



Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjhunwala College
of Arts, Science & Commerce
(Empowered Autonomous College)

Affiliated to
UNIVERSITY OF MUMBAI

Syllabus for the M.Sc.
Program: M.Sc. STATISTICS
Program Code: RJSPSTA
National Education Policy (NEP 2020)
Level 6
(CBCS 2025-2026)

(Choice Based Credit System with effect from the academic year 2025– 2026 for Part I)**Syllabus for Approval**

Sr. No.	Heading	Particulars
1	Title of course	M.Sc. in Statistics
2	Eligibility for admission	A candidate for being eligible for admission to the M.Sc. degree course in Statistics must have passed The B.Sc. (Three Year Integrated course) degree examination of this University (or any other University recognized as equivalent there to) with at least Seven Units in Statistics (i.e. the minimum required for majoring in the subject). OR With Three Units in Statistics at T.Y.B.Sc. in combination with Three Units of Mathematics at the T.Y.B.Sc. students will be admitted to the M.Sc. degree course in Statistics on the basis of marks obtained at the T.Y.B.Sc. examination.
3	Passing Marks	40%
4	No. of Years, Semesters	2 Years, 4 Semesters
5	Level	Post Graduate
6	Pattern	Semester
7	Status	Introduced
8	To be implemented from Academic Year	Part I: 2025 – 2026, Part II: 2026 – 2027

Why Statistics?

In real life a lot of information is available. One tries to use it for the betterment of the future. It can be done by presenting data systematically, analysing it and concluding in an appropriate manner. Statistics is a field of science that allows us to learn from the past data. It allows us to make the appropriate decisions and also to make near accurate predictions. Statistics involves a special way of thinking that can be used for data presentation, analysis and its interpretation. Statistics are not just numbers and facts. It provides tools for making decisions when conditions of uncertainty prevail. Hence Statistical tools and techniques are used in almost all fields which are indispensable for people working in fields like agriculture, business, management, economics, finance, insurance, education, biotechnology and medical science, etc. For the last two decades, large amounts of data has been handled with the help of computers and more sophisticated statistical techniques can be used in an effective manner to draw valid conclusions. Knowledge of different aspects of Statistics has become crucial in the present scenario. There is a continuous demand for statisticians in fields of education, industry, software and research. The syllabi of the three-year B.Sc. degree course in Statistics are framed in such a way that the students at the end of the course can be thorough in statistical techniques for pursuing higher studies and simultaneously can apply statistical tools judiciously to a variety of data sets to arrive at some valid conclusions.

M. Sc Statistics Syllabus Semester I & II

Credit Structure for M Sc. Semester I as per NEP 2020 to be Implemented from the academic year 2025-2026

Semester I

Course Code	Course Name	Group	Teaching Scheme (Hrs/Week)		Credits
			Lectures	Practical	
RJSPSTA101	Probability Theory	DSC-1	3	-	3
RJSPSTA102	Distribution Theory and Its Applications	DSC-2	3	-	3
RJSPSTA103	Linear models and Regression Analysis	DSC-3	3	-	3
RJSPSTA104	R software for data analysis	DSC-4	2	-	2
RJSPSTAP101	Statistical Computing I (Practical based on Paper I, II and III in relevant software)	SC-1		6	3
RJSPSTAE101	Professional Elective-I(Sampling Theory)	PE-1	4	-	4
RJSPSTAE102	Professional Elective-II (Econometrics)	PE-2			
RJSPSTARM101	Research Methodology	RP	4		4
	Total		19	6	22

M. Sc Statistics Syllabus Semester I & II**Syllabus to be implemented from AY 2025-26****COURSE OUTCOMES (COs) M. Sc. Statistics**

SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	PROBABILITY THEORY
COURSE CODE	:	RJSPSTA101
CREDITS	:	03
DURATION	:	45 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand and explain the fundamental principles of probability and its axiomatic foundations.
2	Students will be able to analyze and derive properties of random variables and probability distributions.
3	Students will be able to understand convergence concepts (in probability, distribution, etc.) and their implications.
4	Students will be able to use advanced probability tools like conditional expectation and independence of events.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Demonstrate a rigorous understanding of the axioms of probability and the mathematical framework behind random experiments.	1, 3	Understand
CO2	Apply the laws of large numbers and central limit theorem to analyze sample behavior.	1	Apply and analyze
CO3	Apply limit theorems and convergence concepts in theoretical and applied contexts.	1,4	Analyze and Evaluate
CO4	Utilize tools like conditional probability and independence in complex multi-variable scenarios.	3	Apply, Analyze and Evaluate

M. Sc Statistics Syllabus Semester I & II**SEMESTER I**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTA101	Probability Theory	DSC	Lectures	Practical	
			3	-	3

Unit	Topic	Lectures
I	Sequence : Sequence of sets, limsup and liminf of a sequence of sets, Convergence of sequence, Divergence of sequence, Cauchy Principle, Monotone sequence, different types of sequence. Series: Infinite Series, Different types of series and their convergence, radius of convergence.	15
II	Classes of sets, fields, sigma-fields, minimal sigma-field, Borel sigma -field in R^k , sequence of sets and their limits. Measure, Probability measure and its properties.	15
III	Random Variable, Convergence of sequence of random variable, Convergence in distribution, convergence in probability, almost sure convergence, Convergence in rth mean. Law of large numbers: weak, strong. Central limit theorem: Lindberg's central limit theorem, Liapounov's central limit theorem.	15

