M.Sc. BIOSTATISTICS

Syllabus

UNIVERSITY DEPARTMENT

Program Code: BSTA

2024 – 2026 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A++" Grade by NAAC, Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
On successful completion of the **M. Sc., Statistics** program, the graduates will be able to:	
PEO1	Get employment in government, public, private, industrial, health, business, banking, agricultural and educational sectors
PEO2	Expand their knowledge to set their career in research and higher studies
PEO3	Comprehend the statistical concepts and principles for interdisciplinary research
PEO4	Excel in statistical computing
PEO5	Acquire proficiency in adopting statistical software for data analysis
PEO6	Nurture advancement in statistical theory and applications

Program Specific Outcomes (PSOs)	
On successful completion of M. Sc., Statistics program, the students will be expected to:	
PSO1	Comprehend the theoretical aspects of statistics
PSO2	Recognize the application of statistics in diversified fields
PSO3	Develop computer programs and codes for statistical computation
PSO4	Utilize statistical software effectively for data analysis
PSO5	Understand the conditions and limitations of statistical methods in application
PSO6	Critically analyze statistical data and make interpretations

Program Outcomes (POs)	
On successful completion of the **M. Sc., Statistics** program, the graduates will be able to:	
PO1	Possess adequate knowledge in theory and applications
PO2	Adopt conceptual ideas, principles and methods in diversified fields of study
PO3	Utilize analytical skills for basic mathematical computation
PO4	Utilize software skills for statistical computation
PO5	Prepare to participate in competitive examinations at the state and national level
PO6	Acquire skills to meet the challenges in job placements
PO7	Gain impetus to move for learning at higher level
PO8	Gain effective skills to perform data analysis using statistical tools
PO9	Identify potential areas of applications of statistical theory
PO10	Recognize the importance and value of statistical principles and approach for problem solving on a diversified disciplines

BHARATHIAR UNIVERSITY, COIMBATORE 641 046

M. Sc., Biostatistics Curriculum (University Department)

(For the students admitted during the academic year 2024 – 26 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
24BST13A	Probability and Distribution Theory	4	5	-	25	75	100
24BST13B	Sampling Theory and Methods	4	5	-	25	75	100
24BST13C	Epidemiology & Clinical Trials	4	5	-	25	75	100
24BST13EA	Elective I - Health Informatics	4	5	-	25	75	100
24BST1P1	Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/ SYSSTAT – I	4	-	5	40	60	100
Supportive	Offered By other Departments	2	2	-	12	38	50
	Total	**22**					**550**
SECOND SEMESTER							
24BST23A	Statistical Estimation Theory	4	5	-	25	75	100
24BST23B	Survival Analysis	4	5	-	25	75	100
24BST23C	Testing Statistical Hypotheses	4	5	-	25	75	100
24BST23EB	Elective II – Demography and Vital Statistics	4	5	-	25	75	100
24BST2P2	Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/ SYSSTAT – II	4	-	5	40	60	100
Supportive	Offered By other Departments	2	2	-	12	38	50
	Total	**22**					**550**
THIRD SEMESTER							
24BST33A	Applied Multivariate Statistical Analysis	4	5	-	25	75	100
24BST33B	Linear Models and Design of Experiments	4	5	-	25	75	100
24BST33C	Applied Regression Analysis in Health Care	4	5	-	25	75	100
24BST33EC	Elective III – Categorical Data Analysis	4	5	-	25	75	100
24BST2P3	Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/ SYSSTAT – III	4	-	5	40	60	100
24BST3MP	Mini Project	4	-	-	-	-	100
Supportive	Offered By other Departments	2	2	-	12	38	50
	Total	**26**					**650**
FOURTH SEMESTER							
24BST43A	Research Design and Report Writing	4	5	-	25	75	100

24BST4IP	Internship/Project/Dissertation and Viva	**12**		-			300
24BST4SS	Self-Study	4					100
	Total	**20**					**500**
	Grand Total	**90**					**2250**
CO-SCHOLASTIC COURSES							
ONLINE COURSE							
	SWAYAM – MOOC Course	2					50
VALUE ADDED COURSES							
	Course 1	2					50
	Course 2	2					50
CERTIFICATE COURSES							
	Course 1	2					50
	Course 2	2					50

SWAYAM – MOOC – online course shall be for duration at least 4 weeks with at least 2 credits. The course shall be mandatory and shall be completed within third semester (i.e., before the beginning of fourth semester).

Distribution of Marks and Credits

	Subjects									
	Core	**Elective**	**Supportive**	**Self-Study**	**Mini Project**	**Internship/ Project/ Dissertation and Viva**	**Swayam/ MOOC**	**VAC**	**JOC**	**Total**
Credits	52	12	06	04	04	12	02	04	04	**100**
Marks	1300	300	150	100	100	300	50	100	100	**2500**

VAC: Value Added Course **JOC: Job Oriented Course**

VALUE ADDED COURSES

1. Design & Analysis of Clinical Trials
2. Systematic Review and Meta-analysis
3. Basics of Human Genetics and Genomics
4. Elements of Actuarial Statistics

JOB ORIENTED CERTIFICATE COURSES

1. Basics of Six Sigma Tools
2. Data Analysis using STATISTICA

First Semester

Course Code	24BST13A	TITLE OF THE COURSE	L	T	P	C
Core		Probability and Distribution Theory	4	1	-	4
Pre-requisite		Basic Notions of Probability and Distributions	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. The course explores the concepts of modern probability theory and its applications for decision-making in economics, business, and other fields of social sciences.
2. To Study essential properties of probability distributions
3. To Create and apply customized probability distributions

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Deliberate the fundamental concepts of probability and understand the concepts at higher level	K1, K2
2	Extend the concept of probability and study the essential theorems along with its applications	K2, K3
3	Derive the properties of discrete and continuous probability distributions	K1, K5
4	Develop the concept and properties of bivariate probability distributions	K2, K3
5	Customize the probability distributions through truncation, compound and mixture concepts	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction to Probability	12hours

Random variables: Limits of random variables – Probability, probability space, induced probability space and discrete probability space - Properties. Distribution functions. Expectation and Conditional Expectation – Properties – Inequalities: Jensen's, Holder's, Minkowski's, Cauchy – Schwartz's inequalities - Basic Inequality – Chebychev's and Markov's inequalities.

Unit:2	Convergence and Central Limit Theorem	12 hours

Convergence of random variables: Convergence in probability - convergence almost surely - convergence in distribution - Convergence in rth mean - monotone convergence theorem - Central Limit Theorems: Lindeberg – Levy's central limit theorem - Liaponov's central limit theorem - Lindberg – Feller's central limit theorem (Statement only).

Unit:3	Univariate Distributions	12 hours

Bernoulli, Binomial, Poisson, Negative binomial, Hyper-geometric, Uniform, Normal, Exponential, Lognormal, Cauchy, Beta, Gamma, Laplace, Logarithmic, Pareto and Weibull (derivation for mean & variance only)

Unit:4	Bivariate Distributions	12 hours

Bivariate discrete distributions: Binomial, Poisson, Multinomial distribution. (Mean, variance, covariance & correlation and applications of the above distributions). Bivariate Continuous distribution: Bivariate Exponential and Bivariate Normal distribution. (derivation for mean & variance only)

Unit:5	Truncated, Compound and Mixture Distributions	12 hours

Concept of truncated distribution – compound distribution – mixture distribution and their basic properties such as mean and variance (for case of basic distribuitons such as binomial, Poisson, geometric, etc.).

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

Total Lecture Hours	**62 hours**

Books for Study

1	Johnson, N. L.,, Kemp, A.W., Kotz, S., (2005). Univariate Discrete Distributions, John Wiley and Sons (Asia), Singapore.
2	Johnson, N. L., Kotz, S., and Balakrishnan, N. (2004). Continuous Univariate Distributions. Vol. I, John Wiley and Sons (Asia), Singapore.
3	Johnson, N. L., Kotz, S., and Balakrishnan, N. (2014). Continuous Univariate Distributions, Vol. II. John Wiley and Sons (Asia), Singapore.
4	Halmos, P. R. (1978). Measure Theory, (First Edition in 1950), Second Printing, Springer-Verlag, NY.
5	Bhat, B. R. (2009). Modern Probability Theory – An Introductory Text Book, Third Edition (Reprint), New Age International Private Ltd., New Delhi.

Reference Books

1	Johnson, N. L., and Kotz, S. (1972). Distributions in Statistics, Princeton University Press, Princeton
2	Basu, A. K. (2012). Measure Theory and Probability, Prentice Hall India Learning Private Limited, New Delhi.
3	de Barra, G. (2000), Measure Theory and Integration, New Age International Private Ltd., New Delhi
4	Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.
5	Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/104/111104032/
2	https://youtu.be/6x1pL9Yov1k
3	https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB
4	https://www.youtube.com/watch?v=POv_YgCqAv8&list=PLbMVogVj5nJQWowhOG0-K-yI-bwRRmm3C&index=2

Course Designed By: Dr.K.M.Sakthivel and Dr. V. Kaviyarasu

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	M	S	L	L	L
CO2	S	S	S	L	S	M	S	L	L	L
CO3	S	S	S	L	S	M	S	L	L	L
CO4	M	S	S	L	M	M	S	L	L	L
CO5	M	S	S	L	M	M	S	L	L	L

*S-Strong; M-Medium; L-Low

Course Code	24BST13B	TITLE OF THE COURSE	L	T	P	C
Core		Sampling Theory and Methods	4	1	-	4
Pre-requisite		Basics notions of Descriptive Statistics and Sampling	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Impart the significance of theory and applications of sampling
2. Enhance the ability of deriving the properties of methods of drawing samples
3. Comprehend the concepts of sampling for effective application for designing sample surveys

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the importance of sampling and sample surveys	K2
2	Adopt suitable sampling methods for given situations	K2,K3
3	Observe the effectiveness of sample surveys	K1,K4
4	Design and perform sample surveys	K3,K5
5	Draw random samples using various sampling methods and study the properties	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Notions of Sample Survey	12hours

Population and Sample – Census and sample survey – sampling – sampling unit, sampling frame, sampling distribution, standard error, questionnaire and schedule, sampling design – sampling and non-sampling errors – non-response and its effects – sample surveys – principles of sample survey - Principal steps in sample survey - limitations of sampling.

Unit:2	Simple Random Sampling	12 hours

Simple Random Sampling (with and without replacement): Notations and terminology - Estimates of population total, mean and their variances and standard errors – Pooling of estimates - Determination of sample size. Simple random sampling for attributes -

Unit:3	Stratified Random Sampling	12 hours

Stratified random sampling: Estimates of population total, mean and their variances - Related properties – Allocation of sample sizes – Neyman's proportional and optimum allocations - Comparison of stratified sampling with simple random sampling - Estimation of proportion under stratified random sampling.

Unit:4	Systematic and Cluster Sampling	12 hours

Systematic sampling: Estimates of population total, mean, and their variances and standard errors – systematic sampling with linear trend – comparison of systematic sampling with stratified and simple random sampling – circular systematic sampling - Two stage sampling with equal number of second stage units and cluster sampling.

