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AR-18

M. Sc

M. Sc 3rd SEMESTER REGULAR EXAMINATIONS, NOV/DEC 2019-20

Subject code: AE-307

Subject: MATHEMATICAL STATISTICS-II

Time: 3 Hours

Max Marks: 80

The figures in the right hand margin indicate marks.

SECTION A

Q.1 Answer any four of the following: [4 X4 =16]

a Let X be a random variable with probability density

function f(x) = { 1/3 e^{-x/3}, x > 0; 0, Otherwise

Find (i) P(X > 3) (ii) Moment generating function of X

b If X is a normal variate with mean 2 and S.D. 3, describe the distribution of Y = 1/2 x - 1. Also find P(Y >= 3/2) 4

c If the moments of a random variable X are defined by E(X^r) = 0.6, r = 1, 2, 3, ... Find P(X = 0), P(X = 1), P(X >= 2) 4

d A fair die is tossed 8 times. Find the probability P of obtaining 5 and 6 twice and the other numbers exactly once. 4

e Find the probability distribution of boys and girls in families with 3 children, assuming equal probabilities for boys and girls. 4

f From the following data, obtain R_{1.23}, R_{2.13} 4

Table with 5 columns: X_i, 2, 5, 7, 11; 3, 6, 10, 12; 1, 3, 6, 10

Or

2. Answer all questions from the following [2 x 8 =16]

a A random sample of size n is taken from a general Gamma distribution with parameters lambda and k. Show that the mean X of the sample also follows a Gamma distribution with parameters n*lambda and nk. 2

b Suppose that the reaction time in seconds of a person can be modeled by a lognormal distribution with parameter values, mu = -0.35 and sigma = 0.2. 2

(i) Find the probability that the reaction time is less than 0.6 seconds

(ii) Find the reaction time that is exceeded by 95% of the population.

c A box contains 2^n tickets of which nC_r tickets bear the number r (r = 0, 1, 2, ..., n). Two tickets are drawn from the box. Find the expectation of the sum of their numbers. 2

d Find the standard error of estimate of Y on X and of X on Y from the following data: 2



X	1	2	3	4	5
Y	2	5	9	13	14

- e If X and Y are independent random variables with p.d.f's $f_1(x) = \begin{cases} 2e^{-2x}, & x \geq 0 \\ 0, & x < 0 \end{cases}$ and $f_2(y) = \begin{cases} 3e^{-3y}, & y \geq 0 \\ 0, & y < 0 \end{cases}$ find the density function of their sum $U=X+Y$ 2
- f Find the distribution function of the RV $Y=g(X)$, in terms of the distribution function of X, if it is given that $g(x) = \begin{cases} x - c & \text{for } x > c \\ 0 & \text{for } |x| \leq c \\ x + c & \text{for } x < -c \end{cases}$ 2
- g Is it possible to get the following from a set of experimental data 2
 (i) $r_{23} = 0.8, r_{31} = -0.5, r_{12} = 0.6$ (ii) $r_{23} = 0.7, r_{31} = -0.4, r_{12} = 0.6$
- h The following zero-order, correlation coefficients are given 2
 (i) $r_{12} = 0.98, r_{13} = 0.44, r_{23} = 0.54$ calculate multiple correlation coefficient treating first variable as dependent and second and third variables are independent.

SECTION-B

3. Answer all Questions:

[16 x4 =64]

- a The following is a printout produced from part of a study of the relationship between family income and choice of shopping mall

Shopping Mall

Income	1	2	3	All
1	60	25	14	99
	65.74	25.20	8.09	99.00
2	66	32	9	107
	71.05	27.24	8.71	107.00
3	127	40	8	175
	116.21	44.55	14.24	175.00
All	253	97	31	381
	253.00	97.00	31.00	381.00

CHI-SQUARE = 10.292 with d.f = 4

- (a) For $\alpha = 0.05$, what conclusion would you come to know ?
- (b) Show how the result of 44.55 was calculated for 'shopping mall=2, income=3'

What contribution to the overall chi-square value do the 'shopping mall=2, income=3' make?

OR



- b. Batting 0.400: 13 times from 1900-1941, never since. Find the parameters of the data distribution so that $\mu = 0.260$ and $\sigma = 0.04$. With these values of α and β , what is the probability a batting average exceeds 0.400?

4.

- a The Joint pdf of (X, Y) is given by $f(x, y) = 24xy; x > 0, y > 0, x + y \leq 1$, and $f(x, y) = 0$, elsewhere, find the conditional mean and variance of Y , given X

Or

- b Obtain the equations of the regression lines from the following data, using the method of least squares. Hence find the coefficient of correlation between X and Y . Also estimate the value of (i) Y , when $X = 38$ and (ii) X , when $Y = 18$.

X	22	26	29	30	31	31	34	35
Y	20	20	21	29	27	24	27	31

Put $U = X - 29$ and $V = Y - 27$

5.

- a The current I and the resistance R in a circuit are independent continuous RVs with the following density functions

$$f_i(i) = \begin{cases} 2i, & 0 \leq i \leq 1 \\ 0, & \text{elsewhere} \end{cases} \quad f_r(r) = \begin{cases} \frac{r^2}{9}, & 0 \leq r \leq 3 \\ 0 & \text{elsewhere} \end{cases}$$

Find the pdf of the voltage E in the circuit, where $E=IR$

Or

- b. According to the Maxwell-Boltzmann law of theoretical physics, the pdf of V , the Velocity of a gas molecule is given by

$$f_v(v) = \begin{cases} kv^2 e^{-av^2}, & v > 0 \\ 0, & \text{elsewhere} \end{cases}$$

where a is a constant depending on its mass and the absolute temperature and k is an appropriate constant. Show that the kinetic energy $Y = \frac{1}{2}mV^2$ is a random variable having Gamma distribution.

6.

- a A salesman in a departmental store claims that at most 60 percent of the shoppers entering the store leaves without making a purchase. A random sample of 50 shoppers showed that 35 of them left without making a purchase. Are these sample results consistent with the claim of the salesman? Use a level of significance of 0.05.

Or

- b A cubical die is thrown 9000 times and a throw of 3 or 4 is observed 3240 times. Show that the die cannot be regarded as an unbiased one, and find the extreme limits between which the probability of a throw of 3 or 4 lies.