M.Sc. BIOSTATISTICS

Syllabus

UNIVERSITY DEPARTMENT

Program Code: BSTA

2026 – 2027 onwards

BHARATHIAR UNIVERSITY

**(A State University, Accredited with "A++" Grade by NAAC,
Ranked 46th among Indian Universities by MHRD-NIRF)**

M. Sc. Biostatistics

Syllabus

(with effect from 2026 – 27)

Program Code: BSTA

DEPARTMENT OF STATISTICS

Bharathiar University

(A State University, Accredited with "A^{++}" Grade by NAAC and 46th 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 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. The departments strive to enhance its potentials and capabilities to provide good quality education in statistics by acquiring recognition of the funding agencies.

Program Educational Objectives (PEOs)	
On successful completion of the M. Sc. Biostatistics 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. Biostatistics 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. Biostatistics 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
BRANCH II – STATISTICS

Programme Title: M.Sc. Biostatistics | Programmee Code: BSTA
(For the candidates admitted during 2026 - 2027 and onwards)

List of Core/Elective/Supportive Courses to be offered

CORE Courses

1. Probability and Distribution Theory
2. Sampling Theory and Methods
3. Basic Epidemiology
4. Statistical Computing - I
5. Statistical Estimation Theory
6. Survival Analysis
7. Applied Multivariate Statistical Analysis
8. Research Design and Report Writing
9. Statistical Computing – II
10. Testing Statistical Hypotheses
11. Linear Models and Design of Experiments
12. Fundamentals of Clinical Trials
13. Mini Project
14. Statistical Computing - III
15. Self-Study
16. Internship/Project/Dissertation and Viva

ELECTIVE Courses

1. Health Informatics
2. Official Statistics
3. Robust Statistics
4. Demography and Vital Statistics
5. Applied Regression Analysis
6. Data mining and Big Data
7. Categorical Data Analysis
8. Machine learning using Python
9. Operations Research

VALUE ADDED COURSES

1. Elements of Actuarial Statistics
2. Systematic Review and Meta-Analysis
3. Basics of Human Genetics and Genomics
4. Data Analysis using STATISTICA
5. Disaster Management

JOB ORIENTED CERTIFICATE COURSES

1. Longitudinal Data Analysis
2. Basics of Six Sigma tools
3. Introduction to Machine Learning Techniques
4. Applied Spatial Statistics
5. Predictive Analytics

BHARATHIAR UNIVERSITY, COIMBATORE 641 046

M. Sc., Biostatistics Curriculum (University Department)

(For the students admitted during the academic year 2026 – 27 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
26BST13A	Probability and Distribution Theory	4	5	-	25	75	100
26BST13B	Sampling Theory and Methods	4	5	-	25	75	100
26BST13C	Basic Epidemiology	4	5	-	25	75	100
26BST13EA	Elective I	4	5	-	25	75	100
26BST1P1	**Statistical Computing – I**	4	-	5	25	75	100
Supportive	Offered By other Departments	2	2	-	12	38	50
	Total	**22**					**550**
SECOND SEMESTER							
26BST23A	Statistical Estimation Theory	4	4	-	25	75	100
26BST23B	Survival Analysis	4	4	-	25	75	100
26BST23C	**Applied Multivariate Statistical Analysis**	4	4	-	25	75	100
26BST23D	**Research Design and Report Writing**	4	4	-	25	75	100
26BST23EB	Elective II	4	4	-	25	75	100
26BST2P2	**Statistical Computing – II**	4	-	4	25	75	100
Supportive	Offered By other Departments	2	2	-	12	38	50
	Total	**26**					
THIRD SEMESTER							
26BST33A	**Testing Statistical Hypotheses**	4	4	-	25	75	100
26BST33B	Linear Models and Design of experiments	4	4	-	25	75	100
26BST33C	Fundamentals of Clinical Trials	4	4	-	25	75	100
26BST33EC	**Elective III**	4	4	-	25	75	100
26BST3MP	**Mini Project**	4	4	-	100	-	100
26BST3P3	**Statistical Computing - III**	4	-	4	25	75	100
Supportive	Offered By other Departments	2	2	-	12	38	50
	Total	**26**					**650**
FOURTH SEMESTER							
26BST4SS	Self-Study	4			100	-	100
26BST4IP	Internship / Project / Dissertation and Viva	**12**		-	75	225	300
	Total	**16**					**400**
	Grand Total	**90**					**2250**
CO-SCHOLASTIC COURSES - ONLINE COURSE							
	SWAYAM – MOOC Course	2					50
VALUE ADDED COURSES (VAC)							
	Course 1	2					50
	Course 2	2					50
JOB ORIENTED COURSES (JOC)							
	Course 1	2					50
	Course 2	2					50

SWAYAM – MOOC – online course shall be for a 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 Credits and Marks

	Courses						
	Core	Elective	Supportive	SWAYAM	VAC	JOC	TOTAL
Credits	72	12	06	02	04	04	100
Marks	1800	300	150	50	100	100	2500

First Semester

Course Code	26BST13A	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		2026-27	

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	12 hours

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'scentral 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 distributions 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 in1950),Second Printing, Springer-Verlag, NY.
5	Bhat,B.R.(2009).Modern Probability Theory–An Introductory TextBook, Third Edition(Reprint), New Age International Private Ltd., New Delhi.
6	Dhanavanthan. P, and K.M.Sakthivel (2025). Probability Distributions: A Comprehensive Approach, Ane Publishers and Distributors LLP, New Delhi
ReferenceBooks	
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., NewDelhi
4	Sheldon Ross(2007), Introduction to Probability Models,9thEd., Academic Press,Indian Reprint.
5	Robert V.Hogg, Joseph W.McKean and AllenT.Craig,Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
Related Online Contents [MOOC, SWAYAM, NPTEL,Websitesetc.]	
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	

