

**SYLLABUS**  
**DIBRUGARH UNIVERSITY**  
**FYIPGP 2024**  
**(Under NEP 2020)**



**STATISTICS**  
**(পৰিসংখ্যা)**

*(Recommended by B.O.S. in Statistics, D.U. in its meeting held on 05.03.2024 and approved by U.G. Board in its meeting held on ..... and passed by the Academic Council meeting held on ..... and effective from the session ..... )*

<b>Dibrugarh University</b>	<b>ডিব্ৰুগড় বিশ্ববিদ্যালয়</b>
<b>Vision of University:</b>	To develop human resource by integrating knowledge and skill, human values and compassion for a better world.
<b>Mission of University:</b>	To impart value oriented education and skill based training that foster leadership traits of the learners, thus generating sustainable development, social harmony and peace.
<b>Department of Statistics</b>	<b>পৰিসংখ্যা বিজ্ঞান বিভাগ</b>
<b>Vision of Department:</b>	To empower individuals with statistical expertise that drives home evidence-based decision making, fasters innovation, and promotes societal well-being.
<b>Mission of Department:</b>	To impart a rigorous and comprehensive statistical knowledge that cultivates deep understanding of statistical theories, methods and applications, which foster not only skilled statisticians but also ethical leaders committed to making statistically literate individuals who can harness the power of statistics for informed-decision making and innovation.

## **PREAMBLE**

As recommended by the University Grants Commission (UGC) and proposed for implementation by Dibrugarh University, the Department of Statistics works to implement the relevant components of New Education Policy (NEP), 2020 for Four Year Under Graduate Program (FYUGP). The following facts are taken into consideration when designing the basic structure of the Under Graduate (UG) programme:

- a) Flexibility to switch between disciplines of study,
- b) Opportunity for learners to select the courses of their interest across all disciplines,
- c) Flexible entry and exit options with UG certificates, UG diplomas, or Bachelor degrees depending on the number of credits earned,
- d) Flexibility for students to switch between institutions so they can engage in multi- and/or interdisciplinary learning,
- e) Flexibility to switch to alternative modes of learning,
- f) Knowledge required for self-employment initiatives and entrepreneurship mindset,
- g) Ability for complex critical thinking and real-life problem solving,
- h) Capability to understand global issues, multicultural competence and digital literacy,
- i) Capable on research skills, communication skills, community based engagement, environment awareness, responsibility and accountability.

## INTRODUCTION

The Under Graduate (UG) syllabus of Statistics in light of New Education Policy (NEP), 2020 consists of Major (Core) disciplines, Minor disciplines, Multi-Disciplinary Generic Elective Courses (MDGEC), Ability Enhancement Courses (AEC), Value Added Courses (VAC), Skill Enhancement Courses (SEC), Environmental Education (EE), YOGA, Community Based Engagement (NCC/NSS/Adult Education/Student Mentoring/NGO/Govt. institutions, etc.), Digital and Technological Solutions/Digital Fluency (DTS/DF), Internship, Project, Research Ethics and Methodology, Research Project (Development of Project/Research Proposal, Review of related literature), Dissertation (Collection of Data, Analysis and Preparation of Report) and Discipline Specific Electives (DSE).

The UG degree programme offers certificates, diplomas and degrees as follows:

**UG Certificate:** Students who opt to exit after completion of the first year (Two Semesters) and have secured 44 credits will be awarded a UG certificate. These students are allowed to re-enter within three years and complete the degree programme within the stipulated maximum period of seven years.

Certificate course consists of two Major disciplines, two Minor disciplines, two MDGEC, two AEC, two VAC, two SEC, YOGA and Environmental Education with emphasis on community-based activities.

**UG Diploma:** Students who opt to exit after completion of the second year (Four Semesters) and have secured 88 credits will be awarded the UG diploma. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.

Diploma course consists of six Major disciplines, four Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities and Digital and Technological Solutions/Digital Fluency and Community engagement.

**3-year UG Degree:** Students who wish to undergo a 3-year (Six Semesters) UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 132 credits.

3-year UG degree course consists of fourteen Major disciplines, six Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community-based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship and Project.

**4-year UG Degree (Honours with Research):** Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year (Two Semesters). They should do a research project or dissertation under the guidance of a

faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

4-year UG degree course consists of twenty Major disciplines, eight Minor disciplines, three MDGEC, three AEC, two VAC, three SEC, YOGA, Environmental Education with emphasis on community- based activities, Digital and Technological Solutions/Digital Fluency, Community engagement, Internship, Project, Research Ethics and Methodology, Research Project or one DSE and Dissertation or two DSE.

**UG Degree Programmes with Single Major:** A student has to secure a minimum of 50% credits from the major discipline for the 3-year/4-year UG degree to be awarded a single major.

**UG Degree Programmes with Double Major:** A student has to secure a minimum of 40% credits from the second major discipline for the 3-year/4-year UG degree to be awarded a double major

**Interdisciplinary UG Programmes:** The credits for core courses shall be distributed among the constituent disciplines/subjects so as to get core competence in the interdisciplinary programme.

**Multidisciplinary UG Programmes:** In the case of students pursuing a multidisciplinary programme of study, the credits to core courses will be distributed among the broad disciplines such as Life sciences, Physical Sciences, Mathematical and Computer Sciences, Data Analysis, Social Sciences, Humanities, etc..

The statutory bodies of the Universities and Colleges such as the Board of Studies and Academic Council will decide on the list of courses under major category and credit distribution for double major, interdisciplinary and multidisciplinary programmes.

## AIM

The UG Programme in statistics is designed to teach students how to think analytically, critically and logically, which enables them to employ mathematical reasoning in real-world situations. A UG degree in statistics will expose students to a variety of intriguing and practical concepts that will help them in their preparation for data-scientist/statistician/strategic banker/researcher/biostatistician and other statistics-oriented job profiles in industry, government, public-sector undertaking companies, business, commerce, finance and research.

The program covers a broad range of topics on mathematical and applied statistics. This also covers hands-on sessions in Computer Lab using various software such as C/C++, R, SPSS etc. The comprehensive training on coding and use of software will enable the students to grasp the subject matter better and will make them complete in terms of research and industry perspectives.

The programme aims to increase students' skill in statistics (both mathematical and applied), mathematical analysis and algebra and coding as well as other cross-disciplinary subjects like mathematics, commerce, physics, computer sciences, economics etc. By choosing papers from the MDGEC, AEC, SEC, VAC, YOGA, EE, DTS, DSE, Community based engagement etc., they are able to apply the skills they have learned to situations that happen in the real world. Also aims students' flexibility to move from one discipline to another, to move one institution to another, to switch alternative modes of learning.

## **GRADUATE ATTRIBUTES**

### **Disciplinary Knowledge**

Being able to demonstrate comprehensive knowledge and coherent understanding of both the mathematical and applied components of statistics as well as chosen interdisciplinary areas of study in a broad multidisciplinary context; ability to connect relevant disciplines, as well as recent innovations, with the learning disciplines of choice.

### **Communication Skills**

Capability to express various statistical ideas clearly through data analysis, graphical methods, examples and counter-examples; ability to use statistical tools and techniques effectively as a precise language of communication in other fields of scientific and social studies; ability to pay close attention, read texts and research papers critically, and communicate complicated information clearly and concisely to policy-makers as well as to the public.

### **Moral and Ethical Awareness/Reasoning**

Ability to recognise ethical issues that are pertinent to one's work and pledge not to engage in unethical behaviour such as plagiarism, copyright and infringement of intellectual property rights; ability to appreciate recent developments in various fields and one's research with honesty and integrity in all aspects.

### **Multicultural Competence**

Ability to correlate and compare recent developments in various branches of statistics and related fields like data-science in a variety of organisations worldwide; ability to collaborate research with other scientific disciplines; ability to effectively participate in a multicultural group or society and interact politely with diverse groups, and the acquisition of knowledge of the values and beliefs of multiple cultures, and a global viewpoint to honour diversity.

### **Information/Digital Literacy**

Ability to access, assess and utilize Information and Communications Technology (ICT) tools. Ability to understand, read and write programming language/packages/modules (C; C++; R; SPSS) for computation, simulation, graphics and data analytics.

### **Reflective Thinking**

An understanding of how a researcher or an investigator influences and shapes the information one creates; ability to formulate appropriate questions pertaining to the ideas in almost all branches of science dealing with data in order to propose innovative solutions using the analytics tools and statistical thinking; ability to interpret the findings and use them to solve a variety of problems found in numerous fields of science, economy, agriculture, industry and the society.

### **Cooperation/Team Work**

Ability to collaborate with diverse teams in an effective and respectful manner; capacity to cooperate with people from varied backgrounds in the interests of a common goal.

### **Research Related Skills**

The ability to formulate appropriate questions, problems, and hypotheses by analyzing the datasets and interpreting the findings; ability to demonstrate the results, techniques and predictive models using the concepts statistics; ability to develop methodology and design research proposals.

### **Problem Solving**

Ability to work independently and do in-depth study to find ways that statistical methods are used in various industries and in daily life to improve job possibilities in a wide range of fields and academic study; ability to use innovative, imaginative, lateral thinking, interpersonal skills, and emotional intelligence; ability to tackle various challenges in both familiar and unfamiliar circumstances, then apply what they've learned to deal with real life problems.

### **Critical Thinking**

Capability to analyse and synthesise theoretical and applied problems, as well as acquire knowledge and skills through logical reasoning, analytical thinking and evaluations; ability to find gaps and logical faults in design of any empirical research; inculcate a healthy attitude to be a lifelong learner.

The Objectives of the Undergraduate Programme in Statistics are listed in the following. After completing the programme the students will be able to-

- 1: Apply Statistical tools and techniques to solve problems of other relevant disciplines.
- 2: Pursue higher studies in the subject to take part in the academic enrichment of the subject and society as a whole.
- 3: Develop new techniques/methods for solving the unsolved problems of Statistics and other disciplines.
- 4: Construct Statistical models to mimic real life problems and make prediction and to identify important factors.

### **Teaching Learning Process:**

The outcome-based approach demands a considerable transition from teacher-centric to learner-centric pedagogies and from passive to active/participatory pedagogies, especially in the context of undergraduate study. This course promotes the systematic and sequential acquisition of knowledge and skills. It also focuses on practical abilities, as well as an awareness of the link

between methods and practice. Teaching curriculum involve discussions, presentations, use of required textbooks, e-learning tools, other self-study materials, project, internship, exploring industrial needs and other research activities and so on.

### **Assessment Methods:**

A variety of subject-specific assessment procedures are to be used to determine how well students are progressing. Continuous evaluation will decide the final grade which includes both in-semester evaluation and the final examination. In-semester evaluation will consist of class exams, mid-term exams, assignments etc. as determined by the concerned teacher of the course of study. The following techniques will be used to evaluate how successfully students are meeting their goals: tutorials, timed exams, problem-based assignments, lab reports for practical assignments, observations of practical skills, individual project reports, team project reports, oral presentations, including seminar presentations, viva-voce, quiz and so on.

