UNIVERSITY OF KARACHI

Probability and Statistical Methods

BSCS-306

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ASSIGNMENT : 02 (A)

— BINOMIAL DISTRIBUTIONS :—

QUESTION : 01

$$P = 0.10 \quad , \quad q = 1-P \quad , \quad n = 20$$

$$P(X=x) = {}^n C_x \; P^x \; q^{m-x}$$

$$P(x=x) = {}^{20} C_x \; (0.10)^x \; (0.9)^{20-x}$$

$$P(x \leq 3) = P(0) + P(1) + P(2) + P(3)$$

$$= {}^{20}C_0 \; (0.10)^0 (0.9)^{20-0} + {}^{20}C_1 \; (0.10)^1 (0.9)^{20-1} +$$
$$\quad {}^{20}C_2 \; (0.10)^2 (0.9)^{20-2} + {}^{20}C_3 \; (0.10)^3 (0.9)^{20-3}$$

$$P(X \leq 3) = 0.86 \quad \underline{Ans}$$

QUESTION : 02

$$P = 70\% = 0.7 \quad , \quad q = 0.3$$

(a) $n = 10$

$$P(X=x) = {}^n C_x \; P^x \; q^{n-x}$$

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

$$= {}^{10}C_0 \; P^0 \; q^{10-0} + {}^{10}C_1 \; P^1 \; q^{10-1} + {}^{10}C_2 \; P^2 \; q^{10-2} +$$
$$\quad {}^{10}C_3 \; P^3 \; q^{10-3} + {}^{10}C_4 \; P^4 \; q^{10-4}$$

$$P(x < 5) = 0.047$$

(b) $\quad n = 20$

$$P(x < 10) = \sum_{x=0}^{9} {}^{20}C_x \, (0.7)^x (0.3)^{n-x}.$$

$$P(x \leq 9) = \sum_{x=0}^{9} b(x; 20; 0.7).$$

$$= 0.001 + 0.004 + 0.012$$

$$P(x \leq 9) = 0.017 \quad \uparrow$$

QUESTION : 03

$$P = 75\% \qquad = 0.75 \qquad n = 5$$

(a) $\quad P(x = 2) = b(2; 5; 0.75).$

$\qquad P(x = 2) = 0.088$

(b) $\quad P(x \leq 3) = \sum_{x=0}^{3} b(x; 5; 0.75)$

$$= 0.001 + 0.015 + 0.088 + 0.264$$

$$P(x \leq 3) = 0.368$$

QUESTION : 04

$P = 30\% = 0.3$, $n = 20$

(a)

$$P(x \geq 10) = 1 - P(x \leq 9)$$
$$= 1 - \sum_{x=0}^{9} b(x; 20, 0.3).$$

$$= 1 - 0.001 + 0.007 + 0.028 + 0.072 +$$
$$0.130 + 0.179 + 0.192 + 0.164 +$$
$$0.114 + 0.065$$
$$= 1 - 0.952.$$
$$P(x \geq 10) = 0.048.$$

(b)

$$P(x \leq 4) = \sum_{x=0}^{4} b(x; 20; 0.3).$$

$$= 0.001 + 0.007 + 0.028 + 0.072 +$$
$$0.130$$
$$P(x \leq 4) = 0.238$$

(C) $n = 20$, $x = 5$ $P = 30\% = 0.3$

$P(x = 5) = Bin(20, 0.3)$

$= 0.179 \Rightarrow 18\%$

NO, 30% is an incorrect value / Percentage

of errors.

QUESTION : 05

$P = 60\%$ $= 0.6$, $n = 8$

(a) $P(x = 3) = b(3, 8, 0.6)$

$P(x = 3) = 0.124$

(b) $P = 40\%$ $= 0.4$

$P(x \geqslant 5) = 1 - (x \leqslant 4)$

$= 1 - \sum_{x=0}^{4} b(x, 8, 0.4)$

$= 1 - 0.0A + 0.090 + 0.209 +$

$0.279 + 0.232 +$

$= 1 - 0.827$

$P(x \geqslant 5)$ $= 0.173$

QUESTION 2 : 06

$P = 25\% = 0.25$, $n = 15$.

