.

② Prob Dist:

X:	0	1	2	3	4	----	n
$P(X)$:	p_0	p_1	p_2	p_3	p_4	----	p_n

where $\sum p_i = 1$

where $p_i = \dfrac{e^{-\lambda} \cdot \lambda^{i}}{i!}$

③ $\text{Mean}(x) = E(x) = \sum p_i x_i = p_0 x_0 + p_1 x_1 + \dots + p_n x_n$

$= \dots\dots\dots\dots = \lambda$

④ $\boxed{Var(x) = E(x^2) - E^2(x)} = \sum p_i x_i^2 - (\lambda)^2 = \dots\dots = \lambda$ Learn.

⑤ $S.D(\sigma) = \sqrt{\lambda}$

eg In Case of Poisson Dist., $\boxed{\text{Mean} = \text{Variance}}$

⑥ $\lambda \longrightarrow$ Average per unit time or Average per unit data

eg(i) If on an Average 5 Customers arrive at ticket window per min then $\lambda = 5$ per min

eg(ii) " " " 1 Customer arrives at " " in every 5 mins then $\lambda = \frac{1}{5}$ per min

eg(iv) " " " 3 " " " " " in a time span of 5 mins then

$\lambda = \frac{3}{5}$ per min

Q. A certain airport receives on an Average 4 number of aircrafts per hr then find the prob that exactly 3 aircraft will land in a particular 2 hrs period ?

(a) $512/6e^8$

(b) $512/e^8$

(c) $64/6e^4$

(d) $64/e^4$

$X = \{$ Number of $\underbrace{\text{aircraft Lands}}_{=\text{success}}$ in 2hrs period $\}$

Av. No. of Landings $(\lambda) = 4$ aircrafts per hour $= 8$ aircrafts per two hrs.

$$\boxed{P(X = r\ \text{success}) = \frac{e^{-\lambda} \cdot \lambda^r}{r!}}$$

So $P(X = 3\ \text{aircrafts}) = \frac{e^{-\lambda} \cdot \lambda^3}{3!} = \frac{e^{-8} \cdot (8)^3}{3!} = \frac{512}{6e^8}$ (a)

Q. An observer counts on an average 240 vehicles per hr on a specific highway location. Then find the prob that No vehicle will arrive in a 30 sec time interval?

(a) $1/e$

(b) $2/e$

(c) $2/e^2$

(d) $1/e^2$

$X = \{$ Number of $\underbrace{\text{vehicles arriving}}_{\text{success}}$ in 30 sec time interval $\}$

Av. No. of vehicles (λ) = 240 veh per hr = 4 veh per min = 2 veh (per 30 sec)

$$\boxed{P(X = r \text{ success}) = \frac{e^{-\lambda} \cdot \lambda^r}{r!}}$$

$$P(X = 0 \text{ vehicles}) = \frac{e^{-\lambda} \cdot \lambda^0}{0!} = e^{-\lambda} = e^{-2} = \frac{1}{e^2} = \frac{0.135}{1} = \frac{135}{1000}$$

Note

(1) out of 1000 intervals of 30 sec each, Number of times when No vehicle will arrive = 135 times

(2) $\lambda = 240$ veh/hr $= \frac{240}{60}$ veh/min $= 4$ veh/min $= \frac{4}{60}$ veh/sec $= \frac{1}{15}$ veh/sec.

$= \frac{30}{15}$ veh/(30 sec) $= 2$ veh per 30 sec.

→ $\lambda = 240$ veh per hr $= 4$ veh per min $= 2$ veh per 30 sec.

→ $\lambda = 240$ veh per hr $= 4$ veh per min $= \frac{1}{15}$ veh per sec

$\lambda = 2$ veh / thirty sec

The average amount earned by a employee is 2 rupees per day. What is the probability that $\boxed{3}$ rupees will be earned tomorrow?