Unit:5	Varying Probability Sampling, Ratio and Regression Estimators	12 hours

Varying Probability Sampling: Probability proportional to size (PPS) sampling (with and without replacement) – Stratified PPS – Selection procedures – Ordered and unordered estimates – Desraj, Horwitz – Thompson and Murthy's estimates. Ratio Estimates – Methods of estimation, Approximate variance of the Ratio Estimate - Regression Estimators – Difference Estimators, Regression Estimators in Stratified Sampling.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books for Study

1	Cochran, W.G. (1977). Sampling Techniques, Third Edition, John Wiley & Sons, NY.
2	Des Raj (1978), Sampling Theory, Tata-McGraw Hill, New Delhi.
4	Lohr, S.L. (2021). Sampling: Design and Analysis (3rd ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9780429298899
5	Singh D., and Chowdhary, F. S. (2018). Theory and Analysis of Sample Survey Design, New Age International Private Ltd., New Delhi.

Reference Books

1	Murthy, M. N. (1967). Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
2	Sampath, S. (2000). Sampling Theory and Methods, Narosa Publishing Company, New Delhi.
3	Sukhatme, P. V., and Sukhatme, B. V. (1984). Sampling Theory of Surveys with Applications, Asia Publishing House, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/104/111104073/
2	https://nptel.ac.in/content/storage2/courses/111104073/Module14/Lecture42.pdf
3	https://www.mooc-list.com/tags/sampling-methods

Course Designed By: Dr. S. Gandhiya Vendhan

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	L	S	S	S	M	M	M
CO2	S	M	M	L	S	S	S	M	M	M
CO3	S	M	M	L	S	S	S	M	M	M
CO4	M	M	M	L	S	S	S	M	M	M
CO5	S	M	M	L	S	S	S	M	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST13C	TITLE OF THE COURSE	L	T	P	C
Core		Epidemiology & Clinical Trials	4	1	-	4
Pre-requisite		Basics of Epidemiology and notions of Clinical Trials	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. To prepare students to understand the various concepts and applications in epidemiology.
2. To demonstrate a basic understanding of epidemiologic methods and study design.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Distinguish the roles and relationships between epidemiology and biostatistics in The prevention of disease and the improvement of health.	K2
2	Obtain concepts, methods, and tools of public health data collection, analysis and Interpretation by using various epidemiological study designs.	K2,K3
3	Observe the effectiveness of mortality and morbidity.	K1,K4
4	Equip the students with the information of concept of protocol in clinical trial Experiment.	K3,K5
5	Demonstrate various terminologies in clinical experiment involving different phases and the ethics, principles and conduct of clinical trial experiments with an overview of Phase I-IV trials. Various clinical trial design commonly employed in practice.	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction to Epidemiology	12 hours

Introduction: Definition and Scope of Epidemiology –Epidemiology measures: Prevalence and incidence rates – cumulative incidence rate or risk – case fatality. Causation and Prevention in Epidemiology: Guidelines for causation –causation pie-Hill's Bradford model. The scope of Prevention – Levels of Prevention- epidemics and endemic investigation, surveillance, screening.

Unit:2	Clinical Epidemiology	12 hours

Clinical Epidemiology: Definition, reliability, validity, sensitivity, specificity, predictive values, Likelihood ratio test, selection and interpretation of diagnostic test, Deciding on the best therapy, ROC curves, multiple and parallel tests.

Unit:3	Types of Epidemiological Studies	12 hours

Observational and experimental studies – Descriptive studies – Ecological studies – Cross-sectional studies – Cohort studies - Random control trials –Field trials and Community trials. Planning an Epidemiological Project (Basic Concepts): Introduction – Choosing a project – Describing the population – Questionnaire Preparation- Analysis and Interpretation of data.

Unit:4	Potential Errors in Epidemiological Studies	12 hours

Random error – Systematic error – Selection bias – Measurement bias – The control of confounding – Validity.

Unit:5	Introduction to Clinical Trials	13 hours

Introduction to Clinical trials – Various types of studies - Ethics - Goals of Clinical Trials - Phases of Clinical Trials -Classification of Clinical Trials - Randomization: Fixed Allocation, Simple, Blocked, Stratified, Baseline Adaptive and Response Adaptive - Blinding: Single, Double and

Triple - Designs for Clinical Trials: Parallel Groups Design, Cluster Randomization Designs, Crossover Designs.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books for Study

1	R Bonita, R Beaglehole. T Kjellström, (2006): Basic Epidemiology 2nd Edition. http://apps.who.int/iris/bitstream/10665/43541/1/9241547073_eng.pdf
2	Dicker, Richard, (2006): Principles of Epidemiology in Public Health Practice, 3rd edition. http://www.cdc.gov/ophss/csels/dsepd/ss1978/ss1978.pdf
3	Altman D G, (2006): Practical Statistics for Medical Research, London: Chapman and Hall, 2nd edition.
4	Leon Gordis M, (2014): Epidemiology, NA Saunders Company, 5th edition.
5	P. Armitage,G. Berry, J.N.S. Matthews, (2002**)** : Statistical Methods in Medical Research, Blackwell Science Ltd.
6	David L Sackett, 1985: Clinical Epidemiology, Little Brown & Co. USA,

Reference Books

1	RC Brownson and DB Petittis (2006): Applied Epidemiology: Theory to Practice. Oxford University Press, 2nd edition.
2	Abhaya Indrayan (2013): Medical Biostatistics, Third Edition
3	Sylvia Wassertheil-Smoller Jordan Smoller (2015): Biostatistics and Epidemiology, Fourth Edition
4	Lawrence. M. Friedman, Curt. D. Furberg, David. L. DeMets (2010): Fundamentals of Clinical Trials, 4th Edition

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/104/111104073/
2	https://nptel.ac.in/content/storage2/courses/111104073/Module14/Lecture42.pdf
3	https://www.mooc-list.com/tags/sampling-methods

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	L	S	S	S	M	M	M
CO2	S	S	M	L	S	S	S	M	M	M
CO3	S	S	M	L	S	S	S	M	M	M
CO4	S	S	M	L	S	S	S	M	M	M
CO5	S	S	M	L	S	S	S	M	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST13EA	TITLE OF THE COURSE	L	T	P	C
Elective		Health Informatics	4	1	-	4
Pre-requisite			Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Learn about the structure and function of healthcare systems, including the roles of various stakeholders such as healthcare providers, patients, insurers, and regulators.
2. Learn how to develop and implement tools that provide clinicians with evidence-based information and recommendations to support clinical decision-making.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Utilize various information technology tools and systems effectively within healthcare environments, including electronic health records (EHRs), health information exchange (HIE), and telemedicine platforms.	K1-K6
2	Collect, store, manage, and analyze healthcare data securely and ethically, adhering to relevant data standards and privacy regulations such as HIPAA.	K1-K6
3	Understanding the design, implementation, and evaluation of health information systems. This involves learning about the software and hardware used in healthcare settings, as well as system interoperability and usability.	K1-K6
4	Apply health informatics principles and tools to improve the quality of care and patient safety, including error reporting systems, adverse event detection, and quality improvement initiatives.	K1-K6
5	Collaborate effectively with healthcare professionals, information technologists, researchers, policymakers, and other stakeholders to address complex healthcare challenges through the use of informatics solutions.	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Challenges of Health informatics	12 hours

Introduction to Health informatics – Reading & Writing patient records – Creation of medical knowledge – Access to medical knowledge

Unit:2	Principles of Health informatics – Part 1	12 hours

Representation – Logic – Clinical terms – Knowledge representation

Unit:3	Principles of Health informatics – Part 2	12 hours

Standards in Health informatics – Probability and decision making – Probability and learning from data

Unit:4	Archiving Change	12 hours

Information Technology and Organizational transformation - Archiving change through information - Archiving change through information Technology

Unit:5	Public Health Policy	12 hours

Conceptual and theoretical foundations of health policy formulation - Implementation and analysis in the health care sector with specific applications to health informatics.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Books for Study

1	Taylor P, From Patient data to Medical knowledge – The principles and Practice of Health Informatics (2006); Blackwell Publishing – BMJ Books.

Reference Books

1	Enrico Coiera Hodder Arnold, Guide to health informatics (2013) Third Edition.
2	Frank Sullivan, Jeremy C Wyatt, ABC of Health Informatics, (2006) Blackwell Publishing – BMJ Books.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/browse/health/health-informatics
2	https://swayam.gov.in/
3	https://www.youtube.com/results?search_query=health+informatics

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	L	S	S	S	M	M	M
CO2	S	S	M	L	S	S	S	M	M	M
CO3	S	S	M	L	S	S	S	M	M	M
CO4	S	S	M	L	S	S	S	M	M	M
CO5	S	S	M	L	S	S	S	M	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST1P1	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/SYSSTAT – I	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Provide intensive training in statistical computation using software
2. Impart knowledge in handling statistical data for analysis
3. Instill the students to familiarize with the application of statistical tools

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Use the software for various applications	K1-K6
2	Draw statistical graphs, charts and diagrams	K1-K6
3	Compute statistical measures using software	K1-K6
4	Perform statistical data analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

All the Exercise covered according to the theory papers studied in the FIRST semester

Total lecture hours	**62 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press, New York
2	Almquist, Y. B., Ashir, S., and Brännström, L. A Guide to SPSS: The Basics, Version 1.0.1, Stockholm University, Sweden.
3	Evans, M. (2009). MINITAB Manual, W.H. Freeman and Company, New York.
4	An Introduction to SAS University Edition ,Ron Cody ,II Edition(2018).
5	O'Rourke, N, Hatcher, L and Stepanski, E (2005): A Step-by-Step Approach to Using SAS for Univariate and Multivariate, Statistics,2ndEdition, SAS Press and John Wiley Sons Inc.
6	Learning SAS by Example: A Programmer's Guide, Second Edition Paperback – 2018
7	Crawley, M, J. (2012). The R Book, John Wiley and Sons Private Ltd., NY, 2nd Edition
8	Dalgaard, P. (2008). Introductory Statistics with R, Second Edition, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

Course Designed By: Dr. R. JAISANKAR

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Software Practical using SPSS and MINITAB shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of the four units with internal choice A candidate shall attend all the four questions, each of which shall carry 15 marks. The examination shall be conducted at the end of Semester I. Problems relating to the topics taught using statistical software namely SPSS and MINITAB shall form the basis for setting the question paper.

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Second Semester

Course Code	24BST23A	TITLE OF THE COURSE	L	T	P	C
Core		Statistical Estimation Theory	4	1	-	4
Pre-requisite		Knowledge in Probability Theory andProbability Distributions	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Review the basic concepts of parametric estimation
2. Study properties and methods of statistical estimation theory
3. Study various method of construct confidence intervals

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the concepts and importance of properties of estimators	K3
2	Obtain the optimal estimator for a given parametric function	K6
3	Study the different methods of point estimation	K3
4	Observe consistent and asymptotic behavior of estimators	K5
5	Construct confidence intervals for population parameters	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Properties of Estimator	12 hours

Estimation and point estimation - Sufficiency – Factorization Theorem – Minimal sufficiency, likelihood equivalence – Completeness – Uniformly minimum variance unbiased estimator – Rao - Blackwell and Lehmann - Scheffe theorems.

Unit:2	Bounds of Optimal Estimator	12 hours

Mean-squared error, Fisher's information measure. Cramer-Rao inequality, Bhattacharyainequality, Chapman-Robbins inequality - Fisher's information matrix-simultaneous of parameters in normal (univariate and bivariate) distribution.

Unit:3	Methods of Estimation	12 hours

Methods of point estimation-maximum likelihood method (asymptotic properties of ML estimators are not included), method of moments, method of minimum chi-square and modified minimum chi-square.