Course Code	26BST13B	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		2026-27	

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 / Dr. S. Jayalakshmi

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	26BST13C	TITLE OF THE COURSE	L	T	P	C
Core		Basic Epidemiology	4	1	-	4
Pre-requisite		Basics of Health problems and Epidemics	Syllabus Version		2026-27	

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	Explain different study designs in epidemiology. Understand various cohort and case control studies in biostatistics.	K3,K5
5	Understand the concept of Concept of cause. Identifying the scope of prevention. Understand the basic concepts of clinical epidemiology.	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, History and evolution of epidemiology, Role of epidemiology in public health– Causation and Prevention in Epidemiology: Guidelines for causation –causation pie-Hill's Bradford model. The scope of Prevention – Levels of Prevention- Descriptive Epidemiology: Person, place, and time, Epidemic curves and patterns.

Unit:2	Epidemiology Measures and Assessing Risk Factors	12 hours

Rates, Ratios and Proportion - Prevalence and Incidence, Cumulative incidence and incidence rate: Association between Prevalence and Incidence, Uses of Prevalence and Incidence, Odds Ratio - Confidence interval for OR and statistical significance of OR; Relative Risk (RR) and confidence interval for RR- Attributable risk, Population attributable risk.

Unit:3	Clinical Epidemiology	12 hours

Clinical Epidemiology: Principles of screening, Definition, reliability, validity, sensitivity, specificity, predictive values, Likelihood ratio test, selection and interpretation of diagnostic test, Deciding on the best therapy, ROC curves, Area Under the curve, statistical significance of Area Under the Curve, multiple and parallel tests.

Unit:4	Types of Epidemiological Studies	12 hours

Observational and experimental studies – Descriptive studies – Ecological studies – Cross-Sectional studies – Case control studies, Cohort studies – Randomized controlled 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:5	Potential Errors in Epidemiological Studies	13 hours
Random error – Systematic error – Selection bias – Information bias - Measurement bias – The control of confounding – Validity.		

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/10665/43541/1/9251547073_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	Woodward M (2014). Epidemiology: Study design and data analysis. CRC press.

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. Jayalakshimi / Dr. S. Gandhiya Vendhan

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

Course code	26BST1P1	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Computing – I	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2026-27	

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 Courses studied in the FIRST semester

Total lecture hours **60 hours**

Reference Books

1	Landau, S., and Everitt, B.S. (2004). A Handbook of Statistical Analyses using SPSS, ~~Ch~~apman & 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. S. Gandhiya Vendhan / Dr.K.Pradeepa Veerakumari

Note

Problems relating to the topics which are covered in Semester I shall form the basis for setting the question paper using a spread sheet and a command based software (such as SPSS/MINITAB/SYSTAT etc. and R/Python/SAS etc.). The question paper at the end semester examination shall consist of the five questions with internal choice. A candidate shall attend all the five questions, each of which shall carry 15 marks.

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	26BST23A	TITLE OF THE COURSE	L	T	P	C
Core		Statistical Estimation Theory	4	1	-	4
Pre-requisite		Knowledge in Probability Theory and Probability Distributions	Syllabus Version		2026-27	

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, Bhattacharya inequality, 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	26BST23B	TITLE OF THE COURSE	L	T	P	C
Core		Survival Analysis	4	1	-	4
Pre-requisite		Basics of distribution theory And regression analysis	Syllabus Version		2026-27	

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 in real 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. S. Jayalakshmi / Dr. S. Gandhiya Vendhan

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	26BST23C	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		2026-27	

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 Analysis 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 - Plotting techniques- independent component analysis. Factor analysis: Objectives – The Orthogonal Factor Model- The orthogonal factor model – Estimation of factor loading – factor rotation – Estimation of factor scores - interpretation of factor analysis.

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 – Discrimination between two known populations – Bayes, Minimax and likelihood ratio procedures. 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		
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
5	K. V. Mardia, J. T. Kent, J. M. Bibby (1979), Multivariate Analysis, ISBN: 0125712509.

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/111/104/111104025/
2	https://nptel.ac.in/courses/111/105/111105091/
3	https://nptel.ac.in/courses/106/106/106106139/

Course Designed By: Dr. K. Pradeepa Veerakumari

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	26BST23D	TITLE OF THE COURSE	L	T	P	C
Elective		Research Design and Report Writing	4	1	-	4
Pre-requisite		Basics of Research	Syllabus Version		2026-27	

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 bio-statistical 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

Introduction to Research – Types of research - The scientific methods – significance – criteria of good research. Research process – Research Problems - role of research methods in business and industry. Limitations of research – Basic Principles. Major steps in the research process: Literature review, theoretical contexts, research hypothesis.

Unit:2	Research Designs	12 hours

Meaning of Research design, Need - Pure and applied research - Exploratory research studies in descriptive research - causal research - Field 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. Design of sample survey - Sampling techniques and sample size determination in research problem.

Unit:3	Measurement and Data collection	12 hours

Data Collection - Primary and Secondary data – Ethical issues - Self-report, observational, physiological measure, case study method. Projective techniques: Recodes and available data, Questionnaires and interview schedules, designing self- Report instruments, scales, response bias. Pilot survey, scaling techniques, validity and reliability.

Unit:4	Data Analysis	12 hours

Data preparation – Descriptive statistics – Bivariate and Multivariate methods for data analysis - preliminary Data Analysis – Case studies.

