The University of Burdwan

Syllabus for 2-Year PG Programme: 3+2 Pattern / 1- Year PG Programme: 4+1 Pattern/ PG Diploma (Post-Master's Level): 3+2+1/4+1+1 Pattern in Statistics under Curriculum and Credit Framework for Postgraduate Program (CCFPP) as per NEP, 2020 with effect from 2026-2027

2-year PG Programme

Semester wise & Course wise Credit Distribution Structure under CCFPP as per NEP, 2020

Semester	Course Type	Code & Level	Name of The Course	Credit	L-T-P	Full Marks	Distribution of Marks Th – Pr - I A
I	Major/ Core Course	PG2STAT1011 (400-499)	Advance Research Methodology	6	5 – 1 – 0	75	60 – 0 – 15
	Major/ Core Course	PG2STAT1012 (400-499)	Optimization Techniques	6	5 – 0 – 1	75	40 – 20 – 15
	Major/ Core Course	PG2STAT1013 (400-499)	Exploratory Data Analysis	6	5 – 0 – 1	75	40 – 20 – 15
	Major/ Core Course	PG2STAT1014 (400-499)	Multivariate Techniques	6	5 – 0 – 1	75	40 – 20 – 15
	Minor Course	PG2STAT1021 (300-399)	Applied Statistics	4	3 – 0 – 1	75	40 – 20 – 15
	Total			**28**		**375**	

Semester	Course Type	Code & Level	Name of The Course	Credit	L – T – P	Full Marks	Distribution of Marks Th – Pr - IA
II	Major/ Core Course	PG2STAT2011 (400-499)	Reliability Theory and Survival Analysis	6	5 – 0 – 1	75	40 – 20 – 15
	Major/ Core Course	PG2STAT2012 (400-499)	Advance Inference	4	3 – 0 – 1	75	40 – 20 – 15
	Major/ Core Course	PG2STAT2013 (400-499)	Operations Research	4	3 – 0 – 1	75	40 – 20 – 15
	Major/ Core Course	PG2STAT2014 (400-499)	Advance Data Analysis	4	3 – 0 – 1	75	40 – 20 – 15
	Minor Course	PG2STAT2021 (300-399)	Monte Carlo Method	4	3 – 0 – 1	75	40 – 20 – 15
	Total			**22**		**375**	

Detailed Syllabus

Semester – I

(MAJOR)

Course Code: PG2STAT1011 Credit: 6 Full Marks: 75

Advance Research Methodology

Course Objective: The following are the basic course objectives of the major course PG2STAT1011 (Advance Research Methodology):

1. It introduces some basic concepts of research, developing a research report, and formulating a research hypothesis.
2. It focuses on the basic steps of research and developing a research report.
3. It helps the students for formulating a research hypothesis and developing a research report. Students can get sense for formulating a research problem in every field of studies such as social science, natural science, medical science etc.

Theory **Credit: 6 Full Marks: 60**

Meaning, objectives, motivation in Research, Research Types (Qualitative & Quantitative Research, Longitudinal Research, Survey & Experimental Research), Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Research, Research process, Criteria of good research. (15 L)

Research problems, Selection of research problem, Defining the research problem with Stating Hypothesis or Research question, Research Design, Features of a Good Design, Different research designs, Basic principles of Experimental designs. (15 L)

Sampling designs, Different types of samplings, Steps in Sampling design, Data collection methods, Sampling and non-response errors, measurement in research, sources of errors in measurement, Techniques of developing measurement tools, Scaling, Meaning of scaling. (15 L)

Types of data, Real data and simulation data, Different simulation techniques, Different statistical data analysis methods, Applications of different computer programming languages such as R, Python for analysing data. (15 L)

Report writing and interpretations, Different steps in Report writing, Techniques of interpretations, Different style of References, Report writing using MS Word and Latex. (25 L)

Reference Books

- Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2nd Revised Edition reprint, New Age International Publishers.
- Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.