Unit:4	Consistent Estimators and Asymptotic Properties	12 hours

Consistency and CAN estimators. Asymptotic properties of maximum likelihood estimators. Example of consistent but not asymptotic normal estimators from Pitman family. Fisher's lower Bound for asymptotic variance. Asymptotic relative efficiency. Method of least squares.

Unit:5	Interval Estimation	12 hours

Interval estimation: Confidence level and confidence coefficient. Duality between acceptance region of a test and a confidence interval. Pivotal quantity method. Shortest length confidence intervals. Construction of confidence intervals for population proportion (small and large samples) and between two population proportions (large samples) - Confidence intervals for mean, variance of a normal population, difference between mean and ratio of two normal populations.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books for Study

1	Goon, A. M., Gupta, M. K., and Dasgupta, B. (2013). An Outline of Statistical Theory-Vol.II, World Press, Calcutta. .
2	Kale, B. K. (2000). A First Course on Parametric Inference, Narosa Publishing House, New Delhi.
3	Rohatgi, V. K. (2015). Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons, NY, 3rd Edition

Reference Books

1	Dudewicz, E. J., and Mishra, S. N. (1988). Modern Mathematical Statistics, John Wiley & Sons, NY.
2	Lehman, E. L., and Cassella, G. (1998). Theory of Point Estimation, Second Edition, Springer, NY.
3	Rajagopalan, M., and Dhanavanthan, P. (2012). Statistical Inference, PHI Learning Pvt., Ltd., New Delhi.
4	Rohatgi, V. K., and Saleh, A.K.M.E. (2015), An Introduction to Probability and Statistics, Third Edition, John Wiley & Sons, NY.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayamprabha.gov.in/index.php/Syllabus/detail/10774
2	https://swayam.gov.in/nd1_noc20_ma19/preview
3	https://nptel.ac.in/courses/111/105/111105043/

Course Designed By: Dr. K. M. Sakthivel

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST23B	TITLE OF THE COURSE	L	T	P	C
Core		Survival Analysis	4	1	-	4
Pre-requisite		Basics of distribution theory andregression analysis	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Initiate the awareness of Biostatistics and its need.
2. Make the students have a clear understanding of special kinds of various statistical tools used in biostatistics.
3. Be knowledgeable about the potential applications of these tools.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the concepts and statistical tools used in Biostatistics.	K2
2	Effectively apply these tools on solving the biological problems occurring inreal life.	K3
3	Analyze the given biostatistical data as per the objectives of the problem.	K4
4	Interpret the outcomes of the analyses meaningfully.	K5
5	Create research problems of his own and able to proceed with them.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1 — **12 hours**

Introduction to Survival analysis - terminology and functions of survival analysis - goals - Basic data layout - Censoring-different types of censoring - Mean and median residual life and their elementary properties. Ageing classes - IFR, IFRA, NBU, NBUE, HNBUE, DMRL and their duals, Bathtub Failure rate

Unit:2 — **12 hours**

Parametric survival models based on basic life time distributions - Exponential, Weibull, Gamma, Gompertz - Makeham, log-logistic and log-normal distributions - General method for incorporating covariates in parametric models. Accelerated failure time model, Cox Snell residuals.

Unit:3 — **12 hours**

Kaplan-Meier's method - general features and assumptions - Log rank test for two groups, several groups - alternatives to log rank test: Wilcoxon, Tarone-Ware, Peto-Prentice and Fleming-Harrington tests - Cox PH model and its features - ML estimation of the Cox PH model-HazardRatio - Adjusted survival curves-Cox likelihood.

Unit:4 — **12 hours**

Tests of exponentiality against non-parametric classes- total time on test, Despande test. Rank test for regression coefficients, Competing risk model, parametric and non-parametric inference for this model

Unit:5 — **12 hours**

Evaluating the proportional Hazards Assumptions - Overview - graphical approach - log-log plots - Observed versus expected plots- time-dependent covariates - Stratified Cox Procedure - hazard function - Extension of the Cox PH model - hazard ratio formula - extended Cox likelihood - An overview of Proportional odds model.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books for Study

3	Van Belle, G., Fisher, L. D., Heagerty, P. J., and Lumley, T. (2004). Bio-Statistics - A Methodology for the Health Science, Second Edition, Wiley, NY.
4	Daniel, W. W. and Chad L. Cross (2018). Bio-Statistics: A foundation for analysis in the Health Sciences, Eleventh Edition, John Wiley & Sons, NY.
6	Kleinbaum, D. G., and Klein, M. (2012): Survival Analysis: A Self-Learning Text, Third Edition, Springer – Verlag, NY.

Reference Books

1	Hosmer, Jr. D. W., Lemeshow, S., and Sturdivant, R. X. (2013). Applied Logistic Regression, Third Edition, John Wiley & Sons, Inc., NY.
2	Lee, E. T., and Wang, J. W. (2013). Statistical Methods for Survival Data Analysis, Fourth Edition, Wiley, NY.
3	Rossi, R. J. (2010). Applied Biostatistics for Health Sciences, John Wiley & Sons, Inc., NY
4	Klein, J. P. and Moeschberger, M. L. (2003). Survival Analysis: Techniques for Censored and Truncated Data, Second Edition, Springer – Verlag, NY.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Prof.Shamik Sen, Department of Bioscience and Bioengineering, IIT Bombay, "Introductionto Biostatistics", NPTEL. [https://swayam.gov.in/nd1_noc20_bt28/preview]
2	Dr.Felix Bast, Central University of Punjab, Bathinda, 2020, "Biostatistics and Mathematical Biology", (NPTEL). [https://swayam.gov.in/nd2_cec20_ma05/preview]
3	www.healthknowledge.org.uk

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST23C	TITLE OF THE COURSE	L	T	P	C
Core		Testing Statistical Hypotheses	4	1	1	4
Pre-requisite		Sampling, Distribution, Estimation Theory	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Draw inference about unknown population parameters based on random samples
2. Impart knowledge on statistical hypothesis
3. Understand Neyman-Pearson fundamental lemma for testing statistical hypothesis
4. Understand the test procedures MPT,UMPT,LMPT, LRT and SPRT
5. Inculcate various parametric and non-parametric, sequential test procedures

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Make inferences about statistical unknown population parameters based on random samples	K1-K5
2	Formulate statistical hypothesis	K3
3	Test statistical hypothesis by selecting suitable test procedure.	K3-K4
4	Determine the size of critical region and power of test function.	K5
5	Solve real life problems by applying suitable parametric / nonparametric / sequential testing procedures.	K3-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Hypothesis Testing Preliminaries	12 hours

Fundamental notions of hypothesis testing: null and alternative hypothesis, simple and composite hypothesis, critical region, type I and type II errors, test function, level of significance, randomized and non-randomized tests, power function, P-value - Neyman-Pearson lemma - most powerful test -Applications to standard statistical distributions.

Unit:2	Most Powerful Tests and its variants	12 hours

Monotone likelihood ratio property - Uniformly most powerful tests - Construction of uniformly most powerful tests for one-parameter and multi-parameter exponential families - Unbiased and Invariant tests – Similar test - Applications to standard statistical distribution- Locally most powerful test.

Unit:3	Likelihood Ratio Tests	12 hours

Likelihood ratio (LR) test - asymptotic distribution of LR test statistic-consistency of LR test - Construction of LR tests for testing mean and variance of normal distributions of one or more Populations.

Unit:4	Non-Parametric Tests	12 hours

U statistic – mean and variance of U statistic – One sample: Goodness of fit - Kolmogorov-Smirnov test, Problem of location: Sign test - Wilcoxon's signed-rank test - Two samples: Kolmogorov-Smirnov test - Wald-Wolfowitz runs test - Median test - Mann-Whitney-Wilcoxon test - Chi-square test of independence - More than two samples: Kruskal-Wallis test -Friedman's Test - Concept of Robustness.

Unit:5	Sequential Probability Ratio Tests	12 hours
Basic ideas of sequential sampling - Wald's equation - sequential probability ratio test (SPRT) - error probabilities and approximation of stopping bounds - OC and ASN functions of SPRT - Properties of SPRT - applications to standard distributions - statement of Wald's fundamental identity of sequential analysis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**
Note: Detailed derivations are not required and the subject is to be taught application oriented.		

Books for Study

1	Rohatgi, V. K. (1976). Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons, NY. **(For units 1,2,3,4,5)**
2	Gibbons, J. D. and Chakrabarthi, S. (2010). Nonparametric Statistical Inference, Fifth Edition, Chapman and Hall/CRC Press, FL **(For unit 4)**
3	Wald, A. (1982). Sequential Analysis. John Wiley & Sons, NY. **(For unit 5)**

Reference Books

1	Lehmann, E. L. (1986). Testing Statistical Hypotheses, Second Edn., John Wiley & Sons, NY
2	Goon, A. M., Gupta, M. K., Das Gupta. B. (1973). An outline of Statistical Theory, Vol. II, World Press, Calcutta.
3	Rao, C.R. (2009). Linear Statistical Inference and Its Applications, 2nd Edn., Wiley Eastern Ltd.
4	Gupta, S. C., and Kapoor, V. K. (2020), Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi
5	Rajagopalan, M., and Dhanavanthan, P. (2012). Statistical Inference, PHI Learning Pvt., Ltd., New Delhi.
6	Conover, W. J. (1980). Practical Nonparametric Statistics, Second Edn., John Wiley & Sons, NY.
7	Rohatgi, V. K., and Saleh, A.K.M.E. (2015), An Introduction to Probability and Statistics, Third Edition, John Wiley & Sons, NY.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=34 Paper: P-04.Statistical Inference I P-05.Statistical Inference II
2	https://nptel.ac.in/courses/103/106/103106120/ Introduction to Statistical Hypothesis Testing – IIT Madras

Course Designed By: Dr. R. Muthukrishnan

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST23EB	TITLE OF THE COURSE	L	T	P	C
Elective		Demography and Vital Statistics	4	1	-	4
Pre-requisite		Fundamentals of data and data source	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Learn the core idea of Demographic and Vital Statistical data.
2. Acquire the knowledge of Mortality and Fertility Rate in India.
3. Understand the basics in Life Table, Population projection and Migration.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Learn the basics in Birth, Death and other vital statistics.	K1
2	Provide the basic knowledge in Measurements of Population.	K2
3	Explore the importance of life table and its types.	K3
4	Analyze the concepts of Migration and its importance.	K4
5	Understand the core idea of population projection and their estimation.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Demographic Data	12 hours

Introduction to Demography and vital statistics - Sources Uses and Methods of demographic Data. Population Theories: Errors in demographic data, uses of Balancing equation and Chandrasekharan - Deming formula - Adjustment of age data - use of Myer and UN indices - Population composition and Pyramid.

Unit:2	Measurement of Mortality	12 hours

Measurement of population - Rates and Ratios of vital events - Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates - Direct and Indirect method of Standardization.

Unit:3	Life Tables	12 hours

Stationary and Stable population - Lotka and Dublin's Model - Central Mortality Rates - Force of Mortality. Life Tables: Assumption, description, construction of Life Tables and Uses of Life Tables - Makehams and Gompertz Curve - National and UN Model life table - Abridged life table.

Unit:4	Measurement of Fertility	12 hours

Measurements of Fertility: Nuptiality and Fertility - Crude Birth Rate (CBR) - General Fertility Rate (GFR) - Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase - Pearl's Vital Index - Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR).