Unit:5	Research Report Writing and Interpretation	12 hours

Significance of report writing, Types of report- Technical report, popular report, different steps in report writing, Layout of research report, mechanics of writing a research report. Research report using 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 – plagiarism – meaning of Interpretation – techniques – precautions.

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	Kothari, C.R. and Gaurav Garg (2017): Research Methodology: Methods and Techniques, New Age International Publishers, Reprint, New Delhi
2	Ranjit Kumar (2011): Research methodology: A step by step for beginners, Sage publications, London
3	Yogesh kumar singh (2006): Fundamendals of research methodology in Statistics,

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
3	https://onlinecourses.nptel.ac.in/noc26_ge43/preview
Course Designed By: Dr. V. Kaviyarasu	

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	26BST2P2	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Computing – II	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2026-27	

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 Courses studied in the SECOND semester

Total lecture hours **60 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/ Dr.K.Pradeepa Veerakumari

Note

Problems relating to the topics which are covered in Semester II shall form the basis for setting the question paper using a spread sheet and a command based software (such as SPSS/MINITAB/SYSTAT etc. and R/Python/SAS etc.). The question paper at the end semester examination shall consist of the five questions with internal choice. A candidate shall attend all the five questions, each of which shall carry 15 marks.

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	26BST33A	TITLE OF THE COURSE	L	T	P	C
Core		Testing Statistical Hypotheses	4	1	1	4
Pre-requisite		Distribution, Sampling and Estimation Theory	Syllabus Version		2026-27	

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	265S33B	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 Basics of Design of Experiments	Syllabus Version		2026-27	

The main objectives of this course are to:

1. To teach and understand the theoretical concepts of the general linear model with its types.
2. To make the students familiar with various experimental designs.
3. To make them to understand some advanced concepts of design of 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.	K1
3	Apply various designs of experiments in several practical situations and evaluate	K3
4	To do analyses which are specific to the objectives of the given experiment.	K4
5	Create new types of designs as per the requirements and study their behavior while proceeding to the research.	K5

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

Unit:1	**Linear Models and Comparisons test's**	**13 hours**

Linear Models - Assumptions on Error Components - Fixed/Mixed and Random effect Models – Generalized linear model - Gauss-Markov setup – Estimation of parameters – Testing of hypothesis - Least square method – MLE method - Gauss-Markov theorem - BLUE. Multiple Range Tests: Need – Tukey's Test – Fisher's LSD method, DMRT, Neyman-Kauls test.

Unit:2	**Basic Designs and factorials experiments**	**13 hours**

Principles of Experimentation - Review of Basic Designs with their merits and limitations – Missing plot techniques - Greco and Hyper Greco LSD - Analysis of Covariance – One-way and two-way analysis – Introduction to Factorial Experiments – Advantages and limitations – main effects and interaction effects – 2^n and 3^n systems - Asymmetrical Factorial Experiments.

Unit:3	**Confounding and Fractional factorial experiments**	**12 hours**

Introduction to confounding - advantages and limitations – Total and partial confounding in symmetrical designs and its constructions. Concept of Fractional Replication in Symmetrical Factorial experiments - 1/2 and 1/4 replicates of 2^n , 1/3 replicate of 3^n experiments - Construction and Analysis of the design.

Unit:4	**Other designs and Response surface**	**12 hours**

Introduction to Split-plot design – Strip plot design – Cross over design – Nested design with its analysis – Design of Bio-assays – Direct and Indirect methods - Concept of response surface experiments - First order Response surface designs – Second-order Response surface designs - steepest ascent method.

Unit:5	**Incomplete Block Designs**	**10 hours**
Incomplete Block Designs, Incidence matrix and its properties, C- matrix and its significance - Concept of Connectedness and Orthogonality of block design – Balanced Incomplete Block Design - parametric relationships – inter and intra block analyses. Partially Balanced Incomplete Block Design and its analysis – Two-associate - Youden Square Design – Concept of Simple and Balanced Lattice Designs.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**62 hours**

Text Book(s)

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	Federer, W. T. (1967). Experimental Design: Theory and Application, Indian Edition, Oxford and IBH Publishing Co., New Delhi.
5	Peterson, R. G. (1985). Design and analysis of experiments, Marcel Dekker, NY.

Reference Books

1	Paneerselvam, R. (2012). Design and Analysis of Experiments, PHI Learning Private Ltd., New Delhi.
2	Kempthorne, O. (1965). The Design and Analysis of Experiments, Wiley Eastern India Limited, New Delhi
3	Cochran, W.G. and Cox, G.M. (1992). Experimental Designs, Second Edition, John Wiley & Sons, New york.
4	John, P.W.M. (1971). Statistical Design of Experiments, Macmillan Co., NY.
5	Fisher, R.A. (1966). The Design of Experiments, 8th Edition, Oliver and Boyd, London.

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

1	https://onlinecourses.nptel.ac.in/noc21_mg48/preview
2	https://home.iitk.ac.in/~shalab/spanova.htm
3	https://onlinecourses.nptel.ac.in/noc20_bt11/preview

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	26BST33C	TITLE OF THE COURSE	L	T	P	C
Core		Fundamentals of Clinical Trials	4	1	-	4
Pre-requisite		Basics of Clinical Trials	Syllabus Version		2026-27	

Course Objectives

The main objectives of this course are to:

1. Understand Basics of Clinical Trails
2. Understand design and analysis of clinical trials and the concept of meta-analysis in clinical trials.

