

2023
B.A./B.Sc.
Fourth Semester
CORE – 9
STATISTICS
Course Code: STC 4.21
(Linear Models)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

1. (a) Define best linear unbiased estimator. Describe Gauss-Markov linear model. 3+5=8
- (b) Prove that a necessary and sufficient condition for the linear function $\tilde{l}^T \tilde{\beta}$ of the parameters to be linearly estimable is
- $\text{rank}(A) = \text{rank} \begin{pmatrix} A \\ \tilde{l}^T \end{pmatrix}$, where $\begin{pmatrix} A \\ \tilde{l}^T \end{pmatrix}$ is the matrix obtained from A by adjoining row vector \tilde{l}^T . 6
2. (a) In Gauss-Markov linear model, what is the name of the unknown parameters? What are the different names given to the model depending on the values of the indicator variables? Also define estimable function. 1+3+2=6
- (b) Prove that if $\tilde{l}^T \tilde{\beta}$ is any estimable linear function of the parameters $\beta_1, \beta_2, \dots, \beta_p$ then
- (i) \exists a unique linear function $\tilde{c}^T \tilde{Y}$ of the random variables Y_1, Y_2, \dots, Y_n such that $\tilde{c} \in V(A^T)$ and $E(\tilde{c}^T \tilde{Y}) = \tilde{l}^T \tilde{\beta}$.
- (ii) $V(\tilde{c}^T \tilde{Y})$ is less than the variance of any other linear unbiased estimator $\tilde{l}^T \tilde{\beta}$. 4+4=8

UNIT-II

3. (a) In analysis of variance, what are the values taken by the indicator variable? Describe the test for the linearity of regression. 1+7=8
(b) Describe the application of technique of analysis of variance in the test for polynomial regression. 6
4. (a) Test the hypothesis that p regression lines are parallel to one another, using the technique of analysis of variance. 8
(b) Using the technique of analysis of variance, test the hypothesis that p different regression equations are identical. 6

UNIT-III

5. (a) What is meant by analysis of variance (ANOVA)? Write down the assumptions which are made under ANOVA 2+2=4
(b) Define the following terms: 3
(i) Fixed effect linear model
(ii) Random effect linear model
(iii) Mixed effect linear model
(c) Give the analysis of variance (ANOVA) of one way classified data. 7
6. (a) Estimate various parameters in ANOVA using the principle of Least Squares. 7
(b) Give the statistical analysis for fixed effect additive model. 4
(c) Give the ANOVA table for one-way classified data. Also define the terms associated in the ANOVA table. 3

UNIT-IV

7. (a) Define analysis of covariance (ANCOVA). Give the ANCOVA table for a randomised block design (RBD) with one concomitant variable by defining the terms associated in ANCOVA table. 3+4=7
(b) Give the analysis of covariance (ANCOVA) of one-way layout with one concomitant variable. 7
8. (a) Give the outline of the analysis of covariance technique. 7

- (b) Explain the statistical analysis of ANCOVA. Also estimate the parameters i.e., μ_i and β using the principle of least squares.

2+5=7

UNIT-V

9. (a) What is econometrics? Discuss the different categories of econometrics. 4+3=7
(b) Explain in detail the different types of economic data. 7
10. (a) Explain the concept of general linear model (GLM). 4
(b) Write a short note on generalised least square estimation. 4
(c) Discuss the methods used for detecting autocorrelation. Also mention the remedies used for autocorrelation. 4+2=6
-