Unit:5	Population Projection and Migration	12 hours

Population estimation and Projection – Basic concepts – Growth and Change – Methods of Projection –Exponential and Logistic curve. Migration: Internal and International Migration - Net migration, International and Postcensal estimates - Decennial population Census in India.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Books for Study	
1	Goon, A. M., Gupta, M. K., and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. II, Ninth Edition, World Press, India.
2	Gupta, S. C., and Kapoor, V. K. (2016). Fundamentals of Applied Statistics, Sultan Chand & Sons Private Limited, New Delhi.
3	Mishra, B. D. (1980). An Introduction to the Study of Population, South Asian Publishers Pvt. Ltd., New Delhi.
4	Mukhopadhyay, P. (2011): Applied Statistics, Second Edition, Books and Allied (P) Ltd., India.
Reference Books	
1	Barclay, G. W. (1958). Techniques of Population Analysis, John Wiley and Sons, New York.
2	Biswas, S. (1988). Stochastic Processes in Demography & Application, Wiley Eastern Ltd., India
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/109/104/109104045/
2	https://swayam.gov.in/nd1_noc19_hs39/preview
3	https://nptel.ac.in/courses/109/104/109104150/
Course Designed By: Dr. V. Kaviyarasu	

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST2P2	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/SYSSTAT – II	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Provide intensive training in statistical computation using software
2. Impart knowledge in handling statistical data for analysis
3. Instill the students to familiarize with the application of statistical tools

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Use the software for various applications	K1-K6
2	Draw statistical graphs, charts and diagrams	K1-K6
3	Compute statistical measures using software	K1-K6
4	Perform statistical data analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

All the Exercise covered according to the theory papers studied in the SECOND semester

Total lecture hours **62 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press, New York
2	Almquist, Y. B., Ashir, S., and Brännström, L. A Guide to SPSS: The Basics, Version 1.0.1, Stockholm University, Sweden.
3	Evans, M. (2009). MINITAB Manual, W.H. Freeman and Company, New York.
4	An Introduction to SAS University Edition ,Ron Cody ,II Edition(2018).
5	O'Rourke, N, Hatcher, L and Stepanski, E (2005): A Step-by-Step Approach to Using SAS for Univariate and Multivariate, Statistics,2ndEdition, SAS Press and John Wiley Sons Inc.
6	Learning SAS by Example: A Programmer's Guide, Second Edition Paperback – 2018
7	Crawley, M, J. (2012). The R Book, John Wiley and Sons Private Ltd., NY, 2nd Edition
8	Dalgaard, P. (2008). Introductory Statistics with R, Second Edition, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

Course Designed by Dr. R. Muthukrishnan

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Software Practical using R shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of the four units with internal choice A candidate shall attend all the four questions, each of which shall carry 15 marks. The examination shall be conducted at the end of Semester II. Problems relating to the topics taught using statistical software namely R shall form the basis for setting the question paper.

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Third Semester

Course Code	24BST33A	TITLE OF THE COURSE	L	T	P	C
Core		Applied Multivariate Statistical Analysis	4	1	-	4
Pre-requisite		Linear Algebra, Calculus of Several Variables, Probability theory, Sampling theory, Statistical Inference	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Inculcate deep knowledge on various multivariate distribution and multivariate techniques
2. Develop clear idea on when and where to use dependence and interdependence multivariate methods
3. Bridge the relation between multivariate analysis and machine learning and strengthen the applications in diversified spectrum of fields.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the characteristics of Multivariate Normal Distribution and estimation of parameters.	K1
2	Understand multivariate sampling distributions including Wishart distribution, Hotelling T^2 distribution and their applications	K2
3	Have clear idea about multivariate data reduction techniques such as Principal Component Analysis and Factor Analy sis and their applications.	K3
4	Understand the need and applications of classification and discriminant function analysis, cluster analysis.	K4
5	Understand the application of multidimensional scaling and correspondence analysis.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Multivariate Normal Distribution and its Properties	14 hours

Bivariate Normal Distributions - Assumptions – Properties - Marginal and Conditional Distributions - Multivariate Normal Distributions – Properties- Sampling from Multivariate Normal Distributions- Maximum Likelihood Estimators of the Parameters of Multivariate Normal Distribution - Sampling Distributions of the Mean Vector and the Variance Covariance Matrix – Wishart's Distribution and its Properties(without derivations) – Large sample behavior of the Sample Mean Vector and the Variance Covariance Matrix.

Unit:2	Inferences on Multivariate Normal Distribution	10 hours

Hoteling's T^2 Statistic and its Distribution (Without Derivation) - Properties and Applications-One and Two samples and paired comparisons of the mean vector – Testing the single covariance matrix and the equality of two covariance matrices-MANOVA (One-way and Two-Way) with fixed effects

Unit:3	Factor Analysis and Principal Components Analysis	12 hours

Principal components: Objectives-Extraction of principal components-Properties-Factor analysis: Objectives – The Orthogonal Factor Model- Estimation of parameters -The concepts of Factor rotation and Factor scores.

Unit:4	**Classification and Cluster Analysis**	**12 hours**
Problem of Classification with Two or More Populations-Standards of good Classification-Classification into one of two populations with known prior - Discriminant Analysis: Objectives and assumptions - Fisher's Discriminant Function - Cluster analysis: Distance and similarity measures-hierarchical clustering techniques - agglomerative techniques- single linkage, complete linkage, average linkage methods- nonhierarchical cluster methods- K-means methods.		
Unit:5	**Some Additional Topics on Multivariate Methods**	**12 hours**
Canonical correlation analysis: Extraction of canonical correlation and variables – Multidimensional scaling introduction- Basic algorithm - Correspondence analysis: Introduction - Perceptual mapping with nonmetric data– Simple Correspondence analysis – Decompositional and Compositional approaches - Applications.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books For Study

1	Anderson, T.W. (2009). An Introduction to Multivariate Statistical Analysis, Third Edition, Wiley – Interscience, NY.
2	Johnson, R. A., and Wichern, D. W. (2013). Applied Multivariate Statistical Analysis Sixth Edition, Pearson New International Edition.
3	Jambu, M., and Lebeaux, M.-O. (1983). Cluster Analysis and Data Analysis, North-Holland, NY.
4	Wolfgang Karl Härdle , Léopold Simar (2011), Applied Multivariate Statistical Analysis, Third edition, Springer Publications, https://doi.org/10.1007/978-3-030-26006-4
5	K. V. Mardia, J. T. Kent, J. M. Bibby (1979), Multivariate Analysis, ISBN: 0124712509.

Reference Books

1	Kshirsagar, A. M. (1972), Multivariate Analysis, Marcel Decker, Inc., NY.
2	Morrison, D. F. (2004). Multivariate Statistical Methods, Fourth Edition, Duxbury Press, CA

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/104/111104024/
2	https://nptel.ac.in/courses/111/105/111105091/
3	https://nptel.ac.in/courses/106/106/106106139/

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST33B	TITLE OF THE COURSE	L	T	P	C
Core		Linear Models and Design of Experiments	4	1	-	4
Pre-requisite		Knowledge on Analysis of Variance and Basicsof Design of Experiments	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. To teach the students to understand the theoretical concepts of the general linear model and its types.
2. To make the students familiar with various experimental designs.
3. To make the students understand some advanced concepts of design of experiments like factorial experiments.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Remember and understand the theoretical underpinning of the linear model, analysis of variance and design of experiments.	K1,K2
2	Understand the type of any given experiment and the type of design apt for its analysis.	K2
3	Apply various designs of experiments in several practical situations and evaluate its results.	K3, K5
4	Make further analyses which are specific to the objectives of any experiment.	K4
5	Create new types of designs as per the requirements and study their behaviour while proceeding to the research.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Linear Models and Basic Designs	12 hours

Linear Models - Assumptions on Error Components - Fixed/Mixed and Random effect Models – Generalized linear model - Gauss-Markov setup – Estimation of parameters – Least square method – MLE method - Gauss-Markov theorem-BLUE – Linear parametric function and the condition for its estimability -Test for Linear Hypothesis - Principles of Experimentation - Review of Basic Designs and CRD-RBD-LSD with their merits and limitations.

Unit:2	Comparison Tests and Some Special Types of Designs	12 hours

Multiple Comparison and Multiple Range Tests: Need – Tukey's Test – Fisher's Least Significance Difference method, Duncan's multiple range test, Neyman-Kauls test - Analysis of Covariance – One-way and two-way - Analysis of Graeco Latin Squares, Cross Over Designs, Split Plot and Strip Plot Designs.

Unit:3	Factorial Experiments and Confounding	12 hours

Factorial Experiments – Advantages and limitations – main effects and interaction effects -Analysis of 2^n, 3^n, s^n and n x p Asymmetrical Factorial Experiments – Concept of confounding and its advantages and limitations - Total, partial and balanced Confounding in Symmetrical Factorial experiments –- Analysis of confounded 2^n and 3^n factorial experiments.

Unit:4	Fractional Factorial and Response Surface Designs	12 hours

Concept of Fractional Replication in Symmetrical Factorial experiments - 1/2 and 1/4 replicate of 2^n, 1/3 replicate of 3^n experiments - Construction and Analysis – Concept of response surface Experiments - First order Response surface designs – steepest ascent method – Second-orderResponse surface designs.

Unit:5	**Incomplete Block Designs**	**12 hours**
Incomplete Block Designs - Balanced Incomplete Block Design - Partially Balanced Incomplete Block Design and its analysis – Youden square and lattice designs-Hierarchical and Nested Designs.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**
Note: Detailed derivations are not required and the subject is to be taught application oriented.		

Books for Study

1	Montgomory, D.C. (2012). Design and Analysis of Experiments, Eighth Edition, John Wiley & Sons, NY.
2	Das, M. N., and Giri, N. C. (2011). Design and Analysis of Experiments, Second Edition, New Age International Private Ltd., New Delhi
3	Graybill, F.A. (1961): An Introduction to Linear Statistical Models, McGraw Hill Co., London.
4	Graybill, F. A. (2000). Theory and Applications of Linear Models, Duxbury Press, First Edition, MA.
5	Peterson, R. G. (1985). Design and analysis of experiments, Marcel Dekker, NY.
6	Paneerselvam, R. (2012). Design and Analysis of Experiments, PHI Learning Private Ltd., New Delhi.

Reference Books

1	Fisher, R.A. (1966). The Design of Experiments, 8th Edition, Oliver and Boyd, London.
2	Federer, W. T. (1967). Experimental Design: Theory and Application, Indian Edition, Oxford and IBH Publishing Co., New Delhi.
3	Kempthorne, O. (1965). The Design and Analysis of Experiments, Wiley Eastern India Limited, New Delhi
4	Cochran, W.G. and Cox, G.M. (1992). Experimental Designs, Second Edition, John Wiley & Sons, New York.
5	Nigam, A. K., Puri, P. D., and Gupta, V. K. (1988). Characterizations and Analysis of Block Designs, John Wiley & Sons, NY.
6	John, P.W.M. (1971). Statistical Design of Experiments, Macmillan Co., NY.
7	Joshi, D.D. (1987). Linear Estimation and Design of Experiments, First Edition, New Age International (P) Ltd, New Delhi.
8	Searle, S.R. and Gruber, M. H. J. (2016). Linear Models, Second Edition, John Wiley & Sons, Inc.,

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/105/110105087/

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST33C	TITLE OF THE COURSE	L	T	P	C
Elective		Applied Regression Analysis in Health Care	4	1	-	4
Pre-requisite		Fundamentals of Linear Regression, Correlationand their Properties	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Understand the notions of regression model building.
2. Impart application of regression models in various domains.
3. Instruct the methodology to test assumptions and conditions involved in regression models

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Identify need of regression models	K1,K2
2	Construct and apply regression models	K2,K3
3	Test the model assumptions for its applications	K3,K4
4	Test the model adequacy	K3.K5
5	Learn and apply the generalized linear models	K2,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Regression Models and Properties	12 hours

Simple linear regression-Assumptions, Estimation of model parameters by the method of least squares and by MLE method, standard error of estimators, testing of hypotheses on slope and intercept - interval estimation of model parameters - prediction of a new observation - coefficient of determination -Case where the regressor is random.