Reference

1. Athreya K B and Lahiri S N (2005): Measure Theory, Hindustan Book Agency.
2. Tucker, H.G. (1967): A Graduate course in Probability, Academic Press.
3. Billingsley, P. (1968): Measure, Integration and Probability, McGraw Hill.
4. Chow, Y.S. and Teicher, H. (1979): Probability Theory, Springer.
5. Loeve, M. (1985). Probability Theory, 3rd edition, Springer..
6. Resnick S.I. (2001): A Probability Path, Birkhauser.
7. Basu A K. and A Bandopadhyay (2012): Measure Theory and Probability, PHI Learning Pvt. Ltd.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	DISTRIBUTION THEORY AND ITS APPLICATION
COURSE CODE	:	RJSPSTA102
CREDITS	:	03
DURATION	:	45 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the fundamentals of probability distributions (discrete and continuous).
2	Students will be able to apply distribution theory to model real-world phenomena in areas like finance, biology, and engineering.
3	Students will be able to calculate and interpret the moments, characteristics functions, and other related measures for different distributions.
4	Students will be able to derive and analyze various types of distributions and their properties.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Identify and define different probability distributions, both discrete and continuous, along with their properties.	1	Remember and Understand
CO2	Compute and analyze the moments, skewness, kurtosis, and other important measures of various distributions.	1,2	Apply and Analyze
CO3	Solve real-world problems using distributions (e.g., normal, binomial, Poisson, exponential) in applied contexts such as reliability analysis and financial modeling.	1,3	Analyze and Evaluate
CO3	Demonstrate the application of limit theorems in statistical inference and probability modeling.	6	Apply and Analyze

SEMESTER I

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTA102	Distribution theory and Its Application	DSC	Lectures	Practical	
			3	-	3

Unit	Topic	Lectures
I	Concept of random variable, Expectation, moments, moment generating function, characteristic function, Distribution function, decomposition of distribution function (Jordan's decomposition). Markov's, Chebychev's and Kolmogorov's inequalities, Jensen, Liapounov, holder's and Minkowsky's inequalities.	15
II	Bivariate random variable, joint and marginal probability distributions, joint distribution function, conditional distribution and independence, Bivariate transformation, variance and covariance matrix, conditional expectation and variance. Multiple and partial correlation coefficient. Multiple and partial correlation coefficients, multiple linear regression, inter relationship among partial and multiple correlation and regression coefficients	15
III	Some special statistical univariate discrete distributions: degenerate distribution, two-point distribution, discrete uniform distribution, hypergeometric distribution, negative hypergeometric distribution, negative binomial distribution. Special properties of binomial distribution, Poisson distribution, geometric distribution. Compound distributions. Some special statistical bivariate distributions: negative binomial distribution, hypergeometric distribution, Multinomial distribution. Some special statistical univariate continuous distributions: uniform distribution, gamma distribution, beta distribution, Cauchy distribution, Pareto distribution.	15
References 1. Cassela G. and Berger R. (2002) Statistical Inference (2nd edition), Duxbury Resource Centre. 2. Bhat B.R. (1999): Modern Probability Theory: An introductory test book 3rd edition. New Age International 3. Hogg, R. V., McKean, J. W. and Craig, T. T. (2012). Introduction to Mathematical Statistics, 7th Ed, Pearson Prentice Hall, New Jersey. 4. Rohatgi, V. K. and Saleh, A. K. M. E. (2008) Introduction to Probability and Statistics, paperback, Wiley, New York. 5. Wayne W. Daniel (1990) Applied Nonparametric Statistics (2nd edition) Duxbury Thomas Learning.		

M. Sc Statistics Syllabus Semester I & II**COURSE OUTCOMES (COs) M. Sc. Statistics**

SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	LINEAR MODELS AND REGRESSION ANALYSIS
COURSE CODE	:	RJSPSTA103
CREDITS	:	03
DURATION	:	45 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the theoretical foundations of linear models, including multiple linear regression.
2	Students will be able to derive the estimation methods (e.g., Ordinary Least Squares (OLS)) for parameters in linear models.
3	Students will be able to understand and apply model selection techniques (e.g., stepwise regression).
4	Students will be able to apply linear models and regression techniques to real-world data, including understanding issues like multicollinearity, heteroscedasticity, and autocorrelation.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand and explain the basic concepts of linear regression models, including assumptions and mathematical formulations.	1	Understand
CO2	Estimate the parameters of linear regression models using OLS and interpret the results.	1,3	Apply
CO3	Analyze and assess the goodness of fit of regression models using R-squared, adjusted R-squared, F-statistic, and other diagnostic tools	4	Analyze and Evaluate

M. Sc Statistics Syllabus Semester I & II**SEMESTER I**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		Credits
RJSPSTA103	Linear models and Regression analysis	DSC	Lectures	Practical	
			3	-	3

Unit	Topic	Lectures
I	Linear Algebra - Types of Matrix, Matrix inverses and determinants, Solving systems of equations with matrices, Eigen values and eigenvectors, Orthogonal matrices, Positive definite matrices, Linear transformations, Linear dependence and independence. Linear parametric function and its estimability, Solving linear equations, generalized inverse. Gauss markoff theorem, Interval estimates and test of hypothesis, fundamental theorems on conditional error ss, Test of $\Lambda\beta = d$, generalized least squares.	15
II	Analysis of variance, fixed effect models: i. One-way classification ii. Two-way classification model with and without interaction effect, one observation per cell. Tukey's test for non-additivity. Two-way classification model with and without interaction effect with unequal number of observations per cell.	15
III	Linear regression models, subset selection, Stepwise regression: Forward selection, backward elimination and stepwise. Orthogonal polynomials. Assumptions and box-cox transformations in the Analysis of Variance: q-q plot, use of skewness and kurtosis, Bartlett's test for equality of variances, Levene's test. Ridge regression: Conditioned matrix, need of ridge regression, biased estimator and Mean square error. Bias and MSE of ridge estimator, ridge trace method. Logistic regression: Example, model, MLE of parameters, Iterative procedure to solve likelihood equations, multiple regressors. Multinomial, ordinal, Poisson Analysis of Categorical data: Log linear models, contingency tables.	15