Course Outcome: The following are the course outcomes of the major course PG2STAT1011 (Advance Research Methodology):

1. Students will be able for formulating research problems or research hypotheses in every field of studies such as social science, natural science and medical science etc.
2. Students can make a structure of a research report based on the knowledge of research methodology.
3. They can be able to write a research report based on the knowledge of the subjects and this research methodology course.

Course Code:PG2STAT1012 Credit: 6 Full Marks: 75

Optimization Techniques

Course Objective: The following are the basic course objectives of the major course PG2STAT1012 (Optimization Techniques) :

1. It introduces some basic mathematical optimization formulation techniques, which can be applied in the different real fields such as industry, laboratory experiments, marketing etc.
2. It focuses on the applications of different optimization real problems in industry, marketing, laboratory experiments etc.

3. It helps the students in applying optimization techniques in the different real-life problems such as marketing, agriculture experiments, production process etc.

Theory **Credit: 5 Full Marks: 40**

Mathematical Programming Problems, formulation of Linear Programming problems, convex sets, hyper planes, development of simplex algorithms, artificial variable techniques. (10L)

Duality and its economic interpretations, primal dual algorithms, dual simplex algorithms. (10L)

Transportation problem and Assignment Problem. (10L)

Non-linear programming: Lagrange multiplier technique and Kuhn – Tucker conditions, Quadratic programming. (10L)

Derivative based problem: Newton-Raphson, Quasi-Newton method, Fisher's scoring, EM algorithm and its application, basic idea of convex optimization. (15L)

Reference Books

- H. A. Taha: Operational Research
- D. T. Phillips, A. Ravindran and J. Solberg: Operations Research: Principle and Practice
- G. Hadley: Linear Programming
- G. Hadley: Non-linear and Dynamic Programming
- K. Lange: Optimization.

Optimization Techniques (Lab)

Practical **Credit: 1 (30 Hours)** **Full Marks: 20**

List of Practical

1. Problems on formulation of Linear Programming
2. Problems on simplex algorithms
3. Problems on Dual problem
4. Problems on Transportation
5. Problems on Assignment
6. MLE estimation using Newton-Raphson, Fisher's scoring and Quasi-Newton method

7. EM Algorithm (Mixture of Normal distributions)

Course Outcome: The following are the course outcomes of the major course PG2STAT1012 (Optimization Techniques):

1. Students will be able for applying different optimization techniques in the real fields such as marketing, agriculture experiments, production process etc. They can use the optimization techniques in quality engineering, industrial experiments etc.
2. Students can use the optimization techniques in their real life and real society.
3. They can be able to solve many difficult real problems based on the optimization techniques.

Course Code: PG2STAT1013 Credit: 6 Full Marks: 75

Exploratory Data Analysis

Course Objective: The following are the basic course objectives of the major course PG2STAT1013 (Exploratory Data Analysis):

1. It introduces some basic theoretical concepts of real statistical data analysis to the students.
2. It focuses on the principal steps of real data analysis.
3. It introduces the students to handling real data analysis, managing data, and extracting the inner information of the data sets.

Theory **Credit: 5 Full Marks: 40**

Graphical presentation of data: Bar/ multi-bar plot, line/multi-line diagram, pie/divided bar plot, box plot, steam and leaf display, violin plot, step diagram, histogram, Ogive and scatter plot. (10L)

Empirical distribution function, Glivenko-Cantelli Lemma (Statement only), Distribution function estimation. (15L)

Regression Diagnostics (Theoretical & Graphical methods): Extreme value / Outlier detection, checking for heteroscedasticity and autocorrelation, multicollinearity, tests for normality of errors. (20L)

Categorical Response Data: Nominal/ Ordinal Distinction, Probability Distributions for Categorical Data-Binomial & Multinomial Distributions. (10L)

Inference for a proportion: Wald, Score, and Likelihood-Ratio Inference for Binomial Parameter. (10L)