(a) $P(3 \leq x \leq 6)$.

$= P(x \leq 6) - P(x \leq 2)$.

$= \sum_{x=0}^{6} b(x, 15, 0.25) - \sum_{x=0}^{2} b(x, 15, 0.25)$

$= 0.225 + 0.225 + 0.165 + 0.092$

$= 0.707$.

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

$= \sum_{x=0}^{3} b(x; 15; 0.25)$.

$= 0.013 + 0.067 + 0.156 + 0.225$

$= 0.461$.

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

$= \sum_{x=0}^{5} b(x; 15; 0.25)$

$= 1 - (0.461 + 0.225 + 0.165)$.

$= 1 - 0.851$

$P(x > 5) = 0.149$

QUESTION : 07

$$q = 0.4 \qquad\qquad P = 1 - q = 0.6$$

for 4 engines :

$$x = \frac{4}{2} = 2 \qquad , \quad n = 4$$

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

$$= 1 - \sum_{x=0}^{1} (x ; 4 ; 0.6)$$

$$= 1 - 0.18$$

$$= 0.82$$

for 2 - Engine Plane :

$$n = 2 \quad , \qquad\qquad x = \frac{2}{2} \times \frac{1}{2} = 1$$

$$P(x \geqslant 1) = 1 - P(x \leq 0)$$

$$= 1 - \sum_{x=0}^{0} (n ; 4 ; 0.6)$$

$$= 1 - 0.026$$

$$= 0.974$$

2 engine plane has a higher
probability of success CO_2.
$$0.974 > 0.82.$$

Question : 08

$n = 20$ $P = 0.9$

(a) $P(x = 18) = \overset{18}{\underset{x=0}{\sum}} (x; 20; 0.9) - \overset{17}{\underset{x=0}{\sum}} (x; 20; 0.9)$

             $= 0.608 - 0.323$

             $= 0.285$

(b) $P(x = 15) = \overset{15}{\underset{x=0}{\sum}} (x; 20; 0.9) - \overset{14}{\underset{x=0}{\sum}} (x; 20; 0.9)$

             $= 0.043 - 0.011$

             $= 0.032$

    $P = 0.1$

(c) $P(x \geqslant 2) = 1 - P(x \leqslant 1)$

             $= 1 - \overset{1}{\underset{x=0}{\sum}} (x; 20; 0.1)$

             $= 1 - 0.392$

             $= 0.608$

Question : 09

(a)   Mean $= np = (10)(0.5)$

                $= 5$

     Variance $= npq = (10)(0.5)(0.5)$

                    $= 2.5$

(b) $P(x \geqslant 7) = 1 - P(x \leqslant 6)$

$$= 1 - \sum_{n=0}^{6} (n; 10, 0.5)$$

$$= 1 - 0.828$$

$$= 0.172.$$

QUESTION : ~~10~~ 11

$P = 50\%. = 0.5$. $n = 18$

(a)

$P(x = 10) = C_x^n \, p^x \, \sqrt{}^{n-x}$

$$= C_{10}^{18} \, (0.5)^{10} \, (0.5)^{18-10}$$

$P(x = 10) = 0.1669$

(b)

$P(x \geqslant 10) = 1 - P(x \leqslant 9)$

$$= 1 - \{ 0.1854 + 0.1669 + 0.1213 +$$

$$0.0708 + 0.0326 + 0.0116 + 0.0003$$

$$+ \; 5.83 \times 10^{-4} + 6.8 \times 10^{-5} + 3.81 \times 10^{-6} \}$$

$$= 1 - 0.5895.$$

$P(x \geqslant 10) = 0.4105$

(c) $\quad P(x \le 8) = \sum_{n=0}^{8} C_x^n p^x q^{n-x}$,

$= 3.81 \times 10^{-6} + 6.8 \times 10^{-5} + 5.8 \times 10^{-4} +$

$3.11 \times 10^{-3} + 0.011 + 0.032 + 0.070 +$

$0.121 + 0.166$

$P(x \le 8) = 0.403$

Question 2 12

$n = 12 \quad, \quad p = 0.5 \quad CO_2 \quad guessing$

$P(x=3) = b(3; 12; 0.5)$

$P(x \le 3) = 0.054$