References

1. Kshirsagar A.M.(1983) : A course in Linear Models, 1st edition.
2. Draper N.R & Smith H(1998) : Applied Regression Analysis, 3rd edition, John Wiley and Sons. INC.
3. Song GUI Wang and S.C Chow(1993): Advanced Linear Models, 1st edition, CRC Press.
4. Agresthi (2007): An introduction to categorical data analysis, second edition, John Wiley and Sons. INC.
5. Chatterjee and Haddi (1988): Sensitivity Analysis, , John Wiley and Sons. INC.
6. David W Hosmer and Stanley Lemeshow(2002): Applied Logistic regression, 2nd edition, John Wiley and Sons. INC.
7. Healy M. J. R. (2002): Matrices for Statistics, 2nd edition, Oxford university press .
8. Shantinarayan (2010) : Textbook of Matrices.
9. Cox, D. R. (1989): Analysis of binary data, 2nd edition, Chapman & Hall/CRC.
10. Chaterjee and Price (2012): Regression Analysis by example, 5th edition, John Wiley and Sons.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	R PROGRAMMING FOR DATA ANALYSIS
COURSE CODE	:	RJSPSTA104
CREDITS	:	02
DURATION	:	30 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the basic structure of the R programming language, including syntax, functions, and control structures.
2	Students will be able to develop proficiency in handling data types (vectors, matrices, data frames, lists, factors) and manipulating data in R.
3	Students will be able to create and customize data visualizations using R libraries like ggplot2, plotly, and base R plotting functions.
4	Students will be able to understand and apply data wrangling techniques using dplyr and tidyr for data cleaning and transformation.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand the basic syntax, data types, and control structures in R.	3	Understand
CO2	Manipulate and manage different data structures (e.g., vectors, matrices, data frames, lists) in R.	3,4	Apply and analyze
CO3	Write, debug, and optimize R scripts for statistical analysis, ensuring efficient coding practices.	3,4	Apply and analyze
CO4	Create and customize data visualizations using ggplot2, plotly, and base R plotting functions.	3	Understand and Apply

M. Sc Statistics Syllabus Semester I & II**SEMESTER I**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		Credits
RJSPSTA104	R programming for data analysis	DSC	Lectures	Practical	
			2	-	2

Unit	Topic	Lectures
1	The R project for Statistical Computing, Why R, Introduction & Installation of R, R Basics, Finding Help, Code Editors for R, Exploring RGui, Exploring RStudio, Creating a dataset in R, Basic Mathematical & Arithmetic operations in R, Data input - Entering data from keyboard, Importing data from various data sources	7
2	Data Objects- Data Types & Data Structures (e.g. vectors, lists, Arrays, matrices, data frames), Important built in Packages in R, Working with Packages, Control Statements - if - condition, if - else condition, for loop, nested loops, while loop, repeat and break statement, return statement, next statement Data Visualization in R - Creating bar charts, histogram, scatterplot, boxplot, time series plot using ggplot2 package	8
3	Handling Data in R Workspace, Reading & Importing data from Text files, Excel files, Multiple databases, Exporting Data from R, Manipulating and Processing Data in R, Creating, Accessing and Sorting data frames, Extracting, Combining, Merging, reshaping data frames.	7
4	User defined Functions, Built in functions in R (numeric, character, statistical), Interactive reporting with R markdown, Introduction to tidy verse (group of packages), Introduction to R Shiny.	8
Text Books 1. R for Data Science book by Hadley Wickham. 2. The Book of R by Tilman M. Davies.		

M. Sc Statistics Syllabus Semester I & II**COURSE OUTCOMES (COs) M. Sc. Statistics**

SEMESTER	:	I (Professional Elective-I)
TITLE OF THE SUBJECT/COURSE	:	SAMPLING THEORY
COURSE CODE	:	RJSPSTAE101
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students will be able to Identify and apply various sampling methods, such as simple random sampling, stratified sampling, and systematic sampling.
2	Students will be able to evaluate and use different sampling schemes (e.g., cluster sampling, multistage sampling) for various statistical applications.
3	Students will be able to understand the advanced concepts in sampling theory, including complex sampling designs, non-probability sampling, and sample selection bias.
4	Students will be able to compare different sampling techniques in terms of their efficiency.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand advanced sampling designs such as multistage, stratified, and cluster sampling, and their applications.	1	Understand
CO2	Implement and evaluate multistage sampling, stratified sampling, and cluster sampling in real-world data applications.	1, 3	Apply and analyze
CO3	Apply survey sampling techniques and evaluate their bias, variance, and efficiency in practice.	1	Apply and analyze
CO4	Apply optimal allocation techniques in complex sampling designs, including proportional and optimal allocation for stratified and cluster sampling.	1,3	Understand, Apply and Evaluate

M. Sc Statistics Syllabus Semester I & II**SEMESTER I****Professional Electives - I**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTAE101	Sampling Theory	Professional Elective-I	Lectures	Practical	
			4	-	4

Unit	Topic	Lectures
I	Systematic Sampling: Linear Systematic Sampling and Circular Systematic Sampling. Estimation of Population Mean, its Variance, Variance in terms of intra-sample correlation coefficient. Comparison with SRSWOR. Problem in Estimation of Variance using one systematic sample. Use of interpenetrating sub samples in estimation of variance. Other methods of estimation of variance.	15
II	Ratio and Regression Methods of Estimation and Two-phase Sampling Ratio and Regression Estimation of Population mean/total using SRSWOR. Comparison with Mean per Unit Estimator. Separate and combined ratio and regression estimators in stratified sampling. Mean Square error of Estimators. Unbiased type ratio estimator. . Two phase sampling in stratification.	15
III	Cluster Sampling, Two Stage Sampling and Adaptive Sampling Cluster sampling: For equal and unequal cluster sizes. Estimation of population mean/total, its variance and estimation of variance. Ratio to size estimator, Mean of Unit Means Estimator. Comparison with SRSWOR.. Two Stage Sampling: With and Without Replacement at both the stages. Estimation of Population mean per second stage unit, its variance, estimation of variance. Adaptive Sampling: Adaptive Cluster Sampling, Systematic and strip adaptive cluster sampling. Stratified Adaptive Cluster Sampling.	15
IV	Probability Proportional to size sampling and Network Sampling: Probability proportional to size sampling With Replacement (PPSWR): Hansen-Hurwitz Estimator of population total, its variance and estimator of the variance. Comparison with SRSWR. Cumulative Total Method and Lahiri's method of drawing PPSWR. PPSWOR: Horvitz-Thompson Estimator of Population Total, its variance and estimator of variance. Desraj ordered estimator, its expectation and variance, estimation of variance. Horvitz-Thompson Estimator. Stratification in Network Sampling. Non-sampling Errors: Response and Non-response Errors, Effect of Non-Response in simple random sampling.	15

References

1. Cochran W.G. (2007) sampling Techniques, 3rd Ed., Wiley.
2. P. Mukhopadhyay (2008) Theory and Methods of Survey Sampling, 2nd Ed.

