

Semester	FIVE
Course	Major
Paper Code	C3ST230521T
Paper Title	Linear Models
No. of Credits	4
Theory / Practical /Composite	Theory
Classes per week	4
Module	1

Course Outcomes

1. Remember Gauss Markov model and its assumption
2. Understand the use of concomitant variables in ANOCOVA
3. Apply fundamental theorem of least squares to test a linear hypothesis in Gauss Markov model.
4. Analyze ANOVA models for testing the main and interaction effects of several factors
5. Evaluate performance of multiple comparison of treatment effects
6. Create problems related to regression and use fundamental theorem of least squares for testing

Syllabus

Unit/Module	Content	No. of lectures	CO mapping	Cognitive levels
<i>Unit 1</i>	Gauss Markov setup Gauss Markov model. Estimability of linear parametric function, least square estimation and BLUE, error space, estimation space and orthogonal projection, estimation of error variance. Classification of linear models. Fundamental theorem of least squares. Tests of general linear hypotheses.	10	CO1 CO3	K1 K3
<i>Unit 2</i>	Analysis of Variance Factors of classification. Completely crossed, partially crossed and nested models. Balanced and unbalanced models (definitions and examples)	4		

	<p>One factor fixed effects ANOVA model. Two factor completely crossed fixed effects ANOVA model with and without interaction term.</p> <p>Comparison of treatment effects: Fisher's least significant difference method, Scheffe's method, Tukey's test, multiple range test (Duncan), Newman's Keul's test, Dunnett's test (Applications only)</p> <p>Analysing random and mixed effects model.</p>	8		
		4	CO4 CO5	K4 K5
		9		
Unit 3	<p>Regression</p> <p>Tests related to simple linear regression, multiple linear regression and polynomial regression. Use of qualitative predictors (ordinal and nominal with two or more categories). R squared and adjusted R squared.</p>	9	CO3 CO6	K3 K6
Unit 4	<p>Analysis of Covariance</p> <p>One factor and two factors fixed effects ANCOVA model with p concomitant variables.</p>	8	CO2 CO3	K2 K3

Reading/Reference list

1. Zimmerman, D. L. (2020): Linear Model theory with examples and exercises, Springer.
2. Rutherford, A. (2011): Introducing ANOVA and ANCOVA: a GLM approach, John Wiley & Sons.
3. Renchner, A. C. and Schaalje, G. B. (2008): Linear Models in Statistics (Second edition), JohnWiley &Sons.
4. Scheffe, H. (1959): The Analysis of Variance, John Wiley.

5. Stapleton, J. H. (2009): Linear Statistical Models (Second Edition), Wiley Series.
6. Sengupta, D., Jammalamadaka, S. R. (2003): Linear Models: An Integrated Approach, Vol 6, World Scientific.

Evaluation

	CIA: 30 End-Sem: 70 Total: 100	
Paper Structure for Theory Semester	Short questions (5 marks each) 5 out of 7	Long question (15 marks each) 3 out of 5

CO	CO Description	Cognitive levels
CO1	Remember Gauss Markov model and its assumption	K1
CO2	Understand the use of concomitant variables in ANOCOVA	K2
CO3	Apply fundamental theorem of least squares to test a linear hypothesis in Gauss Markov model.	K3
CO4	Analyze ANOVA models for testing the main and interaction effects of several factors	K4
CO5	Evaluate performance of multiple comparison of treatment effects	K5
CO6	Create problems related to regression and use fundamental theorem of least squares for testing	K6