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(November)

STATISTICS

(Core)

Paper : STSC5A

(Linear Models and Regression Analysis)

Full Marks : 50

Time : 2 hours

The figures in the margin indicate full marks
for the questions

1. Choose the correct alternatives from the
   following :   1×5=5

   (a) A mathematical model where the
        parameters of the model are random
        samples instead of fixed constant are
        known as

        (i) fixed effect model

        (ii) random effect model

        (iii) mixed effect model

        (iv) None of the above

   (b) ANOVA technique is designed to

        (i) compare the homogeneity of several
             means simultaneously

        (ii) test the equality of several popula-
             tion variances

(iii) Both *(i)* and *(ii)*

(iv) Neither *(i)* nor *(ii)*

(c) The assumption of constant variance of the residual is known as

    (i) autocorrelation

    (ii) heteroscedasticity

    (iii) homoscedasticity

    (iv) multicollinearity

(d) If $R^2 = 0 \cdot 80$, then it means

    (i) the estimated regression line is able to explain 20% of the total variation of dependent variable by the explanatory variable

    (ii) the estimated regression line is not able to explain 80% of the total variation of dependent variable by the explanatory variable

    (iii) the estimated regression line is able to explain 80% of the total variation of dependent variable by the explanatory variable

    (iv) None of the above

(e) Multicollinearity is essentially a

    (i) population phenomenon

    (ii) sample phenomenon

    (iii) Both *(i)* and *(ii)*

    (iv) Either *(i)* or *(ii)*

2. Answer the following in brief : $2 \times 5 = 10$

(a) Define linear model in ANOVA setup.

(b) Write two properties of estimability of linear parametric function.

(c) What is the role of the stochastic error term V_i, in regression analysis?

(d) What do you mean by autocorrelation?

(e) Mention any two methods which are commonly used as model adequacy checking.

3. (a) Estimate the error variance or residual sum of squares of the general linear model in matrix form.   7

Or

(b) State and prove Gauss-Markov theorem. $2 + 5 = 7$

4. (a) What are the assumptions of the simple linear regression model? For a simple linear regression model

$$y_i = \beta_0 + \beta_1 x_i + \varepsilon_i$$

find the $100(1 - \alpha)\%$ confidence interval for the mean response at a particular value of the regressor variable X. $2 + 5 = 7$

Or

(b) Calculate mean and variance of a $\hat{\beta}$, the estimated parameter vector of the general linear model in matrix form. $3 + 4 = 7$

5. Answer any *two* of the following : $8 \times 2 = 16$

    (a) Explain the meaning of analysis of variances and give its applications. What is the difference between 'variability within classes' and 'variability between classes'?

    (b) Outline the various steps in carrying out the ANOVA of a two-way classified data with one observation per cell, stating clearly—

        (i) the fixed effects mathematical model;

        (ii) the assumptions used;

        (iii) the hypothesis to be tested;

        (iv) the partitioning of various sum of squares and d.f.;

        (v) the ANOVA table.

    (c) Describe the random effect model for one-way classification, stating clearly the assumptions involved. How does it differ from the fixed effect model?

6. Write an explanatory note on any *one* of the following :   5

    (a) Model adequacy checking

    (b) Orthogonal polynomials

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