M. Sc Statistics Syllabus Semester I & II

3. Des Raj and Chandok P. (1998) Sampling Theory, Narosa Publication.
4. Singh D. and Chaudhary F.S. (1986) Theory and Analysis of Sample Survey Designs, New Age International Publishers.
5. Sukhatme P.V., Sukhatme B.V., Sukhatme S. and Ashok (1984) Sampling theory of Surveys with Applications, ICAR publication.
6. Bansal A, (2017): Survey Sampling, Narosa.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	I (Professional Elective-II)
TITLE OF THE SUBJECT/COURSE	:	ECONOMETRICS
COURSE CODE	:	RJSPSTAE102
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students will be able to Understand the foundational principles of econometrics, including the role of econometric models in economic theory and analysis.
2	Students will be able to develop proficiency in applying linear regression models (both simple and multiple) and understanding their assumptions.
3	Students will be able to estimate and interpret econometric models using Ordinary Least Squares (OLS).
4	Understand the issues related to heteroscedasticity, autocorrelation, and multicollinearity, and learn methods to correct for these issues.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand the basic principles of econometrics and the role of econometric models in economic analysis.	1,3	Understand
CO2	Apply and interpret linear regression models (simple and multiple) in a variety of economic contexts.	1, 3	Apply and analyze
CO3	Diagnose and remedy common econometric issues such as heteroscedasticity, autocorrelation, and multicollinearity in data analysis.	4	Apply, analyze and evaluate
CO4	Interpret results from panel data models, and understand when to apply each model based on data characteristics.	1,3	Understand and apply

M. Sc Statistics Syllabus Semester I & II**SEMESTER I****Professional Electives - II**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		Credits
RJSPSTAE102	Econometrics	Professional Elective-II	Lectures	Practical	
			4	-	4

Unit	Topic	Lectures
I	Introduction to econometrics. A review of least squares and maximum likelihood estimation methods of parameters in classical linear regression model and their properties. Generalized least squares estimation and prediction, construction of confidence regions and tests of hypotheses. Regression analysis under linear restrictions, restricted least squares estimation method and its properties. Autocorrelation, sources and consequences, Autoregressive process tests for autocorrelation, Durbin Watson test.	15
II	Problem of Multicollinearity, its implications. Source of multicollinearity, tools for handling the problem of multicollinearity. Remedies for multicollinearity. Ridge regression. Heteroskedasticity, consequences and tests for it, estimation procedures under heteroskedastic disturbances, Bartlett's test, Breusch Pagan test and 15 49 Goldfelf Quandt test. Dummy Variable Models.	15
III	Specification Error Analysis, Tests for Structural Change and Stability, Asymptotic theory and regressors. Stein-Rule Estimation. Instrumental variable estimation. Measurement Error Models.	15
IV	Simultaneous equations model, problem of identification, necessary and sufficient condition for the identifiability of parameters in a structural equation, ordinary least squares, indirect least squares, two-stage least squares and limited information maximum likelihood method.	15

References

1. Apte, P.G. (1990): Text book of Econometrics. Tata McGraw Hill.
2. Intrulligator, M.D. (1980): Econometric models - Techniques and Applications, Prentice Hall of India.
3. Kleiber, C. and Zeileis, A. (2008): Applied Econometrics with R, Springer, NY

M. Sc Statistics Syllabus Semester I & II**COURSE OUTCOMES (COs) M. Sc. Statistics**

SEMESTER	:	I (Practical Based on Major Paper-I ,II and III)
TITLE OF THE SUBJECT/COURSE	:	Statistical Computing-I
COURSE CODE	:	RJSPSTAP101
CREDITS	:	03
DURATION	:	90 HOURS

LEARNING OBJECTIVES	
1	Students will be able to solve problems related to probability using statistical software R.
2	Students will be able to solve real life problems using standard probability distribution and Inequalities.
3	Students will be able to perform statistical analysis using linear models and regression analysis.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Analyze various probability distributions and their characteristics using software.	1,3,5	Analyze and Apply
CO2	Estimate and interpret the parameters of different distributions through practical exercises.	1, 3.,4	Analyze and Apply
CO3	Implement regression models (simple and multiple) using real datasets.	1,3,4,6	Analyze and Apply

M. Sc Statistics Syllabus Semester I & II**SEMESTER I**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RSPSTAP101	Statistical Computing-I	Practical	Lectures	Practical	
			-	6	3
List of Practical's: Practical 1: Standard Discrete Distributions Practical 2: Standard Continuous Distribution Practical 3: Distribution Function Practical 4: Different types of Inequality Practical 5: Matrix Theory-I Practical 6: Matrix Theory-II Practical 7: Linear Model Practical 8: ANOVA-I Practical 9: ANOVA-II Practical 10: Linear Regression Practical 11: Ridge Regression					

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	I
TITLE OF THE SUBJECT/COURSE	:	RESEARCH METHODOLOGY
COURSE CODE	:	RJSPSTARM101
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Understand the fundamentals of research methodology, including its principles, types, and approaches
2	Develop the ability to design and plan statistical research studies, focusing on formulating research questions, hypotheses, and objectives.
3	Understand and apply ethical considerations in research, including issues related to informed consent, confidentiality, and data integrity.
4	Develop skills in conducting literature reviews and synthesizing research findings.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand the principles of research methodology and the role of statistics in research design.	6,7	Understand
CO2	Design and plan a statistical research study, including hypothesis formulation, research questions, and study objectives	6	Understand and Apply
CO3	Identify and apply various data collection methods (e.g., surveys, sampling, experimental designs) suitable for different types of research.	6,7	Understand and Apply
CO4	Evaluate the ethical considerations involved in research, including issues of confidentiality, data integrity, and research ethics.	6,7	Understand and Evaluate

M. Sc Statistics Syllabus Semester I & II**SEMESTER I****Research Methodology**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		Credits
RJSPSTARM101	Research Methodology	RM	Lectures	Practical	
			4	-	4

