KANNUR UNIVERSITY

(Abstract)

M.Sc Biostatistics in the Dept. of Statistical Sciences, Mangattuparamba Campus - Scheme (Credit distribution for courses) & Syllabus of the First Semester -Approved & Implemented w.e.f 2023 admission - Orders issued

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ACADEMIC C SECTION

ACAD/ACAD C3/365/2023 Dated: 21.11.2023

Read:-1. GO (Ms) No 528/2022/HEDN dated 22/10/2022

2. Letter No Acad C3/20143/2022 dated 26/11/2022

3. Email dated 07/01/2023 from the Head, Dept of Statistical Sciences, Mangattuparamba Campus.

4. U.O of even number dated 07/02/2023

5. Minutes of the online meeting of the Expert Committee dated 21/03/2023.

6. UO of even number dated 22/06/2023

7. UO No ACAD C/ACAD C3/22373/2019 dated 12/09/2023

8. Email dated 05/11/2023 from the Head, Dept of Statistical Sciences, Mangattuparamba Campus.

9. Minutes of the meeting of the Department Council dated 18/09/2023

ORDER

1. As per paper read (1) above, Govt. of Kerala granted Administrative Sanction for starting Project Mode Programme *M.Sc Biostatistics with Specialization in Epidemiology and SAS Programming* in the Dept. of Statistical Sciences, Mangattuparamba campus, Kannur University during the Academic Year 2022-'23.

2. As per paper read (2) above, HoD, Dept. of Statistical Sciences was requested to prepare and submit the draft Scheme & Syllabus for the aforementioned Programme along with a panel of five-member Experts to constitute a committee to scrutinize the syllabus.

3. As per paper read (3) above, HoD, Dept. of Statistical Sciences submitted the Scheme and Syllabus for the Programme *MSc Biostatistics with Specialization in Epidemiology and SAS Programming* along with a panel of ten experts to scrutinize the syllabus.

4. As per paper read (4) above, a ten member Expert Committee was constituted, with the Head , Dept of Statistical Sciences as the Coordinator, to scrutinize the Scheme & Syllabus of the aforesaid programme. Head , Dept. of Statistical Sciences was authorised to submit the final Scheme & Syllabus of the Programme after incorporating the corrections/modifications , if any, suggested by the Expert Committee.

5 . As per paper read (5) above, the Expert Committee suggested to change the nomenclature of the Programme as ***MSc Biostatistics*** instead of *MSc Biostatistics with Specialization in Epidemiology and SAS Programming*.

6. Accordingly, as per paper read (6) above, nomenclature of the Programme is changed from *MSc Biostatistics with Specialization in Epidemiology and SAS Programming* to ***MSc***

Biostatistics.

7. As per paper read (7) above, Revised Regulations for PG Programmes under CBCSS in the University Teaching Depts./ Schools was implemented w.e.f 2023 admission.

8. As per paper read (8) above, the Head, Dept. of Statistical Sciences submitted the Scheme (Distribution of credits for courses) & Syllabus of the First Semester MSc Biostatistics Programme w.e.f 2023 admission, incorporating the suggestions of the Expert Committee and also in accordance with the revised Regulations implemented in the Teaching Departments / Schools of Kannur University w.e.f 2023 admissions. Department Council in its meeting held on 18/09/2023 vide paper read (9) above approved the aforesaid syllabus.

9. The Vice Chancellor, after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11(1), Chapter III of Kannur University Act 1996, approved the **Scheme (distribution of credits) & Syllabus of the First Semester MSc Biostatistics Programme** subject to reporting to the Academic Council and accorded sanction to implement the syllabus of M.Sc Biostatistics Programme in the Department of Statistical Sciences, Mangattuparamba Campus w.e.f 2023 admission.

10.Scheme (Distribution of Credits) & Syllabus of the First Semester MSc Biostatistics Programme implemented in the Department of Statistical Sciences, Mangattuparamba Campus with effect from 2023 admission, is appended and uploaded in the University website (www.kannuruniversity.ac.in)

11. Orders are issued accordingly.

Sd/-

Narayanadas K

DEPUTY REGISTRAR (ACAD)

For REGISTRAR

To: 1.Head, Dept of Statistical Sciences, Mangattuparamba Campus
2.Convener, Curriculum Committee.

Copy To: 1. To Exam Branch (through PA to CE)
2. PS to VC/ PA to PVC/ PA to R/PA to CE
3. EP IV / EXCI/SWC 4 . DR/ AR I /AR II (Acad)
5 . To Webmanager (to publish in the website) 6 . Computer Programmer
7 . SF/DF/FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY CIVIL STATION P.O. KANNUR Pin-670 002 THAV

KANNUR UNIVERSITY

M.Sc. BIOSTATISTICS

SCHEME & SYLLABUS

(*Under Choice Based Credit & Semester System)*

2023-24 admission onwards

DEPARTMENT OF STATISTICAL SCIENCES

Mangattuparamba Campus

KANNUR UNIVERSITY

Post Graduate Programme in Biostatistics

M.Sc. Biostatistics programme is a two-year programme divided into four semesters. A student is required to complete at least 80 credits for the completion of the programme and the award of degree.