Unit:2	Tests for Assumptions	12 hours

Model adequacy checking - residual plots for checking normality, homoscedasticity and detection of outliers. Test for Lack of fit of the model. Durbin – Watson test for autocorrelation. Need for transformation-Analytical methods for selecting a transformation - - Variance stabilizing transforms and transforms to linearize the model.

Unit:3	Multicollinearity	12 hours

Multicollinearity – sources, effects, diagnostics, Methods of dealing with multi collinearity (collection of additional data, model specification, Ridge and Lasso regression) - Selection of Variables – forward selection, backward elimination and stepwise regression.

Unit:4	Generalized Linear Model for longitudinal Data	12 hours

Generalized Linear model – generalized and weighted least squares -fitting generalized linear models-Regression models for Longitudinal Data: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian and gamma -parameter estimation and inference in the Generalised linear models.

Unit:5	Non-linear Regression	12 hours

Non-linear regression: Non-linear regression models- Non-linear least squares - Linearization transforms, their uses and limitations-Parameter estimation - Linearization-Gauss-Newton method -Other estimation methods: Steepest descent, Fractional increments, Marquardt's compromise (concepts only)- Statistical inference- Non-parametric regression – Poisson regression.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	62 hours

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books for Study

1	Draper, N. R. and Smith, H. (1998). Applied Regression Analysis, Third Edition, John Wiley and Sons.
2	Montgomary, D. C., Peck, E. A., and Vining, G. G. (2012). Introduction to Linear Regression Analysis, Fifth Edition, John Wiley & Sons, NY.

3	Peter Martin (2022) - Regression Models for Categorical and Count Data – Sage Publications
4	Garrett M. Fitzmaurice, Nan M. Laird, James H. Ware(2012) Applied Longitudinal Analysis. 2nd Edition. Wiley.
Reference Books	
1	Hosmer, D.W., Lemeshow, S., and Sturdivant, R. X. (2013). Applied Logistic Regression, Third Edition, John Wiley & Sons, NY.
2	Seber, G.E.F. and Wild, C.J. (2003). Nonlinear Regression, John Wiley & Sons, NY.
3	Neter, J., Wasserman, W., and Kutner, M.H. (2004). Applied Linear Statistical Models, Fourth Edition, McGraw Hill Publishers
4	Robert D. Gibbons, Donald Hedeker (2006), Longitudinal Data Analysis. Wiley Interscience
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/Procedures/NCSS/Multiple_Regression.pdf
2	https://nptel.ac.in/courses/111/104/111104098/
3	http://people.sabanciuniv.edu/berrin/cs512/lectures/10x-logistic-regression-new.pdf
4	https://nhorton.people.amherst.edu/ips9/IPS_09_Ch14.pdf
5	https://online.stat.psu.edu/stat504/node/149/
6	https://online.stat.psu.edu/stat504/node/171/
Course Designed By: Dr. R. Jaisankar	

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST33EC	TITLE OF THE COURSE	L	T	P	C
Elective		Categorical Data Analysis	4	1	-	4
Pre-requisite			Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. To develop students' abilities in understanding the concepts of categorical data.
2. To present theory and techniques for the analysis of categorical data.
3. To enable students to learn how to choose appropriate techniques, to analyse categorical data, and present results

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Identify and summaries categorical data into 2*2/ I*J contingency tables.	K1- K6
2	Apply and interpret ODDS ratio, RR and perform tests for independent of attributes in contingency tables using various methods.	K1 -K6
3	Demonstrate skills in using standard analytic methods for single and two-way classification data, including the use of Poisson and multinomial models for data, odds ratios, and Pearson's chi-squared and likelihood ratio statistics.	K1 - K6
4	Identify the need for, the structure, and the usefulness of, generalized linear models. Fit and interpret the results of fitting, generalized linear models, including log-linear models (for example trend models) and logistic regression models.	K1 - K6
5	Obtain and fit good models in three-way situations using a Various Matched-Pair Models.	K1 - K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Contingency table analysis	12 hours

Introduction - Nature of Categorical data - Statistical inference for a proportion - Contingency Tables and their distribution: Binomial and Multinomial sampling - Table structure comparing proportions - Comparing proportions in two-by-two tables: Difference of proportions - Relative risk - Odds Ratio - Properties of Odds Ratio - relationship between Odds Ratio and Relative Risk

Unit:2	Measures of Association	12 hours

Nominal and Ordinal Measures of Association - Inference for Contingency tables: Interval estimation for difference of proportions, odds ratio, log odds ratio and relative risk - Testing Independence in Two-Way tables: Pearson and Likelihood-ratio chi-square tests - Yate's correction for continuity-Residuals for cells in a contingency table-Partitioning chi-squared - Trend tests for 2 x J tables - Testing Independence for Ordinal Data-Fisher Exact Test for 2 x 2 tables - Exact Inference for small samples - Association in Three-Way Tables: Partial Tables - Marginal and conditional and Odds Ratios - Homogeneous Association - Cochran-Mantel-Hansel methods

Unit:3	Logistic regression	12 hours

Logit models for Binary data-Binomial GLM for 2 x 2 contingency tables - Logistic regression: Interpreting logistic regression - Inference for logistic regression - Maximum likelihood estimate - test of overall regression and goodness of fit - Deviance statistic, Wald test, LR test, Score test-Logistic regression diagnostics - Multiple Logistic Regression

Unit:4	Logit models for multinomial responses	12 hours

Nominal Responses: Baseline-Category Logit Model - Ordinal Responses: Cumulative Logit Models - Ordinal Responses: Cumulative Link Models - Alternative Models for Ordinal Responses

Unit:5	Log linear models for contingency tables	12 hours

Log linear Models for Two-Way Tables - Log linear Models for Independence and Interaction in Three-Way Tables - Inference for Log linear Models - Log linear Models for Higher Dimensions

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Books for Study

1	Agresti, A. (2013): Categorical data analysis, John Wiley & Sons, 3rd edition.
2	McCullagh, P. and Nelder, J.A. (1991): Generalized Linear Models, Chapman and hall, London, 2nd edition.
3	Draper NR and Smith H (1998): Applied Regression Analysis, John Wiley & Sons, 3rd edition.
4	Hosmer D., Lemeshow S., Sturdivant RX (2013). Applied Logistic Regression, ISBN-13: 978-0470582473ISBN-10: 0470582472, 3rd edition.

BOOKS FOR REFERENCE

1	Agresti, A. (2007): An Introduction to Categorical data analysis, John Wiley & Sons, 2nd edition.
2	Armitage, P. and Berry, G. (2001): Statistical methods in Medical Research, Wiley Blackwell Scientific Publications, USA, 4th edition.
3	Deshpande, J.V., Gore, A.P. and Shanubhogue, A. (2022): Statistical Analysis of Non Normal Data, New Age International Publishers Ltd., New Delhi, Second edition.
4	Hardin, J.W., and Hilbe, J.M. (2012): Generalized Estimating Equation, Chapman and Hall, London, 2nd edition.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/courses?query=categorical%20data%20analysis
2	https://www.youtube.com/results?search_query=categorical+data+analysis

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST2P3	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/SYSSTAT – III	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. Provide intensive training in statistical computation using software
2. Impart knowledge in handling statistical data for analysis
3. Instill the students to familiarize with the application of statistical tools

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Use the software for various applications	K1-K6
2	Draw statistical graphs, charts and diagrams	K1-K6
3	Compute statistical measures using software	K1-K6
4	Perform statistical data analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

All the Exercise covered according to the theory papers studied in THIRD semester

Total lecture hours	**62 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press, New York
2	Almquist, Y. B., Ashir, S., and Brännström, L. A Guide to SPSS: The Basics, Version 1.0.1, Stockholm University, Sweden.
3	Evans, M. (2009). MINITAB Manual, W.H. Freeman and Company, New York.
4	An Introduction to SAS University Edition, Ron Cody ,II Edition(2018).
5	O'Rourke, N, Hatcher, L and Stepanski, E (2005): A Step-by-Step Approach to Using SAS for Univariate and Multivariate, Statistics,2ndEdition, SAS Press and John Wiley Sons Inc.
6	Learning SAS by Example: A Programmer's Guide, Second Edition Paperback – 2018
7	Crawley, M, J. (2012). The R Book, John Wiley and Sons Private Ltd., NY, 2nd Edition
8	Dalgaard, P. (2008). Introductory Statistics with R, Second Edition, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

Course Designed by Dr. R. Muthukrishnan

Note: The maximum marks for continuous internal assessment and end semester University examination for Statistical Software Practical using SPSS and MINITAB shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of the four units with internal choice A candidate shall attend all the four questions, each of which shall carry 15 marks. The examination shall be conducted at the end of Semester II. Problems relating to the topics taught using statistical software namely SPSS and MINITAB shall form the basis for setting the question paper.

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST3MP	TITLE OF THE COURSE	L	T	P	C
Core		Mini Project	4	1	-	-
Pre-requisite		Knowledge of Applied statistical methods	Syllabus Version		2024 -25	

The mini-project has to be assessed by the Department of Statistics faculty.

Fourth Semester

Course Code	24BST33C	TITLE OF THE COURSE	L	T	P	C
Elective		Research Design and Report Writing	4	1	-	4
Pre-requisite		Basics of Research Designs and Report Writing	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. To learn statistical techniques useful for research work.
2. To understand the qualitative and quantitative methods used biostatistical research

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Know different types of data produced in their area of study.	K1,K2
2	Create, manage, visualize, and summarize datasets.	K2,K3
3	Use and understand the inferential procedures.	K3,K4
4	Apply suitable sampling design. To understand and apply basic designs	K3.K5
5	Apply suitable statistical techniques to analyze the data and interpret the results.	K2,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Research Methods	12 hours

Scientific Research: The scientific method and problem solving. Characteristics to the scientific approach. Purpose of scientific approach. Research as Decision- making process: Research alternatives, role of research methods in business and industry. Limitations of research. Major steps in the research process: Literature review, theoretical contexts, research problem, research hypothesis.

Unit:2	Research Designs	12 hours

Exploratory research studies in case of descriptive research and studies, causal research studies, Experimental, Quasi-Experimental and non-experimental research. Surveys and evolution research, Retrospective (case- control), Prospective (cohort and case cohort) and case studies, historical research. Sampling techniques and sample size determination,

Unit:3	Measurement and Data collection	12 hours

Primary and Secondary, Self-report, observational, physiological measure. Projective techniques: Recodes and available data, Questionnaires and interview schedules, designing self- Report instruments, scales, response bias.

