UNIVERSITY OF KARACHI

Probability and Statistical Methods

BSCS-306

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ASSIGNMENT 2(B)

"POISSON DISTRIBUTION"

QUESTION : 01

(a) $\lambda = 3$, $x = 5$

$$P(x=5) = \frac{e^{-3} \times 3^5}{5!}$$

$$= 0.10082$$

(b) $P(x<3) = P(x \leq 2)$

$$= P(0) + P(1) + P(2)$$

$$= 0.0498 + 0.1494 + 0.224$$

$$= 0.4232$$

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

$$= 1 - 0.1991$$

$$= 0.8009$$

QUESTION : 02

$\lambda = 2$

(a) $P(X = x) = \dfrac{e^{-\lambda}\lambda^{x}}{x!}$

$P(x \geq 4) = 1 - P(x \leq 3)$

$= 1 - 0.8571$

$= 0.1429$

(b) $P(x = 0) = \dfrac{e^{-2} \times 2^{0}}{0!}$

$= 0.1353$

QUESTION : 03

$\lambda = 6$

(a) $P(x < 4) = P(x \leq 3)$

$= 0.002 + 0.015 + 0.045 + 0.089$

$= 0.1512$

(b) $P(6 \leq x \leq 8) = P(6) + P(7) + P(8)$

$= 0.1606 + 0.1376 + 0.10325$

$= 0.4015$

QUESTION : 04

(a) $\lambda = 10$

$P(X > 15) = 1 - P(X \leq 15)$

$= 1 - 0.95126$

$= 0.04874$

(b) $X \sim Bin(n, p)$

$X \sim Bin(3, 0.4874)$

$P(X = x) = {}^3C_1 (0.04874)^3 \times (1 - 0.04874)^2$

$= 0.1391$

QUESTION : 05

$\lambda = 5$

(a) $P(x > 5) = 1 - P(x \leq 5)$

$= 1 - P(0) + P(1) + P(2) + P(3) + P(4) + P(5)$

$= 1 - 0.6160$

$= 0.3840$

(b) $n = 4$ $x = 3$

$$P(x=3) = {}^4C_3 \, (0.3840)^3 \, (1-0.3840)^1$$

$$= 0.139$$

QUESTION : 06

$p = 0.02$, $n = 2000$, $x = 5$

$\lambda = np = 40$

$$P(x < 5) = P(x \leq 4)$$

$$= \frac{e^{-40} \cdot 40^4}{4!} + \frac{e^{-40} \cdot 40^3}{3!} + \frac{e^{-40} \cdot 40^2}{2!} + \frac{e^{-40} \cdot 40^1}{1!} + \frac{e^{-40} \cdot 40^0}{0!}$$

$$= 5.0204 \times 10^{-13}$$

QUESTION : 07

$\lambda = 10000 / 1000 = 10$

$P(x=6) = 0.063$

$P(x=7) = 0.09$

$P(x=8) = 0.112$

QUESTION 08

$p = 0.004$, $n = 1875$

$\lambda = np = 7.5$

(a)