DURATION: 2 Years (4 semesters)

INTAKE: 15.

OBJECTIVES OF THE PROGRAMME

1. Gain sound knowledge in theoretical and practical aspects of Biostatistics.
2. Acquire the working knowledge of various statistical software and programming languages.
3. Acquire skills and competencies in Biostatistical computing methods and develop algorithms and computer programmes for analyzing complex datasets.
4. Communicate effectively complex statistical ideas to people working in diverse spheres of academics and organizational setups.
5. Handle and analyze large databases related to various biomedical research and make meaningful interpretations of the results.
6. Get wide range of job opportunities in industry as well as in government sector.
7. Make unique contribution for the development of discipline by addressing complex and challenging problems in emerging areas of the discipline.
8. Imbibe effective scientific and/or technical communication in both oral and writing.
9. Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in Biostatistical sciences.

ELIGIBILITIES:

The selection procedure will be based on an entrance examination by the University. The eligibility criteria for appearing entrance examination is any of the following degree with overall 50% marks:

1. B.Sc. Statistics/Biostatistics as core course.
2. B.A./B.Sc. Mathematics
3. B.Sc. Computer Science with Statistics/Mathematics as complementary course
4. B. Tech/B.E degree.
5. B.Sc. with Mathematics and Statistics as core courses.

ADMISSION:

- The selection of the candidate is mainly based on the marks secured in the Degree Course/Admission test.
- The admission test will cover statistics and mathematics at the undergraduate level.

Relaxation & Weightage

Relaxation and weightage will be as per Kannur University rule.

COURSE DETAILS:

A student must register for the required number of courses at the beginning of each semester. No students shall register for more than 24 credits and less than 16 credits per semester.

A total of 80 credits shall be the minimum for successful completion of the course in which a minimum of 60 credits for core course and 12 credits for electives are mandatory. Those who secure only minimum credit for core/ elective subjects has to supplement the deficiency for obtaining the minimum total credits required for successful completion of the program from the other divisions.

EVALUATION:

The faculty member who teaches the course shall do evaluation of the students for each course on the basis of Continuous Evaluation and End Semester Examination shall be evaluated by External Examiners. The proportion of the distribution of marks among the continuous evaluation and end semester examination shall be **40:60**.

Continuous Evaluation includes assignments, seminars, written examination and viva voce for each course. Weightage to the components of continuous evaluation shall be given for all theory papers of the course as follows:

Components of CE	Minimum Number	Weightage	Grade Points	Practical Weightage	Grade Points

Test paper	2	40	16	-	-
Assignments	1	20	08	--	--
Seminar/ Viva Voce	1	40	16		--
Record	--	--	--	-	-

Test Paper: For each course there shall be at least two class tests during a semester.

Assignments: Each student shall be required to do one assignment for each course.

Seminar: Students are required to present a seminar on a selected topic in each paper. The evaluation of the seminar shall be done by the concerned teacher handling the course.

Viva Voce – End semester theory Viva Voce examination will be conducted for each paper before the commencement of public examination.

Attendance: Minimum attendance required for each paper shall be 75% of the total number of classes conducted for that semester. Those who secured the minimum requirement of attendance only be allowed to register/appear for End Semester Examination.

Condonation of attendance to a maximum of 10 days in a semester subject to a maximum of two times during the whole period of the PG program may be granted by the university as per university rules.

Conduct of Examination:

The Vice Chancellor will approve the panel of examiners submitted by the Head of the Department. All the teachers of the Department will be the members of the Board of examiners with Head of the Department as the Chairperson. There shall be a minimum of two external examiners. The panel approved by the Vice-Chancellor will be entrusted with the setting of question papers, conduct and evaluation of examination.

Research Project:

The students have to complete a minor research project during IV Semester in collaboration with any of the authorized research institutions located within or outside the state or within their own Department.

Distribution of Grades for the MSc Biostatistics Programme with effect from 2023- 24 Onwards									
	1	2	3	4	5	6	7	8	Total Credits
	Discipline Specific		Electives						
Semester	Core Courses (DSC)	Electives (DSE)	Interdisciplinary/ Multidisciplinary Elective	AEC 2 Credits	SEC (SEC) 2 Credits	VAC / MOOC 2 Credits	Internship / Field Visit / Minor Project / Institutional /Industrial Visit 2 Credits	Dissertation / Major Project	
1	MSBST01DSC01(4C) MSBST01DSC02(4C) MSBST01DSC03(4C) MSBST01DSC04(4C)	**Pool A** MSBST01DSE01/ MSBST01DSE02							**19**
	16 Credits	**3 Credits**							
2	MSBST02DSC05(4C) MSBST02DSC06(4C) MSBST02DSC07(4C) MSBST02DSC08(4C)	**Pool B** MSBST02DSE03/ MSBST02DSE04		Offered by other Departments	Offered by other Departments				**23**
	16 Credits	**3 Credits**		**2 Credits**	**2 Credits**				
3	MSBST03DSC09(4C) MSBST03DSC10(4C)	**Pool C** MSBST03DSE05 to 13 (any 3)	Offered by other Departments			MSBST03DSC12	MSBST03DSC11		**23**
	8 Credits	**3 Credits x 3= 9 credits**	**4 Credits**			**2* Credits**	**2 Credits**		
4		**Elective III (Pool D)**							
		MSBST04DSE14/ MSBST04DSE15 **6 Credits**						MSBST04DSC13(12C)	**18**
		6 Credits						**12 Credits**	
	Total Credit for MSc Biostatistics Program								**83**

