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Total No. of Questions : 5]

SEAT No. :

P511

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F. Y. B. Sc.

STATISTICS / STATISTICAL TECHNIQUES

Discrete Probability and Probability Distributions

(2013 Pattern) (Paper - II)

Time : 3 Hours] *[Max. Marks : 80*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*
3) *Use of Statistical tables and calculator is allowed.*
4) *Symbols have their usual meanings.*

Q1) A) Attempt each of the following:

a) Give one real life situation where geometric distribution can be applied. **[1]**

b) Write the sample space of a random experiment of tossing 3 coins. **[1]**

c) State moment generating function (m.g.f.) of a binomial distribution with parameters n and p. **[1]**

d) If A and B are independent events with P(A)=0.6 and P(B)=0.5, find $P(A \cap B)$. **[1]**

B) Choose correct alternative for the following: **[1 each]**

a) If $P(A \cap B)$ =0, then the two events A and B are

i) Exhaustive events ii) Dependent events

iii) Mutually exclusive events iv) Independent events

b) If X and Y are independent random variables with m.g.f. $M_X(t)$ and $M_Y(t)$ respectively then, $M_{X+Y}(t)$ is :

i) $M_X(t) + M_Y(t)$ ii) $M_X(t) - M_Y(t)$

iii) $M_X(t) / M_Y(t)$ iv) $M_X(t) * M_Y(t)$

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c) If X ~ P(m) then variance of X *is*

i) $2m$ ii) m

iii) $4m$ iv) 0

d) If X and Y are two random variables with means E(X)=2 and E(Y)=3, then E(2X–3Y) is :

i) –5 ii) –1

iii) 13 iv) 5

C) a) If Karl Pearson's coefficient of correlation between X and Y $(\rho(x,y))$ is 0.6, then find $\rho\left(\frac{x+2}{-5}, \frac{y-3}{2}\right)$. **[2]**

b) Let $X \sim B\left(n=10, p=\frac{1}{3}\right)$ then state the mode of X. **[2]**

c) For a probability distribution of X, obtain cumulative distribution function (c.d.f.) of X. **[2]**

x	–1	0	1
$p(x)$	1/2	1/4	1/4

d) State Baye's theorem. **[2]**

Q2) Attempt <u>any four</u> of the following: **[4 each]**

a) Explain the following terms with one illustration each.

i) Mutually exclusive events.

ii) Sure event.

b) Let X and Y are two independent discrete r.v's. show that $E(XY)=E(X) \cdot E(Y)$

c) If A and B are mutually exclusive and non empty events defined on sample space Ω, show that $P(A \mid A \cup B) = \frac{P(A)}{P(A)+P(B)}$.

d) For a Poisson distribution with P(X=2)=P(X=3), compute $P(X \geq 1)$.

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e) If P(A)=0.4, P(B)=0.6 and $P(A \cup B)$=0.8, find

i) $P(A \cap B)$ ii) $P(A' \cap B)$

f) Define the following terms:

i) Pairwise independence of three events.

ii) Partition of the sample space.

Q3) Attempt any four of the following: **[4 each]**

a) Give the classical definition of probability. State its limitations.

b) Define a discrete uniform distribution with parameter 'n'. Find its mean and variance.

c) Let X ~ B(n,p). State the c.g.f. of X, hence find mean of X.

d) The probability mass function (p.m.f.) of a r.v. X is given by,

$$P(X=x) = K\ {}^5C_x \quad ; x=0,1,2,3,4,5,\ K>0$$
$$= 0 \quad ; \text{otherwise.}$$

Find the value of K.

e) A committee of 4 persons has to be formed out of 5 graduate and 4 non graduate persons. Find the probability that the committee consists of at most 2 non graduate persons.

f) State and prove multiplication theorem of probability for two events A and B defined on sample space Ω.

Q4) Attempt any two of the following:

a) The joint probability distribution of (X,Y) is given below:

X \ Y	0	1	2	3
–1	0.05	0.05	0.075	0.075
0	0.10	0.25	0.075	0.075
1	0.10	0.05	0.05	0.05

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Find i) $E(Y|X = 0)$ and **[4]**

ii) $V(Y|X = 0)$. **[4]**

b) i) Obtain variance of a linear combination of two variables X and Y; $V(aX + bY)$. **[6]**

ii) What do you mean by a deterministic model? State one example of it. **[2]**

c) State and prove binomial approximation to hypergeometric distribution. **[8]**

d) For a certain probability distribution if mean = 5, Variance = 2, coefficient of skewness = +1 and coefficient of kurtosis = +1, find first four raw moments of the distribution. **[8]**

Q5) Attempt <u>any one</u> of the following:

a) i) The joint p.m.f. of (X,Y) is given by,

$$P(x,y) = c(x^2+y^2) \quad ; c>0, x = -1,1.$$
$$y = -2,2.$$
$$= 0 \quad ;\text{otherwise.}$$

Obtain I) c

II) Marginal p.m.f's of X and Y

III) Are X and Y independent? Justify. **[8]**

ii) Let X and Y be two independent Poisson random variables with mean 3 and 2 respectively. Find: **[8]**

I) $P(X=4|X+Y=5)$ II) $E(X|X+Y=5)$

b) i) If the probability that a certain test yields a positive reaction is equal to 0.4. What is the probability that less than 5 negative reactions occur before the first positive one? **[5]**

ii) State the p.m.f. of hypergeometric distribution. Find mean and variance of the distribution. **[8]**

iii) What is the probability that a non-leap year should have fifty three Sundays? **[3]**

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