## **PROGRAM OUTCOMES (POs)**

**PO1:** Graduates will demonstrate a strong understanding of fundamental statistical concepts, theories, and methodologies.

**PO2:** Graduates will be proficient in collecting, cleaning, analyzing, and interpreting data using statistical software and techniques.

**PO3:** Graduates will possess a solid foundation in mathematical concepts and techniques relevant to statistics, including calculus, linear algebra, and probability theory.

**PO4:** Graduates will be competent in using statistical software packages such as R, Python, or SPSS to conduct data analysis and visualization.

**PO5:** Graduates will be able to design experiments, surveys, and observational studies to address research questions and hypotheses effectively.

**PO6:** Graduates will understand and apply inferential statistical methods such as hypothesis testing, confidence intervals, regression analysis, and analysis of variance.

**PO7:** Graduates will have knowledge of advanced statistical techniques for analyzing complex datasets with multiple variables, including multivariate analysis, factor analysis, and cluster analysis.

**PO8:** Graduates will be proficient in analyzing time-series data and forecasting future trends using appropriate statistical models and techniques.

**PO9:** Graduates will be able to communicate statistical findings effectively to diverse audiences through written reports, oral presentations, and data visualization.

**PO10:** Graduates will demonstrate critical thinking skills and the ability to apply statistical reasoning to solve real-world problems in various domains.

**PO11:** Graduates will understand the ethical principles and guidelines governing the conduct of statistical research and practice, including issues related to confidentiality, data integrity, and bias.



**PO12:** Graduates will engage in lifelong learning and professional development activities to stay updated with advancements in the field of statistics and pursue career opportunities in academia, industry, government, or research.

**DIBRUGARH UNIVERSITY, RAJABHETA, DIBRUGARH – 786004**

**FYIPGP Structure as per UGC Credit Framework of December, 2022**

Year	Semester	Course	Title of the Course	Total Credit	
Year 01	1 <sup>st</sup> Semester	C - 1	Descriptive Statistics	4	
		Minor 1	Basic Statistical Methods	4	
		GEC - 1	Statistical Methods	3	
		AEC 1	Modern Indian Language	4	
		VAC 1	Value Added Course 1	2	
		SEC 1	Collection of Data and its Presentation	3	
	<b>Total</b>				<b>20</b>
	2 <sup>nd</sup> Semester	C - 2	Probability Theory and Statistical Distributions	4	
		Minor 2	Basic Probability Theory and Distributions	4	
		GEC - 2	Basics of Statistical Distributions and Inference	3	
		AEC 2	English Language and Communication Skills	4	
		VAC 2	Value Added Course 2	2	
		SEC 2	Data Science using MS EXCEL	3	
	<b>Total</b>				<b>20</b>
<p align="center"><b>The students on exit shall be awarded Undergraduate Certificate (in the Field of Study/Discipline) after securing the requisite 44 Credits in Semester 1 and 2 provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill based courses earned during 1<sup>st</sup> and 2<sup>nd</sup> Semester</b></p>					
Year 02	3 <sup>rd</sup> Semester	C - 3	Sampling Distributions	4	
		C - 4	Mathematics for Statistics	4	
		Minor 3	Survey Sampling and National Accounts Statistics	4	
		GEC - 3	Applied Statistics	3	
		VAC 3	Digital and Technological Solutions / Digital Fluency	2	
	SEC - 3	Introduction to Data Analysis in Python	3		
<b>Total</b>				<b>20</b>	

**Abbreviations Used:**

- **C = Major**
- **GEC = Generic Elective Course / Multi Disciplinary Course**
- **AEC = Ability Enhancement Course**
- **SEC = Skill Enhancement Course**
- **VAC = Value Added Course**

**INTEGRATED M.Sc. IN STATISTICS PROGRAMME (NEP)  
DETAILED SYLLABUS OF 1<sup>st</sup> SEMESTER**

<b>Title of the Course</b>	:	<b>Descriptive Statistics</b>
<b>Course Code</b>	:	<b>STSC1</b>
<b>Nature of the Course</b>	:	<b>Major</b>
<b>Total Credits</b>	:	<b>04</b>
<b>Distribution of Marks</b>	:	<b>60 (50T+10P) (End Sem)+ 40 (In-Sem)</b>

**COURSE OBJECTIVES:**

**Knowledge:**

- To understand basic concepts of statistics, statistical data and its types.
- To understand tabular and graphical representation of data.
- To learn different measures of central tendency and dispersion.
- To gain knowledge of correlation and Regression.
- To learn basic concept of index numbers and its methods.

**Skills:**

- To develop skills in using different scales of measurement.
- To learn to interpret statistical data using techniques of central tendency, dispersion, moments, skewness and kurtosis.
- To develop skills in using different methods of correlation and regression and its coefficient.
- To gain proficiency in Index numbers and its different methods and construction

**Attitude:**

- To develop a keen interest in different scales of measurement.
- To build up concern in different measures of central tendency and dispersion.
- To accumulate significance of moments, skewness, and kurtosis.
- To develop concern about correlation and regression and its different types.
- To cultivate meticulous approach to index numbers and its different methods.

**COURSE OUTCOMES:**

After the completion of this course, students will be able to:

**CO1:** Understand the basic concepts of statistics, statistical data and its types.

ILO1: Define statistics, statistical data, population and sample.

ILO2: Describe different types of statistical data.

ILO3: Understand different scales of measurement.

**CO2:** Understand tabular and graphical representation of statistical data.

ILO1: Describe different tabular representation of data.

ILO2: Discuss different graphical representation of data.

ILO3: Understand different tabular and graphical representation of data with illustrations.

- CO3:** Determine different measures of attributes for categorical data.  
 ILO1: Understand theory of attributes.  
 ILO2: Discuss independence and association of attributes.  
 ILO3: Describe different methods of measuring association.
- CO4:** Evaluate measures of central tendency and dispersion to statistical data.  
 ILO1: Describe different measures of central tendency with geometry.  
 ILO2: Discuss different measure of dispersion with geometry.  
 ILO3: Describe moments, skewness and kurtosis with geometry.
- CO5:** Evaluate correlation and regression and its types and methods using statistical data.  
 ILO1: Understand scatter diagram and methods of curve fitting  
 ILO2: Describe correlation, its types and methods of measuring correlation.  
 ILO3: Describe regression and its types, lines of regression and regression coefficients.  
 ILO4: Understand multiple and partial correlation and coefficient of determination.
- CO6:** Demonstrate Index numbers and its methods and construction for statistical data.  
 ILO1: Understand different types and construction of Index numbers.  
 ILO2: Describe methods of constructing Index numbers.  
 ILO3: Describe test of consistency of Index numbers.  
 ILO4: Discuss Chain Indices, Inflation and Deflation of Index numbers.  
 ILO5: Discuss methods of construction of cost of living Index numbers.

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge		CO1		CO3, CO4, CO5		
Procedural Knowledge		CO2			CO6	
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	M	M	M	L	M	M	S	M	S
CO2	S	S	M	M	M	M	L	M	M	S	M	S
CO3	S	S	M	M	M	M	L	M	M	S	M	S
CO4	S	S	M	M	L	M	M	M	M	S	M	S
CO5	S	S	M	M	M	M	M	M	M	S	M	S
CO6	S	S	M	M	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<p><b>Basic Statistics:</b> Definition and scope of Statistics, concepts of statistical population and sample.</p> <p><b>Types of Data and its Collection:</b> quantitative and qualitative, primary and secondary, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.</p> <p><b>Presentation of Data:</b> Tabular and graphical.</p> <p><b>Categorical Data:</b> Attributes and different measures of their association.</p>	09	02	-	11
2 (14 Marks)	<p><b>Measures of Central Tendency:</b> Mathematical and positional measures with their geometry.</p> <p><b>Measures of Dispersion:</b> Range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections with their geometry.</p>	10	02	-	12
3 (11 Marks)	<p><b>Bivariate Data:</b> Definition, scatter diagram, simple correlation, interpretation of r and rank correlation. Simple linear regression, principle of least squares squares and its geometry, fitting of polynomials and exponential curves.</p> <p><b>Multivariate Data:</b> Definition, partial and multiple correlation, interpretation of R, and coefficient of determination.</p>	09	01	-	10
4 (13 Marks)	<p><b>Index Numbers:</b> Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers. Inflation and deflation. Headline and core inflation and interpretation. Tests of adequacy of Index Numbers.</p>	09	02	-	11
5 (10 Marks)	<p><b>List of Practical: (both calculator and computer based)</b></p> <ol style="list-style-type: none"> <li>Graphical representation of data.</li> <li>Problems based on measures of central tendency.</li> <li>Problems based on measures of dispersion.</li> <li>Problems based on combined mean and variance and coefficient of variation.</li> <li>Problems based on moments, skewness and kurtosis.</li> <li>Construction of box plot.</li> </ol>	-	-	08	16

7. Fitting of polynomials, exponential curves with computation of residuals.				
8. Karl Pearson correlation coefficient.				
9. Correlation coefficient for a bivariate frequency distribution.				
10. Fitting of lines of regression, and angle between lines.				
11. Spearman rank correlation with and without ties.				
12. Partial and multiple correlations.				
13. Planes of regression and variances of residuals for given simple correlations.				
14. Planes of regression and variances of residuals for raw data.				
15. Calculation of price and quantity index numbers using simple and weighted average of price relatives.				
16. Test based on adequacy of index numbers.				
17. Calculation of the chain base index numbers.				
18. Calculation of consumer price index number.				
<b>Total</b>	<b>37</b>	<b>07</b>	<b>08</b>	<b>60</b>

*Where, L: Lectures T: Tutorials P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Goon A. M., Gupta M. K. and Dasgupta B. (2002). Fundamentals of Statistics, Vol. I & II, 8<sup>th</sup> Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006). John E. Freund's Mathematical Statistics with Applications, (7<sup>th</sup> Edn.), Pearson Education, Asia.
3. Mood, A. M. Graybill, F. A. and Boes, D. C. (2007). Introduction to the Theory of Statistics, 3<sup>rd</sup> Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd, Delhi.
4. Barman. M. P., Hazarika. J, Bora. T (2021). Statistical Methods, Mahaveer Pub, Dibrugarh.
5. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
6. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International, New Delhi, India.
7. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
8. D. N. Elhance, Veena Elhance, and B. M. Aggarwal (2018). Fundamentals of Statistics. Kitab Mahal Daryaganaj New Delhi, India.
9. George. A. F. Seber and Alan. J. Lee (2012). Linear Regression Analysis. John Wiley & Sons, United Kingdom.
10. Linear algebra and its applications / David C. Lay, University of Maryland, College Park,

Steven R. Lay, Lee University, Judi J. McDonald, Washington State University. – Fifth edition.

11. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh Prakashan, Dibrugarh.