(a) 0.85

(b) 0.75

(c) 0.18

(d) 0.32

$X = \{\text{Amount earned by employee } \underbrace{\text{tomorrow}}_{=\text{single day}}\}$

Av amount earned by employee $(\lambda) = 2$ Rs per day

$$P(X = 3\text{ Rs}) = \frac{e^{-\lambda} \cdot \lambda^3}{3!} = \frac{e^{-2} \cdot (2)^3}{6} = \frac{8}{6e^2} = 0.18$$

Q. Traffic office imposes on an Average 5 Number of penalties per day on Traffic voilators then find the prob that office will impose fewer than 3 penalties on a particular day ?

(a) $35/2e^5$

(b) $37/2e^5$

(c) $37/e^5$

(d) $1/2e^5$

$X = \{$ Number of penalties on a particular day $\}$ → success

= Single day

Average No. of penalties $(\lambda) = 5$ penalties per day

$P(X = r \text{ success}) = \dfrac{e^{-\lambda} \cdot \lambda^r}{r!}$

So $P(X<3) = P(X \le 2) = P(X = 0 \text{ or } 1 \text{ or } 2) = P(X=0) + P(X=1) + P(X=2)$

$= e^{-\lambda}\left[\dfrac{\lambda^0}{0!} + \dfrac{\lambda^1}{1!} + \dfrac{\lambda^2}{2!}\right] = e^{-5}\left(1 + 5 + \dfrac{25}{2}\right) = \dfrac{37}{2e^5}$ (b)

4. Q. In a Bike Race, the probability of a Motorist being killed in a accident is $\frac{1}{2400}$ then Find the prob that, in a Race having 200 motorist,

(i) there will be No Fatal accident (0.92)

(ii) " " " at least one Fatal accident. (0.08)

M-I Using Binomial Dist^e (already discussed in previous chapter)

$$n = 200,\ p = \frac{1}{2400},\ q = \frac{2399}{2400}$$

$$P(X=0) = {}^{n}C_{r}\, p^{r} q^{n-r} = {}^{200}C_{0}\,(p)^{0}(q)^{200} = 0.92 \text{ Ans}$$

M-II Using Poisson Dist $\longrightarrow$ $X = \{$ No. of F.A in one Race $\}$

$= $ Success.

$n = 200$ Bikers.

$p = P(FA) = \frac{1}{2400}$

So Av. No. of FA in one Race $\boxed{(\lambda) = np} = 200 \times \frac{1}{2400} = \frac{1}{12}$ FA per Race.

① $P(X = 0\ FA) = \frac{e^{-\lambda} \cdot \lambda^0}{0!} = e^{-\lambda} = e^{-\frac{1}{12}} \simeq 0.92$ Ans.

② $P(\text{at least one FA}) = ? = 1 - P(\text{None})$

$P(X \geq 1) = 1 - P(X = 0) = 1 - 0.92 = 0.08$ Ans

Note: out of 2400 Bikers, Average Number of Bikers killed in an Accident = 1

So out of 200 " , Average " " " " " " $= \frac{1}{2400} \times 200 = \frac{1}{12} = \lambda$

Q A Travel agency has two cars, which it hires out day by day.

HW The number of $\boxed{\text{demands}}$ for a car follows poisson Distribution with mean 1.5. then find the number of days in a yr when car is not used?

(a) 81 days

(b) 70 days

(c) 223 days

(d) 19 days

(ii) find the number of days in a year when some demands are refused?

(a) 295 days

(b) 70 days

(c) 223 days

(d) 19 days

Q. If X is P.R.V s.t $\boxed{P(X=1)=P(X=2)}$ then find Variance of X?

HW

(a) ∞

(b) 1

✓(c) 2

(d) $\sqrt{2}$

Q. Find the Recurrence Relation for Poisson Random Variable

(HW)

OR

If $X \sim P\{\lambda\}$ then P.T $\boxed{P(r+1) = \frac{\lambda}{r+1} P(r)}$

NIRMAN
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Happy Learning

Thank you!