Contingency Tables: Probability Structure for Contingency Tables: Joint, Marginal, and Conditional Probabilities, Relative risk and odds ratio-properties. Measures of association and tests for independence in contingency tables: Nominal-Nominal, Ordinal– Ordinal and Nominal–Ordinal Tables. Exact Inference for Small Samples-Fisher's Exact Test for 2 × 2 Tables. (10L)

Association in more than two-way classified data: Partial association, Conditional Versus Marginal Associations- Simpson's Paradox, Conditional and Marginal Odds, log-odds ratio and its distribution, Independence-Conditional Versus Marginal. (9L)

Reference Books

- A. Agresti: Categorical Data Analysis.
- C. R. Bilder and T. M. Loughin: Analysis of categorical data with R.
- R. A. Johnson & D. W. Wichern: Applied Multivariate Statistical Analysis.
- Weisberg, S.: Applied linear regression.

Exploratory Data Analysis (Lab)

Practical **Credit: 1(30 Hours) Full Marks: 20**

List of Practical

1. Problems on multicollinearity, autocorrelation, heteroscedasticity and normality.
2. Problems on empirical distribution functions.
3. Problems on categorical data analysis.

Course Outcome: The following are the course outcomes of the major course PG2STAT1013 (Exploratory Data Analysis):

1. Students will be able for applying different statistical data analysis techniques to collecting inner information of a data set.
2. Students can manage and analyze any kind of real data in our real life.
3. They can be able to write a report based on a real data set. Based on the real data analysis, they can interpret many facts in the real society. These data analysis practice make them as a data scientist or a data managing project expert.

Course Code:PG2STAT1014 Credit: 6 Full Marks: 75

Multivariate Techniques

Course Objective: The following are the basic course objectives of the major course PG2STAT1014 (Multivariate Techniques):

1. It introduces some basic theoretical concepts and applications of several multivariate techniques to the students.
2. It focuses on the applications of basic multivariate techniques to the different real situations of daily life and our different activities in the society.
3. It introduces the students to handling multivariate variables similarly as univariate variables.

Theory **Credit: 5 Full Marks: 40**

Multivariate Data: multiple regression, multiple and partial correlation coefficients. (10L)

Random Vector: Probability mass/density functions, Distribution function, mean vector& Dispersion matrix, Marginal & Conditional distributions. Multiple and partial correlation coefficient. (22L)

Multivariate normal distribution and its properties, MLEs of parameters, Distribution of QF under normality, Cochran's theorem, Multivariate testing using union-intersection principle (testing of mean only). (25L)

Applications of Multivariate Analysis: Principal Components Analysis and Factor Analysis (Applications oriented discussions only, derivations are not required), Classification problem using Mahalanobis distance, Cluster analysis (K-means clustering and Hierarchical clustering). (20L)

Reference Books

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I, 8thEdn. The World Press, Kolkata
- Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis, 3rd Edn., John Wiley
- Johnson, R.A. And Wichern, D.W. (2007): Applied Multivariate Analysis, 6th Edn., Pearson & Prentice Hall
- Kshirsagar, A.M. (1972): Multivariate Analysis, 1st Edn. Marcel Dekker.

- Hardle. W.K, Simar, L and Fengler, M.R. (2024): Applied Multivariate Statistical Analysis.

Multivariate Techniques (Lab)

Practical **Credit: 1 (30 Hours) Full Marks: 20**

List of Practical

1. Test for Multiple Correlation.
2. Test for Partial Correlation.
3. Multiple Regression.
4. Principal Components Analysis.
5. Factor Analysis.
6. Cluster Analysis.
7. Classification problem.

Course Outcome: The following are the course outcomes of the major course PG2STAT1014 (Multivariate Techniques):

1. Students will be acquainted with the multivariate theoretical concepts and applications in the different fields of the subject Statistics such as real data analysis, data modeling and interpretations etc.
2. Students will be able to apply different multivariate techniques in the different real-life activities, different problems in Medical Science, Psychology, Social science etc.
3. They can interpret different real unknown situations based on multivariate theory and techniques.