Unit	Topic	Lectures
I	Introduction: research meaning and characteristic, research objectives, Positivism and post-positivist approach to research. Beginning Stages of Research Process: Problem definition, Qualitative research, Quantitative Research, primary and Secondary data research. Business Research: Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues.	15
II	Research Methods and Data Collection: Survey research, communicating with respondents, Observation methods, Descriptive and experimental Research type, Inductive and deductive approach, Action research, research steps. Formulation of research problem: problem selection, literature review, formulation of hypothesis. Variables: dependent, independent and Intervening variables.	15
III	Data collection and sampling: Probability sampling, Non probability sampling, Survey method, contact method, questioner. Selection of project domain: Publication ethics, Tools and evaluation. Selection of tentative project area and process of literature survey – Literature survey components and procedures Basic components of a research paper – procedures and processes, Journal types, Scopus, web of science, Science Citation Index, H-index, Google citations.	15
IV	Research Paper Writing Title selection, paragraph writing, report design, conclusion formation, diagrams and equations, citations, plagiarism, paper format, scopes index journals, predatory journals, digital object identifier/ISBN number and publication, research ethics. Presentation of selected project proposal: Oral presentation. Preparation of a report on the selected project proposal, Attending special invited lectures, practical orientation in searching and collecting literature through library, online tools, presenting a seminar on selected project.	15

References

1. "Business Research Methods", William G. Zikmund, B J Babin, J.C. Carr, Atanu Adhikari, M. griffin, Cengage, 8e, 2016.
2. Professionals, Second Edition, New York: IEEE Press, 2002
3. Handbook of Qualitative Research, Norman K. Denzin, Yvonna S. Lincoln.

M. Sc Statistics Syllabus Semester I & II

Credit Structure for M Sc. Semester I as per NEP 2020 to be Implemented from the academic year 2025-2026.

Semester II

Course Code	Course Name	Group	Teaching Scheme (Hrs/Week)		Credits
			Lectures	Practical	
RJSPSTA201	Estimation Theory	DSC-1	3	-	3
RJSPSTA202	Multivariate Analysis and Its Applications	DSC-2	3	-	3
RJSPSTA203	Design of Experiments	DSC-3	3	-	3
RJSPSTA204	Python Essential	DSC-4	2	-	2
RJSPSTAP201	Statistical Computing II (Practical based on Paper I, II and III in relevant software)	SC-II		6	3
RJSPSTAE201	Professional Elective-I(Stochastic Processes)	PE-1	4	-	4
RJSPSTAE202	Professional Elective-II (Clinical Studies Data Management and Medical Writing)	PE-2			
RJSPSTAOJT201	On Job Training	OJT	4		4
	Total		19	6	22

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Estimation Theory
COURSE CODE	:	RJSPSTA201
CREDITS	:	03
DURATION	:	45 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the foundational concepts of Estimation Theory, including the types of estimators and their properties.
2	Students will be able to derive and apply different point estimators such as Maximum Likelihood Estimators (MLE) and Method of Moments (MM).
3	Students will be able to Understand and apply the properties of estimators, including bias, consistency, efficiency, and sufficiency.
4	Students will be able to learn about the Cramer-Rao Lower Bound (CRLB) and its application in determining the efficiency of estimators.
5	Study Bayesian Estimation methods, including the use of prior distributions and posterior distributions.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand the basic concepts and definitions in Estimation Theory, including different types of estimators (e.g., point estimators, interval estimators).	1,3,5	Understand
CO2	Derive and apply point estimators such as Maximum Likelihood Estimators (MLE) and Method of Moments.	1, 3	Understand and Apply
CO3	Evaluate the properties of estimators such as bias, consistency, efficiency, and sufficiency.	1,3	Apply and Analyze
CO4	Apply the Cramer-Rao Lower Bound (CRLB) to find the efficient estimator and compare the efficiency of different estimators.	1,3,5,6	Apply, Analyze and Evaluate

M. Sc Statistics Syllabus Semester I & II

CO5	Understand and apply Bayesian Estimation techniques, including the use of prior and posterior distributions in parameter estimation.	1,2,3	Understand and Apply
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SEMESTER II

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTA201	Estimation Theory	DSC	Lectures	Practical	
			3	-	3

Unit	Topic	Lectures
I	Data reduction, sufficiency, Neyman factorization theorem, minimal sufficiency, completeness, ancillarity and Basu's theorem. One-parameter exponential family, multi-parameter exponential family and Pitman family. Unbiased estimator, estimability of parametric functions, uniformly minimum variance unbiased estimators, Rao-Blackwell and Lehmann-Scheffe theorems.	15
II	Methods of estimation: Method of moments, method of maximum Likelihood estimation (M.L.E.), properties of M.L.E, Scoring method, Large sample properties of MLE, Newton-Raphson method. Bounds for the variance: Cramer-Rao lower bound, Bhattacharya bound. EM algorithm and its applications: EM algorithm for incomplete data, EM algorithm for mixture models, EM algorithm for missing values.	15
III	General decision problems, loss function, risk function, estimation and testing viewed as general decision problems, minimax decision, Bayes decision, least favorable prior, Bayes estimation under squared error loss, some simple illustrations based on binomial, Poisson, and normal distributions, procedure for obtaining minimax estimators from Bayes estimators. Introduction to Bootstrapping. Jackknife estimator and Gibbs Sampling.	15

References

1. Cassela G. and Berger R. (2002) Statistical Inference (2nd edition), Duxbury Resource Centre.
2. Ulhas Jayram Dixit (2016) Examples in parametric inference with R (1st edition), Springer.
3. A.C. Davison and D.V. Hinkley (2009) Bootstrap Methods and their application, Cambridge University Press.
4. Geoffrey J. McLachlan and Thriyambakam Krishnan (2008). The EM Algorithm and Extension, Wiley.
5. William M. Bolstad (2010). Understanding Computational Bayesian Statistics, Wiley.
6. Hogg, R. V., McKean, J. W. and Craig, T. T. (2012). Introduction to Mathematical Statistics, 7th Ed, Pearson Prentice Hall, New Jersey.
7. Lehmann, E. L. and Casella, G. (1998). Theory of Point Estimation, 2nd Ed, Springer, New York.
8. Rohatgi V.K. : Introduction to Probability and Statistics, paperback, Wiley, New York.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Multivariate Analysis and Its Applications
COURSE CODE	:	RJSPSTA202
CREDITS	:	03
DURATION	:	45 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the key concepts and techniques used in multivariate analysis, including the structure and types of multivariate data.
2	Students will be able to learn to apply various multivariate techniques like Principal Component Analysis (PCA), Factor Analysis (FA), Cluster Analysis.
3	Students will be able to gain proficiency in dimensionality reduction techniques and understand their application in real-world problems.
4	Students will be able to understand the limitations and assumptions of multivariate techniques and their applications in various fields.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Understand the principles and concepts of multivariate analysis, including the types of multivariate data and the need for multivariate techniques.	1,3,5	Remember and Understand
CO2	Apply Principal Component Analysis (PCA) and Factor Analysis (FA) for dimensionality reduction and feature extraction.	1, 3	Understand, Apply and
CO3	Perform Cluster Analysis and interpret the results to group observations based on similarity.	1,3	Apply and Analyze
CO4	Implement multivariate techniques in real-world applications such as market research, health sciences, and psychometrics.	1,2,3	Apply, Analyze and Evaluate