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<b>Title of the Course</b>	:	<b>Basic Statistical Methods</b>
<b>Course Code</b>	:	<b>MINSTS1</b>
<b>Nature of the Course</b>	:	<b>Minor</b>
<b>Total Credits</b>	:	<b>04</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

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#### **Skills:**

- To develop skills in using different scales of measurement.
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- To develop a keen interest in different scales of measurement.
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After the completion of this course, students will be able to:

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ILO1: Define statistics, statistical data, population and sample.

ILO2: Describe different types of statistical data.

ILO3: Understand different scales of measurement.

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ILO1: Describe different tabular representation of data.

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ILO3: Understand different tabular and graphical representation of data with illustrations.

**CO3:** Determine different measures of attributes for categorical data.

ILO1: Understand theory of attributes.

ILO2: Discuss independence and association of attributes.

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- CO4:** Evaluate measures of central tendency and dispersion to statistical data.  
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CO2	S	S	M	M	M	M	L	M	M	S	M	S
CO3	S	S	M	M	M	M	L	M	M	S	M	S
CO4	S	S	M	M	L	M	M	M	M	S	M	S
CO5	S	S	M	M	M	M	M	M	M	S	M	S
CO6	S	S	M	M	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

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1 (12 Marks)	<p><b>Basic Statistics:</b> Definition and scope of Statistics, concepts of statistical population and sample.</p> <p><b>Types of Data and its Collection:</b> quantitative and qualitative, primary and secondary, attributes, variables, scales of measurement nominal, ordinal, interval and ratio.</p> <p><b>Presentation of Data:</b> Tabular and graphical.</p>	09	01	-	10
2 (13 Marks)	<p><b>Measures of Central Tendency:</b> Mathematical and positional measures with their geometry.</p> <p><b>Measures of Dispersion:</b> range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections with their geometry.Box plot and its interpretation.</p>	09	02	-	11
3 (12 Marks)	<p><b>Bivariate Data:</b> Definition, scatter diagram, simple correlation and rank correlation. Simple linear regression, principle of least squares (Legendre and Gauss) and fitting of polynomials and exponential curves.</p> <p><b>Multivariate Data:</b> Definition, partial and multiple correlation, and coefficient of determination.</p>	09	02	-	11
4 (13 Marks)	<p><b>Index Numbers:</b> Definition, Construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers, tests of adequacy of Index Numbers, inflation(Core and Headline).</p>	10	02	-	12
5 (10 Marks)	<p><b>List of Practical: (both calculator and computer based)</b></p> <ol style="list-style-type: none"> <li>1. Graphical representation of data.</li> <li>2. Problems based on measures of central tendency.</li> <li>3. Problems based on measures of dispersion.</li> <li>4. Problems based on combined mean and variance and coefficient of variation.</li> <li>5. Problems based on moments, skewness and kurtosis.</li> <li>6. Construction of box plot.</li> <li>7. Fitting of polynomials, exponential curves with computation of residuals.</li> <li>8. Karl Pearson correlation coefficient.</li> <li>9. Correlation coefficient for a bivariate</li> </ol>	-	-	08	16

	frequency distribution.				
	10. Fitting of lines of regression, and angle between lines.				
	11. Spearman rank correlation with and without ties.				
	12. Partial and multiple correlations.				
	13. Planes of regression and variances of residuals for given simple correlations.				
	14. Planes of regression and variances of residuals for raw data.				
	15. Calculation of price and quantity index numbers using simple and weighted average of price relatives.				
	16. Test based on adequacy of index numbers.				
	17. Calculation of the chain base index numbers.				
	18. Calculation of consumer price index number.				
	<b>Total</b>	<b>37</b>	<b>07</b>	<b>08</b>	<b>60</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Goon A. M., Gupta M. K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8<sup>th</sup> Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7<sup>th</sup> Edn.), Pearson Education, Asia.
3. Mood, A. M. Graybill, F. A. and Boes, D. C. (2007): Introduction to the Theory of Statistics, 3<sup>rd</sup> Edn., (Reprint), Tata McGraw-Hill Pub. Co.Ltd, Delhi.
4. Barman. M. P., Hazarika. J, Bora. T (2021): Statistical Methods, Mahaveer Pub, Dibrugarh.
5. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
6. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International, New Delhi, India.
7. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
8. D. N. Elhance, Veena Elhance, AND B. M. Aggarwal (2018). Fundamentals of Statistics. Kitab Mahal Daryaganaj New Delhi, India.
9. George. A. F. Seber and Alan. J. Lee (2012). Linear Regression Analysis. John Wiley & Sons, United Kingdom.
10. Linear algebra and its applications / David C. Lay, University of Maryland, College Park, Steven R. Lay, Lee University, Judi J. McDonald, Washington State University. – Fifth edition.
11. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh Prakashan, Dibrugarh.

<b>Title of the Course</b>	:	<b>Statistical Methods</b>
<b>Course Code</b>	:	<b>GECSTS1</b>
<b>Nature of the Course</b>	:	<b>Generic Elective</b>
<b>Total Credits</b>	:	<b>03</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

### **COURSE OBJECTIVES:**

#### **Knowledge:**

- To understand basic concepts of statistics, statistical data and its types.
- To understand tabular and graphical representation of data.
- To learn different measures of central tendency and dispersion.
- To gain knowledge of correlation and Regression.

#### **Skills:**

- To develop skills in using different scales of measurement.
- To learn to interpret statistical data using techniques of central tendency, dispersion, moments, skewness and kurtosis.
- To develop skills in using different methods of correlation and regression and its coefficient.

#### **Attitude:**

- To develop a keen interest in different scales of measurement.
- To build up concern in different measures of central tendency and dispersion.
- To accumulate significance of moments, skewness, and kurtosis.
- To develop concern about correlation and regression and its different types.

### **COURSE OUTCOMES:**

After the completion of this course, students will be able to:

**CO1:** Understand the basic concepts of statistics, statistical data and its types.

ILO1: Define statistics, statistical data, population and sample.

ILO2: Describe different types of statistical data.

ILO3: Understand different scales of measurement.

**CO2:** Understand tabular and graphical representation of statistical data.

ILO1: Describe different tabular representation of data.

ILO2: Discuss different graphical representation of data.

ILO3: Understand different tabular and graphical representation of data with illustrations.

**CO3:** Evaluate measures of central tendency and dispersion to statistical data.

ILO1: Describe different measures of central tendency with geometry.

ILO2: Discuss different measure of dispersion with geometry.

ILO3: Describe moments, skewness and kurtosis with geometry.

**CO4:** Evaluate correlation and regression and its types and methods using statistical data.

ILO1: Understand scatter diagram and methods of curve fitting

ILO2: Describe correlation, its types and methods of measuring correlation.

ILO3: Describe regression and its types, lines of regression and regression coefficients.

ILO4: Understand multiple and partial correlation and coefficient of determination.

- CO5:** Determine different measures of attributes for categorical data.  
 ILO1: Understand theory of attributes and consistency of data.  
 ILO2: Discuss independence and association of attributes.  
 ILO3: Describe different methods of measuring association.

**Table: Learning Outcome Representation (CO): Bloom’s Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge		CO1				
Procedural Knowledge			CO2		CO3, CO4, CO5	
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P11	P12
CO1	S	S	M	M	M	M	L	M	M	S	M	S
CO2	S	S	M	M	M	M	L	M	M	S	M	S
CO3	S	S	M	M	M	M	L	M	M	S	M	S
CO4	S	S	M	M	L	M	M	M	M	S	M	S
CO5	S	S	M	M	M	M	M	M	M	S	M	S
CO6	S	S	M	M	M	M	L	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<b>Introduction:</b> Definition and scope of Statistics, concepts of statistical population and sample. <b>Data:</b> quantitative and qualitative, primary and secondary, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. <b>Presentation:</b> tabular and graphic, including histogram and ogives.	07	01	-	08
2 (14 Marks)	<b>Measures of Central Tendency:</b> Mathematical and positional measures with their geometry. <b>Measures of Dispersion:</b> range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections with their geometry.	09	01	-	10
3 (14 Marks)	<b>Bivariate Data:</b> Definition, scatter diagram, simple correlation, interpretation of r and rank correlation. Simple linear regression, principle of least squares and its geometry, fitting of polynomials and exponential curves. <b>Multivariate Data:</b> Definition, partial and multiple correlation, interpretation of R, and coefficient of determination.	10	01	-	11
4 (10 Marks)	<b>Categorical Data:</b> Attributes, consistency of data, independence and association of attributes, measures of association and contingency.	05	01	-	06
5 (10 Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Graphical representation of data. 2. Problems based on measures of central tendency. 3. Problems based on measures of dispersion. 4. Problems based on combined mean and variance and coefficient of variation. 5. Problems based on moments, skewness and kurtosis 6. Fitting of polynomials, exponential curves. 7. Karl Pearson correlation coefficient. 8. Partial and multiple correlations. 9. Spearman rank correlation with and without ties. 10. Correlation coefficient for a bivariate frequency distribution. 11. Fitting of lines of regression, and angle between lines 12. Testing the independence of attributes.	-	-	05	10
	<b>Total</b>	<b>31</b>	<b>04</b>	<b>05</b>	<b>45</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Goon A. M., Gupta M. K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A. M., Graybill, F. A. and Boes, D. C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Barman. M. P., Hazarika. J., Bora. T. (2021): Statistical Methods, Mahaveer Pub, Dibrugarh.
5. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
6. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International, New Delhi, India.
7. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
8. D. N. Elhance, Veena Elhance, and B. M. Aggarwal (2018). Fundamentals of Statistics. Kitab Mahal Daryaganaj New Delhi, India.
9. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh Prakashan, Dibrugarh

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<b>Title of the Course</b>	:	<b>Collection of Data and its Presentation</b>
<b>Course Code</b>	:	<b>SECSTS1</b>
<b>Nature of the Course</b>	:	<b>Skill Enhancement</b>
<b>Total Credits</b>	:	<b>03</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

## **COURSE OBJECTIVES:**

### **Knowledge:**

- To understand the fundamentals of data collection and presentation
- To differentiate between primary and secondary data
- To grasp the concept of big data
- To familiarize with data collection methods
- To learn sampling techniques and sample size determination
- To comprehend ethical considerations in data collection

### **Skills:**

- To design effective data collection instruments
- To execute data collection methods
- To perform data analysis
- To visualize data effectively
- To edit and code data
- To conduct exploratory data analysis

### **Attitudes:**

- To value the importance of data in decision-making
- To maintain objectivity in data collection
- To adhere to ethical standards
- To encourage critical thinking
- To promote accuracy and precision
- To embrace lifelong learning

## **COURSE OUTCOMES:**

After the completion of this course, students will be able to:

### **CO1: Understand the Fundamentals of Data Collection and Presentation**

ILO 1: Explain the importance and uses of scientific data in various fields.

ILO 2: Identify and distinguish between different types of data: qualitative and quantitative.

ILO 3: Describe the processes involved in data collection and presentation.

### **CO2: Differentiate Between Primary and Secondary Data**

ILO 1: Define primary and secondary data with examples.