*credits are over and above the total credit requirement.

	FIRST SEMESTER								
Sl No	**Course Code**	**Title of Paper**	**Contact Hours/Week**			**Marks**			
			L	**T/S**	**P**	**ESE**	**CE**	**Total**	**Credits**
DISCIPLINE SPECIFIC CORE COURSES (DCE)									
1.1	MSBST01DSC01	Mathematical Methods for Biostatistics	4	1		60	40	100	4
1.2	MSBST01DSC02	Probability and Distribution Theory	4	2		60	40	100	4
1.3	MSBST01DSC03	Sampling Methods	4	1		60	40	100	4
1.4	MSBST01DSC04	Introduction to Biostatistics	4	2		60	40	100	4
DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)									
1.5	MSBST01DSEXX	Elective-I-DSE (Pool A)		2	6	60	40	100	3
Total			**16**	**8**	**6**	**300**	**200**	**500**	**19**

L=Lecture, T/S=Tutorials/Seminar, P/I=Practical/Internship, CE =Continuous Evaluation, ESE = End Semester Evaluation

Sl No	**POOL A:- List of Courses for Elective -I DISCIPLINE SPECIFIC ELECTIVES (DSE)**								
1.5a	MSBST01DSE01	Biostatistical Computing Using R (**Practical**)		2	6	60	40	100	3
1.5b	MSBST01DSE02	Biostatistical Computing Using SPSS (**Practical**)		2	6	60	40	100	3

KANNUR UNIVERSITY

DEPARTMENT OF STATISTICAL SCIENCES

VISION

Motivated by optimism and responsibility, the vision is to develop an exemplary centre for studies, practice and research in Statistics which will be beneficial to the stakeholders and the society.

MISSION

To develop an excellent centre of quality teaching and research in Statistics

To develop an international centre for advanced statistical computing and data analysis.

PROGRAMME OUTCOMES

PO 1 : **Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 : **Problem Solving:** Identify, formulate, conduct investigations, and find solutions to problems based on in-depth knowledge of relevant domains.

PO 3 : **Communication:** Speak, read, write and listen clearly in person and through electronic media in English/language of the discipline, and make meaning of the world by connecting people, ideas, books, media and technology.

PO 4 : **Responsible Citizenship:** Demonstrate empathetic social concern, and the ability to act with an informed awareness of issues.

PO 5 : **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO 6 : **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAMME SPECIFIC OUTCOME

PSO 1: Expertise in the field of biostatistical theory and its practical applications.

PSO 2: Expertise to take up responsibilities as efficient Biostatisticians/Statistical Officers/Research Officers/ Statistical Analytics.

PSO 3: Expertise on techniques of biostatistics and in the field of data analysis.

PSO 4: Make Awareness on recent trends in biostatistical theory and applications.

PSO 5: Utilize statistical methods and tools to analyze data sets, draw meaningful conclusions, and make informed decisions based on biostatistical inferences.

PSO6: Demonstrate proficiency in using statistical software such as R and SPSS, to perform statistical computations, visualize data, and facilitate biostatistical analysis.

COURSE OUTCOME

CO1 : Demonstrate an in-depth understanding of advanced mathematical concepts, including advanced calculus, linear algebra, complex analysis, differential equations, and discrete mathematics.

CO 2 : Apply rigorous proof techniques to establish mathematical results, including theorems, lemmas, and propositions, and communicate mathematical arguments effectively.

CO 3 : Formulate mathematical models for real-world problems, analyze their properties, and interpret the results in the context of the original problem.

CO 4 : Apply numerical techniques and algorithms to approximate solutions of mathematical problems, analyze their accuracy, convergence, and stability.

CO 5 : Develop research skills, including literature review, problem formulation, data collection, experimental design, and statistical analysis, to conduct independent mathematical research.