(MINOR)

Course Code:PG2STAT1021 Credit: 4 Full Marks: 75

Applied Statistics

Course Objective: The following are the basic course objectives of the major course PG2STAT1021 (Applied Statistics):

1. It introduces some basic theoretical concepts and applications of time series analysis, Index number, industrial statistical quality control and demography to the students.
2. It focuses on the applications of basic business economics, time series analysis, industrial and vital statistics to the different real situations of daily life and our different activities in the society.
3. It introduces the students to handling time series, business economics, quality engineering and vital statistics data analysis.

Theory **Credit: 3 Full Marks: 60**

Economic Time Series: Components of time series, Decomposition of time series-Additive and multiplicative model with their merits and demerits, Illustrations of time series. Measurement of trend by method of free-hand curve, method of semi-averages and method of least squares (linear, quadratic and modified exponential). Measurement of seasonal variations by method of ratio to trend. (10L)

Index numbers: Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number & wholesale price index number. Index of Industrial Production and rate of inflation. Uses and limitations of index numbers. (12L)

Measures of Inequality and Development: Gini's coefficient and Lorenz curve, Human Development Index. (12L)

Statistical Quality Control: Importance of statistical methods in industrial research and practice. Determination of tolerance limits. Causes of variations in quality: chance and assignable. General theory of control charts, process &product control, Control charts for variables: X- bar and R- charts. Control charts for attributes: p and c-charts. (10L)

Demographic Methods: Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates. (8L)

Life (mortality) tables: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR. (8L)

Reference Books

- Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta
- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9thEdition World Press, Kolkata.
- Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4th Edition (Reprint), Sultan Chand & Sons
- Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition Wiley India Pvt. Ltd.

Applied Statistics (Lab)

Practical **Credit: 1(30 Hours) Full Marks: 20**

List of Practical

1. Measurement of trend: Fitting of linear, quadratic trend, exponential curve and plotting of trend values and comparing with given data graphically.
2. Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.
3. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation.
4. Construction of Consumer and wholesale price index numbers, fixed base index number and consumer price index number with interpretation.
5. Gini's coefficient, Lorenz curve, Human Development Index.
6. Construction and interpretation of X bar & R-chart.
7. Construction and interpretation p-chart (fixed sample size) and c-chart.
8. Computation of measures of mortality.
9. Completion of life table.
10. Computation of measures of fertility and population growth.

Course Outcome: The following are the course outcomes of the major course

PG2STAT1021 (Applied Statistics):

1. Students will be acquainted with some basic theoretical concepts and applications of time series analysis, Index number, industrial statistical quality control and demography, and they will be able to analyze real business economics, vital, quality engineering and time series data analysis and interpretations etc.
2. Students will be able to apply these topics in the different real-life activities such as in social science, business economics, rate of vital events, and the product & process quality.
3. They can forecast different time related social events, social trends, lifestyle measure, different vital events and product & process quality.

Semester – II

Course Code: PG2STAT2011 Credit: 6 Full Marks: 75

Reliability Theory and Survival Analysis

Course Objective: The following are the basic course objectives of the major course PG2STAT2011 (Reliability Theory and Survival Analysis):

1. It introduces some basic theoretical and application concepts of Survival analysis and Reliability Theory to the students.
2. It focuses on the applications of basic Survival analysis and Reliability Theory to the different real daily life situations and our different social activities.
3. It introduces the students to handling survival and reliability data sets, and understanding their nature.