Expected Course Outcomes

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

Understand the need for ethics of clinical trial. Describe different types of forms used in clinical trial.	K2
Understand about different types of errors that occur during the conduct of clinical trial. Have a clear idea on clinical practice and clinical data management.	K2,K3
Understand about different types of randomization procedures used in clinical trials. Have an idea on different types of blinding. Describe different types of designs used in clinical trials	K1,K4
Describe multi-center trials. Have a clear idea on reporting and interpreting of results in a clinical trial. Describe surrogate endpoints.	K3,K5
Understand different types of bioassay and their analysis. Describe meta-analysis.	K5,K6

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

Unit:1	Introduction to Clinical Trials	12 hours

Introduction to clinical trials: Basic Concepts, Definition, Need and Ethics of clinical trials, Bias and Random error in clinical trials, Conduct of clinical trials, Design of Phase- I to IV trials, Single and Multi – Center trials. Concepts of blinding, Randomization techniques.

Unit:2	Design of Clinical Trials	12 hours

Parallel group designs, Crossover designs, Symmetric designs, Adaptive designs, Group sequential designs, Zelen's designs, design of bioequivalence trials. Outcome measures. Type of control, design of studies with matched and unmatched controls, end points of clinical trials.

Unit:3	Statistical Analysis in Clinical Trials	12 hours

Sample size determination in one and two sample cases, comparative trials, activity studies, and for ANOVA. Selection and design of trials with surrogate end points, analysis of surrogate end point data.

Unit:4	Meta-Analysis in Clinical Trials	12 hours

Meta-analysis in clinical trials: Concept and goals, fixed and random effect approaches. Bioassay: Direct and indirect assays, Quantal and quantitative assays, Parallel line and slope ratio assays, Design of bioassays.

Unit:5	Planning and Conduct of Clinical Trials	13 hours

Protocol development, Multicenter Trials: Reasons for Multicenter Trials, Conduct of Multicenter Trials, Deviations from protocol, Stopping rules, Considerations of adverse effects and non- compliance.

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	Evans S, Ting N (2016). Fundamental concepts for new clinical trialists. CRC Press.
2	Friedman LM, Furberg C, DeMets DL, Reboussin DM, Granger CB (2015). Fundamentals of clinical trials. New York: Springer.
3	Hackshaw A (2025). A concise guide to clinical trials. John Wiley & Sons.
4	Shih WJ, Aisner J (2015). Statistical design and analysis in clinical trials. CRC Press.
5	Chen, D.G. and Peace, K.E. (2011). Clinical Trial Data Analysis Using R. Chapman &Hall
6	Kulinskaya E, Morgeathaler S, Staudte R G (2008). Meta-analysis, Wiley.
Reference Books	
1	Das, M. N. and Giri (2008). Design of Experiments, New Age, India
2	Jennison and B.W. Turnbull (1999): Group Sequential Methods with Applications to Clinical Trials, CRC Press.
3	Dmitrienko A (2017), Pulkstenis E. Clinical Trial Optimization Using R. CRC Press.
4	Hayes RJ, Moulton LH (2017). Cluster randomized trials. CRC Press.
5	Korosteleva O (2008). Clinical Statistics: introducing clinical trials, survival analysis and longitudinal data analysis. Jones and Bartlett Publishers.
6	Borenstein M, Hedges LV, Higgins JPT, Rothstein HR (2009). Introduction to Meta-Analysis, Wiley.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.my-mooc.com/en/mooc/clintrials
2	https://www.mooc-list.com/tags/clinical-trials
3	https://clinicaltrials.gov/
Course Designed By: Dr. S. Gandhiya Vendhan / Dr. S. Jayalakshmi i	

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

Course code	26BST3P3	TITLE OF THE COURSE	L	T	P	C
Core: Practical		Statistical Computing - III	-	1	4	4
Pre-requisite		Knowledge in Statistical Methods	Syllabus Version		2026-27	

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 Courses studied in THIRD semester

Total lecture hours **60 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. Problems relating to the topics which are covered in Semester III shall form the basis for setting the question paper using a spread sheet and a command based software (such as SPSS/MINITAB/SYSTAT etc. and R/Python/SAS etc.). The question paper at the end semester examination shall consist of the five questions with internal choice. A candidate shall attend all the five questions, each of which shall carry 15 marks.

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	26BST3MP	TITLE OF THE COURSE	L	T	P	C
Core		Mini Project	4	1	-	-
Pre-requisite		Knowledge in applied statistical methods	Syllabus Version		2026-27	

All the admitted candidates shall have to carry out mini project work during the third 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 mini project work at the end of the third semester. The report shall be evaluated internally by the department Faculty/Guide. The maximum marks for the report shall be fixed as 100, which is split with the following components:

Evaluation of Report by the Guide : 50 marks
Presentation **:** 25 Marks
Viva : 25 Marks

Note: Mini Project report to be evaluated by the Department Faculty (Internal Evaluation only)

Fourth Semester

Course code	26BST4SS	TITLE OF THE COURSE	L	T	P	C
Core		Self-Study	4	1	-	-
Pre-requisite		Knowledge in statistical theory and methods	Syllabus Version		2026-27	
The self-study report should be submitted by the candidates on the specific topics like Bayesian Inference, Robust Inference, Machine Learning techniques, Artificial Tools, Data Mining, Spatial Epidemiology etc.,						

Note: Self-Study report to be evaluated by the Department Faculty (Internal Evaluation only)

Course code	26BST4IP	TITLE OF THE COURSE	L	T	P	C
Core		Internship / Project / Dissertation and Viva	4	1	-	-
Pre-requisite		Knowledge in statistical theory methods	Syllabus Version		2026-27	

All the admitted candidates shall have to carry out internship/project/dissertation work during the fourth semester under the supervision of the faculty of the Department of Statistics in the University. Candidates may be given Three months' duration for internship/data collection for their project during the IV semester of study. Candidates shall have to submit three copies of the report of the internship/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 internship/project/dissertation report and viva – voce examination shall be fixed as 300, which is split with the following components:

Internal Assessment Marks by the Guide : 75 marks
(For Internship students: Guide: 50 Marks + Hospital/Institution's Supervisor: 25 Marks)

External Assessment
Evaluation of Report jointly by the Guide and External Examiner : 150 marks

Conduct of Viva-Voce Examination jointly by the External Examiner and Guide : 75 marks

Elective Courses

Course Code	26BST_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Health Informatics	4	1	-	4
Pre-requisite		Health related data handling	Syllabus Version		2026-27	

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. S. Gandhiya Vendhan / Dr. S. Jayalakshmi

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	26BST_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Official Statistics	4	1	-	4
Pre-requisite		Basic notions of health, social and economic sectors	Syllabus Version		2026-27	

Course Objectives

The main objectives of this course are to:

1. Understand the functioning of government and policies.
2. Promote human resource development in the official statistics and encourage research and development in theoretical and applied statistics.
3. Execute the data handling tasks in various government records

Expected Course Outcomes

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

1	Understand the fundamentals of measurement in official statistics	K1
2	Evaluate the methods for data collection, analysis and interpretation of health, social and economic.	K2
3	Use appropriate methods for presenting and preparing commentaries on official statistics.	K3,K4
4	Execute the tasks in agricultural and economic statistics	K5
5	Overcome the limitations that arises from measurement and processes of statistical production.	K6

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

Unit:1	Statistical System in India	12 hours

Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO). Organization of large scale sample surveys. General and special data dissemination systems.

Unit:2	Official Statistics	12 hours

Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications - Banking and finance.

Unit:3	Agricultural and Social Statistics	12 hours

System of Collection of Agricultural Statistics - Crop forecasting and estimation - Productivity, fragmentation of holdings - Support prices - Buffer stocks - Impact of irrigation projects**.** Statistics related to industries, foreign trade - Balance of payment - Inflation - Social statistics.

Unit:4	Index Numbers	12 hours

Index Numbers: Price, Quantity and Value indices. Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers, Chain Index Number. Consumer Price Index, Wholesale Price Index and Index of Industrial Production – Construction of index numbers and uses.

Unit:5	National Income	12 hours

National Income – Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India. Measurement of income inequality: Gini's coefficient, Lorenz curves, Application of Pareto and Lognormal as income distribution.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

Total Lecture Hours **62 hours**

Books for Study

1	Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan.
2	C. S. O. (1990). Basic Statistics Relating to the Indian Economy.
3	C.S.O. (1995). Statistical System in India.
4	C. S. O. (1999). Guide to Official Statistics.
5	Mukhopadhyay, P. (2011). Applied Statistics, Second Edition, Books & Allied Ltd, India.

Reference Books

1	Bhaduri, A. (1990). Macroeconomics: The Dynamics of Commodity Production, Macmillan India Limited, New Delhi.

2	Branson, W. H. (1992). Macroeconomic Theory and Policy, Third Edition, Harper Collins
3	Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol. 2, World
4	Panse, V. G. (1964). Estimation of Crop Yields (FAO), Food and Agriculture Organization of
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.classcentral.com/course/swayam-macro-economics-19942
2	https://www.classcentral.com/course/swayam-economics-of-health-and-health-care-14023
Course Designed By: Dr. S. Jayalakshmi / Dr. S. Gandhiya Vendhan	

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

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

Course Code	26S_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Robust Statistics	4	1	-	4
Pre-requisite		Sampling, Distribution, Estimation, Testing of Hypotheses, Design of Experiments, Multivariate Statistics	Syllabus Version		2026-27	

Course Objectives:

The main objectives of this course are to:

1. Know various assumptions and limitations of existing statistical procedures
2. Impart knowledge on normality assumption and outlier detection
3. Understand the basics of robust statistics in the context of measures of location and scale
4. Inculcate various robust statistics under univariate, multivariate and regression procedures
5. Impart basic knowledge on data depth

Expected Course Outcomes:

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

1	Visualize the data by conventional and modern methods	K1-K4
2	Compute various statistical measures by using robust methods	K1-K5
3	Fit a model by applying suitable conventional / robust procedures	K1-K6
4	Make inferences about population parameters based on random samples.	K3-K6
5	Solve real life problems by applying suitable conventional / robust statistical procedures.	K3-K6

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

Unit:1	Introduction	12 hours

History of Normal Distribution – Normal curve - problems with assuming normality - detecting outliers – basic idea of robust statistics - tools for judging robustness –qualitative, quantitative, and infinitesimal robust ness - influence function, breakdown point, maximum asymptotic bias.

Unit:2	Measure of location and scale	12 hours

Measures of location and scale – quantiles - trimmed means – winsorized mean – M-estimates of location - dispersion estimates – median absolute deviation - M-estimates of scale – properties of M-estimates – influence function, breakdown point, maximum bias, and asymptotic normality – outlier detection methods - concept of L-estimates and R-estimates.

Unit:3	Statistical Inference	12 hours

Confidence interval and tests - student's t and non-normality - basic bootstrap methods – percentile method – bootstrap t method — inferences about the population trimmed mean – inferences based on M-estimates.

Unit:4	Linear Regression	12 hours

Review of Least Square method – Least Median of Squares – Least Trimmed Squares - Regression M-estimates – robust tests for linear hypothesis – robust test using M-estimates – regression quantiles – equvariance property of regression estimate.

