



WEST BENGAL STATE UNIVERSITY
B.Sc. Honours 4th Semester Examination, 2022

STSACOR09T-STATISTICS (CC9)

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.*

Answer any four questions from the question nos. 1-6

5×4 = 20

1. In the context of multiple linear regression, define partial regression coefficients. Show that covariate x_i and the residual $x_{1.23\dots p}$ are uncorrelated for any i , $i = 1, 2, \dots, p$. 2+3
2. In a linear model $\mathbf{y} = \mathbf{X}\boldsymbol{\theta} + \mathbf{e}$, define (i) linear parametric function (LPF), (ii) estimability of LPF and (iii) row space of \mathbf{X} . 1+2+2
3. Write down the linear model required for least square estimation. Show that least square estimate of $\boldsymbol{\theta}$ is unbiased. 2+3
4. Judge whether the parametric functions $(\theta_1 - 2\theta_2 + \theta_3)$ and $(2\theta_1 - \theta_2 - \theta_3)$ are estimable, when 5

$$\mathbf{X} = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix} \quad \text{and} \quad \boldsymbol{\theta} = (\theta_1, \theta_2, \theta_3)'$$

5. Define 'Error Space'. If a vector \mathbf{b} belongs to error space, the show that \mathbf{b} belongs to the orthogonal space of the column space of design matrix. 2+3
6. State 'Two way ANOVA model' with fixed effects. Also state the associated assumptions required to test the related hypothesis. What is the estimate of the 'error variance'? 2+3

Answer any *two* questions from the question nos. 7-9

10×2 = 20

7. (a) Consider the following model:

5+5

$$y_j = \beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \dots + \beta_p x_{pj} + e_j, \quad j = 1, 2, \dots, n.$$

Test whether the first three covariates in the model are insignificant in predicting y .

- (b) Show that

$$1 - R^2_{1.23\dots n} = (1 - r_{12}^2)(1 - r_{13.2}^2)\dots(1 - r_{1n.23\dots(n-1)}^2)$$

8. Three computers are randomly selected from a computer lab, and the computing times for a task are collected 30 times for all three computers.

7+3

- (i) Set up a suitable model for the data. Write down the hypothesis to be tested and carry out the test.
 (ii) In this context, find unbiased estimators of the variance parameters involved in the model.

9. (a) Briefly discuss the difference between ANOVA and ANCOVA models.

3+7

- (b) Give an example of real life data set which can be modeled by one-way ANCOVA model with one concomitant variable. Analyse this model in order to test the relevant hypothesis.

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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