Theory **Credit: 5 Full Marks: 40**

Reliability Theory: Reliability concepts and measures, parallel and series systems. (5L)

Lifetime distributions, reliability function, hazard rate, means remaining life, common lifetime distributions. (9L)

Lifetime testing experiments involving exponential and Weibull distributions (both complete and censored cases), Estimation and confidence interval for reliability, Two models: proportional hazard and the location-scale models for exponential and Weibull distributions. (10L)

Survival Analysis: Survival Analysis: Functions of survival times, survival distributions and their applications- exponential, gamma, Weibull, Rayleigh, lognormal distributions, and distribution having bath-tub shaped hazard function. Mean Residual Time. (15L)

Censoring Schemes: Type I, Type II and progressive or random censoring with biological examples. Estimation of mean survival time and variance of the estimator for Type I and Type II censored data with numerical examples. (20L)

Non-parametric methods: Actuarial and Kaplan-Meier methods for estimating survival function and variance of the Estimator, log-rank test. (15L)

Competing Risk Theory (Basic Idea with real life examples). (5L)

Reference Books

- CLee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival data Analysis, 3rdEdition, John Wiley and Sons.
- Kleinbaum, D.G. (1996): Survival Analysis: A self-learning text, Springer.
- Chiang, C.L. (1968): Introduction to Stochastic Processes in Bio Statistics, John Wiley and Sons.
- Indrayan, A. (2008): Medical Biostatistics, 2nd Edition Chapman and Hall/CRC.
- R. E. Barlow and F. Proschan: Statistical Theory of Reliability and Life Testing
- J. F. Lawless: Statistical Models and Methods for Lifetime Data.

Theory of Reliability and Survival (Lab)

Practical **Credit: 1 (30 Hours)** **Full Marks: 20**

List of Practical

1. To estimate survival function.
2. To determine death density function and hazard function.
3. To identify type of censoring and to estimate survival time for type I censored data.
4. To identify type of censoring and to estimate survival time for type II censored data.
5. To identify type of censoring and to estimate survival time for progressively type I censored data.
6. Estimation of mean survival time and variance of the estimator for type I censored data.
7. Estimation of mean survival time and variance of the estimator for type II censored data.

8. Estimation of mean survival time and variance of the estimator for progressively type I censored data.
9. To estimate the survival function and variance of the estimator using Non-parametric methods with Actuarial methods.
10. To estimate the survival function and variance of the estimator using Non-parametric methods with Kaplan-Meier method.
11. Comparing survival functions using log-rank test.

Course Outcome: The following are the course outcomes of the major course PG2STAT2011 (Reliability Theory and Survival analysis):

1. Students will be acquainted with the survival analysis and reliability theory and their applications.
2. Students will be able to developing survival data models, and extracting the inner information from a survival data set. Similarly, they will be able to handle reliability data sets.
3. They can interpret different survival and reliability problems based on the respective data analysis.

Course Code: PG2STAT2012 Credit: 4 Full Marks: 75

Advance Inference

Course Objective: The following are the basic course objectives of the major course PG2STAT2012 (Advance Inference):

1. It introduces some advanced level theoretical and application concepts of Inference theory.
2. It focuses on the applications of advanced levels of inference problems in the different daily life situations.
3. It introduces the students to interpreting several unknown real problems in daily life.

Theory **Credit: 3 Full Marks: 40**

Families of distributions with monotone likelihood ratio (MLR) property and application in testing problems. (10L)

Ancillary statistics, Basu's theorem and its applications. (8L)

Exponential family of distributions and its roles in inference. (5L)

Analysis of random effect models (univariate case). (7L)

Bayesian Inference–Choice of priors, estimation, testing, interval estimation and prediction for some common models and common priors, Idea of credible interval. (8L)

Sequential procedures, Wald's SPRT and its properties, fundamental identity, OC and ASN functions, optimality of SPRT. (7L)

Reference Books

- J. O. Berger: Statistical Decision Theory and Bayesian Analysis
- C. P. Robert: The Bayesian Choice
- E. L. Lehman: Testing of Statistical Hypotheses
- T. S. Ferguson: Mathematical Statistics
- D. A. S. Fraser: Nonparametric methods in Statistics
- B. K. Ghosh: Sequential Tests of Statistical Hypotheses