Unit:5	Multivariate Statistics	12 hours

Visualization of multivariate data – Outlier detection methods – Robust measures of location vector and scatter matrix – Multivariate M-estimators of location and scatter – High breakdown estimators of multivariate location and scatter - Minimum Volume Ellipsoid estimator – Minimum Covariance Determinant estimator – affine equivariance property of multivariate estimators - Mahalanobis distance – Robust distance - Concept of data depth.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture Hours	62 hours

Text Book(s)

1	Huber (1981). Robust Statistics, Wiley
2	Jana Jureckova and Jan Picek (2006). Robust Statistical Methods with R, Chapman & Hall/CRC
3	Wilcox, R.R. (2010). Fundamentals of Modern Statistical Methods, Springer.
4	Wilcox, R.R. (2017). Introduction to Robust Estimation and Hypothesis Testing, Elsevier.

Reference Books	
1	Wilcox(2009). Basic Statistics, Oxford University Press.
2	Rohatgi, V. K. (1976). Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons, NY.
3	Montgomery, D.C., Peck, E.A. and Vining, G.G. (2011). Introduction to linear regression analysis, Wiley
4	Shevylyakov, G.L.and H.Oja (2016). Robust Correlation: Theory and Applications, Wiley
5	Tiku, M.L. and Akkaya, A.D. (2004). Robust estimation and hypothesis testing, New Age International (P) Limited.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://www.stat.rutgers.edu/home/dtyler/ShortCourse.pdf
2	http://cmstatistics.org/CMStatistics2015/docs/WinterCourseAR_Regression.pdf?20180201194816
3	https://cseweb.ucsd.edu/~slovett/workshops/robust-statistics-2019/slides/donoho-univariate.pdf
4	https://cseweb.ucsd.edu/~slovett/workshops/robust-statistics-2019/slides/donoho-multivariate.pdf
5	https://cseweb.ucsd.edu/~slovett/workshops/robust-statistics-2019/slides/donoho-regression.pdf
Course Designed By: Dr. R. Muthukrishnan	

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

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

Course Code	26BST_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Demography and Vital Statistics	4	1	-	4
Pre-requisite		Fundamentals of vital data and their source	Syllabus Version		2026-27	

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	26BST_3E	TITLE OF THE COURSE	L	T	P	C
Elective		Applied Regression Analysis	4	1	-	4
Pre-requisite		Fundamentals of Linear Regression, Correlation and their Properties	Syllabus Version		2026-27	

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 mature of regression models	K1,K2
2	Construct linear and non-linear regression models	K2,K3
3	Test model assumptions and conditions	K3,K4
4	Identify appropriate test statistic and carryout tests of significance	K3.K5
5	Build logistic regression and generalized linear models	K2,K6

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

Unit:1	Simple Regression Models and Properties	12 hours

Simple regression models with one independent variable, assumptions, estimation of parameters, standard error of estimator, testing the significance of regression coefficients, standard error of prediction. Testing of hypotheses about parallelism, equality of intercepts, congruence. Extrapolation, optimal choice of independent variable.

Unit:2	Tests for Assumptions	12 hours

Diagnostic checks and correction: graphical techniques, tests for normality, uncorrelatedness, homoscedasticity, lack of fit, modifications like polynomial regression, transformations on Y or X. Inverse regression.

Unit:3	Multiple Regression Models and Properties	12 hours

Multiple regression: Standard Gauss Markov Setup. Least square (LS) estimation, Error and estimation spaces. Variance - Covariance of LS estimators. Estimation of error variance, case with correlated observations. LS estimation with restriction on parameters. Simultaneous estimation of linear parametric functions.

Unit:4	Non-linear Regression Models	12 hours

Non-linear regression: Linearization transforms, their use & limitations, examination of non-linearity initial estimates, iterative procedures for NLS grid search, Newton-Raphson, steepest descent, Marquardt's methods. Logistic Regression: Logic transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression.

Unit:5	Logistic Regression and GLM	12 hours

Multiple logistic regressions, forward, backward method. Interpretation of parameters relation with categorical data analysis. Generalized Linear model: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian and gamma.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

Total Lecture hours	62 hours

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.

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. (1989). Applied Linear Statistical Models, Second Edition, Irwin, IL.

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. Muthukrishnan / Dr S. Gandhiya Vendhan	

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

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

Course Code	26BST_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Data Mining and Big Data	4	1	-	4
Pre-requisite		Data, Data Structure and Data Source	Syllabus Version		2026-27	

Course Objectives

The main objectives of this course are to:

1. Understand the role of separate database for decision making.
2. Learn the core ideas of data mining techniques in different case studies.
3. Inculcate the concept learning and Machine learning theory.

Expected Course Outcomes

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

1	Get knowledge about database and their structure in social media	K1
2	Gain knowledge over the importance of KDD and Data Mining	K2
3	Apply data mining techniques in real world scenario.	K3
4	Explore the analyze of computational aspects in KDD Environment.	K4,K5
5	Develop a case studies on a different applications of data mining and Big data.	K6

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

Unit:1	Database and Data Visualization	12 hours

Introduction to Data - Growth in Data - Database - Data understanding and preparation - Structured, Semi structured and Unstructured data - Data Models - Data Warehouse - Operational data - Data Process - Data Visualization - Structure Query Language - Applications.

Unit:2	Knowledge Discovery Process	12 hours

Introduction to Data Mining – Definition - An expanding universe of data production factor – data mining verses query tools – data mining in marketing – practical applications. Learning: – self learning – machine learning– concept learning - decision support system – integration with data mining – client / server data warehousing – multi processing machine – cost justification.

Unit:3	Knowledge Discovery Environment	12 hours

Knowledge discovery process and KDD Environment: Introduction – data selection – cleaning – enrichment – coding – data mining and its techniques – reporting - ten golden rules.