M. Sc Statistics Syllabus Semester I & II**SEMESTER II**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		Credits
RJSPSTA201	Multivariate Analysis and Its Application	DSC	Lectures	Practical	
			3	-	3

Unit	Topic	Lectures
I	Multivariate Data and Multivariate Graphical display, Mean vector, dispersion matrix, Correlation matrix. Multivariate Normal Distribution and Its Properties. Wishart Distribution and its Properties. Hotelling T^2 statistic and its application to test the hypothesis about the mean vector of multivariate normal distribution in case of one and two samples.	15
II	Principal Component Analysis_ Introduction, Method of Extraction of Principal Component, Graphical Representation of Principal Component , Properties of Principal Components, Decision Regarding Number of Principal Components, The Effect of Ignoring Some Components. Factor Analysis- Introduction, The model for factor analysis, Estimation of Factor Loading, Estimation of Factor Loadings from correlation Matrix, Factor extraction, Interpretation of factors, Factor Score, Factor rotation.	15
III	Cluster Analysis- Introduction, Basic Steps of Cluster Analysis, Forming Clusters, and Test regarding Clustering. Discriminant Analysis- Scope of Discriminant analysis, Method of Discrimination, Probability of Misclassification, Test of Discriminant Function. Introduction to Lasso Regression.	15

References

1. K.C. Bhuyan (2005): Multivariate Analysis and Its Application, New Central Book Agency Limited.
2. Johnson Richard A and Wicheren D.W. (1998): Applied Multivariate Statistical Analysis (4th Edition).
3. Giri Narayan C. (1995): Multivariate Statistical Analysis.
4. Parimal Mukhopadhyay (2008): Multivariate Statistical Analysis, World Scientific Publishing Co Pte Ltd.
5. Dillon William R & Goldstein Mathew (1984): Multivariate Analysis: Methods and Applications.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Design of Experiments
COURSE CODE	:	RJSPSTA203
CREDITS	:	03
DURATION	:	45 HOURS

LEARNING OBJECTIVES	
1	Students will be able to learn about the key experimental designs, including completely randomized designs (CRD), randomized block designs (RBD), and factorial designs.
2	Students will be able to understand the concept of randomization, replication, and blocking in experimental design to minimize biases.
3	Students will be able to Formulate and conduct experiments based on one-way, two-way, and multifactorial experimental designs.
4	Students will be able to learn how to design experiments for response surface methodology

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Apply different experimental designs like completely randomized designs (CRD), randomized block designs (RBD), and factorial designs to various experimental scenarios.	1,2,3	Understand and Apply
CO2	Formulate and design experiments based on one-way, two-way, and multifactorial designs considering the experimental objectives.	1, 3,5	Understand, Apply and
CO3	Perform analysis of variance (ANOVA) on experimental data to evaluate the significance of treatment effects and interactions.	1,3,5,6	Apply and Analyze
CO4	Design experiments for response surface methodology (RSM).	1,2	Remember and Apply

M. Sc Statistics Syllabus Semester I & II**SEMESTER II**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTA203	Design of Experiments	DSC	Lectures	Practical	
			3	-	3

Unit	Topic	Lectures
I	Randomized Block design, Latin Square Design , Graeco-Latin Square Design, Balance Incomplete Block Design, C matrix , Statistical analysis of BIBD, Estimation of Parameters, Model adequacy checking.	15
II	Factorial design – An example. The advantage of factorial designs. 2^2 factorial designs. General 2^k factorial experiment. Blocking, Confounding and partial confounding. Experiments with Random Factors Random Effects Models, The Two-Factor Factorial with Random Factors, The Two-Factor Mixed Model. The Two-Stage Nested Design, The Split-Plot Design.	15
III	Response Surface Methods: Introduction to Response Surface Methodology, The Method of Steepest Ascent, Analysis of a Second-Order Response Surface, Experimental Designs for Fitting Response Surfaces.	15
References 1. Montgomery D. C. (2017). Design and analysis of experiments Wiley. 2. Das, M.N. and Giri N. C. (1986): Design and analysis of experiments, New Age International. 3. M.C. Chakrabarti (1963): Mathematica of Design and Analysis of Experiments, Asia Publishing House. 4. Cochran W. G. and Cox G.M. (1959): Experimental Design, Asia publishing House. 5. Fisher R. A. (1935): The Design of Experiments, Olive and Boyd.		