Advance Inference (Lab)

Practical **Credit: 1(30 Hours)** **Full Marks: 20**

List of Practical

1. Problems on Bayesian Inference.
2. Problems on SPRT.
3. Testing problems using MLR.

Course Outcome: The following are the course outcomes of the major course PG2STAT2012 (Advance Inference):

1. Students will be acquainted with the advanced levels of testing of hypothesis and estimation problems.
2. Students will be enabled to testing and estimating different real complicated problems based on the knowledge of the current course Advance Inference.
3. They can interpret different daily life complex problems and several scientific hypotheses.

Course Code: PG2STAT2013 Credit: 4 Full Marks: 75

Operations Research

Course Objective: The following are the basic course objectives of the major course PG2STAT2013 (Operations Research):

1. It introduces some basic problems of Operations Research for different optimization techniques, which can be applied in the different real fields such as industry, laboratory experiments, marketing etc.
2. It focuses on the applications of Operations Research in the different optimization real problems in industry, marketing, laboratory experiments etc.
3. It helps the students in applying Operations Research techniques in the different real-life problems such as marketing, industry, production process and solving many unknown problems etc.

Theory **Credit: 3 Full Marks: 40**

Definition and scope of OR, models and their solutions, decision making under certainty, uncertainty, risk and competition. (10L)

Game Theory: Games in normal form; pure and mixed strategies; solution of 2X2, mX2, 2Xn and mXn zero sum games by dominance principles and graphical method; LP formulation of matrix games; fundamental theorem of matrix game. (10L)

Analytical structure of inventory problems, EOQ formula of Harris and Wilson and its sensitivity analysis, extension of EOQ formula allowing quantity discounts and shortages, models with random demand, static risk models, ABC analysis. (10L)

Replacement problems, short term and long-term deterministic strategies, stochastic replacement strategies, block, age and random replacement policies, staffing problem, Travelling salesman problem. (10L)

Queuing models-specifications and effectiveness measure, M/M/1and M/M/C queues and their steady state solutions, waiting time distribution for M/M/1 queue. (5L)

Reference Books

- H. A. Taha: Operational Research
- D. T. Phillips, A. Ravindran and J. Solberg: Operations Research: Principle and Practice

- C. Gross and C. M. Harris: Fundamentals of Queuing Theory

Operation Research (Lab)

Practical **Credit: 1(30 Hours)** **Full Marks: 20**

List of Practical

1. Problems on Game Theory
2. Problems on the Inventory Problem
3. Problems on Replacement Theory
4. Problems on Queuing Theory

Course Outcomes: The following are the course outcomes of the major course PG2STAT2013 (Operations Research):

1. Students will be able for applying the knowledge of Operations Research in the different real field optimization techniques in the real fields such as marketing, agriculture experiments, production process etc. They can use the optimization techniques in quality engineering, industrial experiments etc.
2. Students can use the optimization techniques in their real life and real society.
3. They can be able to solve many difficult real problems based on the optimization techniques.

Course Code:PG2STAT2014 Credit: 4 Full Marks: 75

Advance Data Analysis

Course Objective: The following are the basic course objectives of the major course PG2STAT2014 (Advance Data Analysis):

1. It introduces some basic theoretical concepts of real statistical data analysis to the students.
2. It focuses on the principal steps of real data analysis.
3. It introduces the students to handling real data analysis, managing data, and extracting the inner information of a data set.