Unit:4	Machine Learning	12 hours

Introduction to Classification, Prediction and Clustering - Decision Tree induction - Information Gain - Gini Index - Bayesian classification - Naive Baye's classifier - Linear and Non-Linear regression - Logistic regression - Partitioning Clustering - Hierarchical Clustering - Distance Measure - Density based clustering - Text Mining - Web Mining - Case studies.

Unit:5	Big Data Science	12 hours

Big data: What and Why — data science - convergence of key trends - structured, semi structured and unstructured data – industry examples of big data – Web analytics - big data and marketing – fraud and big data - risk and big data – credit risk management –big data and healthcare - Case studies.

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

Books for Study	
1	Adriaans, P., and Zantinge, D. (1996). Data Mining, First Edition, Addison Wesley Professional, London
2	Agneswaran, V. S. (2014). Big Data Analytics Beyond Hadoop, First Edition, Pearson FT Press.
3	Gupta, G. K. (2014). Introduction to Data Mining with Case Studies, Third Edition, PHI Learning Private Limited, New Delhi.

Reference Books	
1	Delmater, R., and Hancock, M. (2001). Data Mining Explained, Digital Press, MA.
2	Hand, D., Mannila, H., and Smyth, P. (2001). Principles of Data Mining, MIT Press, London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc20_cs92/preview
2	https://swayam.gov.in/nd2_cec19_cs01/preview
3	https://nptel.ac.in/courses/106/105/106105174/

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	S	S	S	S	S
CO2	S	S	L	S	S	S	S	S	S	S
CO3	S	S	L	S	M	S	S	S	M	M
CO4	S	S	L	S	M	M	S	S	M	M
CO5	S	S	L	S	M	S	S	S	M	M

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

Course Code	26BST_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Categorical Data Analysis	4	1	-	4
Pre-requisite		Attributes Classification and Hypothesis testing	Syllabus Version		2026-27	

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: 978-0470582573ISBN-10: 0470582572, 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. Muthukrishnan	

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

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

Course code	26S_3E_	TITLE OF THE COURSE	L	T	P	C
Elective		Machine Learning using Python	4	1	-	4
Pre-requisite		Knowledge in Basic Programming and Multivariate Analysis	Syllabus Version		2026-27	

Course Objectives:

The main objectives of this course are to:

1. Comfortably Perform basics operations in Python
2. Understand machine learning concepts
3. Explore and execute the machine learning concepts for real time data using Python

Expected Course Outcomes:

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

1	Perform basic operations and concepts in Python	K3
2	Understand and use the essential modules in Python	K3
3	Evaluate the scope and opportunities of machine learning	K5
4	Gain knowledge and hands-on training in machine learning techniques	K5
5	explore program skills for machine learning techniques	K6

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

Unit: 1	**Basics of Python**	**12 hours**
Type of variables, data types, lists, control statements, functions, classes, files and exceptions.		
Unit:2	**Essential Modules in Python**	**12 hours**
Jupyter Notebook, Numpy, Scipy, Matplotlib, Pandas, mglearn		
Unit:3	**Supervised Learning**	**12 hours**
Classification and Regression, k-Nearest Neighbors, k-Nearest Neighbors, Decision Trees, Neural Networks		
Unit:4	**Unsupervised Learning -1**	**12 hours**
Preprocessing and Scaling, Scaling training, Dimensionality Reduction, Feature Extraction, and Manifold Learning		
Unit:5	**Unsupervised Learning -2**	**12 hours**
Clustering: k- Means clustering, Agglomerative Clustering, DBSCAN		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture Hours	**62 hours**

Text Book(s)

1	Introduction to Machine Learning with Python – A Guide for Data Scientists by Andreas C. Muller & Sarah Guido(2017), O'Reilly
2	Machine Learning in Python : Essential Techniques for Predictive Analysis by Micheal Bowles (2015), Wiley
3	Python Crash Course : A hands-on, Project- Based Introduction to Programming by Eric Matthes(2016), no starch press

Reference Books

1	Python for Probability, Statistics and Machine Learning (second edition) (2019) by Jose Unpingco, Springer
2	Practical Statistics for Data Scientists(second edition)(2020) by Peter Bruce, Andrew Bruce & Peter Gedeck, O'Reilly

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

1	https://swayam.gov.in/nd1_noc20_cs29/preview
2	https://swayam.gov.in/nd1_noc19_cs59/preview
3	https://nptel.ac.in/courses/106/106/106106202/

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	M	S	M	S	S	S	M	M
CO2	S	S	M	S	M	S	S	S	M	M
CO3	S	S	M	S	M	S	S	S	M	M
CO4	S	S	M	S	M	S	S	S	M	M
CO5	S	S	M	S	M	S	S	S	M	M

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

Course Code	26BST_3E	TITLE OF THE COURSE	L	T	P	C
Core		Operations Research	4	1	-	4
Pre-requisite		Basic knowledge in operations research	Syllabus Version		2026-27	

Course Objectives

The main objectives of this course are to:

1. Understand the importance and concepts of optimization
2. Obtain the optimal solution for both linear and non-linear problem
3. Form and address solution to any real time optimization problem

Expected Course Outcomes

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

1	Form and Solve the linear programming problem	K4
2	Solve the integer programming problem	K3
3	Understand and evaluate the non-linear programming problem	K5
4	Design and develop inventory problem	K6
5	Explore and address the queueing problem	K4

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

Unit:1	Linear	12 hours

Review of linear programming problems – Simplex algorithm – Use of artificial variables - Two-phase method and Big-M method - Degeneracy in LPP. Duality – Interpretation of duality – Dual Simplex Method - Simple problems.