ILO 2: Evaluate the advantages and disadvantages of using primary versus secondary data.

ILO 3: Identify sources of secondary data and discuss their reliability and relevance.



**CO3: Grasp the Concept of Big Data**

ILO 1: Explain what big data is and its significance in contemporary research and business.

ILO 2: Identify the challenges associated with big data collection, storage, and analysis.

ILO 3: Discuss real-world applications and case studies involving big data.

**CO4: Develop and Execute Data Collection Methods**

ILO 1: Design effective questionnaires, schedules, and interview protocols.

ILO 2: Conduct surveys, interviews, and observations in a structured manner.

ILO 3: Demonstrate the ability to collect accurate and reliable data from various sources.

**CO5: Analyze and Interpret Data Using Statistical Techniques**

ILO 1: Apply descriptive statistics to summarize and describe data.

ILO 2: Use exploratory data analysis techniques to identify patterns and outliers.

ILO 3: Create effective data visualizations, such as charts and graphs, to present findings.

**CO6: Adhere to Ethical Standards and Maintain Objectivity in Data Collection**

ILO 1: Identify and address ethical issues in data collection and analysis.

ILO 2: Maintain objectivity and avoid biases in data collection processes.

ILO 3: Understand the importance of confidentiality and data protection.

**Table: Learning Outcome Representation (CO): Bloom’s Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge		CO1, CO3				
Conceptual Knowledge		CO2				
Procedural Knowledge			CO4, CO5, CO6			
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	M	M	M	L	M	M	S	M	S
CO3	S	S	M	S	M	L	M	M	M	S	M	S
CO4	S	S	M	M	S	L	M	M	M	S	M	S
CO5	S	S	M	M	S	S	M	M	M	S	M	S
CO6	S	S	M	M	M	L	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<b>Introduction to Data Collection</b> and Presentation, Scientific data and its importance, Importance of data in decision-making, The role of data collection and presentation in research, Big data and Small data, Qualitative and Quantitative data, primary and Secondary data.	05	01	-	06
2 (12 Marks)	<b>Different Data Collection Methods:</b> Primary data collection techniques, Surveys: questionnaires and schedule with respect to different objectives in the field of health sciences, social sciences, Behavioural Sciences, Business etc. Interviews: structured, semi-structured, and unstructured interviews. Observations: participant and non-participant observations. Secondary data collection techniques, Publicly available datasets, Government and organizational reports.	08	01	-	09
3 (12 Marks)	<b>Data Collection Design and Execution:</b> Planning and formulating research questions, Sampling techniques and sample size determination, Designing effective survey questions and interview protocols, Conducting observations and maintaining objectivity, Ethical considerations in data collection, Data Cleaning, Organization, and Validation, Data pre-processing techniques, Identifying and handling missing data, Outlier detection and treatment, Data validation and reliability checks, Data Analysis and Interpretation. Data coding, scaling techniques and development of Likert type scale.	08	01	-	09
4 (14 Marks)	<b>Statistical Analysis Techniques:</b> Introduction to statistical analysis techniques, Descriptive statistics: measures of central tendency and dispersion, Inferential statistics: hypothesis testing and confidence intervals, Exploratory data analysis: data visualization and graphical techniques, Choosing appropriate visualization methods, Creating effective charts, graphs, and info graphics. Formulation of digital presentation and report writing.	10	01	-	11

5 (10 Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Preparation of questionnaires and schedule to solve a particular research question. 2. Conduct of a small sample survey in the institution among the students. 3. Collect of a secondary data set from a local government or private organization. 4. Determination of sample size of a survey. 5. Detection of outliers 6. Graphical representation of Data- bar graph, histogram, ogive, polynomial curve and box plot. 7. Problems based on measures of central tendency. 8. Problems based on measures of dispersion.	-	-	05	10
<b>Total</b>		<b>31</b>	<b>04</b>	<b>05</b>	<b>45</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Goon A. M., Gupta M. K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A. M. Graybill, F. A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co.Ltd.
4. Barman. M. P., Hazarika. J, Bora. T (2021): Statistical Methods, Mahaveer Pub, Dibrugarh
5. Brace, I (2013) Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research. Kogan Page. UK.
6. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh Prakashan, Dibrugarh

**INTEGRATED M.Sc. IN STATISTICS PROGRAMME (NEP)  
DETAILED SYLLABUS OF 2<sup>nd</sup> SEMESTER**

<b>Title of the Course</b>	<b>:</b>	<b>Probability Theory and Statistical Distributions</b>
<b>Course Code</b>	<b>:</b>	<b>STSC2</b>
<b>Nature of the Course</b>	<b>:</b>	<b>Major</b>
<b>Total Credits</b>	<b>:</b>	<b>04</b>
<b>Distribution of Marks</b>	<b>:</b>	<b>60 (End Sem) + 40 (In-Sem)</b>

**COURSE OBJECTIVES:**

**Knowledge:**

- To familiarize students with the foundational concepts of probability theory, laws and theorems.
- To provide knowledge on useful probability distributions, their properties and applications of various distributions.

**Skills:**

- To develop practical skills in fitting statistical distributions to data.
- Gain hands-on experience in fitting distributions using calculators and computer software and enhance practical statistical analysis skills.

**Attitude:**

- To cultivate an analytical and methodical approach towards statistical problems, encourage systematic problem-solving techniques and foster a critical mindset for analyzing and interpreting statistical data.
- To promote confidence in using statistical tools and methodologies, and build competence in applying theoretical knowledge to practical scenarios.

**COURSE OUTCOMES:**

After successful completion of this course, students will be able to:

**CO1:** Understand and apply the foundational concepts of probability theory.

ILO1: Knowledge about the random experiments, sample space, and events and ability to distinguish between random and non-random experiments.

ILO2: Knowledge to conceptualise the probabilities of events including frequentist and axiomatic approach.

ILO3: They will be able to solve problems involving conditional probability, laws of addition and multiplication, and independent events.

ILO4: They will learn the notion of conditional probability including the concept of Bayes' Theorem.

**CO2:** Identify and utilize different types of random variables and their distributions.

ILO1: Differentiate between discrete and continuous random variables.

ILO2: Define and illustrate the probability mass function, probability density function, and cumulative distribution function for various random variables.

ILO3: Perform univariate transformations of random variables, understand their properties and analyze two-dimensional random variables to determine joint,

marginal, and conditional distributions.

**CO3:** Calculate and interpret expectations, moments, and generating functions for various distributions.

ILO1: Compute expectations for single and bivariate random variables and understand their significance.

ILO2: Determine moments and cumulants for given distributions and explain their applications. Use moment-generating functions, cumulant-generating functions, and characteristic functions in statistical analysis.

ILO3: Compute expectations for single and bivariate random variables and understand their significance.

**CO4:** Apply knowledge of standard probability distributions in real-world scenarios.

ILO1: Describe and use properties of standard probability distributions such as Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, Uniform, Normal, Exponential, Cauchy, Beta, and Gamma distributions.

ILO2: Identify limiting and approximation cases of these distributions and understand their relevance.

ILO3: Utilize these distributions in practical applications and problem-solving, demonstrating their importance in statistical analysis.

**CO5:** Perform practical fitting of distributions using calculators and computer-based methods.

ILO1: Fit a Binomial and Poisson distribution to a given data set using both calculators and computer software

ILO2: Fit Geometric and Negative Binomial distributions to provided data sets

ILO3: Fit Normal and Exponential distributions to data

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge			CO1			
Conceptual Knowledge			CO2			
Procedural Knowledge				CO3, CO4	CO5	
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	S	M	L	M	M	M	S	M	S
CO3	S	S	M	S	M	M	M	M	M	S	M	S
CO4	S	S	M	S	M	S	M	M	M	S	M	S
CO5	S	S	M	S	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<b>Probability:</b> Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability– classical, statistical, and axiomatic. Computation of probability by conditioning, laws of addition and multiplication, independent events, theorem of total probability, Bayes’ theorem and its applications.	10	02	-	12
2 (18 Marks)	<b>Random Variables:</b> discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations. <b>Two Dimensional Random Variables:</b> discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., computation of probability, expectation & variance by conditioning, independence of variables, bivariate transformations with illustrations. Mathematical Expectation of random variables and related theorems. Moment generating function (mgf) and characteristic function (cf), properties, uses and related theorems.	15	03	-	18
3 (15 Marks)	<b>Standard Discrete Distributions:</b> Binomial, Poisson, geometric, negative binomial, hypergeometric (their applications, properties and fitting).	12	03	-	15
4 (15 Marks)	<b>Continuous Univariate Distributions:</b> Uniform, exponential, Cauchy, beta, gamma and normal distribution (their applications, properties and fitting).	12	03	-	15
<b>Total</b>		<b>49</b>	<b>11</b>	<b>-</b>	<b>60</b>

*Where,**L: Lectures**T: Tutorials**P: Practical***MODES OF IN-SEMESTER ASSESSMENT:****(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

### **SUGGESTED READINGS:**

1. Hogg, R. V., Tanis, E. A. and Rao J. M. (2009). Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P. L. (1970). Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.
4. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
5. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International, New Delhi, India.
6. Bhuyan, K. C. (2010). Probability Distribution Theory and Statistical Inference. New Central Book Agency (P) Limited.
7. Biswas, S. (1991). Topics in statistical methodology. New Age International.
8. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub. Mumbai, India.
9. D. N. Elhance, Veena Elhance, and B. M. Aggarwal (2018). Fundamentals of Statistics. Kitab Mahal Daryaganaj New Delhi, India.
10. McColl, J. H. (2004). Multivariate probability. John Wiley and Sons.
11. Ross, S. M. (2014). Introduction to probability models. Academic Press Inc.
12. Robert Hogg, Joseph McKean, Allen Craig (2018). Introduction to Mathematical Statistics. Pearson; 8th Edn.
13. Alexander M. Mood, Franklin A. Graybill, Duane C. Boes (1974). Introduction to the Theory of Statistics. McGraw-Hill Education; 3rd edition, India.
14. Wolfgang Karl Härdle & Zdeněk Hlávka (2015). Multivariate Statistics: Exercises and Solutions. Springer Nature; 2<sup>nd</sup> Edn., India.
15. Jeffrey J. Hunter and J. William Schmidt (2014). Mathematical Techniques of Applied Probability: Discrete Time Models: Basic Theory. Academic Press, 1st Edition.
16. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh Prakashan, Dibrugarh

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<b>Title of the Course</b>	:	<b>Basic Probability Theory and Distributions</b>
<b>Course Code</b>	:	<b>MINSTS2</b>
<b>Nature of the Course</b>	:	<b>Minor</b>
<b>Total Credits</b>	:	<b>04</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

### **COURSE OBJECTIVES:**

#### **Knowledge:**

- To familiarize students with the foundational concepts of probability theory, laws and theorems.
- To provide knowledge on useful probability distributions, their properties and applications of various distributions.