Theory **Credit: 3 Full Marks: 40**

Generalized linear models, analysis of binary and group data by using logistic models, loglinear models; discrete data analysis using Poisson regression. Nonparametric regression: Kernel Regression, K-NN, Spline regression. (10L)

Splitting the dataset (Concept of Test and Train data), Cross-validation. Bias and Variance Tradeoff. Applications in different non-parametric regression methods. (9L)

Missing data: Inference for data with missing values. Different types of missing data mechanism. MLE using E-M algorithms. Various imputation techniques (single and multiple imputation). (9L)

Resampling techniques: Introduction to Jack knife and Bootstrap–methods for estimating bias and standard error based i.i.d. random variables. Standard examples. (10L)

Statistical learning: fundamental ideas of supervised and unsupervised learning. (7L)

Reference Books

- R. J. A Little, & D. B. Rubin: Statistical analysis with missing data.
- B. Efron& R. J. Tibshirani: An introduction to the bootstrap.
- J. Shao, & D. Tu.: The jackknife and bootstrap.
- T. Hastie, R. Tibshirani, & J. Friedman.: Elements of statistical learning: Data mining,inference& prediction.
- G. James, D. Witten, T Hastie, & R. Tibshirani.: An introduction to statistical learning withapplications in R.
- D. Ruppert, M.P. Wand and R. J. Carroll: Semiparametric Regression.

Advance Data Analysis (Lab)

Practical **Credit: 1 (30 hours) Full Marks: 20**

List of Practical

1. Problems on EM algorithm
2.Problems Non-parametric regression
3. Application of Cross-Validation technique.
4. Problems on resampling methods.

Course Outcome: The following are the course outcomes of the major course

PG2STAT2014 (Advance Data Analysis):

1. Students will be able for applying different statistical data analysis techniques for collecting inner information of a data set.
2. Students can manage and analyze any kind of real data in our real life.
3. They can be able to write a report based on a real data set. Based on the real data analysis, they can interpret many facts in the real society. These data analysis practice make them as a data scientist or a data managing project expert.

(MINOR)

Course Code: PG2STAT2021 Credit: 4 Full Marks: 75

Monte Carlo Method

Course Objective: The following are the basic course objectives of the major course PG2STAT2021 (Monte Carlo Method):

1. It introduces some basic computer applications such as generating random numbers & different probability distributions, simulations of some probability distributions etc.
2. It focuses on the basic computer applications in different areas of statistics such as probability distributions, random number generations, simulations etc.
3. It helps the students in applying computer knowledge for studying many theoretical concepts using simulation study.

Theory **Credit: 3** **Full Marks: 60**

Using the computer for random number generation. A brief look at some popular approaches. Simulating a coin toss, a die roll and a card shuffle. CDF inversion method. Simulation from standard distributions. Finding probabilities and moments using simulation. (20L)

Monte Carlo integration. Basic idea of importance sampling. MCMC not included. (10L)

Generating from Binomial and Poisson distributions, and comparing the histograms to the PMFs. Generating from Uniform (0,1) distribution, and applying inverse CDF

transforms. Simulating Gaussian distribution using Box-Muller method. Approximating the expectation of a given function of a random variable using simulation. Graphical demonstration of the Law of Large Numbers. Approximating the value of pi by simulating dart throwing. (25L)

Reference Books

- Shonkwiler, Ronald W. and Mendivil, Franklin (2009): Explorations in Monte Carlo Methods (Undergraduate Texts in Mathematics)
- Carsey, Thomas M. and Harden, Jeffrey J. (2014): Monte Carlo Simulation and Resampling Methods for Social Science.

Monte Carlo Method (Lab)

Practical **Credit: 1(30 Hours) Full Marks: 20**

List of Practical

1. Basic idea about C/C++ and R programming
2. Using R and C/C++ verify different Monte Carlo techniques (simulation-based approach).

Course Outcome: The following are the course outcomes of the major course PG2STAT2021 (Monte Carlo Method):

1. Students will be able to apply computer knowledge for studying some theoretical concepts such as generating random numbers & different probability distributions, simulations of some probability distributions etc.
2. Students can use computer applications in different areas of statistics such as probability distributions, random number generations, simulations etc.
3. They can be able to explain many theoretical concepts using simulation study.