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Python Essentials
COURSE CODE	:	RJSPSTA204
CREDITS	:	02
DURATION	:	30 HOURS

LEARNING OBJECTIVES	
1	Students will be able to develop logical and algorithmic thinking.
2	Students will be able to Understand Python syntax and semantics.
3	Students will be able to apply Python in scientific and data-driven contexts.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Explain the syntax, semantics, and basic structure of Python programming.	1,3	Remember
CO2	Apply control structures, loops, and functions to write Python programs for problem-solving.	1, 3	Understand, Apply and
CO3	Demonstrate the use of Python's built-in data types and data structures (lists, tuples, dictionaries, sets).	1,3	Apply and Analyze
CO4	Implement file handling and perform input/output operations using Python.	1,2	Apply

SEMESTER II

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		Credits
RJSPSTA204	Python Essentials	DSC	Lectures	Practical	
			2	-	2

Unit	Topic	Lectures
I	Introduction of high-level language: Keywords and identifiers, statements & comments, Indentation, python variables, Data Types: Text, Numeric, Sequence, Mapping, Set, Boolean, Binary and None, type conversion, I/O and import, python operators, Namespace. Python Flow Control: If-else, for and while loop, continue and break statement, pass, try catch, Python Functions: Functions and arguments, user defined function, static variables, Built-in function global local functions, recursive functions, Global keywords, Modules and Packages. Python Data Structures: Array, List, Tuple, Set, Dictionary, Bag, stack, Queue Python Object & Class: Introduction of OPPs, class, object, encapsulation, Inheritance, polymorphism, Iterators, operator overloading. Exception handling: difference between Syntax error and exception, try -except statement, finally block, Try with Else clause, raise Keyword,	15
II	Python Files: File formats: csv, tsv, xml and JSON, File handling: read, write, append and delete files. Advance Python Programming Regular Expression, abstract classes, constructors and destructors, decorators and Generators, Magic methods OS Module, Map, Flatmap and Lambda Python Modules Numpy, Pandas, Matplotlib, Seaborn, Bokeh and Beautifulsoup, Streamlit	15

	Data Analysis: Types of Data Analysis: Descriptive and Exploratory Data Analysis, Pandas Series and Dataframe, series/dataframe methods: describe(), show() etc., Pivot Tables, data cleansing: missing data, Outliers Detection, Data Wrangling, report generation and web scraping. Visual Data Analysis: Pyplot, Markers, Line, Labels, Grid, Subplot, Scatter, Bars, boxplot, Pie Chart, Bar Chart, Histogram, Gantt Chart, Heat Map, Box and Whisker Plot, Waterfall Chart, Area Chart, Scatter Plot, Pictogram Chart, Timeline, Highlight Table, Bullet Graph, Choropleth Map, Word Cloud, Network Diagram, Correlation Matrices.	
References 1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755. 2. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014. 3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365. 4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, "Data Structures and Algorithms in Python", 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176. 5. Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978-0199480173 6. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278.		

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II Professional Elective-I
TITLE OF THE SUBJECT/COURSE	:	Stochastic Processes
COURSE CODE	:	RJSPSTAE201
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the foundational concepts of probability theory relevant to stochastic processes.
2	Students will be able to differentiate between deterministic and stochastic systems and recognize the role of randomness in real-world processes.
3	Students will be able to analyze the behavior of stochastic processes over time, including transient and steady-state (stationary) analysis.
4	Students will be able to solve problems involving expected values, variances, transition probabilities, and limiting distributions.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Define and describe key concepts in stochastic processes including Markov chains, Poisson processes, and renewal processes.	1,3,4	Understand
CO2	Apply probability theory to model and solve problems involving discrete and continuous-time stochastic processes.	1, 3,6	Apply
CO3	Analyze the behavior of Markov chains, including classification of states, stationary distributions, and limiting behavior.	1,3,6	Analyze
CO4	Solve real-world problems using Poisson processes and renewal theory.	1,2,6	Apply

M. Sc Statistics Syllabus Semester I & II**SEMESTER II****Professional Electives - I**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTAE201	Stochastic Processes	Professional Elective-I	Lectures	Practical	
			4	-	4

Unit	Topic	Lectures
I	Introduction to stochastic processes (SPs): Classification of SPs according to state space and time domain. Countable state Markov chains (MC's), Chapman-Kolmogorov equations; calculation of n-step transition probability and its limit. Stationary distribution, classification of states; transient MC; random walk and gambler's ruin problem; Applications from social, biological and physical sciences.	15
II	Poisson process, Generalization of Poisson process. Renewal theory and its applications, Distribution of $N(t)$, Limit theorems and their application, Renewal reward processes, Regenerative processes, Computing the renewal function, Applications to patterns and insurance.	15
III	Continuous-time Markov chains, Birth and Death Processes, The transition probability function $P_{ij}(t)$, Limiting probabilities, Time reversibility, The reversed chain, Computing the transition probabilities.	15
IV	Brownian motion and stationary processes, White noise, Gaussian processes. Galton-Watson branching process, probability of ultimate extinction, distribution of population size. Martingale in discrete time.	15

References

1. Ross, S. M. (2014). Introduction to Probability Models, 11th Ed, Academic Press, New York.
2. Medhi, J. (2017). Stochastic Processes, Paperback, 4th Ed, New Age International.
3. Ross S. M. (2011). An elementary Introduction to Mathematical Finance, 3rd Ed, Cambridge University Press, London.
4. Bhat, B. R. (2000). Stochastic Models: Analysis and Applications, New Age International.
5. Cinlar, E. (2013). Introduction to Stochastic Processes, Paperback, Dover Publications Inc.
6. Hoel, P. G., Port, S. C. and Stone, C. J. (1986). Introduction to Stochastic Processes, Waveland Pr Inc.
7. Pinsky, M. A. and Karlin, S. (2010). An Introduction to Stochastic Modeling, 4th Ed, Academic Press.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II Professional Elective-II
TITLE OF THE SUBJECT/COURSE	:	Clinical Studies Data Management and Medical Writing
COURSE CODE	:	RJSPSTAE202
CREDITS	:	04
DURATION	:	60 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand the importance and role of data management and medical writing in clinical trials.
2	Students will be able to gain knowledge of regulatory requirements (ICH-GCP, 21 CFR Part 11, etc.) guiding clinical data management and documentation.
3	Students will be able to learn the tools and techniques for designing, collecting, validating, and managing clinical trial data.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Explain the structure and lifecycle of clinical trials and the function of data management.	1	Understand
CO2	Apply good clinical data management practices to handle data collection, entry, and validation.	1, 3	Understand
CO3	Analyze data quality issues and implement query management and discrepancy resolution.	1,3	Apply and Analyze

M. Sc Statistics Syllabus Semester I & II**SEMESTER II****Professional Electives - II**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTAE202	Clinical Studies Data Management and Medical Writing	Professional Elective-II	Lectures	Practical	
			4	-	4

Unit	Topic	Lectures
I	Biostatistics: Descriptive Statistics - Data Types; Collection; Sampling, Compilation; Tables & Graphs, Measures of Central Tendency, Measures of variation.	15
II	Clinical Data Management: Overview, scope, terminologies; Principles of CDM.	15
III	Clinical Data Management: Data Entry, Queries & Data Clarification, Electronic Data Capture, Software in CDM.	15
IV	Medical Writing: Literature Search & Medical Articles, Contract writing, Publication, Abstracts, Bibliography, Clinical Study Reports.	15

References

1. Prokscha, Susanne. *Practical Guide to Clinical Data Management*, 4th Edition. Routledge, 2021. ISBN: 978-1032495583.
2. Rondel, Richard K., Varley, Sheila A., and Webb, Colin F. *Clinical Data Management*, 2nd Edition. Wiley-Blackwell, 2007.
3. Akhtar, Kamal. *Clinical Data Management: A Beginner's Guide*. Independently published, 2015.

