RAN-2403081803022001

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M.Sc. (Sem.-III) Examination October - 2025

Applied Statistics-Applied Regression Analysis (MAS:302)

Time: 3 Hours] **[Total Marks: 70**

સૂચના : / Instructions

(1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book

(2) Attempt all questions.

(3) Each question carries 14 marks.

(4) Answer any two out of the three bits given in each question.

Seat No.:

Student's Signature

Q.1. a. Explain the following terms:

i. Ordinary Least Square Method
ii. Normal Equations
iii. PRESS Residuals
iv. Odds Ratio
v. Coefficient of Determination
vi. Dispersion Matrix
vii. Multicollinearity.

b. Consider Three-variable linear regression model. State its assumptions and hence obtain OLSE estimators of regression co-efficient along with its variances.

c. Obtain maximum likelihood estimator for the parameters of simple linear regression model under the assumption of normality.

Q.2. a. What is the general form of the Generalised Gauss-Markov Linear Model (GMLM)? State its assumptions and obtain GLSE.

b. A company wants to predict sales (in thousands of units) based on advertising budget for TV (X_1, in \$1000) and social media (X_2, in \$1000). The multiple linear regression model is fitted as:

$$\widehat{Y} = 50 + 2.5X_1 + 1.8X_2$$

Questions:

1. Interpret the coefficients of X_1 and X_2.
2. Predict sales if TV budget =\$20,000 and social media budget = \$15,000.
3. What assumptions must be checked before interpreting the model?

c. Explain the testing procedure involved in checking model significance under the setup of regression analysis.

Q.3. a. Give two points of differences for the following terms

i. R^2 and Adjusted R^2
ii. Causation and Correlation
iii. Logistic and Count Regression.

b. Write a detailed note on Likelihood Ratio Test.

c. Derive the moment generating function of X'AX; where X~N (μ, V) and V is non-singular matrix.

Q.4. a. Consider the model,

$$y_1 = \beta_1 + 2\beta_2 + \varepsilon_1$$
$$y_2 = 3\beta_1 + \beta_2 + \varepsilon_2$$
$$y_3 = -\beta_1 + 4\beta_2 + \varepsilon_3$$

Where $E(\varepsilon_i) = 0$ *and they are uncorrelateds*

$V(\varepsilon_i)$ *is contant*. Obtain linear unbiased estimator of β_1 and β_2 along with its variances

b. If the errors do not have constant variance and/or are correlated, what problems result? Is ordinary least squares still appropriate, and if not, explain the methodology to be used in such case.

c. Prove that OLSE of simple linear regression model is BLUE.

Q.5. a. i Consider $Q(x) = 4x_1^2 + 6x_1x_2 + 2x_2^2$. Obtain a symmetric matrix A associated with it.

ii. Consider a symmetric matrix $A = \begin{bmatrix} 2 & 5 \\ 5 & -3 \end{bmatrix}$. Write quadratic form $Q_A(x)$ defined by A in terms of components $\begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$ and hence obtain $Q_A\begin{pmatrix} 2 \\ 5 \end{pmatrix}$, $Q_A\begin{pmatrix} 0 \\ 1 \end{pmatrix}$ and $Q_A\begin{pmatrix} 1 \\ -2 \end{pmatrix}$.

b. Write a detailed note on: Residual Analysis.

c. Write a detailed note on: Quadratic forms