Unit:4	Research Report	12 hours

Data preparation and preliminary Data Analysis.

Unit:5	Report Writing	12 hours

Statistical analysis, model building and decision making, the context, style of research report. Types of research documents, writing and formatting of report, presentation of critique.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

Total Lecture hours **62 hours**

Note: Detailed derivations are not required and the subject is to be taught application oriented.

Books for Study

1. Denise F. Polit and and applications, J.B. Bernadette P. Hungler (1984) Essential of Nursing Research Methods Lippinott Company, U.K.
2. Carol T. Bush (1985): Nursing Research, Reston Publishing C. Reston,
3. Cheryl B. Setter (1984): Nursing Research in a Service Setting Reston Publishing Co. Reston.

Reference Books

1. Louise H. Kidder (1991): Research Methods in Social Relations. VI Edition, Holt Rinehart and Winston, New York.
2. Kothari, C.R. (2019). Research Methodology: Methods and Techniques, New Age International Publishers, Fourth edition, New Delhi

3	Sinha , S.C. and Dhtman, A.K., (2002). Research Methodology, Ess Ess Publications.
4	Day RA (2011) How to write and publish a Scientific paper. Greenwood press, 7th Edition
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/courses?query=research%20methodology
2	https://onlinecourses.nptel.ac.in/noc23_ge36/preview
Course Designed By: Dr. R. Jaisankar	

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST4IPV	TITLE OF THE COURSE	L	T	P	C
Core		Internship/Project/Dissertation and Viva	4	1	-	-
Pre-requisite		Knowledge in statistical theory and methods	Syllabus Version		2024 -25	

The marks for the internship will be awarded by the corresponding academic / research institutions / Hospitals in which a candidate is pursue the internship.

All the admitted candidates shall have to carry out a project/dissertation work during the fourth semester under the supervision of the faculty of the Department of Statistics in the University. Candidates shall have to submit three copies of the report of the project/dissertation work at the end of the fourth semester at least two weeks before the last working day and shall have to appear for a viva-voce examination. The report shall be evaluated and viva-voce examination shall be conducted jointly by an External Examiner and the Project Guide. The maximum marks for the project/dissertation report and viva – voce examination shall be fixed as 300, which is split with the following components:

Internal Assessment Marks by the Project/Dissertation Guide : 100 marks

Evaluation of Project/Dissertation Report jointly by the External Examiner and the Guide : 100 marks

Conduct of Viva-Voce Examination jointly by the External Examiner and the Guide : 100 marks

Course code	24BST4SS	TITLE OF THE COURSE	L	T	P	C
Core		Self-Studies	4	1	-	-
Pre-requisite		Knowledge in statistical theory and methods	Syllabus Version		2024 -25	

The self-study report should be submitted by the candidates on the specific topics like Bayesian Regression, Spatial Epidemiology etc., The report has to be assessed by the Department of Statistics Faculty.

Elective Courses

Course Code	24BST13EA	TITLE OF THE COURSE	L	T	P	C
Elective		Health Informatics	4	1	-	4
Pre-requisite			Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

3. Learn about the structure and function of healthcare systems, including the roles of various stakeholders such as healthcare providers, patients, insurers, and regulators.
4. Learn how to develop and implement tools that provide clinicians with evidence-based information and recommendations to support clinical decision-making.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Utilize various information technology tools and systems effectively within healthcare environments, including electronic health records (EHRs), health information exchange (HIE), and telemedicine platforms.	K1-K6
2	Collect, store, manage, and analyze healthcare data securely and ethically, adhering to relevant data standards and privacy regulations such as HIPAA.	K1-K6
3	Understanding the design, implementation, and evaluation of health information systems. This involves learning about the software and hardware used in healthcare settings, as well as system interoperability and usability.	K1-K6
4	Apply health informatics principles and tools to improve the quality of care and patient safety, including error reporting systems, adverse event detection, and quality improvement initiatives.	K1-K6
5	Collaborate effectively with healthcare professionals, information technologists, researchers, policymakers, and other stakeholders to address complex healthcare challenges through the use of informatics solutions.	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Challenges of Health informatics	12 hours

Introduction to Health informatics – Reading & Writing patient records – Creation of medical knowledge – Access to medical knowledge

Unit:2	Principles of Health informatics – Part 1	12 hours

Representation – Logic – Clinical terms – Knowledge representation

Unit:3	Principles of Health informatics – Part 2	12 hours

Standards in Health informatics – Probability and decision making – Probability and learning from data

Unit:4	Archiving Change	12 hours

Information Technology and Organizational transformation - Archiving change through information - Archiving change through information Technology

Unit:5	Public Health Policy	12 hours

Conceptual and theoretical foundations of health policy formulation - Implementation and analysis in the health care sector with specific applications to health informatics.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Books for Study	
1	Taylor P, From Patient data to Medical knowledge – The principles and Practice of Health Informatics (2006); Blackwell Publishing – BMJ Books.

Reference Books	
1	Enrico Coiera Hodder Arnold, Guide to health informatics (2013) Third Edition.
2	Frank Sullivan, Jeremy C Wyatt, ABC of Health Informatics, (2006) Blackwell Publishing – BMJ Books.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.coursera.org/browse/health/health-informatics
2	https://swayam.gov.in/
3	https://www.youtube.com/results?search_query=health+informatics

Course Designed By: Dr. R. Jaisankar

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST23EB	TITLE OF THE COURSE	L	T	P	C
Elective		Demography and Vital Statistics	4	1	-	4
Pre-requisite		Fundamentals of data and data source	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

4. Learn the core idea of Demographic and Vital Statistical data.
5. Acquire the knowledge of Mortality and Fertility Rate in India.
6. Understand the basics in Life Table, Population projection and Migration.

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Learn the basics in Birth, Death and other vital statistics.	K1
2	Provide the basic knowledge in Measurements of Population.	K2
3	Explore the importance of life table and its types.	K3
4	Analyze the concepts of Migration and its importance.	K4
5	Understand the core idea of population projection and their estimation.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Demographic Data	12 hours

Introduction to Demography and vital statistics - Sources Uses and Methods of demographic Data. Population Theories: Errors in demographic data, uses of Balancing equation and Chandrasekharan - Deming formula - Adjustment of age data - use of Myer and UN indices - Population composition and Pyramid.

Unit:2	Measurement of Mortality	12 hours

Measurement of population - Rates and Ratios of vital events - Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates - Direct and Indirect method of Standardization.

Unit:3	Life Tables	12 hours

Stationary and Stable population - Lotka and Dublin's Model - Central Mortality Rates - Force of Mortality. Life Tables: Assumption, description, construction of Life Tables and Uses of Life Tables - Makehams and Gompertz Curve - National and UN Model life table - Abridged life table.

Unit:4	Measurement of Fertility	12 hours

Measurements of Fertility: Nuptiality and Fertility - Crude Birth Rate (CBR) - General Fertility Rate (GFR) - Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase - Pearl's Vital Index - Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR).

Unit:5	Population Projection and Migration	12 hours

Population estimation and Projection – Basic concepts – Growth and Change – Methods of Projection –Exponential and Logistic curve. Migration: Internal and International Migration - Net migration, International and Postcensal estimates - Decennial population Census in India.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Books for Study	
1	Goon, A. M., Gupta, M. K., and Dasgupta, B. (2016). Fundamentals of Statistics, Vol. II, Ninth Edition, World Press, India.
2	Gupta, S. C., and Kapoor, V. K. (2016). Fundamentals of Applied Statistics, Sultan Chand & Sons Private Limited, New Delhi.
3	Mishra, B. D. (1980). An Introduction to the Study of Population, South Asian Publishers Pvt. Ltd., New Delhi.
4	Mukhopadhyay, P. (2011): Applied Statistics, Second Edition, Books and Allied (P) Ltd., India.

Reference Books	
1	Barclay, G. W. (1958). Techniques of Population Analysis, John Wiley and Sons, New York.
2	Biswas, S. (1988). Stochastic Processes in Demography & Application, Wiley Eastern Ltd., India

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/109/104/109104045/
2	https://swayam.gov.in/nd1_noc19_hs39/preview
3	https://nptel.ac.in/courses/109/104/109104150/

Course Designed By: Dr. V. Kaviyarasu

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course Code	24BST33EC	TITLE OF THE COURSE	L	T	P	C
Elective		Categorical Data Analysis	4	1	-	4
Pre-requisite			Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

1. To develop students' abilities in understanding the concepts of categorical data.
2. To present theory and techniques for the analysis of categorical data.
3. To enable students to learn how to choose appropriate techniques, to analyse categorical data, and present results

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Identify and summaries categorical data into 2*2/ I*J contingency tables.	K1- K6
2	Apply and interpret ODDS ratio, RR and perform tests for independent of attributes in contingency tables using various methods.	K1 -K6
3	Demonstrate skills in using standard analytic methods for single and two-way classification data, including the use of Poisson and multinomial models for data, odds ratios, and Pearson's chi-squared and likelihood ratio statistics.	K1 - K6
4	Identify the need for, the structure, and the usefulness of, generalized linear models. Fit and interpret the results of fitting, generalized linear models, including log-linear models (for example trend models) and logistic regression models.	K1 - K6
5	Obtain and fit good models in three-way situations using a Various Matched-Pair Models.	K1 - K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Contingency table analysis	12 hours

Introduction - Nature of Categorical data - Statistical inference for a proportion - Contingency Tables and their distribution: Binomial and Multinomial sampling - Table structure comparing proportions - Comparing proportions in two-by-two tables: Difference of proportions - Relative risk - Odds Ratio - Properties of Odds Ratio - relationship between Odds Ratio and Relative Risk

Unit:2	Measures of Association	12 hours

Nominal and Ordinal Measures of Association - Inference for Contingency tables: Interval estimation for difference of proportions, odds ratio, log odds ratio and relative risk - Testing Independence in Two-Way tables: Pearson and Likelihood-ratio chi-square tests - Yate's correction for continuity-Residuals for cells in a contingency table-Partitioning chi-squared - Trend tests for 2 x J tables - Testing Independence for Ordinal Data-Fisher Exact Test for 2 x 2 tables - Exact Inference for small samples - Association in Three-Way Tables: Partial Tables - Marginal and conditional and Odds Ratios - Homogeneous Association - Cochran-Mantel-Hansel methods

Unit:3	Logistic regression	12 hours

Logit models for Binary data-Binomial GLM for 2 x 2 contingency tables - Logistic regression: Interpreting logistic regression - Inference for logistic regression - Maximum likelihood estimate - test of overall regression and goodness of fit - Deviance statistic, Wald test, LR test, Score test- Logistic regression diagnostics - Multiple Logistic Regression

Unit:4	Logit models for multinomial responses	12 hours
Nominal Responses: Baseline-Category Logit Model - Ordinal Responses: Cumulative Logit Models - Ordinal Responses: Cumulative Link Models - Alternative Models for Ordinal Responses		
Unit:5	**Log linear models for contingency tables**	**12 hours**
Log linear Models for Two-Way Tables - Log linear Models for Independence and Interaction in Three-Way Tables - Inference for Log linear Models - Log linear Models for Higher Dimensions		

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**62 hours**

Books for Study

1	Agresti, A. (2013): Categorical data analysis, John Wiley & Sons, 3rd edition.
2	McCullagh, P. and Nelder, J.A. (1991): Generalized Linear Models, Chapman and hall, London, 2nd edition.
3	Draper NR and Smith H (1998): Applied Regression Analysis, John Wiley & Sons, 3rd edition.
4	Hosmer D., Lemeshow S., Sturdivant RX (2013). Applied Logistic Regression, ISBN-13: 978-0470582473ISBN-10: 0470582472, 3rd edition.