COURSE OUTCOMES (COs) M. Sc. Statistics

SEMESTER	:	II (Practical Based on Major Paper-I ,II and III)
TITLE OF THE SUBJECT/COURSE	:	Statistical Computing-II
COURSE CODE	:	RJSPSTAP201
CREDITS	:	03
DURATION	:	90 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand theoretical concepts of estimation, multivariate statistics, and experimental design through hands-on applications.
2	Students will be able to apply statistical methods in estimation theory to compute and interpret point and interval estimates.
3	Students will be able to perform practical analysis involving multivariate data using techniques like PCA, factor analysis, and discriminant analysis.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Evaluate the performance of estimators using criteria like bias, MSE, and consistency.	1, 2,3,4	Evaluate
CO2	Perform multivariate techniques such as Principal Component Analysis (PCA), clustering, and factor analysis.	1, 2,3,4	Apply
CO3	Design and conduct experiments using appropriate experimental layouts.	1, 2,3,4	Create

M. Sc Statistics Syllabus Semester I & II**SEMESTER II****Practical-II**

Course code	Course name	Group	Teaching Scheme (Hrs/Week)		credits
RJSPSTAPA201	Statistical Computing-II	Practical	Lectures	Practical	
			-	6	3

List of Practical's:

Practical 1: UMVUE

Practical 2: Maximum Likelihood Estimate and EM algorithm

Practical 3: Bayesian Estimation

Practical 4: Bootstrap sampling Method

Practical 5: Multivariate Distribution

Practical 6: Principal Component Analysis

Practical 7: Factor Analysis

Practical 8: Cluster Analysis

Practical 9: Design of Experiment -I

Practical 10: Design of Experiment - II

Practical 11: Factorial Experiment

Practical 12: Response Surface Methodology

M. Sc Statistics Syllabus Semester I & II**COURSE OUTCOMES (COs) M. Sc. Statistics**

SEMESTER	:	II
TITLE OF THE SUBJECT/COURSE	:	On Job Training
COURSE CODE	:	RJSPSTAOJT201
CREDITS	:	04
DURATION	:	120 HOURS

LEARNING OBJECTIVES	
1	Students will be able to understand workplace structure, roles, and responsibilities in a professional.
2	Students will be able to apply academic knowledge to real-world tasks, tools, and problem-solving scenarios.
3	Students will be able to develop communication, teamwork, and interpersonal skills in a multidisciplinary environment.

Course Outcome Number	On completing the course, the student will be able to:	PSO Addressed	Blooms Level
CO1	Describe the organizational structure, workflow, and roles in a real-world industry or clinical setup.	1,2,3,5	Understand
CO2	Apply theoretical knowledge to assigned practical tasks in a professional setting.	1,2,3,5	Apply
CO3	Demonstrate skills in using tools, instruments, or software relevant to the field.	1,2,3,5	Apply

SEMESTER II**On Job Training**

Course Code	Course Name	Group	Teaching Scheme (Hrs/Week)		Credits
			Lectures	Practical	
RJSPSTAOJT201	On Job Training (OJT)	OJT		120	4

M. Sc Statistics Syllabus Semester I & II

OJT will be done in research institutions/ industry/ educational institution/ factories involved in Statistical Analysis related activities.

Minimum duration - 120 hour

Total marks for OJT- 100

OJT and Report writing

Dept. of _____ Course Code _____ Date _____

UID No _____ Roll No _____ Marks _____

/60

Name of student: _____

Title of Assignment: _____

OJT Assessment Grid : Place one tick in each appropriate row. Overall mark should reflect the positions of ticks in the individual rows. In boxes that have more than one set of marks, cancel out the marks that are not applicable and circle the correct marks.

OJT (Parameters)	Marks	80 – 100% Excellent	60 -80% Good	40 – 60% Satisfactory	20 – 40% Average
Work Done at OJT includes attendance	50	40-50 / 50	30-40/ 50	20-30 / 50	10-20/50
Report writing and conclusions	30	24-30 / 30	18-24 /30	12-18 / 30	6-12/30
Presentation Communication	20	16-20/20	12-16/10	8-12/10	4-6/10

M. Sc Statistics Syllabus Semester I & II

Scheme of Examinations

1. Internal Examination 25 marks various modes with different weightage (Presentation, seminar, mcq, quiz etc.)
2. One External (Semester End Examination) of 50 marks. Duration: 2 hours.
3. One Practical at the end of Semester consisting of Practical I 75 marks (based on all three major paper).
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
6. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of M Sc Semester I Statistics as per the minimum requirements.
7. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practical for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.

Paper Pattern for DSC

Q1. Attempt any ONE sub question.

i 10M

ii 10M

Q2. Attempt any ONE sub question.

i 10M

ii 10M

Q3. Attempt any ONE sub question.

i 10M

ii 10M

Q.4. Attempt any FOUR sub questions.

i 5M

ii 5M

iii 5M

iv 5M

v 5M

vi 5M

Paper Pattern for Electives

Q1.			Attempt <u>ANY ONE</u> sub question.	
	A			15M
	B			15M
Q2.			Attempt <u>ANY ONE</u> sub question.	
	A.			15M
	B			15M
Q3.			Attempt <u>ANY ONE</u> sub question.	
	A			15M
	B			15M
Q4.			Attempt <u>ANY ONE</u> sub question.	
	A			15M
	B			15M