#### **Skills:**

- To develop practical skills in fitting statistical distributions to data.
- Gain hands-on experience in fitting distributions using calculators and computer software and enhance practical statistical analysis skills.

#### **Attitude:**

- To cultivate an analytical and methodical approach towards statistical problems, encourage systematic problem-solving techniques and foster a critical mindset for analyzing and interpreting statistical data.
- To promote confidence in using statistical tools and methodologies, build competence in applying theoretical knowledge to practical scenarios.

### **COURSE OUTCOMES:**

After successful completion of this course, students will be able to:

**CO1:** Understand and apply the foundational concepts of probability theory.

ILO1: Knowledge about the random experiments, sample space, and events and ability to distinguish between random and non-random experiments.

ILO2: Knowledge to conceptualise the probabilities of events including frequentist and axiomatic approach.

ILO3: They will be able to solve problems involving conditional probability, laws of addition and multiplication, and independent events.

ILO4: They will learn the notion of conditional probability including the concept of Bayes' Theorem.

**CO2:** Identify and utilize different types of random variables and their distributions.

ILO1: Differentiate between discrete and continuous random variables.

ILO2: Define and illustrate the probability mass function, probability density function, and cumulative distribution function for various random variables.

ILO3: Perform univariate transformations of random variables, understand their properties and analyze two-dimensional random variables to determine joint, marginal, and conditional distributions.

**CO3:** Calculate and interpret expectations, moments, and generating functions for various



distributions.

ILO1: Compute expectations for single and bivariate random variables and understand their significance.

ILO2: Determine moments and cumulants for given distributions and explain their applications. Use moment-generating functions, cumulant-generating functions, and characteristic functions in statistical analysis.

ILO3: Compute expectations for single and bivariate random variables and understand their significance.

**CO4:** Apply knowledge of standard probability distributions in real-world scenarios.

ILO1: Describe and use properties of standard probability distributions such as Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, Uniform, Normal, Exponential, Cauchy, Beta, and Gamma distributions.

ILO2: Identify limiting and approximation cases of these distributions and understand their relevance.

ILO3: Utilize these distributions in practical applications and problem-solving, demonstrating their importance in statistical analysis.

**CO5:** Perform practical fitting of distributions using calculators and computer-based methods.

ILO1: Fit a Binomial and Poisson distribution to a given data set using both calculators and computer software

ILO2: Fit Geometric and Negative Binomial distributions to provided data sets

ILO3: Fit Normal and Exponential distributions to data

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge			CO1			
Conceptual Knowledge			CO2			
Procedural Knowledge				CO3, CO4	CO5	
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	S	M	L	M	M	M	S	M	S
CO3	S	S	M	S	M	M	M	M	M	S	M	S
CO4	S	S	M	S	M	S	M	M	M	S	M	S
CO5	S	S	M	S	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<b>Probability:</b> Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability– classical, statistical, and axiomatic. Computation of probability by conditioning, laws of addition and multiplication, independent events, theorem of total probability, Bayes’ theorem and its applications.	09	01	-	10
2 (13 Marks)	<b>Random Variables:</b> discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations. <b>Two Dimensional Random Variables:</b> discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, bivariate transformations with illustrations.	09	02	-	11
3 (12 Marks)	<b>Mathematical Expectation and Generating Functions:</b> Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications.Computation of expectations by conditioning,.	09	02	-	11
4 (13 Marks)	<b>Standard Probability Distributions:</b> Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases.	10	02	-	12
5 (10Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Fitting of binomial distribution. 2. Fitting of Poisson distribution. 3. Fitting of geometric distribution. 4. Fitting of negative binomial distribution. 5. To find the ordinate for a given area for normal distribution. 6. Fitting of normal distribution. 7. Fitting of exponential distribution. 8. Computation of probability by conditioning.	-	-	08	16
	<b>Total</b>	<b>37</b>	<b>07</b>	<b>08</b>	<b>60</b>

*Where, L: Lectures T: Tutorials P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)

- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

### **SUGGESTED READINGS:**

1. Hogg, R. V., Tanis, E. A. and Rao J. M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P. L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.
4. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
17. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International, New Delhi, India.
5. Bhuyan, K. C. (2010). Probability Distribution Theory and Statistical Inference. New Central Book Agency (P) Limited.
6. Biswas, S. (1991). Topics in Statistical Methodology. New Age International.
7. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
8. D. N. Elhance, Veena Elhance, B.M. Aggarwal (2018). Fundamentals of Statistics. Kitab Mahal Daryaganaj New Delhi, India.
9. McColl, J. H. (2004). Multivariate probability. John Wiley and Sons.
10. Ross, S. M. (2014). Introduction to probability models. Academic Press Inc.
11. Robert Hogg, Joseph McKean, Allen Craig (2018). Introduction to Mathematical Statistics. Pearson; 8th Edn.
12. Alexander M. Mood, Franklin A. Graybill, Duane C. Boes (1974). Introduction to the Theory of Statistics. McGraw-Hill Education; 3rd edition, India.
13. Wolfgang Karl Härdle & Zdeněk Hlávka (2015). Multivariate Statistics: Exercises and Solutions. Springer Nature; 2<sup>nd</sup> Edn., India.
14. Jeffrey J. Hunter and J. William Schmidt (2014). Mathematical Techniques of Applied Probability: Discrete Time Models: Basic Theory. Academic Press, 1st Edition.

<b>Title of the Course</b>	:	<b>Applied Probability Theory and Statistical Inference</b>
<b>Course Code</b>	:	<b>GECSTS2</b>
<b>Nature of the Course</b>	:	<b>Generic Elective</b>
<b>Total Credits</b>	:	<b>03</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

### **COURSE OBJECTIVES:**

Knowledge:

- To study useful probability distributions and their properties and applications of these distributions.
- To study useful sampling distributions and their properties, applications to make inferences about populations.

Skills:

- To make informative decisions using statistical tests.
- To make evidence-based decisions based on statistical analysis.

Attitude:

- To develop a critical and analytical mindset towards statistical data. Foster a methodical approach to problem-solving in statistics.
- To promote confidence in applying statistical methods using statistical tools and techniques. Instil the importance of accuracy and reliability in statistical analysis.

### **COURSE OUTCOMES:**

After successful completion of this course, students will be able to:

**CO1:** Understand and apply the foundational concepts of probability and random variables

ILO1: Define and explain random experiments

ILO2: Solve problems involving conditional probability

ILO3: Differentiate between discrete and continuous random variables and illustrate their probability mass function (pmf)

**CO2:** Calculate mathematical expectations and understand generating functions

ILO1: Define and compute the mathematical expectation for different types of random variables.

ILO2: Explain and use generating functions in the context of probability distributions.

ILO3: Illustrate the concepts of moments and cumulants through generating functions.

**CO3:** Identify and utilize basic statistical and sampling distributions in data analysis.

ILO1: Describe and use properties of basic statistical distributions such as Binomial

ILO2: Define and apply basic sampling distributions such as Chi-square

ILO3: Differentiate between population and sample

ILO4: Explain the basic idea of significance testing

**CO4:** Perform and interpret various tests of significance for hypothesis testing.

ILO1: Conduct tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems) and perform tests for the significance of the

- correlation coefficient.
- ILO2: Analyze categorical data using Chi-square tests of proportions, association, and goodness-of-fit, including Yates' correction.
- ILO3: Conduct analysis of variance (one-way classification) and interpret the results. Check the consistency of data and find associations among attributes using statistical methods.

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge			CO1	CO4		
Procedural Knowledge				CO2	CO3	
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	S	M	L	M	M	M	S	M	S
CO3	S	S	M	S	M	M	M	M	M	S	M	S
CO4	S	S	M	S	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (15 Marks)	<b>Probability:</b> Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Computation of probability by conditioning,, laws of addition and multiplication, independent events, theorem of total probability. <b>Random Variables:</b> discrete and continuous random variables, Idea of mathematical expectation.	10	01	-	11
2 (10 Marks)	<b>Basic Statistical Distributions:</b> Discrete and continuous,p.m.f., p.d.f. and c.d.f. <b>Basic Sampling Distributions:</b> Chi-square, t and F (Definition and use only).	05	01	-	06
3 (10 Marks)	<b>Basic of Hypothesis Testing:</b> Idea of population, sample, Parameter and statistic. What and why of testing of hypothesis. Procedure of testing hypothesis. The basic idea testof significance. Null and alternative	06	01	-	07

	hypotheses. Type I & Type II errors, critical region, level of significance, concept of p-value.				
4 (15 Marks)	<b>Statistical Tests:</b> Large sample test, test of mean and proportion. Small sample tests- t, F, Chi-square. Tests for the significance of correlation coefficient. <b>Categorical Data:</b> Tests of association and goodness-of-fit using Chi-square test, Yates' correction.	10	01		11
5 (10 Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Test of mean and proportion. 2. Chi-square tests of association. 3. Chi-square test of goodness-of-fit. 4. Test for correlation coefficient. 5. Checking consistency of data and finding association among attributes. 6. Test for variance (F-test)	-	-	05	10
	<b>Total</b>	<b>31</b>	<b>04</b>	<b>05</b>	<b>45</b>

*Where,*

*L: Lectures*

*T: Tutorials*

*P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Goon, A. M., Gupta M. K. and Das Gupta (2005). Fundamentals of statistics, Vol.-I & II.
2. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
3. Bhuyan, K. C. (2010). Probability Distribution Theory and Statistical Inference. New Central Book Agency (P) Limited.
4. Biswas, S. (1991). Topics in Statistical Methodology. New Age International.
5. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
6. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International, New Delhi, India.
7. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh Prakashan, Dibrugarh

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<b>Title of the Course</b>	:	<b>Data Science using MS EXCEL</b>
<b>Course Code</b>	:	<b>SECSTS2</b>
<b>Nature of the Course</b>	:	<b>Skill Enhancement</b>
<b>Total Credits</b>	:	<b>03</b>
<b>Distribution of Marks</b>	:	<b>60 (End Sem) + 40 (In-Sem)</b>

## **COURSE OBJECTIVES:**

### **Knowledge:**

- To Understand Excel Data Types and Structures
- To Learn Cell and Worksheet Operations
- To Grasp Advanced Excel Functions and Tools

### **Skills:**

- To Perform Data Analysis and Visualization
- To Execute Cell and Worksheet Operations
- To Use Advanced Excel Tools for Data Management

### **Attitudes:**

- To Cultivate Attention to Detail
- To Foster a Problem-Solving Mindset
- To Promote Data-Driven Decision Making

## **COURSE OUTCOMES:**

After the completion of this course, students will be able to:

### **CO1: To Understand Excel Data Types and Structures**

- ILO 1: Identify different data types used in Excel.
- ILO 2: Explain the structure of an Excel worksheet.
- ILO 3: Describe naming conventions and create named ranges.
- ILO 4: Understand the importance of data types in performing calculations and analyses.