$P(x < 5) = P(x \leq 4)$

$= 0.1321$

(b) $P(8 \leq x \leq 10) = P(8) + P(9) + P(10)$

$= 0.138 + 0.115 + 0.086$

$= 0.339$

QUESTION 09

$\lambda = 2$, $x = 4$

$$P(x=4) = \frac{e^{-2} \cdot 2^4}{4!}$$

$= 0.0902$

QUESTION : 10

$n = 10$, $P = 1/500$

$\lambda = np = \frac{1}{50}$

$P(x=0) = 0.98$

$P(x=1) = 0.02$

$P(x=2) = 0.000196$

Thus number of Packets are

$n_0 = 0.9802 \times 10000 = 9802$

$n_1 = 0.0196 \times 10000 = 196$

$n_2 = 0.000196 \times 1000 = 2$

QUESTION : 11

$3P(X=1) = P(X=2)$

$\frac{3\lambda^{1} e^{-\lambda}}{1!} = \frac{\lambda^{2} e^{-\lambda}}{2!}$

$3 \times 2 = \lambda$

$6 = \lambda$

$$P(x=4) = \frac{(6)^4 e^{-6}}{4!}$$

$$= 0.042.$$

QUESTION : 12

Mean $= \lambda$, S.D $= \sqrt{\lambda}$

$$\lambda = \sqrt{\lambda}$$

$$\lambda^2 = (\sqrt{\lambda})^2$$

$$\lambda^2 - \lambda = 0.$$

$$\boxed{\lambda = 0} \quad , \quad \boxed{\lambda = 1}$$

at $\lambda = 0$ all probabilities will be 0

at $\lambda = 1$

(a) $P(x=0) = 0.368$

(b) $P(x=2) = 0.184$

(c) $P(x=4) = 0.015$

QUESTION : 13

$$P(X=2) = \frac{5}{4} P(X=3) + 3P(X=4)$$

$$\frac{e^{-\lambda}\lambda^2}{2!} = \frac{5}{4}\left[\frac{e^{-\lambda}\lambda^3}{3!}\right] + 3\left[\frac{e^{-\lambda}\lambda^4}{4!}\right]$$

$$\frac{e^{-\lambda}\lambda^2}{2} = \frac{5}{4} \times \frac{e^{-\lambda}\lambda^3}{6} + \frac{3\, e^{-\lambda}\lambda^4}{24}$$

$$\frac{\cancel{e^{-\lambda}}\lambda^2}{\cancel{2}\,1} = \frac{5\cancel{e^{-\lambda}}\lambda^3 + 3\cancel{e^{-\lambda}}\lambda^4}{\cancel{24}\,12}$$

$$12\lambda^2 = 5\lambda^3 + 3\lambda^4$$

$$12 = 5\lambda + 3\lambda^2$$

$$\boxed{\lambda = -3} \qquad \boxed{\lambda = \frac{4}{3}}$$

Not possible.

QUESTION : 14

$n = 1000$, $P = 0.0001$

$\lambda = np = 0.1$

(a) $(P\ X \geq 3) = 1 - (P\ X \leq 2)$

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

$= 1 - [0.9048 + 0.0905 + 0.0045]$

$= 0.002$.

(b) $P(3 \leq x \leq 5) = P(x=3) + P(x=4) + P(x=5)$

$= 0.0002 + 0 + 0$

$= 0.0002$

QUESTION 2 IS

$P = 1/1000 = 0.0001$

$n = 50$, $\lambda = 0.05$

(a)

$P(x=0) = 0.9512$

(b) $P(x=2) = 0.0012$

(c) $P(x<4) = P(x \leq 3)$

$= P(0) + P(1) + P(2) + P(3)$

$= 0.9512 + 0.0416 + 0.0012 + 0$

$P(x<4) = 1$

No of Packets $= 1 \times 10000 = 10000$

QUESTION : 16

$x \sim P(2)$, $\lambda = 2$

$x \sim P(3)$, $\lambda = 3$.

$P(x+y = 4)$

let $z \sim P(x+y)$

$z \sim P(5)$

where $z = 5$

$$P(z = 4) = \frac{e^{-5} \cdot 5^4}{4!}$$

$= 0.1754$.

QUESTION : 17

$n = 225$ $p = 1/150$.

$\lambda = 1.5$

$P(X \leq 1) = P(0) + P(1)$

$= 0.2231 + 0.3347$

$= 0.5576$

QUESTION : 18

$n = 400$, no of mispriints $= 20$

$\lambda = \frac{n}{\text{No. of mispriints}} = \frac{400}{20} = 20$

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

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

$= 0.999$

QUESTION : 19

$\lambda = 3$

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

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

$= 1 - [0.0497 + 0.1493]$

$= 0.8008$