Unit:2	Integer and Dynamic Programming	12 hours

Integer programming problem (IPP) – Pure and mixed integer programming problems - Gomory's constraints and cutting plane algorithm - Mixed IPP – Branch and Bound technique. Dynamic programming problem (DPP) - Principle of optimality – Recursive equation approach Characteristics of DPP.

Unit:3	Non-linear Programming	12 hours

Non-Linear Programming (NLPP): Formulation of NLPP - Constrained optimization problems – Graphical solution - Kuhn-Tucker conditions. Quadratic Programming: Wolf's and Beale's methods

Unit:4	Inventory	12 hours

Analytic structure of Inventory Problems, Concept of economic order quantity, its sensitivity nalysis and extensions allowing quantity discounts and shortages, Deterministic and probabilistic inventory models - Models with random demand, and static risk models - Multi-item deterministic inventory problems.

Unit:5	Queueing Theory and Network Analysis	12 hours

Queueing systems, queueing models, classification of models - M/M/1, M/M/C and M/C/1 queues and their steady state solutions, Waiting Time Distributions for M/M/1 and M/M/C Models. Network scheduling by PERT/CPM, PERT: Basic components, determination of flows and critical path.

Unit:6	Contemporary	2 hours

Expert lectures, online seminars – webinars

	Total Lecture Hours	62 hours

Books for Study

1	Hillier, F. S. and Leiberman, G. J. (1990). Introduction to Operations Research, Fifth Edition,
2	Kanti Swarup, Gupta, P. K., and Man Mohan. (2017). Operations Research, Nineteenth Edition, Sultan Chand & Sons, New Delhi.
3	Taha, H. A. (1982). Operations Research: An Introduction, Third Edition, McMillan Publishing Co., Inc., London.
4	Sharma, S. D. (2017). Operations Research: Theory, Methods and Applications, Kedar Nath, R

Reference Books

1	Saaty, T. L. (1961). Elements of Queuing Theory, McGraw-Hill Co., NY.

2	Wagner, H. M. (1980). Principles of Operations Research with Application to Managerial Decisions, Second Edition, Prentice Hall India Learning Private Limited, New Delhi.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd2_cec20_ma10/preview
2	https://swayam.gov.in/nd1_noc19_ma29/preview
3	https://nptel.ac.in/courses/112/106/112406131/
4	https://nptel.ac.in/courses/112/106/112406134/
Course Designed By: Dr. K. M. Sakthivel / Dr. S. Jayalakshmi	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	L	S	M	S	L	L	M
CO2	S	S	M	L	S	M	S	L	L	M
CO3	S	S	L	L	S	M	S	L	L	M
CO4	S	S	M	L	S	M	S	L	L	M
CO5	S	S	S	L	S	M	S	L	L	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		2026-27	

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 Tabulation of 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-Skewness and 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.	
2.	Gupta, S.P and M.P. Gupta (2002). Business Statistics, Sultan Chand & Sons, New Delhi	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/111106112	
2	https://nptel.ac.in/courses/110107114	
3	https://nptel.ac.in/courses/111102160	
Course Designed By: Dr. V.KAVIYARASU		
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		2026-27	

Course Objectives

The main objectives of this course are to:

1. Introduce the basics of biostatistics
2. Instil knowledge to compute statistical measures for analyzing 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- Measures of 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)

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, Chapman and

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

1	http://digimat.in/nptel/courses/video/102101056/L01.html
2	https://nptel.ac.in/courses/102101056

Course Designed By: Dr. K. Pradeepa Veerakumari

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

BHARATHIAR UNIVERSITY, COIMBATORE - 641 046

BRANCH II – STATISTICS

M.Sc. Biostatistics

(Choice Based Credit System)

(For the candidates admitted during the academic year 2026 – 2027 and onwards)

Objective of the Programme

The programme aims to instill and inspire the domain knowledge on theoretical and applied aspects of Biostatistics 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, Python, etc. 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, UGC NET in Statistics, SET, Indian Statistical Service (ISS) of UPSC, etc.

Eligibility Criteria for Admission

A candidate who has acquired a degree in B.Sc., Statistics / B.Sc., Biostatistics to join M. Sc. BIOSTATISTICS programme.

Duration of the Programme

The duration of the 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. BIOSTATISTICS.

Pattern of Choice Based Credit System

The programme 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). At least one paper presentation/publication during the programme of study is mandatory.

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

Core – Theory	10 x 4 Credits	=	40 Credits
Core – Practical	03 x 4 Credits	=	12 Credits
Core - Mini Project	01 x 4 Credits	=	04 Credits
Core - Self-study	01 x 4 Credits	=	04 Credits
Core - Internship/Project/Dissertation and Viva	01 x 12 Credits	=	12 Credits
Elective Courses	03 x 4 Credits	=	12 Credits
Supportive Courses	03 x 2 Credits	=	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 course offered by the Department. The distribution of marks is as given under:

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 Marks

Distribution of Continuous Internal Assessment Marks for Core - Practical Course

Record Work	:	10 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% of marks in aggregate comprising both continuous internal assessment and end semester University examination in each course shall be declared to have passed the course for the award of the degree in M.Sc. Biostatistics.

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 the course 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 Courses)

The question paper for each of the core and elective courses 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 Courses)

The question paper for each of the core - practical courses (Statistical Computing – I, II and III) shall consists of five questions with internal choice. The maximum marks for each of the practical courses shall be 75. A candidate shall attend all the five questions, each of which shall carry 15 marks. The composition of the question paper shall be as given below:

Time: Three Hours Max. Marks: 75

Answer all the questions

Each question carries *fifteen* marks

Q. No. 1 – Q. No. 5 - Questions with internal choices (either (a) or (b) type)

Pattern of Question Paper – (for Supportive Courses)

The question paper for each of the supportive coursee 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)