FIRST SEMESTER M.Sc. BIOSTATISTICS PROGRAMME

DISCIPLINE SPECIFIC CORE COURSE

Course Code & Title	**MSBST01DSC01-MATHEMATICAL METHODS FOR BIOSTATISTICS**	
Programme	**M.Sc. Biostatistics**	**Semester I**
Course Objectives	● To introduce the concept of sequence and series. ● To understand the improper integrals, beta and gamma functions. ● Learn Taylor's Theorem with applications. ● Describe optima of functions using examples. ● To achieve ideas on vector space, subspaces, independence of vectors, basis and dimension. ● Cayley-Hamilton theorem. ● Establish the relation between algebraic and geometric multiplicity. ● To achieve ideas on quadratic forms and reduction of quadratic forms and gets ability for solving problems in these areas.	

Modules	Content	Module Outcome
Module I: Sequence and series **(15 Hours)**	Sequences, series and their convergence, limit superior, limit inferior, limit of sequences, Cauchy sequence. Comparison test, D'Alembert's ratio test, Cauchy's root test, Raabi's test, Gauss test, Cauchy's integral test, Absolute convergence of series, Leibnitz's test for the convergence of alternating series, conditional convergence, indeterminate form, L'Hospital 's rule (problems only).	The students will be able to: ● Explain convergences of sequences and series. ● Solve problems using various tests to examine the convergences of series. ● Explain the concept of L Hospital's Rule

Module II: Special functions **(15 Hours)**	The beta and gamma functions, duplication formula for gamma function, incomplete beta and gamma functions, functions of several variables, Limits and continuity, Taylor's theorem and its applications, Conditions for the optima of multivariate functions, Lagrange's method for constrained optimum, examples (bivariate case only)	• Explain proper and improper beta and gamma functions. • Understand the calculus of multivariable functions • To find local and global optima of functions.
Module III: Vectors and Matrices **(15 Hours)**	Vector space, Subspaces, Linear dependence and independence, Basis and dimensions, Matrices and determinants, symmetric, orthogonal and idempotent matrices, Row and column space of matrix, Rank, inverse, Characteristic polynomial, Cayley-Hamilton Theorem (statement and problem).	• To be familiar with vector space, subspace and examples. • Explain linear dependence and independence. • State Cayley-Hamilton theorem and solve problems.
Module IV: Eigen values and spectral decomposition **(15 Hours)**	Eigen values and eigen vectors, Spectral decomposition, Algebraic and geometric multiplicities, Generalized inverse, Quadratic forms, Classification of quadratic forms, Properties and reductions.	• Determine the Eigen values and Eigen vectors of the given matrix • Write down the spectral decomposition of the given matrix • Explain different types of quadratic forms.

Text Books

1. Malik, S.C & Arora, S. (2006***). Mathematical Analysis, Second Edition,*** New-age international publishers.
2. Mathai, A. M. & Haubold, H. J. (2017***). Linear Algebra – A course for Physicists and Engineers,*** De Gruyter, Germany.

Reference books

1. Rudin, W. (2013). ***Principles of Real Analysis (3rdEd.)*** McGraw Hill.
2. Ramachandra Rao & Bhimasankaran (1992). ***Linear Algebra.*** Tata McGraw Hill, New Delhi.
3. Apsostol, T. M. (1974). ***Mathematical Analysis, Second Edition***. Narosa, New Delhi.
4. Rao, C. R. (2002***). Linear Statistical Inference and Its Applications, Second Edition***, John Wiley and Sons, New York.

Course Outcomes	After successful completion of this course, student will be able to: 1. Understand the concepts of limit and continuity of functions and their properties 2. Understand convergence of sequences and series of real numbers and functions. 3. Understand the vector space, matrices and its properties 4. Understand the properties of quadratic forms and its reduction.

TEACHING LEARNING STRATEGIES

- **Lecturing, Visualization, Team Learning**

MODE OF TRANSACTION

- **Lecture, Seminar, Discussion, Questioning and Answering**

ASSESSMENT RUBRICS

Components	**Weightage**
End Semester Evaluation	**60**
Continuous Evaluation	
Tests	16
Assignment	08

Seminar	16
Total	**40**

Sample Questions to Test Outcomes:

1. Define limit of sequence of real numbers. Give an example of a sequence for which limit does not exist.

2. What is meant by absolute convergence of series?

3. What is incomplete gamma function?.

4. State conditions for the optima of a multivariate function.

5. State Cayley-Hamilton theorem.

6. Explain Gram-Schmidth orthogonalization process.

7. Write a short note on different types of quadratic forms.

DISCIPLINE SPECIFIC CORE COURSE

Course Code & Title	**MSBST01DSC02- PROBABILITY AND DISTRIBUTION THEORY**		
Programme	**M.Sc. Biostatistics**	**Semester**	I
Course Objectives	The Course aims • To introduce the basic concepts of probability • To understand the connection between three approaches of definitions of probability. • To get an idea on important theorems in probability using axiomatic definition of probability • To learn about various discrete and continuous probability distributions needed for biostatistical analysis.		

