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PB

Total No. of Pages: 02

Roll No. _____

M.A./M.Sc. (Semester-III) Examination - Dec.-2025
MATHEMATICS
Paper-MATH 303
Mathematical Statistics-I

Time Allowed: Three Hours

Maximum Marks: 100

This question paper contains two sections as under

021

Section-A **Max. Marks-20**

This section will have 10 questions, having 02 questions from each unit. Answer in about 20 words. All questions will have equal marks. (10×02=20)

Section-B **Max. Marks-80**

This section will have 10 questions, having 02 questions from each unit, one question to be attempted from each unit. Words limit approximately 400 words. Questions may have sub divisions. All questions will have equal marks. (16×05=80)

021

Section-A

1. i) State Jenson's inequality.
   ii) Does there exist a variate x for which
   $$P[\mu_x - 2\sigma \le x \le \mu_x + 2\sigma] = 0.6?$$
   iii) Define multiple correlation.
   iv) Write multiple correction in terms of total and partial corrrelations.
   v) A poisson distribution has a double mode at x=1 and $x=2$. What is the probability that x will have one or the other of these two values?
   vi) Define Hyper-Geometric distribution.
   vii) Define Beta distribution of second kind.
   viii) Find mode of Normal distribution.
   ix) Write two applications of C-chart.
   x) Define statistical quality control.

021

Section-B

Unit-I

2. i) Let X_i assume the values i and $-i$ with equal probabilities. Show that the law of large numbers cannot be applied to the independent variables $x_1, x_2, x_3, \ldots\ldots, x_n$.
   ii) A systematic die is thrown 600 times. Find the minimum value of the probability of getting 80 to 120 sixes.

OR

   i) State and prove Markov's inequality.
   ii) If x is the number scored in a throw of a fair die, show that the Cheby Chev's inquality gives $P\{|x-\mu| \ge 2.5\} \le 0.47$, where μ is the mean of x, while the actual probability is zero.

Unit-II

3. i) Find the equation of plane of regression of x_2 on x_1 and x_3 using the following data :

$\overline{x_1} = 40;$ $\overline{x_2} = 70;$ $\overline{x_3} = 90$

$\sigma_1 = 3;$ $\sigma_2 = 6;$ $\sigma_3 = 7$

$r_{12} = 0.4;$ $r_{23} = 0.5;$ $r_{13} = 0.6$

Also, find the value of x_2 for $x_1 = 30, x_3 = 40$

ii) Show that the correlation coefficient between the residuals $x_{1.23}$ and $x_{2.13}$ is equal and opposite to that between $x_{1.3}$ and $x_{2.3}$.

OR

Show that $1 - R^2_{1.23} = (1 - r^2_{12})(1 - r^2_{13.2})$

Deduce that

i) $R_{1.23} \geq r_{12}$ ii) $R^2_{1.23} = r^2_{12} + r^2_{13}$, *if* $r_{23} = 0$

iii) $1 - R^2_{1.23} = \dfrac{(1-\delta)(1+2\delta)}{(1+\delta)}$, Provided all coefficients of zero order are equal to δ.

iv) If $R_{1.23} = 0$, x_1 is uncorrelated with any of other variables i.e. $r_{12} = r_{13} = 0$

Unit-III

4. i) Let x_1, x_2 be independent random variables each having geometric distribution $q^k p$; $k = 0, 2, 2, \ldots\ldots$. Show that the conditional distribution of x_1 given $x_1 + x_2$ is uniform.

ii) Fit a Poisson distribution to the following data :

Number of mistakes per page :	0	1	2	3	4	Total
Number of Pages :	109	65	22	3	1	200

OR

The trinomial distribution of two random variables x and y is given by

$$f_{x,y}^{(x,y)} = \frac{n!}{x!\,y!(n-x-y)!} p^x q^y (1-p-q)^{n-x-y}$$

for $x, y = 0, 1, 2, \ldots\ldots, n$ and $x + y \leq n,$, where $o \leq p,$ and $p + q \leq 1,$.

i) Find the marginal distributions of X and Y.

ii) Find the conditional distributions of X and Y and obtain (a) $E(Y/X=x)$ and (b) $E(X/Y=y)$.

iii) Find the correlation coefficient between X and Y.

Unit-IV

5. Find mean, varianc, β_1 and β_2 for beta distribution of first kind.

OR

i) Find moment generating function about origin of normal distribution.

ii) State and prove lack of memory property for exponential distribution.

Unit-V

6. Write advantages and limitations of statistical quality control.

OR

i) Construct a control chart for the proportion of defectives obtained in repeated random samples of size 100 from a process which is considered to be under control when the proportion of defective P is equal to 0.20. Draw the control line and the upper and the lower control limits on paper.

ii) Write steps for making control chart.