

Semester	THREE
Paper Number	11
Paper Code	MDTS 4313
Paper Title	Interdisciplinary Paper + Advanced Regression Techniques
No. of Credits	3 + 3
Course description	<p>11A: Interdisciplinary Elective; 2 Theory + 2 Practical Classes/ week</p> <p>11B: Elective; 3 Theory classes/week</p>
Course Objective	<p>11A: Interdisciplinary Paper</p> <p>At the end of the course, a student is expected to</p> <ol style="list-style-type: none"> 1. Identify the different forms of data. 2. Visually represent different types of data using standard softwares. 3. Carry out analysis of metric data by using different measures. 4. Learn the genesis of different probability distributions and choose them appropriately to fit a given data. 5. Build regression models to multivariate data. 6. Understand the concepts of inferential statistics, estimate and test hypotheses of parameters of interest in different setups. <p>11B:Advanced Regression Techniques</p> <p>At the end of course, a student is expected to :</p> <ol style="list-style-type: none"> 1. Build regression models on data when classical assumptions on the response cannot be made. 2. To be able to identify non-linear relations between the response and predictors and fit them on the given data. 3. To overcome the difficulties of polynomial regression and improve upon it by the use of splines. 4. To assess the stability of regression coefficients in a regression model through bootstrapping. 5. To be able to extend non-linear relationships to arbitrary and flexible functions using a Generalized Additive Model.
Syllabus	<p>11A- Interdisciplinary Paper</p> <p>Data: Population and Sample. Classification of data according to the nature of the characteristic being measured. Types of Data- Time Series, Cross Sectional, Categorical, Spatial, Longitudinal/Panel, Spatio Temporal. Scales of Measurement. (4L)</p> <p>Diagrammatic Representation: Exploratory Data Analysis. Visual Presentation of different types of data. (2L)</p> <p>Descriptive Statistics: Moment and Quantile Measures of univariate data. Product Moment correlation, linear regression, Odds Ratio of contingency tables. Multiple linear regression. Logistic regression. Outliers. (4L)</p> <p>Probability Theory: Random variable. Binomial, Poisson, Normal. (7L)</p>

	<p>Statistical Methods: Statistic and Parameter. Concept of Sampling distribution. Estimate and standard error. Confidence Intervals. Tests for means. Analysis of variance tests for one way and two way layout. Pearsonian chi-square tests in contingency tables. (9L)</p> <p>11B-Advanced Regression Techniques:</p> <p>Smoothing Techniques: Scatterplot Smoothing. Different types of smoothers. Kernel Smoothing. Selection of smoothing parameters.</p> <p>Regression Splines: Simple knot selection schemes. Adaptive knot selection schemes. Adaptive regression splines. MARS.</p> <p>Generalized Additive Models: Additive Models, GAM. Scoring Techniques. Estimation of link function. Analysis of Deviance. Transformation of Response – ACE algorithm and generalization of Box Cox transformation.</p> <p>Nonlinear Regression: Fixed and Random regressor models. Least Squares and Maximum Likelihood Estimation. Identifiability and Ill conditioning problems. Residual Analysis.</p> <p>Bootstrapping: Parametric and nonparametric bootstrapping in linear regression models.</p>		
List of Practical	Based on the theory topics		
Reading/Reference Lists	<p>11A- Interdisciplinary Paper</p> <ol style="list-style-type: none"> 1. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics 2. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi. 3. Moulin, P. and Venugopal, V.V., Statistical Inference for Engineers and Data Scientists, Cambridge University Press. 4. Ismay, C. and Kim, A.Y., Statistical Inference via Data Science, A ModernDive into R and the Tidyverse, CRC Press Talor and Francis group, 2020. <p>11B-Advanced Regression Techniques:</p> <ol style="list-style-type: none"> 1. P.J. Green and B.W. Silverman : Nonparametric Regression & Generalized Linear Models 2. M.P. Wand and M.C. Jones : Kernel Smoothing 3. T. Hastie and R.Tibshirani : Generalized Additive Models 4. G. Seber and C. Wild : Nonlinear Regression 		
Evaluation			
11A: Interdisciplinary Paper		11B: Advanced Regression Techniques	
Theory	Practical	Theory	Practical
CIA: 5	Continuous Assessment: 15	CIA: 5	Continuous Assessment: 15
End Sem Exam: 25	End Sem Viva: 5	End Sem Exam: 25	End Sem Viva: 5
Total : 30	Total: 20	Total : 30	Total: 20
Paper Structure			

11A: Interdisciplinary Paper	11B: Advanced Regression Techniques
5 Marks question: 1 out of 2 10 Marks question: 2 out of 3	5 Marks question: 1 out of 2 10 Marks question: 2 out of 3