Modules	Content	Module Outcome

Module I: Probability and Random Variables **(15 Hours)**	Computation of probability based on classical and empirical definitions. Axiomatic approach to probability, probability space, conditional probability space, independence of events, Bayes' theorem and examples, random variable, distribution function, density function, expectation, variance and moments of a random variable and properties.	• Understand various definitions of probability • Conditional probability and Bayes' theorem • Concept of random variable and their distributions
Module II: Important large sample theorems **(15 Hours)**	Definition of moment generating function and its limitations, characteristic function, elementary properties, characteristic functions and moments. Sequence of random variables, various modes of convergence of sequence random variables (definition only), Weak law of large numbers, strong law of large numbers, central limit theorem, DeMoivre-Laplace and Lindbergh-Levy forms of CLT. Applications of CLT in biostatistics.	• Definition of characteristic function • Concept of weak and strong laws of large numbers • Concept of central limit theorem and its applications in biostatistics
Module III: Special Discrete Distributions **(15 Hours)**	Discrete Uniform, Bernoulli, Binomial, Poisson, Geometric, Negative binomial, Hyper geometric, Multinomial. Properties of these distributions. Sample simulation and fitting of discrete distributions.	• Explain different discrete distributions. • Properties of discrete distributions • Simulation of samples from standard discrete distributions

Module IV: Special Continuous Distributions **(15 Hours)**	Continuous Uniform, Exponential, Beta, Gamma, Normal, Weibull, Pareto, Laplace, Logistic, Cauchy and log-normal distributions. Properties of these distributions. Sample simulation and fitting of continuous distributions.	• Explain different continuous distributions • Properties of continuous distributions • Simulation of samples from standard continuous distributions
References	***Text Books*** 1. Krishnamurthy, K.(2006). ***Handbook of Statistical Distributions with Applications*** .Chapman & Hall/CRC, New-York 2. Schinazi, R.B. (2010). ***Probability with Statistical Applications*** *Second Ed* . Springer, New York. ***Reference Books*** 1. Bhat, B.R. (2004). ***Modern Probability Theory***, New Age Publishers, New Delhi. 2. Rohatgi, V. K. (2020). ***An Introduction to Probability Theory and Mathematical Statistics***, Wiley Eastern 3. Johnson, N.L., Kotz, S.and Balakrishnan, N. (1995). ***Continuous Univariate Distributions****, Vol. I &Vol. II,* John Wiley and Sons, New-York. 4. Johnson, N.L., Kotz. S. and Kemp. A.W.(1992). ***Univarite Discrete Distributions,*** John Wiley and Sons, New York.	
Course Outcomes	After successful completion of this course, student will be able to: 1. Understand the concepts of probability and properties. 2. Understand characteristic function and its properties 3. Understand various laws of large numbers and central limit theorems. 4. Understand the concepts of discrete and continuous distributions. 5. Understand the normal distribution and various non-normal distributions, their properties and applications for scientific research.	

TEACHING LEARNING STRATEGIES

- **Lecturing, Visualization, Team Learning**

MODE OF TRANSACTION

- **Lecture, Seminar, Discussion, Questioning and Answering**

ASSESSMENT RUBRICS

Components	Weightage
End Semester Evaluation	**60**
Continuous Evaluation	
Tests	16
Assignment	08
Seminar	16
Total	**40**

Sample Questions to test Outcomes:

1. Define Poisson random variable. Find the moment generating function of a Poisson random variable.

2. Show that in the case of binomial distribution mean is always greater than variance, however, mean equal to variance in the case of Poisson distribution.

3. Define t-statistic and explain its important applications. Write down the probability density function of Student's t-distribution.

4. Obtain the characteristic generating function of a standard normal distribution.

5. Define bivariate normal distribution. Show that linear combination of independent normal variables is normally distributed.

6. Define chi-square distribution. Obtain the MGF of the Chi-square distribution. Use it to obtain the mean and variance.

DISCIPLINE SPECIFIC CORE COURSE

Course Code & Title	**MSBST01DSC03- SAMPLING METHODS**		
Programme	**M.Sc. Biostatistics**	**Semester**	I
Course Objectives	• Explain different types of sampling • Explain different errors in sampling • Difference between SRSWR and SRSWOR • Concept of stratified random sampling • Explain systematic sampling • Explain ratio and regression estimators		

Modules	Content	Module Outcome
Module I: Sampling theory and Simple random sampling **(15 Hours)**	Introduction to sampling theory, Errors in sampling, simple random sampling (with and without replacement)- estimation of population mean and population mean square, determination of sample size, comparing efficiency of SRSWOR with SRSWR, simple random sampling with attributes.	• Concept of sampling theory • Explain different types of errors • Differentiate between SRSWR and SRSWOR • Explain SRS with attributes
Module II: Stratified random sampling and allocations. **(15 Hours)**	Stratified random sampling- estimation of population mean and variance, methods of allocation of sample size to different strata, comparison of allocations.	• Concept of stratified random sampling • Explain methods of allocations

