UE-5722

M.A. / M.Sc. (Sem. IV) Examination, June-2025

MATHEMATICS

PAPER - MATH 403

Mathematical Statistics-II

Time Allowed : **Three Hours**

Maximum Marks : **100**

This question paper contains two sections as under:

Max. Marks-20

Section-A

This section will have ***10*** *questions, having* ***02*** *questions from each unit with no internal choice. Answer in about* ***20*** *words. All questions will have equal marks.* ***(02×10=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 aproximately 400-500 words. Questions may have sub divisions. All questions will have equal marks. ***(16×05=80)***

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SECTION-A

1 (i) Derive characteristic function of Chi-square $\left(\chi^2\right)$ distribution.

(ii) Define Student-t distribution.

(iii) Define method of moments.

(iv) In random sampling from Normal population $N\left(\mu, \sigma^2\right)$, find the maximum likelihood estimator for μ when σ^2 is known.

(v) Define consistent estimator.

(vi) Write Cramer-Rao inequality.

(vii) Show that correlation coefficient is the geometric mean between regression coefficients.

(viii) Write partial correlation coefficient.

(ix) Write two advantages of non-parametric test over parametric test.

(x) Define contingency table.

SECTION-B

UNIT-I

2 If X_1 and X_2 are two independent χ^2-variates with n_1 and n_2 df respectively, then $\frac{X_1}{X_2}$ is a $\beta_2\left(\frac{n_1}{2}, \frac{n_2}{2}\right)$ variate.

OR

Below are given the gain in weights (in kgs.) of pigs fed on two diets A and B.

Gain in weight

Diet A: 25, 32, 30, 34, 24, 14, 32, 24, 30, 31, 35, 25

Diet B: 44, 34, 22, 10, 47, 31, 40, 30, 32, 35, 18, 21, 35, 29, 22

Using paired t-test how two diets differ significantly as regards their effect an increasing in weight.

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UNIT - II

3 Find maximum likelihood estimator of the parameters α and λ, (λ being large), of the distribution

$$f(x; \alpha, \lambda) = \frac{1}{\lceil\lambda} \left(\frac{\lambda}{\alpha}\right)^{\lambda} e^{-\lambda x/\alpha} x^{\lambda-1}; 0 < x < \infty, \lambda > 0$$

Where for large values of λ

$$\psi(\lambda) = \frac{\lambda}{\partial\lambda} \log \lceil\lambda = \log \lambda - \frac{1}{2\lambda}$$

OR

Estimate α and β in the case of Pearson's type-III distribution by method of moments:

$$f(x; \alpha, \beta) = \frac{\beta^{\alpha}}{\lceil\alpha} x^{\alpha-1} e^{-\beta x}, 0 \le x < \infty$$

UNIT - III

4 If T_1 and T_2 be two unbiased estimators of $x(\theta)$ with variance σ_1^2, σ_2^2 and correlation ρ, what is the best unbiased linear combination of T_1 and T_2 and what is the variance of such a combination?

OR

Write test for the equality of means of two Normal population when variances are also equal.

UNIT - IV

5 Show that if $X_3 = a X_1 + b X_2$, the three partial correlations are numerically equal to unity, $r_{13.2}$ having the sign of a, $r_{23.1}$, the sign of b and $r_{12.3}$ the opposite of a/b.

OR

Obtain the equation of two lines of regression for the following data. Also obtain the estimate of x for $y = 70$.

x :	65	66	67	67	68	69	70	72
y :	67	68	65	68	72	72	69	71

UNIT - V

6 Obtain the rank correlation coefficient for the following data:

x :	68	64	75	50	64	80	75	40	55	64
y :	62	58	68	45	81	60	68	48	50	70

OR

For a 2×2 table

a	b
c	d

prove that Chi-square test of independence gives

$$\chi^2 = \frac{N(ad-bc)^2}{(a+c)(b+d)(a+b)(c+d)}, \quad N = a+b+c+d.$$

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