BOOKS FOR REFERENCE

1	Agresti, A. (2007): An Introduction to Categorical data analysis, John Wiley & Sons, 2nd edition.
2	Armitage, P. and Berry, G. (2001): Statistical methods in Medical Research, Wiley Blackwell Scientific Publications, USA, 4th edition.
3	Deshpande, J.V., Gore, A.P. and Shanubhogue, A. (2022): Statistical Analysis of Non Normal Data, New Age International Publishers Ltd., New Delhi, Second edition.
4	Hardin, J.W., and Hilbe, J.M. (2012): Generalized Estimating Equation, Chapman and Hall, London, 2nd edition.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.coursera.org/courses?query=categorical%20data%20analysis
2	https://www.youtube.com/results?search_query=categorical+data+analysis

Course Designed By: Dr. R. Jaisankar

Practical

ourse code	24BST1P1	TITLE OF THE COURSE	L	T	P	C
Core: Practical		**Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/SYSSTATA – I**	**-**	**1**	**4**	**4**
Pre-requisite		Knowledge in Statistical Methods	**Syllabus Version**		**2024-25**	

Course Objectives

The main objectives of this course are to:

4. Provide intensive training in statistical computation using software
5. Impart knowledge in handling statistical data for analysis
6. Instill the students to familiarize with the application of statistical tools

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Use the software for various applications	K1-K6
2	Draw statistical graphs, charts and diagrams	K1-K6
3	Compute statistical measures using software	K1-K6
4	Perform statistical data analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

All the Exercise covered according to the theory papers studied in the FIRST semester

Total lecture hours	**62 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press, New York
2	Almquist, Y. B., Ashir, S., and Brännström, L. A Guide to SPSS: The Basics, Version 1.0.1, Stockholm University, Sweden.
3	Evans, M. (2009). MINITAB Manual, W.H. Freeman and Company, New York.
4	An Introduction to SAS University Edition ,Ron Cody ,II Edition(2018).
5	O'Rourke, N, Hatcher, L and Stepanski, E (2005): A Step-by-Step Approach to Using SAS for Univariate and Multivariate, Statistics,2ndEdition, SAS Press and John Wiley Sons Inc.
6	Learning SAS by Example: A Programmer's Guide, Second Edition Paperback – 2018
7	Crawley, M, J. (2012). The R Book, John Wiley and Sons Private Ltd., NY, 2nd Edition
8	Dalgaard, P. (2008). Introductory Statistics with R, Second Edition, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

Course Designed By: Dr. R. JAISANKAR

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Software Practical using SPSS and MINITAB shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of the four units with internal choice A candidate shall attend all the four questions, each of which shall carry 15 marks. The examination shall be conducted at the end of Semester I. Problems relating to the topics taught using statistical software namely SPSS and MINITAB shall form the basis for setting the question paper.

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST2P2	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/ SYSSTATA – II	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

7. Provide intensive training in statistical computation using software
8. Impart knowledge in handling statistical data for analysis
9. Instill the students to familiarize with the application of statistical tools

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Use the software for various applications	K1-K6
2	Draw statistical graphs, charts and diagrams	K1-K6
3	Compute statistical measures using software	K1-K6
4	Perform statistical data analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

All the Exercise covered according to the theory papers studied in the SECOND semester

Total lecture hours	**62 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press, New York
2	Almquist, Y. B., Ashir, S., and Brännström, L. A Guide to SPSS: The Basics, Version 1.0.1, Stockholm University, Sweden.
3	Evans, M. (2009). MINITAB Manual, W.H. Freeman and Company, New York.
4	An Introduction to SAS University Edition ,Ron Cody ,II Edition(2018).
5	O'Rourke, N, Hatcher, L and Stepanski, E (2005): A Step-by-Step Approach to Using SAS for Univariate and Multivariate, Statistics,2ndEdition, SAS Press and John Wiley Sons Inc.
6	Learning SAS by Example: A Programmer's Guide, Second Edition Paperback – 2018
7	Crawley, M, J. (2012). The R Book, John Wiley and Sons Private Ltd., NY, 2nd Edition
8	Dalgaard, P. (2008). Introductory Statistics with R, Second Edition, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

Course Designed by Dr. R. Muthukrishnan

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Software Practical using R shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of the four units with internal choice A candidate shall attend all the four questions, each of which shall carry 15 marks. The examination shall be conducted at the end of Semester II. Problems relating to the topics taught using statistical software namely R shall form the basis for setting the question paper.

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	24BST2P3	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Data Analysis Using R/SAS/SPSS/STATA/MINITAB/SYSSTATA – III	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2024-25	

Course Objectives

The main objectives of this course are to:

4. Provide intensive training in statistical computation using software
5. Impart knowledge in handling statistical data for analysis
6. Instill the students to familiarize with the application of statistical tools

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Use the software for various applications	K1-K6
2	Draw statistical graphs, charts and diagrams	K1-K6
3	Compute statistical measures using software	K1-K6
4	Perform statistical data analysis	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

All the Exercise covered according to the theory papers studied in THIRD semester

Total lecture hours	**62 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, Chapman & Hall/CRC Press, New York
2	Almquist, Y. B., Ashir, S., and Brännström, L. A Guide to SPSS: The Basics, Version 1.0.1, Stockholm University, Sweden.
3	Evans, M. (2009). MINITAB Manual, W.H. Freeman and Company, New York.
4	An Introduction to SAS University Edition, Ron Cody ,II Edition(2018).
5	O'Rourke, N, Hatcher, L and Stepanski, E (2005): A Step-by-Step Approach to Using SAS for Univariate and Multivariate, Statistics,2ndEdition, SAS Press and John Wiley Sons Inc.
6	Learning SAS by Example: A Programmer's Guide, Second Edition Paperback – 2018
7	Crawley, M, J. (2012). The R Book, John Wiley and Sons Private Ltd., NY, 2nd Edition
8	Dalgaard, P. (2008). Introductory Statistics with R, Second Edition, Springer

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

Course Designed by Dr. R. Muthukrishnan

Note: The maximum marks for continuous internal assessment and end semester University examination for Statistical Software Practical using SPSS and MINITAB shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of the four units with internal choice A candidate shall attend all the four questions, each of which shall carry 15 marks. The examination shall be conducted at the end of Semester II. Problems relating to the topics taught using statistical software namely SPSS and MINITAB shall form the basis for setting the question paper.

Mapping with Programme Outcomes										
Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	L	S	S	M	S	S	M	M
CO2	S	S	L	S	S	M	S	S	M	M
CO3	S	S	L	S	S	M	S	S	M	M
CO4	S	S	L	S	S	M	S	S	M	M
CO5	S	S	L	S	S	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Supportive Courses

Course Code		TITLE OF THE COURSE	L	T	P	C
Supportive		Descriptive Statistics	2	1	-	2
Pre-requisite		Basic mathematical computations	Syllabus Version		2023-24	

Course Objectives

The main objectives of this course are to:

1. Introduce the basics of statistics
2. Instil knowledge to compute statistical measures for analysing data
3. Instruct the basic theory and applications of probability

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the theory and applications of basic statistics	K1-K6
2	Compute statistical measures for decision making	K1-K6
3	Solve problems on basic probability	K2-K6
4	Perform correlation and regression analysis	K1-K6
5	Make interpretations of results from the derived results	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Statistics and Statistical Data	6 hours

Origin-Scope-Functions, limitations, uses and Misuses of statistics. Classification and Tabulationof data, Diagrammatic and graphic representation of data.

Unit:2	Basic Statistical Measures	6 hours

Measure of Central tendency–Measures of Dispersion-relative measures of dispersion-Skewnessand Kurtosis-Lorenz's curve.

Unit:3	Basic Notions of Probability	6 hours

Elementary Probability space-Statistical probability Axiomatic approach to probability-Finitely additive and countable additive probability functions-Addition and multiplication theorems- Conditional probability-Bayes theorem-Simple problems.

Unit:4	Random Variables and Probability Functions	6 hours

Random variables-Discrete and continuous random variables-Distribution function and probability density function of a random variable-Expectation of a random variable-Addition and product theorems-Evaluation of standard measures of location, dispersion, Skewness and Kurtosis.

Unit:5	Correlation and Regression	6 hours

Simple linear correlation and regression-Regression equations-their properties spearman's Rank correlation Co-efficient.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**32 hours**
Books for Study		
1	Goyal, J. K., and Sharma, J. N. (2014), Mathematical Statistics, Krishna Prakashan Private	
	Limited, Meerut.	
2	Gupta, S. P. (2012). Statistical Methods, Sultan Chand & Sons, New Delhi.	
3	Gupta, S C., and Kapoor, V. K. (2018). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand & Sons, New Delhi.	
Reference Books		
1	Goon, A. M., Gupta, M. K., and Das Gupta, B. (2013). Fundamentals of Statistics, Vol.1, World Press Private Ltd, Calcutta.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/111/105/111105041/	
2	https://nptel.ac.in/courses/111/106/111106112/	
Course Designed By: Dr. R. Jaisankar		
	Limited, Meerut.	
2	Gupta, S. P. (2012). Statistical Methods, Sultan Chand & Sons, New Delhi.	
3	Gupta, S C., and Kapoor, V. K. (2018). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand & Sons, New Delhi.	
Reference Books		
1	Goon, A. M., Gupta, M. K., and Das Gupta, B. (2013). Fundamentals of Statistics, Vol.1, World Press Private Ltd, Calcutta.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/111/105/111105041/	
2	https://nptel.ac.in/courses/111/106/111106112/	
Course Designed By: Dr. R. Jaisankar		
Mapping with Programme Outcomes		

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	L	M	M	M	M	L	L
CO2	S	S	M	L	M	M	M	M	L	L
CO3	S	S	M	L	M	M	M	M	L	L
CO4	S	S	M	L	M	M	M	M	L	L
CO5	S	S	M	L	M	M	M	M	L	L

*S-Strong; M-Medium; L-Low

Course Code	TITLE OF THE COURSE	L	T	P	C
Supportive	Statistical Methods for Biologists	2	1	-	2
Pre-requisite	Basic mathematical computations	Syllabus Version		2023-24	

Course Objectives

The main objectives of this course are to:

1. Introduce the basics of biostatistics
2. Instil knowledge to compute statistical measures for analysing data
3. Instruct the applications of statistical methods for biological problems

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Understand the theory and applications of basic statistics	K1-K6
2	Compute statistical measures for decision making	K2-K3
3	Formulate hypotheses and perform statistical analysis for biological problems	K1-K6
4	Perform analysis of variance for experimental designs	K1-K6
5	Make interpretations of results from the derived results	K1-K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Statistical Data, Classification and Tabulation	6 hours

Nature of Biological and Clinical experiments of data-Classification and tabulation of data-Diagrammatic representation of data- Histogram and frequency curves

Unit:2	Basic Measures of Statistics	6 hours

Measures of Central tendency-Mean, Median, Mode, Geometric mean, Harmonic Mean- Measuresof deviation – Range, Mean deviation, Quartile and standard deviation – Measures of Skewness and Kurtosis.

Unit:3	Correlation and Regression	6 hours

Correlation : Rank Correlation – Multiple and Partial Correlation – Regression – Regression equations for biological problems.