Module III: Complex sampling schemes **(15 Hours)**	Systematic sampling, circular systematic sampling. Cluster sampling, multistage sampling, multiphase sampling.	• Explain circular systematic sampling • Explain cluster sampling • Explain two stage cluster sampling
Module IV: Auxiliary information based sampling **(15 Hours)**	Ratio and regression methods of estimation- bias and appropriate variances, unbiased ratio estimator, difference estimator, comparison of ratio estimator with regression estimator, Probability proportional to size sampling.	• Concept of ratio estimator • Explain regression estimator • Explain difference estimator • Concept of PPS sampling
References	***Text Books*** 1. Singh, D and Chowdhary, F.S. (1986). ***Theory and Analysis of Sample Survey Designs***, New Age International, New Delhi. 2. Cochran. W.G. (2007). ***Sampling Techniques***, John Wiley & Sons, New York. ***Reference books*** 1. Des Raj, D. and Chandhok, P. (1998). ***Sample Survey Theory***, Narosa Publishing House, New Delhi. 2. Gupta and Kapoor (2010). ***Fundamentals of Applied Statistics***. Sulthan Chand & Sons. 3. Murthy, M.N. (1967). ***Sampling Theory & Methods*** .Statistical Publishing Society, Calcutta. 4. Parimal Mukopadhyay (2012). ***Theory & Methods of Survey Sampling***, PHI Learning, New Delhi.	

Course Outcomes	After successful completion of this course, student will be able to: 1. Understand the concepts of probability and non-probability sampling. 2 Understand the estimation methods for population mean, total and proportion under various sampling schemes. 3 Understand the use of auxiliary information for the estimation various population parameters

TEACHING LEARNING STRATEGIES

- **Lecturing, Visualization, Team Learning**

MODE OF TRANSACTION

- **Lecture, Seminar, Discussion, Questioning and Answering**

ASSESSMENT RUBRICS

Components	**Weightage**
End Semester Evaluation	**60**
Continuous Evaluation	
Tests	16
Assignment	08
Seminar	16
Total	**40**

Sample Questions to test Outcomes:

1. Explain probability sampling and non probability sampling.

2. Define standard error of sample mean and explain its uses in the construction of confidence interval, testing hypothesis and to obtain p-value.

3. Explain circular systematic sampling.

4. Prove that sample mean is an unbiased estimate of population mean under stratified random sampling.

5. Distinguish between ratio estimators and regression estimators.

6. Explain the difference between the methods of SRS and varying probability scheme.

DISCIPLINE SPECIFIC CORE COURSE

Course Code & Title	**MSBST01DSC04– INTRODUCTION TO BIOSTATISTICS**		
Programme	**M.Sc. Biostatistics**	**Semester**	I
Course Objectives	• Introduce the concept of proportions, ratio and odds • Introduce the concept of risk, relative risk and their measurement • Explain applications of various probability models in medical research • Explain concept of estimation and its applications in biostatistics • Introduce the concept of hypothesis testing and applications in clinical research.		

Modules	**Content**	**Module Outcome**
Module I: Descriptive Methods for Categorical Data **(15 Hours)**	Proportions:- Comparative Studies, Screening Tests, Displaying Proportions. Rates:- Changes, Measures of Morbidity and Mortality, Standardization of Rates. Ratios:- Relative Risk, Odds and Odds Ratio, Generalized Odds for Ordered 2xk Tables, Mantel–Haenszel Method, Standardized Mortality Ratio.	• Explain proportions, ratios and rates • Explain risk, relative risk and odds ratio. • Explain Mantel–Haenszel Method and Standardized Mortality Ratio

Module II: Descriptive Methods for Continuous Data **(15 Hours)**	Tabular and Graphical Methods:- One-Way Scatter Plots, Frequency Distribution, Histogram and the Frequency Polygon, Cumulative Frequency Graph and Percentiles, Stem-and-Leaf Diagrams, Measures of Location, Measures of Dispersion, Box Plots, Special Case of Binary Data, Coefficients of Correlation, Pearson's Correlation coefficient, Nonparametric Correlation coefficients.	• Explain graphical and tabular methods • Explain measures of central tendency and dispersion • Explain parametric and non parametric correlations
Module III: Probability Models for data and estimation **(15 Hours)**	Practical applications of Normal, Binomial and Poisson distributions in bio medical research, Pair-Matched Case–Control Study, Introduction to Confidence interval Estimation, Estimation of Proportions, Estimation of Odds Ratios, Estimation of Correlation Coefficients.	• Explain various applications of probability models in medical research • Estimation of proportions, odds ratio and correlation coefficients • Give an introduction to Pair-Matched Case–Control Study and confidence interval estimation
Module IV: Introduction to Statistical Tests of Significance **(15 Hours)**	Hypothesis Tests, Statistical Evidence, Errors, Summaries and Conclusions, Rejection Region, P Values, Type I and Type II Errors, Relationship to Confidence Intervals. One-Sample Problem with Binary Data, Analysis of Pair-Matched Data, Comparison of Two Proportions, Mantel–Haenszel Method, Inferences for General Two-Way Table, Fisher's Exact Test, Ordered 2x k Contingency Tables.	• Explain basic concepts of hypothesis testing and P value • Comparison of Population proportions • Understand , Mantel–Haenszel Method, and Fisher's Exact Test.