### **CO2: To Learn Cell and Worksheet Operations**

- ILO 1: Freeze panes and split sheets to manage large datasets effectively.
- ILO 2: Hide and unhide rows, columns, and sheets to control the visibility of data.
- ILO 3: Apply wrapping, merging, and alignment techniques for better data presentation.
- ILO 4: Use conditional formatting to highlight important data points.

### **CO3: To Grasp Advanced Excel Functions and Tools**

- ILO 1: Utilize logical functions (IF, AND, OR) to perform conditional operations.
- ILO 2: Apply text functions (LEFT, RIGHT, MID, CONCATENATE) for data manipulation.
- ILO 3: Use mathematical functions (SUM, AVERAGE, MAX, MIN) for basic calculations.
- ILO 4: Implement statistical functions (STDEV, VAR, CORREL) for data analysis.

### **CO4: To Perform Data Analysis and Visualization**

- ILO 1: Transform raw data into frequency and cumulative frequency tables.

- ILO 2: Create various types of charts (bar, column, line, pie, scatter) to visualize data.  
 ILO 3: Use the data analysis tool pack for descriptive statistics, histograms, and correlations.  
 ILO 4: Perform chi-square tests using raw data and Excel formulas

**Table: Learning Outcome Representation (CO): Bloom’s Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge		CO1	CO2	C04		
Procedural Knowledge		CO3				
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	S	M	L	M	M	M	S	M	S
CO3	S	S	M	S	M	M	M	M	M	S	M	S
CO4	S	S	M	S	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)



UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<b>In Layout of Excel Worksheet:</b> Variable Name; Data Types; Freezing panes, Splitting Data sheets, Hiding operations; Wrapping, Merging, Alignments. <b>Cell Operations:</b> Conditional Formatting; Sorting; Filtering, Custom Filtering; Insert, Delete, Format Cells; <b>Data Tools:</b> Remove Duplicates, Data Validation; Data Table Formatting Operations (Table Styles)	-	-	07	14
2 (12 Marks)	<b>Simple Cell Functions:</b> SUM, Average, MAX, MIN, Count; Column/Row Operations (Arithmetic): Adding, Subtracting, Multiplying, Dividing, Powering, Finding percentage. <b>Descriptive Statistics:</b> Measures of Central Tendency, Measures of Dispersion, Regression and Correlation. Transforming Raw Data to Frequency Table (Discrete, Continuous). Cumulative Frequency Table. Data Visualization using Charts – Bar, Column, Line, Pie, Scatter, etc.	-	-	07	14
3 (13 Marks)	<b>Excel Functions:</b> LOGICAL functions, TEXT functions, some MATHEMATICAL and STATISTICAL functions. Pivot Tables in Excel. Introduction to LOOKUP functions in Excel (How, Where and Why) – VLOOKUP, HLOOKUP, INDEX, MATCH)	-	-	09	18
4 (13 Marks)	<b>Excel Add-Ins:</b> Data Analysis Tool Pak (Descriptive Statistics, Histogram, Correlation, Regression, t-test, F-test, Z-test, ANOVA-one way, two way with multiple no. of observations), Perform Chi-Square Test using Raw Data and Excel Formulas. Excel report writing.	-	-	11	22
5 (10Marks)	Reporting from Excel Outputs. Project Compilation. Real life Data Analysis.	-	-	11	22
<b>Total</b>		-	-	<b>45</b>	<b>90</b>

Where,

L: Lectures

T: Tutorials

P: Practical

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)

- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Berk, K N. (2003): Data analysis with Microsoft Excel. Duxbury Press, London.
2. Nigam, M. (2019): Data analysis with Excel. BPB Publications, New Delhi.
3. Ramirez, A. (2020): Excel Formulas and Functions 2020: The Step by Step Excel Guide with Examples on How to Create Powerful Formulas. Caprioru, India.

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**INTEGRATED M.Sc. IN STATISTICS PROGRAMME (NEP)  
DETAILED SYLLABUS OF 3<sup>rd</sup> SEMESTER**

<b>Title of the Course</b>	<b>:</b>	<b>Sampling Distributions</b>
<b>Course Code</b>	<b>:</b>	<b>STSC3</b>
<b>Nature of the Course</b>	<b>:</b>	<b>Major</b>
<b>Total Credits</b>	<b>:</b>	<b>04</b>
<b>Distribution of Marks</b>	<b>:</b>	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

**COURSE OBJECTIVES:**

**Knowledge:**

- To study different sampling distributions and their properties.
- To understand the mathematical foundation necessary for further study in statistical inference.

**Skills:**

- To develop proficiency in applying the Central Limit Theorem and other limit laws in practical scenarios.
- To gain expertise in conducting tests of significance and constructing confidence intervals using various sampling distributions.

**Attitude:**

- To cultivate a critical approach towards statistical hypothesis testing and decision-making.
- To encourage a methodical and logical approach to solving statistical problems.

**COURSE OUTCOMES:**

After the completion of this course, students will be able to:

**CO1:** Understand and apply various convergence concepts and limit laws in statistical analysis.

ILO1: Understand and distinguish between different types of convergence.

ILO2: Apply limit laws such as Chebyshev's inequality, WLLN, and SLLN to solve problems.

ILO3: Utilize the Central Limit Theorem and Liapunov Theorem in practical scenarios.

**CO2:** Describe and utilize order statistics in practical applications.

ILO1: Define order statistics and describe their distributions.

ILO2: Calculate and interpret the distribution of the smallest and largest order statistics.

ILO3: Understand and use the joint distribution of  $r^{\text{th}}$  and  $s^{\text{th}}$  order statistics.

**CO3:** Understand key sampling distribution concepts and conduct large sample tests.

ILO1: Define key concepts such as random sample, parameter, and statistic.

ILO2: Describe the sampling distribution of sample means, variances, and proportions.

ILO3: Conduct large sample tests for single proportions, differences of proportions, single means, differences of means, standard deviations, and differences of standard deviations using the CLT.

**CO4:** Utilize  $\chi^2$  distribution, Student's t-distribution and Snedecore's F-distribution for significance testing and confidence intervals.

ILO1: Derive the pdf of the  $\chi^2$  distribution, Student's t-distribution, and Snedecore's F-distribution and describe their properties.

ILO2: Conduct tests of significance and construct confidence intervals using  $\chi^2$ , t and F distributions.

**CO5:** Perform practical statistical tests and construct confidence intervals using both manual and computer-based methods.

ILO1: Perform practical tests of significance and construct confidence intervals for proportions, means, and standard deviations.

ILO2: Conduct exact sample tests based on the  $\chi^2$  distribution.

ILO3: Test the goodness of fit and independence of attributes.

ILO4: Use computer-based tools to analyze data and interpret results effectively.

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge			CO1,CO2			
Procedural Knowledge				CO3, CO4, CO5		
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	S	M	L	M	M	M	S	M	S
CO3	S	S	M	S	M	M	M	M	M	S	M	S
CO4	S	S	M	S	M	S	M	M	M	S	M	S
CO5	S	S	M	S	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<p><b>Limitlaws:</b> convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution and their inter relations, Chebyshev's inequality, WLLN, SLLN. and their applications, De-Moivre Laplace theorem, Central Limit Theorem (CLT) for i.i.d. variates, applications of CLT and Liapunov Theorem.</p> <p><b>Order Statistics:</b> Introduction, distribution of the <math>r^{\text{th}}</math> order statistic, smallest and largest order statistics. Joint distribution of <math>r^{\text{th}}</math> and <math>s^{\text{th}}</math> order statistics.</p>	08	01	-	09
2 (13 Marks)	<p><b>Sampling Distribution:</b> Definitions of random sample, parameter and statistic, sampling distribution of a statistic, sampling distribution of sample mean, standard errors of sample mean, sample variance and sample proportion.</p> <p><b>Testing of Hypotheses:</b> Null and alternative hypotheses, level of significance, Type I and Type II errors, their probabilities and critical region. Large sample tests, use of CLT for testing single proportion, difference of two proportions, single mean, difference of two means, standard deviation and difference of standard deviations by classical and p-value approaches.</p>	10	02	-	12
3 (12 Marks)	<p><b>Exact sampling distribution (<math>\chi^2</math> distribution):</b> Definition and derivation of p.d.f. of <math>\chi^2</math> with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean, variance, m.g.f., cumulant generating function, mode, additive property and limiting form of <math>\chi^2</math> distribution. Tests of significance and confidence intervals based on distribution.</p>	09	02	-	11
4 (13 Marks)	<p><b>Student's t-Distribution:</b> Student's and Fisher's t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution.</p> <p><b>Snedecore's F-distribution:</b> Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode. Distribution of <math>1/F(n_1, n_2)</math>. Relationship between t, F and <math>\chi^2</math> distributions. Test of significance and confidence Intervals based on t and F distributions.</p>	10	02	-	12
5	<b>List of Practical: (both calculator and computer based)</b>	-	-	08	16

(10Marks)	<ol style="list-style-type: none"> <li>1. Testing of significance and confidence intervals for single proportion and difference of two proportions.</li> <li>2. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.</li> <li>3. Testing of significance and confidence intervals for difference of two standard deviations.</li> <li>4. Exact sample tests based on chi-square distribution.</li> <li>5. Testing if the population variance has a specific value and its confidence intervals.</li> <li>6. Testing of goodness of fit.</li> <li>7. Testing of independence of attributes.</li> <li>8. Testing based on 2 X 2 contingency table without and with Yates' corrections.</li> <li>9. Testing of significance and confidence intervals of an observed sample correlation coefficient.</li> <li>10. Testing and confidence intervals of equality of two population variances.</li> </ol>				
	<b>Total</b>	<b>37</b>	<b>07</b>	<b>08</b>	<b>60</b>
	<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practical</i>	

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Goon, A. M., Gupta, M. K. and Dasgupta, B. (2003). An Outline of Statistical Theory, Vol. I, 4<sup>th</sup>Edn. World Press, Kolkata.
2. Rohatgi V. K. and Saleh, A. K. Md. E. (2009). An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
3. Hogg, R. V. and Tanis, E. A. (2009). A Brief Course in Mathematical Statistics. Pearson Education.
4. Johnson, R. A. and Bhattacharya, G.K. (2001). Statistics-Principles and Methods, 4<sup>th</sup>Edn. John Wiley and Sons.
5. Mood, A. M., Graybill, F. A. and Boes, D. C. (2007). Introduction to the Theory of Statistics, 3<sup>rd</sup>Edn. (Reprint). Tata McGraw-Hill Pub. Co.Ltd.
6. Gupta, S. C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
7. Medhi, J. (1992). Statistical Methods: An Introductory Text. New Age International.
8. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
9. Alan Stuart and J. Keith Ord (1994). Kendall's Advanced Theory of Statistics, Distribution Theory. John Wiley & Sons Inc; Volume 1 Edn.
10. Kakaty, S. C. (2003). Mathematical Statistics: Theory and Applications, Kaustubh

Prakashan, Dibrugarh.

