

B.Sc. (Honours) Examination, 2019
Semester-VI
Statistics
Course : BSC-62
(Linear Models and Categorical Data Analysis)

Time : 3 Hours

Full Marks : 40

Questions are of value as indicated in the margin

Answer **any four** questions

1. a) Consider the following model

$$E(y_1) = \beta_1 + \beta_2$$

$$E(y_2) = \beta_1 + \beta_3$$

$$E(y_3) = \beta_3 - \beta_2$$

Where y_1, y_2, y_3 are independent random variables having common variance σ^2 . Find the Best Linear Unbiased Estimator of the function $\beta_1 - \beta_2 + 2\beta_3$. 8

- b) State Gauss-Markov theorem with assumptions in the context of estimability of parameters of a linear model. 2
2. Consider the model

$$y_1 = \beta_1 + \epsilon_1$$

$$y_2 = 2\beta_1 - \beta_2 + \epsilon_2$$

$$y_3 = \beta_1 + 2\beta_2 + \epsilon_3$$

$$\text{where } \epsilon \sim N(0,1)$$

Derive an appropriate test for testing the hypothesis $H_0 : \beta_1 = \beta_2$. 10

3. a) Use the technique of analysis of variance for testing whether two regression lines are parallel. 7
- b) How would you interpret an observed F which is less than one? 3
4. a) Derive the expected values of mean squares for two way classified data with one observation per cell under fixed effect model. 8
- b) Under this model set up is it possible to test the interaction effect? If not, when will that be possible? 2
5. Describe how the ANOVA technique can be applied to test that there is no dependence of y (dependent variable) on the k fixed variables $x_1, x_2, \dots, x_k$ (independent variables). 10
6. a) What is an ANCOVA model? Explain how does it reflect better model adequacy diagnostics. 3
- b) Under a one-way layout with one fixed concomitant variable describe how the equality of factor effects can be tested. 7
7. a) Define Pearson's χ^2 Goodness of Fit statistic and likelihood-Ratio Goodness-of-Fit statistic G^2 . Show that G^2 and χ^2 statistics usually have similar values. 5
- b) State and prove Fisher's exact test for a 2×2 contingency table. 5
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