References	***Text Books*** 1. Chap T.L. (2003). ***Introductory Biostatistics***, John Wiley & Sons. ***Reference books*** 1. Rosner, B. (2010). ***Fundamentals of Biostatistics***, Cenage Learning, Harvard University. 2. Chernick, M.R. and Fris, R.H. (2003). ***Introductory Biostatistics for the Health Sciences,*** John Wiley & Sons. 3. Peter Armitage, Geoffrey Berry, J. N. S. Matthews (2008).· ***Statistical Methods in Medical Research***. John Wiley & Sons 4. Daniel, Wayne W (2009). ***Biostatistics: A Foundation for Analysis in the Health Sciences.*** John Wiley & Sons.
Course Outcomes	After successful completion of this course, student will be able to: 1. Understand the descriptive methods for different types of data. 2. Understand the concepts of risk, odds and odds ratio. 3. Understand the concept of inferential procedures for medical research. 4. Understand different methods of comparison of proportions for biostatistical studies.

TEACHING LEARNING STRATEGIES

- **Lecturing, Visualization, Team Learning**

MODE OF TRANSACTION

- **Lecture, Seminar, Discussion, Questioning and Answering**

ASSESSMENT RUBRICS

Components	Weightage
End Semester Evaluation	**60**
Continuous Evaluation	

Tests	16
Assignment	08
Seminar	16
Total	**40**

Sample Questions to Test Outcomes:

1. Define odds and odds ratio.

2. Explain sensitivity and specificity.

3. Describe relative risk. How to quantify it.

4. Explain Mantel–Haenszel Method.

5. Explain contingency table.

6. Describe Pair-Matched Case–Control Study.

SEMESTER I

DISCIPLINE SPECIFIC ELECTIVES

Course Code & Title	**MSBST01DSE01 - BIOSTATISTICAL COMPUTING USING R (PRACTICAL)**		
Programme	**M.Sc. Biostatistics**	**Semester**	**I**
Course Objectives	• Define the basic concepts of R software and R packages • Describe various concepts required for developing the R Language • Build our new functions in R • Illustrate different R-Graphics facilities • Find rank and inverse using R software • Describe different sampling methods using R software		

Modules	Content	Module Outcome
Module I: Basic Concepts of R Programming **(20 Hours)**	Introduction to R- Objects and their classes, operators, vectors and matrices, list and data frames, indexing and accessing data, importing and exporting data. Common built-in functions, R-Graphics.	• Define basics of statistical software R • Demonstrate the important data structures such as arrays, matrix, data frames, Class function etc. • Design an overview of the R Language such as Expressions, Objects, Symbols, Functions.

Module II: Matrices and Standard Probability Distributions **(25 Hours)**	Matrices, rank, determinants and inverse. Eigen values and vectors, power of matrices, g-inverse, system of linear equations, roots of algebraic and transcendental equations. Plotting of cdf and pdf of standard distributions. Generations of random samples from standard distributions, demonstrations of the sampling distributions	• How to find rank and inverse using R software. • How to solve system of linear equations using R software • Plotting pdf and cdf curve of different distributions
Module III: Biostatistical Sampling Methods **(25 Hours)**	Random samples elections, estimation of mean pro-portion, variance, confidence interval and efficiency under SRS, stratified random sampling, Various kind of allocation, stratification, estimators based on ratio and regression methods pps sampling, two stage cluster sampling, and systematic sampling.	• How to draw random samples using different sampling techniques • PPS sampling techniques using R softwares • Ratio and regression methods using R softwares.
Module IV: Biostatitical data analysis **(20 Hours)**	Measures of Morbidity and Mortality in R, Relative Risk, Odds and Odds Ratio, Generalized Odds for Ordered 2 x k Table, Mantel–Haenszel Method, Box Plots, Estimation of Proportions and Odds Ratios, testing of hypotheses.	• Compute Morbidity and Mortality in R • Computation of Odds and odds ratio using R • Data description using Box plot • Inference procedures in R

References	***Text Books*** 1. Maria D.U., Ana F.M. and Alan T.A. (2008*):* ***Probability and Statistics with R***. CRC Press. 2. Dalgaard, P. (2008): ***Introductory Statistics with R****, (Second Edition),* Springer. ***Reference books*** 1. Purohit, S.G, Ghore, S.D and Deshmukh, S.R. (2004): ***Statistics Using R.*** Narosa. 2. Babak Shahbaba. (2012). ***Biostatistics with R: An Introduction to Statistics through Biological Data.*** Springer New York.
Course Outcomes	After successful completion of this course, student will be able to: 1. Understand various built in functions in R programming for biostatistical data analysis. 2. Understand different functions in R programming for writing compute r programmes and develop computer programmes for different problems 3. Understand the usage of packages in R for drawing various diagrams and computing descriptive statistics, comparison of means, ANOVA, non-parametric tests, simple correlation and regression procedures