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<b>Title of the Course</b>	:	<b>Mathematics for Statistics</b>
<b>Course Code</b>	:	<b>STSC4</b>
<b>Nature of the Course</b>	:	<b>Major</b>
<b>Total Credits</b>	:	<b>04</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

## **COURSE OBJECTIVES:**

### **Knowledge**

- Grasp the definitions and properties of limits, continuity, and differentiability.
- Learn the convergence tests for series, including comparison, ratio, and root tests.
- Understand the calculation and properties of determinants.
- Learn various matrix operations including addition, multiplication, and inversion.
- Understand the definitions and properties of vector spaces and subspaces.
- Learn about basis, dimension, and linear transformations.

### **Skills**

- Solve complex problems in real analysis using the learned theoretical concepts.
- Analyze the convergence and divergence of series through various tests.
- Execute matrix addition, subtraction, multiplication, and inversion accurately.
- Utilize determinants in solving linear equations and understanding matrix properties.

### **Attitude**

- Develop a critical and analytical approach towards mathematical problems.
- Encourage curiosity and questioning to deepen understanding of mathematical concepts.
- Cultivate an appreciation for the beauty and logic inherent in mathematical structures and proofs.
- Develop an attitude of persistence and patience in solving complex mathematical problems.

## **COURSE OUTCOMES:**

After the completion of this course, students will be able to:

**CO1:** Understand the foundational concepts of Real Analysis and Series analysis.

ILO1: Define and explain the principles of limits, continuity, and differentiability.

ILO2: Explain various convergence tests such as comparison, ratio, and root tests.

ILO3: Understand and describe the properties of power series

**CO2:** Comprehend Determinants and Matrices:

ILO1: Define and calculate determinants and explain their properties.

ILO2: Describe various matrix operations including addition, multiplication, and inversion.

ILO3: Apply determinants in solving linear equations and analyzing matrix properties.

**CO3:** Explore and Understand Vector Spaces

ILO1: Define vector spaces and subspaces, and explain their properties.

ILO2: Explain the concepts of basis, dimension, and linear transformations.

ILO3: Explore applications of the Cayley-Hamilton theorem in solving matrix equations.



ILO4: Understand the process of diagonalizing quadratic forms and their geometric interpretations.

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge		CO1				
Procedural Knowledge			CO2, CO3			
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	L	M	M	M	S	M	S
CO2	S	S	M	S	M	L	M	M	M	S	M	S
CO3	S	S	M	S	M	L	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (13 Marks)	<b>Real Analysis:</b> Real Numbers. Bounded and unbounded sets, neighborhoods and limit points, Suprimum and infimum, derived sets, open and closed sets, sequences and their convergence, limits of some special sequences. Cauchy's general principle of convergence, Cauchy's first theorem on limits, monotonic sequences.	10	02	-	12
2 (12 Marks)	<b>Series Analysis:</b> Infinite series, positive termed series and their convergence, Comparison test, D'Alembert's ratio test, Cauchy's nth root test, Raabe's test. Gauss test, Cauchy's condensation test and integral test (Statements and Examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence	09	01	-	10
3 (12 Marks)	<b>Determinants and Matrices:</b> Algebra of matrices and determinants. Types of Matrices: triangular, symmetric and skew symmetric matrices, idempotent matrices, orthogonal matrices, singular and non-singular matrices related results and their properties. Trace of a matrix, unitary, involutory andn nilpotent matrices.	09	01	-	10
4 (13 Marks)	<b>Vector Space:</b> Definition, properties, basis, dimension, span, linear dependency. <b>Matrix Operations:</b> Rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices. Generalized inverse (concept with illustrations).Partitioning of matrices and simple properties. Characteristic roots and Characteristic vector, useful Properties of characteristic roots, Cayley-Hamilton theorem, Quadratic forms definition and classifications; Linear orthogonal transformation.	10	02	-	12
5 (10Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Problems related to linearly independence and dependence. 2. Determination of rank of a matrix. 3. Inverse of a matrix. 4. Solution of system of equations. 5. Problems related to quadratic forms. 6. Determination of eigen values and vectors. 7. Classification of quadratic form with eigen value.	-	-	08	16

	<b>Total</b>	<b>38</b>	<b>06</b>	<b>08</b>	<b>60</b>
<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practical</i>		

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Franklin A Graybill (1969). Introduction to matrices with applications in statistics. Belmont, Calif., Wadsworth Pub. Co, First Edition Lay David C.: Linear Algebra and its Applications, Addison Wesley,2000.
2. Malik S. C. and Savita Arora, (1994): Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delh.
3. Somasundram D. and Chaudhary B. (1987): A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi,.
4. Gupta S. L. and Nisha Rani, (1995): Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., New Delhi.
5. Shanti Narayan, (1987): A course of Mathematical Analysis, 12th revised Edition, S. Chand & Co. (Pvt.) Ltd., New Delhi.
6. Bartle, R. G. and Sherbert, D. R. (2002): Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia) Pte. Ltd.,Singapore.
7. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. (2003): Numerical methods for scientific and engineering computation, New age International Publisher, India.
8. Lay David C.: Linear Algebra and its Applications, Addison Wesley,2000.
9. Schaum's Outlines: Linear Algebra, Tata McGraw-Hill Edition, 3<sup>rd</sup> Edition,2006.
10. Krishnamurthy V., Mainra V. P. and Arora J. L.: An Introduction to Linear Algebra (II, III, IV,V).
11. Jain P. K. and Khalil Ahmad: Metric Spaces, Narosa Publishing House, New Delhi, 1973
12. Biswas, S. (1997): A Textbook of Matrix Algebra, New Age International,1997.
13. Artin, M.: Algebra. Prentice Hall of India,1994.
14. Datta K. B.: Matrix and Linear Algebra. Prentice Hall of India Pvt. Ltd.,2002.
15. Searle S. R.: Matrix Algebra Useful for Statistics. John Wiley & Sons.,1982.
16. Vasishtha, A. R., and Vasishtha, A. K. (1991). *Matrices*. Krishna Prakashan Media.

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<b>Title of the Course</b>	:	<b>Survey Sampling and National Accounts Statistics</b>
<b>Course Code</b>	:	<b>MINSTS3</b>
<b>Nature of the Course</b>	:	<b>Minor</b>
<b>Total Credits</b>	:	<b>04</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

## **COURSE OBJECTIVES:**

### **Knowledge**

- Understand the concept of population and sample in statistical surveys.
- Differentiate between complete enumeration and sampling methods.
- Identify sources of sampling and non-sampling errors in surveys.
- Describe various types of sampling techniques: non-probability and probability sampling.

### **Skills**

- Demonstrate proficiency in simple random sampling (with and without replacement) and its application.
- Apply procedures for selecting samples in statistical surveys.
- Compute estimates for population mean, total, and proportion based on sample data.
- Calculate variances of estimates and understand their implications for precision.

### **Attitude**

- Appreciate the importance of stratified random sampling for improving estimation accuracy.
- Evaluate proportional and optimum allocations in stratified sampling.
- Analyze practical challenges in allocation and assess gains in precision through stratification.
- Critically compare systematic sampling with simple random sampling and stratified sampling in the presence of linear trends.

## **COURSE OUTCOMES:**

After the completion of this course, students will be able to:

### **CO1: Understand the Foundations of Sample Surveys**

ILO1: Define the concepts of population and sample.

ILO2: Differentiate between complete enumeration and sampling methods.

ILO3: Identify sources of sampling and non-sampling errors in surveys.

### **CO2: Master Estimation Techniques in Sample Surveys**

ILO1: Compute estimates for population mean, total, and proportion.

ILO2: Calculate variances of population estimates and determine sample sizes.

ILO3: Understand procedures for estimating variances of sample estimates.

### **CO3: Analyze Systematic and Cluster Sampling**

ILO1: Implement systematic sampling to estimate population mean and total.

ILO2: Compute variances of estimates in systematic sampling ( $N=nk$ ).

ILO3: Compare systematic sampling with simple random sampling (SRS) and stratified sampling.

**CO4: Introduction to Ratio and Regression Methods**

ILO1: Utilize ratio and regression methods for estimating population parameters.

ILO2: Approximate population mean and total using initial ratio and regression methods.

ILO3: Calculate variances of estimates and compare with SRS methods.

**CO5: Understand Official Statistical Systems in India**

ILO1: Describe the present official statistical system in India.

ILO2: Evaluate methods used for collecting official statistics, including their reliability and limitations.

ILO3: Identify the roles of MoSPI, NSO, and National Statistical Commission in statistical governance.

**CO6: Examine Government Publications and Statistical Data**

ILO1: Analyze key publications from the Government of India containing statistical data.

ILO2: Interpret data related to population, industry, and finance from official publications.

ILO3: Assess the reliability and relevance of statistical data for policy-making and research.

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge		CO1, CO5	CO2, CO4		CO6	
Procedural Knowledge				CO3		
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M	M	S	L	L	L	M	M	M	S
CO2	S	S	M	S	M	M	L	L	S	M	L	M
CO3	S	S	M	S	M	M	L	L	S	S	L	M
CO4	S	M	S	M	M	M	L	L	M	S	L	M
CO5	S	S	M	S	L	L	L	L	S	M	M	S
CO6	S	S	M	S	M	M	L	L	S	S	S	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	<b>Sample Survey:</b> Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, Determination of sample size.	10	02	-	12
2 (14 Marks)	<b>Stratified Random Sampling:</b> Techniques, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision. <b>Systematic Sampling:</b> Techniques, estimates of population mean and total, variances of these estimates ( $N=nk$ ). Comparison of systematic sampling with SRS and stratified sampling in presence of linear trend and corrections.	11	02	-	13
3 (14 Marks)	<b>Introduction to Ratio and regression methods of estimation,</b> first approximation to the population mean and total (for SRS of large size), variances of these estimates and estimates of these variances, variances in terms of correlation coefficient for regression method of estimation and their comparison with SRS. Cluster sampling (equal clusters only) estimation of population mean and its variance.	11	02	-	13
4 (10 Marks)	<b>Present official statistical system in India,</b> Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), National Statistical Office (NSO) and National Statistical Commission. Government of India's Principal publications containing data on the topics such as population, industry and finance.	05	01	-	06
5 (10 Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Determination of sample size. 2. Drawing of a random sample: with and without replacement. 3. Estimation of population mean, population mean square, population variance and standard error: with and without replacement and establish all	-	-	08	16

	properties relative to SRS. 4. Stratified Sampling: different allocation methods of selecting sample size, and compare relative efficiencies and gain in precision. 5. Systematic sampling and its comparison with SRS and stratified sampling in presence of a lineartrend. 6. Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS. 7. Cluster sampling: estimation of mean or total, variance of the estimate.				
	<b>Total</b>	<b>37</b>	<b>07</b>	<b>08</b>	<b>60</b>
<i>Where,</i>	<i>L: Lectures</i>	<i>T: Tutorials</i>	<i>P: Practical</i>		

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Cochran W.G. (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.
2. Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. Asok, C. (1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics.
3. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.
4. Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House. New Delhi.
5. Goon A.M., Gupta M.K. and Dasgupta B. (2001): Fundamentals of Statistics (Vol.2), World Press.
6. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi. <http://mospi.nic.in/>
7. Laishram Ladusingh (2018). Survey Sampling Methods. PHI Learning, India.