Unit:4	Basic Sampling Methods	6 hours

Basic concepts of sampling – Simple random sample – Stratified sample – systematic sample – cluster sample. Test of significance based on large sample – Mean, Variance and Proportions.

Unit:5	Analysis of Variance and Basic Experimental Designs	6 hours

Analysis of variance –One way and Two way classifications – Completely Randomized blocks – Randomized Block design and Latin Square Design (Simple problems based on biological data)

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	32 hours

Books for Study	
1	Lewis, A. E. (1984). Biostatistics, Van Nostrand Reinhold Publications.
2	Campbell, R. C. (1967): Statistics for Biologists, University Press, Cambridge, UK.
3	Kapur, J. N., and Saxena, H. C. (1986). Mathematical Statistics, S. Chand & Co., Ltd., New Delhi.
Reference Books	
1	Pagano, M., and Gauvrean, K. (2018). Principles of Biostatistics, Second Edition, Chapmanand Hall/CRC Press, NY.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/102/106/102106051/
2	https://nptel.ac.in/courses/102/101/102101056/
Course Designed By: Dr. R. Jaisankar	
Mapping with Programme Outcomes	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	L	M	M	M	M	M	S
CO2	S	S	M	L	M	M	M	M	M	S
CO3	S	S	M	L	M	M	M	M	M	S
CO4	S	S	M	L	M	M	M	M	M	S
CO5	S	S	M	L	M	M	M	M	M	S

*S-Strong; M-Medium; L-Low

Annexure

BHARATHIAR UNIVERSITY, COIMBATORE - 641 046

BRANCH II - STATISTICS

M.Sc., Statistics / M.Sc. Biotatistics

(Choice Based Credit System)

(For the candidates admitted during the academic year 2024 – 2026 and onwards)

Objective of the Course

The course aims to instill and inspire the domain knowledge on theoretical and applied aspects of Biotatistics in a broader spectrum. It intends to impart awareness on the importance of the conceptual framework of Biostatistics across diversified fields and to afford practical training on the applications of statistical methods for carrying out analysis of data using sophisticated statistical software like SAS, SYSTAT, SPSS, etc., and using the programming knowledge in R and C++. The course curriculum has been designed in such a way to cater the needs of the stakeholders to get placements in industries and institutions on successful completion of the course and to provide them ample skill and opportunities to meet the challenges at the national level competitive examinations like CSIR NET in Mathematical Sciences, SET, Indian Statistical Service (ISS) of UPSC, etc.

Eligibility Criteria for Admission

A candidate who has acquired a degree in B.Sc., Statistics or B.Sc., Mathematics with Statistics as an allied / ancillary subject or as one of the subjects or B. Sc., in Mathematics with Computer Applications having Statistics as one of subjects shall be permitted to join M. Sc., STATISTICS course.

A candidate who has acquired a degree in B.Sc., Statistics or B.Sc., Mathematics with Statistics as an allied / ancillary subject or as one of the subjects or B. Sc., Mathematics with Computer Applications having Statistics as one of subjects or B.Sc., in Computer Science with Statistics as one of the subjects or B.C.A., with Statistics as one of the subjects shall be permitted to join M. Sc., BIOSTATISTICS course.

Duration of the Course

The duration of the M. Sc., STATISTICS / M. Sc., BIOSTATISTICS course is two years which comprise of four semesters. A candidate who has been admitted to the course shall appear all the four semester examinations during the course of study. On successful completion of all the examinations, he / she shall qualify himself/herself for the award of the degree in M.Sc., STATISTICS or M. Sc., BIOSTATISTICS.

Pattern of Choice Based Credit System

The course of study shall be based on the pattern of Choice Based Credit System (CBCS) with continuous internal assessment and comprehensive external assessment. The comprehensive external assessment shall be done at the end semester University examination. The odd semester shall begin in July and the even semester shall begin in December. Each candidate shall earn a minimum of 100 credits, which include non-scholastic courses, viz., one online SWAYAM/MOOC course of 2 credits, two value added courses each with 2 credits and two job oriented courses each with 2 credits. The non-scholastic courses shall not be considered for computing CGPA (Cumulative Grade Point Average).

The break-up of total credits for theprogramme shall be as given under:

Core Papers – Theory	13 x 4 Credits = 52 Credits
Core Papers – Practical	04 x 4 Credits = 16 Credits
Elective Papers	03 x 4 Credits = 12 Credits
Core: Project/Dissertation	01 x 4 Credits = 04 Credits
Supportive Papers	02x3Credits= 06 Credits
SWAYAM/MOOC Online Course	01 x 2 Credits = 02 Credits
Value Added Courses	02 x 2 Credits = 04 Credits
Job Oriented Courses	02 x 2 Credits = 04 Credits

Components for Internal Assessment

Tests, assignments, seminars and attendance shall be the components for continuous internal assessment. A maximum of 25 marks shall be allotted under continuous internal assessment in each theory paper offered by the Department. The distribution of marks is as givenunder:

Marks for Tests	15
Marks for Assignments / Seminar	: 05 (Average of Assignment and
Seminar Marks)Attendance	05

Distribution of Marks for Attendance

90% and above	: 5 Marks
Between 85% and 90%	: 4 Marks
Between 80% and 85%	: 3 Marks
Between 75% and 80%	: 2 Marks
Between 70% and 75%	: 1 Mark

Distribution of Continuous Internal Assessment Marks for Core - Practical Paper

Record Work	: 25 Marks
Test	: 10 Marks
Attendance	: 05 Marks

Award of Degree

A candidate who secures a minimum of 50% of marks in the continuous internal assessment as well as in the end semester University examination and also a minimum of 50% ofmarks in aggregate comprising both continuous internal assessment and end semester University examination in each paper shall be declared to have passed the course for the award of the degreein M.Sc., Statistics or M.Sc., Statistics (with Computer Applications).

A candidate who secures a minimum of 7.5 out of 10 CGPA (Cumulative Grade Point Average) and above in aggregate comprising both continuous internal assessment and end semester University

examination shall be declared to have passed the examination in FIRST CLASS WITH DISTINCTION, if the candidate has passed all the examination prescribed for thecourse in the first appearance.

A candidate who secures a minimum of 6.0 out of 10 CGPA and above comprising both continuous internal assessment and end semester University examination in aggregate shall be declared to have passed the examination in FIRST CLASS.

A candidate who clears all the papers prescribed for the course in the FIRST APPEARANCE shall be eligible for Ranking/Distinction.

Pattern of Question Paper – (for core - theory and elective subjects)

The question paper for each of the core and elective papers shall consist of three sections. While Section A shall contain 10 objective type questions, Section B and Section C shall contain questions of descriptive nature. Internal choice (either / or type) shall be given in Section B and Section C. In Section A, there shall be two questions each with four multiple choices from each of the five units. In Sections B and C, there shall be one question with internal choice (either/or type) from each of the five units. The composition of the question paper shall be as given below:

Time: Three Hours Max.Marks: 75

Section A – (10 x 1 = 10)
Answer *All* the questions
Each question carries *one* mark

Choose the correct answer

Q. No.1. – Q. No. 10 - Objective questions with four multiple choices

Section B – (5 x 5 = 25)

Answer all the questions
Each question carries *five* marks
Q. No. 11 – Q. No. 15 - Questions with internal choices(either (a) or (b) type)

Section C – (5 x 8 = 40)
Answer all the questions Each question carries *eight* marks

Q. No. 15 – Q. No. 20 - Questions with internal choices (either (a) or (b) type

Pattern of Question Paper – (for core – practical subjects)

The question paper for each of the core - practical papers (Statistics Practical I and II, Programming Lab I and II, Statistical Software Practical using SPSS and MINITAB, and Statistical Software Practical using R shall consist of four questions with internal choice. The maximum marks for

each of the practical papers shall be 60. A candidate shall attend all the four questions, each of which shall carry 15 marks. The composition of the question paper shall be as given below:

Time: Three Hours Max. Marks: 60

Answer all the questions

Each question carries *fifteen* marks

Q. No. 1 – Q. No. 4 - Questions with internal choices (either (a) or (b) type)

Pattern of Question Paper – (for supportive subject)

The question paper for each of the supportive papers shall consist of three sections. While Section A shall contain 5 objective type questions, Section B and Section C shall contain questions of descriptive nature. Internal choice (either / or type) shall be given in Section B and Section C. In Section A, there shall be one question each with four multiple choices from each of the five units. In Sections B, there shall be one question with internal choice (either/or type) from each of the five units and in Section C, there shall be three questions with internal choice (either/or type from all the five units. The composition of the question paper shall be as follows:

Time: Two Hours Max. Marks: 38

Section A – (5 x 1 = 5)

Answer All the questions

Each question carries one mark

Q. No.1. – Q. No. 5 - Objective questions with four multiple choices

Section B – (5 x 3 = 15)

Answer all the questions

Each question carries three marks

Q. No. 6 – Q. No. 10 - Questions with internal choices (either (a) or (b) type)

Section C – (3 x 6 = 18)

Answer all the questions

Each question carries six marks

Q. No. 11 – Q. No. 13 - Questions with internal choices (either (a) or (b) type)

M. Sc., Biostatistics

Syllabus

(with effect from 2024 – 26)

Program Code: STAB

DEPARTMENT OF STATISTICS

Bharathiar University

(A State University, Accredited with "A^{++}" Grade by NAAC and 21th Rank among Indian Universities by MHRD-NIRF)

Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY, COIMBATORE 641046

DEPARTMENT OF STATISTICS

MISSION

The Department of Statistics aims to instill and inspire the domain knowledge on theoretical and applied aspects of Statistics in a broader spectrum. It intends to impart awareness on the importance of the conceptual framework of statistics across diversified fields and to afford practical training on the applications of statistical methods for carrying out analysis of data using sophisticated statistical software. The curriculum of post-graduate programme of the Department is designed in such a wayto cater the needs of the stakeholders to get placements in industries and institutions on successful completion of the course and to provide them ample skill and opportunities to meet the challenges at the national level competitive examinations. The departments strive to enhance its potentials and capabilities to provide good quality education in statistics by acquiring recognition of the funding agencies.

BHARATHIAR UNIVERSITY, COIMBATORE 641 046

BRANCH II – STATISTICS

Course Title: M.Sc. Biostatistics | Course Code: BSTA
(For the candidates admitted during 2024 - 2025 and onwards)

List of Core/Elective/Supportive Subjects to be offered

CORE SUBJECTS

1. Probability and Distribution Theory
2. Sampling Theory and Methods
3. Epidemiology and Clinical trials
4. Statistical Data Analysis Using R/SAS/SPSS/STATA – I
5. Statistical Estimation Theory
6. Survival Analysis
7. Applied Multivariate Statistical Analysis
8. Testing Statistical Hypotheses
9. Statistical Data Analysis Using R/SAS/SPSS/STATA – II
10. Linear Models and Design of Experiments
11. Applied Regression Analysis
12. Statistical Data Analysis Using R/SAS/SPSS/STATA – III

ELECTIVE SUBJECTS

1. Health Informatics
2. Demography and Vital Statistics
3. Categorical Analysis

VALUE ADDED COURSES

1. Design & Analysis of Clinical Trials
2. Systematic Review and Meta-analysis
3. Basics of Human Genetics and Genomics

JOB ORIENTED CERTIFICATE COURSES

2. Basics of Six Sigma Tools