TEACHING LEARNING STRATEGIES

- **Practical sessions through computers, statistical computations, Team Learning**

MODE OF TRANSACTION

- **Lecture, Seminar, Discussion, Questioning and Answering**

ASSESSMENT RUBRICS

Components	Weightage
End Semester Evaluation	**60**
Continuous Evaluation	
Tests	16
Assignment	08
Seminar	16
Total	**40**

Sample Questions to Test Outcomes:

1. Write an R program to create a matrix taking a given vector of numbers as input. Display the matrix.
2. Import a given dataset in R, and conduct its descriptive analysis.
3. Select a simple random sample of 50 numbers without replacement from the numbers 1 to 2000.
4. Generate a random sample of size 100 from a standard normal distribution.
5. Illustrate the law of large numbers using R.
6. Enter the given 2 matrices, and find their product.

DISCIPLINE SPECIFIC ELECTIVE

Course Code & Title	MSBST01DSE02-BIOSTATISTICAL COMPUTING USING SPSS (PRACTICAL)		
Programme	**M.Sc. Biostatistics**	**Semester**	I
Course Objectives	• The main focus of the course will be on to solve biostatistical research question using SPSS • Illustrate different toolboxes in SPSS • Data definition and access and data analysis and presentation. • Apply SPSS software to develop different statistical tools • Students get awareness to chose appropriate statistical technique and interpret results using SPSS.		

Modules	Content	Module Outcome
Module I: SPSS Environment, Basic Concepts of SPSS Programming **(20 Hours)**	Introduction to SPSS- Starting SPSS, Working with data file, SPSS windows, Menus, Dialogue boxes. Preparing the Data file, Creating data file and entering data, Defining the variables, Entering data, modifying data file, import file. Variable types in SPSS and Defining variables – Creating a Codebook in SPSS. Screening and cleaning data, Manipulation of data.	▪ Understand the installation and familiar with toolboxes of SPSS. ▪ Data management and modifications of data.

Module II: Preliminary Analysis in SPSS **(25 Hours)**	Computing Variables- Recoding (Transforming) Variables: Recoding Categorical String Variables using Automatic Recode - Sorting Data - Grouping or Splitting Data. Categorical variables, continuous variables. The Explore procedure - Frequencies Procedure – Descriptive - Compare Means - Frequencies for Categorical Data, different statistical distributions	▪ Working with Data types ▪ Recoding and sorting ▪ Descriptive statistics ▪ Explore procedure, graphics in SPSS
Module III: Inferential Statistics **(25 Hours)**	Pearson Correlation, Chi-square Test of Independence – Inferential Statistics for Comparing Means: One Sample t Test, Paired Samples T Test, Independent Samples T Test, One-Way ANOVA. Two way ANOVA, Multivariate ANOVA.	▪ Compute and interpret correlation coefficients ▪ Learn how to conduct various statistical tests using SPSS ▪ Preparing ANOVA
Module IV: Non-Parametric statistics **(20 Hours)**	Independent Chi square Test, Mann- Whitney test , Wilcoxon signed rank test, Kruskal-Wallis test. Interpreting the output of tests, p-value computation.	▪ Learn how to perform non parametric tests ▪ Get p value of various tests ▪ Interpretation of test results

References	***Books for study*** 1. Hinton, P. R., Brownlow, C, Mc Murray, I. and Cozens, B. (2004): ***SPSS Explained,*** Routledge, Taylor and Francis group, New York. ***Reference books*** 1 Field, A. (2011); ***Discovering Statistics Using SPSS,*** Sage Publications. 2 William E. Wagner. (2015). ***Using IBM SPSS statistics for research methods and social science statistics***, Fifth edition, SAGE Publications, Inc.
Course Outcomes	After successful completion of this course, student will be able to: 1. Build capacity to analyzing complex information with the help of SPSS. 2. Understand with the tool box of statistical software SPSS 3. Summarize variables using frequencies and descriptive analysis. 4. Understand to producing cross tabulation tables and testing for significant relationships with chi square test. 5. Understand the usage of assessing relationships between continuous variables through plots and correlations.

TEACHING LEARNING STRATEGIES

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End Semester Evaluation	**60**
Continuous Evaluation	
Tests	16
Assignment	08
Seminar	16
Total	**40**

Sample Questions to Test Outcomes:

1. Compute t-test for difference of means on a given continuous variable, based on a categorical variable.

2. Compute descriptive statistics of a given continuous variable of a dataset.

3. Perform an appropriate ANOVA for the given data.

4. Perform appropriate non parametric test for the given data.

5. Load the given external spreadsheet data into SPSS, and obtain the pie chart, histogram of the variables.

6. Perform MANOVA for the given data set.