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<b>Title of the Course</b>	:	<b>Applied Statistics</b>
<b>Course Code</b>	:	<b>GECSTS3</b>
<b>Nature of the Course</b>	:	<b>Generic Elective</b>
<b>Total Credits</b>	:	<b>03</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

## **COURSE OBJECTIVES:**

### **Knowledge:**

- Understand the construction and application of index numbers in economics.
- Learn the principles and methods of statistical quality control.
- Gain knowledge about demographic methods and their significance.

### **Skills:**

- Develop the ability to compute and interpret various index numbers.
- Acquire skills in constructing and analyzing control charts for variables and attributes.
- Enhance capabilities in calculating and interpreting demographic measures.

### **Attitude:**

- Appreciate the role of statistics in economics, industry, and society.
- Develop a methodical and analytical approach to solving statistical problems.
- Foster a critical mindset towards data interpretation and quality control processes.

## **COURSE OUTCOMES:**

After the completion of this course, students will be able to

**CO1:** Develop a comprehensive understanding of index numbers.

ILO1: Ability to define and describe various types of index numbers.

ILO2: Competence in constructing price and quantity index numbers using Laspeyre's, Paasche's, Marshall-Edgeworth's, and Fisher's formulas.

ILO3: Skill in interpreting consumer price index numbers and wholesale price index numbers.

ILO4: Understanding the uses and limitations of index numbers.

ILO5: Capability to perform base shifting, splicing, and deflating of index numbers.

**CO2:** Gain proficiency in statistical quality control techniques.

ILO1: Knowledge of the importance of statistical methods in industrial research and practice.

ILO2: Understanding the causes of variations in quality: chance and assignable.

ILO3: Ability to construct and interpret X-bar and R-charts for variables.

ILO4: Proficiency in creating and analyzing p-charts and c-charts for attributes.

ILO5: Skill in estimating process capability and understanding its implications.

**CO3:** Acquire in-depth knowledge of demographic methods.

ILO1: Understanding the measurement of population, rates, and ratios of vital events.

ILO2: Ability to compute and interpret measures of mortality, including CDR, SDR, IMR, and standardized death rates.

ILO3: Competence in measuring fertility and reproduction rates, including CBR, GFR,



and TFR.

ILO4: Proficiency in constructing and using life tables and understanding their uses.

ILO5: Skill in measuring population growth using GRR and NRR.

**CO4:** Develop practical skills in statistical analysis and interpretation.

ILO1: Ability to construct and interpret statistical control charts (X-bar & R-chart, s-chart, np-chart, p-chart, c-chart, u-chart).

ILO2: Skill in constructing and interpreting single sample inspection plans, including OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves.

ILO3: Competence in calculating process capability and comparing 3-sigma control limits with specification limits.

ILO4: Proficiency in performing practical calculations related to demographic measures and index numbers.

**CO5:** Foster a critical and analytical approach towards statistical data and methods.

ILO1: Appreciation for the role of statistics in economics, industry, and society.

ILO2: Development of a methodical and analytical approach to solving statistical problems.

ILO3: Ability to critically analyze data and interpret results in the context of quality control and demographic analysis.

ILO4: Understanding the application of statistical methods in real-world scenarios.

ILO5: Skill in presenting statistical findings effectively through various modes of assessment (assignments, presentations, laboratory work).

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge			CO1, CO2			
Procedural Knowledge				CO3, CO4	CO5	
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	S	M	M	M	S	M	S
CO2	S	S	M	S	M	M	M	M	M	S	M	S
CO3	S	S	M	S	M	S	M	M	M	S	M	S
CO4	S	S	M	S	M	S	M	M	M	S	M	S
CO5	S	S	M	S	M	M	M	M	M	S	M	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (15 Marks)	<b>Index Numbers:</b> Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number. Uses and limitations of index numbers. Base shifting, Splicing and deflating of Index numbers, idea of inflation.	09	01	-	10
2 (15 Marks)	<b>Statistical Quality Control:</b> Importance of statistical methods in industrial research and practice. Causes of variations in quality: chance and assignable. General theory of control charts, process & product control, Control charts for variables: X- bar and R-charts. Control charts for attributes: pandc-charts.	09	01	-	10
3 (20 Marks)	<b>Demographic Methods:</b> Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates. Life (mortality) tables: its concept, types and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR	12	03	-	15
4 (10 Marks)	<b>List of Practical: (both calculator and computer based)</b> 1. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation. 2. Construction of wholesale price index number, fixed base index number and consumer price index number with interpretation 3. Construction and interpretation of X bar & R-chart 4. Construction and interpretation p-chart (fixed sample size) and c-chart 5. Computation of measures of mortality 6. Completion of life table 7. Computation of measures of fertility and population growth	-	-	05	10
	<b>Total</b>	<b>30</b>	<b>05</b>	<b>05</b>	<b>45</b>

*Where, L: Lectures T: Tutorials P: Practical*

**MODES OF IN-SEMESTER ASSESSMENT:**

**(40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
2. Gun, A. M., Gupta, M. K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9<sup>th</sup> Edition World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4<sup>th</sup> Edition(Reprint), Sultan Chand & Sons
4. Montgomery, D. C. (2009): Introduction to Statistical Quality Control, 6<sup>th</sup> Edition, Wiley India Pvt.Ltd.
5. Gupta, S. C. (1990). Fundamentals of Statistics. Himalaya Pub, Mumbai, India.
6. Pathak, K. B., Ram, F. (2016): Techniques of Demographic Analysis, Himalaya Publishing House.
7. Keyfitz N., Beckman John A.: Demography through Problems S-Verlag New York.

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<b>Title of the Course</b>	:	<b>Introduction to Data Analysis in Python</b>
<b>Course Code</b>	:	<b>SECSTS3</b>
<b>Nature of the Course</b>	:	<b>Skill Enhancement</b>
<b>Total Credits</b>	:	<b>03</b>
<b>Distribution of Marks</b>	:	<b>60 (50T + 10P) (End Sem) + 40 (In-Sem)</b>

## **COURSE OBJECTIVES:**

### **Knowledge**

- To Understand the Basics of Python Installation and Setup
- To Learn Python Data Types, Variables, and Arithmetic Operations
- To Gain Knowledge of Python File Handling Techniques
- To Explore Python Libraries for Data Analysis

### **Skills**

- To Perform Data Manipulation with Pandas
- To Create Data Visualizations Using Matplotlib and Seaborn
- To Conduct Exploratory Data Analysis (EDA) in Python
- To Apply Statistical Analysis Techniques Using Python

### **Attitudes**

- To Develop a Systematic Approach to Data Analysis Using Python
- To Foster Attention to Detail in Data Cleaning and Preprocessing
- To Encourage Creativity in Data Visualization and Presentation
- To Promote Ethical Use and Reporting of Data Analysis Results

## **COURSE OUTCOMES:**

After the completion of this course, students will be able to

### **CO1: Demonstrate Proficiency in Python Basics**

- ILO1: Install and set up Python software and IDEs.
- ILO2: Understand and use different Python data types and variables.
- ILO3: Perform arithmetic operations using Python.

### **CO2: Implement File Handling and Data Manipulation in Python**

- ILO1: Open, read, modify, delete, and save files using Python.
- ILO2: Utilize lambda functions for concise operations.
- ILO3: Manipulate data using Pandas Series and DataFrames.

### **CO3: Create and Customize Data Visualizations**

- ILO1: Generate basic plots using Matplotlib, including line plots, scatter plots, and histograms.
- ILO2: Customize plots and add annotations for better clarity.
- ILO3: Use Seaborn and Plotly for advanced and interactive visualizations.

### **CO4: Conduct Exploratory and Statistical Data Analysis**

- ILO1: Perform descriptive statistics and data summarization.
- ILO2: Handle missing values and outliers in datasets.

- ILO3: Apply hypothesis testing, correlation analysis, and regression analysis using Python.

**Table: Learning Outcome Representation (CO): Bloom's Taxonomy Table**

Cognitive Knowledge Dimensions	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge		CO1				
Procedural Knowledge			CO1, CO2, CO3, CO4			
Metacognitive Knowledge						

**Table: Course Outcome (CO) and Program Outcome (PO) mapping**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	L	M	S	L	L	L	L	L	L	L	S
CO2	S	L	M	S	L	L	L	L	S	L	L	S
CO3	S	L	M	S	L	M	M	L	S	L	L	S
CO4	S	L	M	S	L	M	M	L	S	L	L	S

(S= Strong, M= Medium, L= Low)

UNITS	CONTENTS	L	T	P	Total Hours
1 (10 Marks)	<b>Introduction to Python:</b> Installation of Software. Introduction to Python editors and IDE's. Overview of Python. Overview of data analysis process. Data types, variables and arithmetic calculations: Different types of data. Arithmetic calculations (addition, subtraction, multiplication, division)	-	-	06	12
2 (12 Marks)	<b>File Handling:</b> Open file, read file, modify file, delete file, save file. Lambda function. Introduction to Python libraries for data analysis: NumPy, Pandas, Matplotlib	-	-	08	16
3 (14 Marks)	<b>Data Manipulation with Pandas:</b> Introduction to Pandas Series and DataFrames. Data ingestion and manipulation. Data cleaning and preprocessing techniques. <b>Data Visualization:</b> (Manually and with Matplotlib) Introduction to Matplotlib library. Creating basic plots: line plots, scatter plots, histograms. Customizing	-	-	10	24

	plots and adding annotations <b>Advanced Data Visualization:</b> Seaborn: high-level interface for drawing attractive statistical graphics. Plotting time series data. Interactive visualization with Plotly				
4 (14 Marks)	<b>Exploratory Data Analysis (EDA):</b> Descriptive statistics: mean, median, mode, standard deviation, etc. Data summarization and aggregation. Handling missing values and outliers Statistical Analysis: (Manually and with Pandas) Hypothesis testing: t-tests, chi-square tests. Correlation analysis. Introduction to regression analysis	-	-	10	24
5 (10 Marks)	<b>Project report:</b> Real-world data analysis project covering various domains such as finance, healthcare, marketing, etc. Applying learned concepts and techniques to solve practical problem. Presentation of project findings and insights.	-	-	10	40
	<b>Total</b>	-	-	<b>45</b>	<b>90</b>

*Where, L: Lectures T: Tutorials P: Practicals*

**MODES OF IN-SEMESTER ASSESSMENT: (40 Marks)**

- Sessional test(s)
- Objective test, Assignments (Class, Home), Paper Presentation, Laboratory Works, Concept note writing.

**SUGGESTED READINGS:**

1. Textbook: "Python for Data Analysis" by Wes McKinney
2. Online tutorials and documentation for Python libraries (NumPy, Pandas, Matplotlib, Seaborn, Plotly)

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