SYLLABUS
DIBRUGARH UNIVERSITY
FYUGP 2020

<u>STATISTICS</u>

(Recommended by B.O.S. in Statistics, D.U. in its meeting held on 22.08.2023 and approved by P.G. Board in its meeting held on ……………….. and passed by the Academic Council meeting held on …………………. and effective from the session ………………..)

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 dependingon 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, environmentawareness, 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-basedactivities.

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, Internshipand 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 awardedUG 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 themajor 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 constituentdisciplines/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, asses 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 withpeople 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.

Aftercompleting 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 subjectand 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 include 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.

FYUGP Structure as per UGC Credit Framework of December, 2022

Year	Semester	Course	Title of the Course	Total Credit
Year 01	1st 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	Understanding India	2
		VAC 2	Health and Wellness	2
		SEC 1	Collection of Data and its Presentation	3
				22
	2nd 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 3	Environmental Science	2
		VAC 4	Yoga Education	2
		SEC 2	Data Analytics using MS EXCEL	3
				22
	**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 1st and 2nd Semester**			
Year 02	3rd Semester	C - 3	Sampling Distributions	4
		C - 4	Mathematics for Statistics	4
		Minor 3	Statistical Inference-I	4
		GEC – 3	Applied Statistics	3
		VAC 3	Digital and Technological Solutions / Digital Fluency	2
		AEC – 3	Calculus	2
		SEC – 3	Data Analysis Using SPSS Software	3
				22

Abbreviations Used:

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

B.Sc. IN STATISTICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 1ˢᵗ SEMESTER

Title of the Course	:	**Descriptive Statistics**
Course Code	:	**STSC1**
Nature of the Course	:	**Major**
Total Credits	:	**04**
Distribution of Marks	:	**80 (End Sem) (60T+20P) + 20 (In-Sem)**

COURSE OBJECTIVES:
- To be familiar with basic tools and techniques of descriptive Statistics.
- To apply the knowledge in the context of an applied topic such as index number.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, primary and secondary, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives. Categorical data: Attributes and different measures of their association.	08	01	-	09
2 (16 Marks)	Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.	10	02	-	12
3 (16 Marks)	Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.	10	02	-	12
4 (16 Marks)	Index Numbers: 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.	10	02	-	12

		L	T	P	
5 (20 Marks)	**List of Practicals** 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. Correlation coefficient for a bivariate frequency distribution. 9. Lines of regression, angle between lines and estimated values of variables. 10. Spearman rank correlation with and without ties. 11. Partial and multiple correlations. 12. Planes of regression and variances of residuals for given simple correlations. 13. Planes of regression and variances of residuals for raw data. 14. Calculate price and quantity index numbers using simple and weighted average of price relatives. 15. To calculate the Chain Base index numbers. 16. To calculate consumer price index number.	-	-	15	30
	Total	38	07	15	75

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

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics
  - Debate

LEARNING OUTCOMES:
After the completion of this course:
- Students are expected to develop a clear understanding of the fundamental concepts of descriptive Statistics.
- Students will also learn handling various types of data and their graphical representation.
- Students are expected to apply different measures of location and dispersion in real life problems.
- Students will also learn handling bivariate data and are expected to understand significance of various coefficients of correlation, fitting of linear/nonlinear curve and formulation index numbers.

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, Delhi.
4. Barman. M. P., Hazarika. J, Bora. T (2021): Statistical Methods, Mahaveer Pub, Dibrugarh.

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Title of the Course	:	**Basic Statistical Methods**			
Course Code	:	**MINSTS1**			
Nature of the Course	:	**Minor**			
Total Credits	:	**04**			
Distribution of Marks	:	**80 (End Sem) (60T+20P) + 20 (In-Sem)**			

COURSE OBJECTIVES:
- To be familiar with basic tools and techniques of descriptive Statistics.
- To apply the knowledge in the context of an applied topic such as index number.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, primary and secondary, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, Categorical data: Attributes and different measures of their association.	08	01	-	09
2 (16 Marks)	Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.	10	02	-	12
3 (16 Marks)	Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.	10	02	-	12
4 (16 Marks)	Index Numbers: 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 (Core and Headline).	10	02	-	12
5 (20 Marks)	**List of Practicals** 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	-	-	15	30

kurtosis.			
6. Fitting of polynomials, exponential curves.			
7. Karl Pearson correlation coefficient.			
8. Correlation coefficient for a bivariate frequency distribution.			
9. Lines of regression, angle between lines and estimated values of variables.			
10. Spearman rank correlation with and without ties.			
11. Partial and multiple correlations.			
12. Planes of regression and variances of residuals for given simple correlations.			
13. Planes of regression and variances of residuals for raw data.			
14. Calculate price and quantity index numbers using simple and weighted average of price relatives.			
15. To calculate the Chain Base index numbers.			
16. To calculate consumer price index number.			

	Total	38	07	15	75

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

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics
  - Debate

LEARNING OUTCOMES:

After the completion of this course:
- Students are expected to develop a clear understanding of the fundamental concepts of descriptive Statistics.
- Students will also learn handling various types of data and their graphical representation.
- Students are expected to apply different measures of location and dispersion in real life problems.
- Students will also learn handling bivariate data and are expected to understand significance of various coefficients of correlation, fitting of linear/nonlinear curve and formulation index numbers.

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, Delhi.
4. Barman. M. P., Hazarika. J, Bora. T (2021): Statistical Methods, Mahaveer Pub, Dibrugarh.

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Title of the Course	:	**Statistical Methods**			
Course Code	:	**GECSTS1**			
Nature of the Course	:	**Generic Elective**			
Total Credits	:	**03**			
Distribution of Marks	:	**80 (End Sem) + 20 (In-Sem)**			

COURSE OBJECTIVES:
- To be familiar with basic tools and techniques of Statistics.
- To gain knowledge about the basics of probability theory and its applications.

UNITS	CONTENTS	L	T	P	Total Hours
1 (15 Marks)	Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, primary and secondary, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives.	06	01	-	08
2 (15 Marks)	Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.	07	01	-	08
3 (18 Marks)	Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.	09	01	-	10
4 (12 Marks)	Categorical data: Attributes and different measures of their association. Contingency table.	05	01	-	06
5 (20Marks)	**Co-requisites** (with simple numerical examples) 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. Lines of regression, angle between lines and estimated values of variables.	15	-	-	15
	Total	41	04	-	45

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**

- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:

After the completion of this course:

- Students are expected to develop a clear understanding of the fundamental concepts of descriptive Statistics.
- Students will also learn handling various types of data and their graphical representation.
- Students are expected to apply different measures of location and dispersion in real life problems.
- Students should have developed knowledge of the role of probability and its distributions in statistical analyses.

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. Elhance. D. N., Elhance V., Aggarwal B.M (2018): Fundamentals of Statistics, Kitab Mahal; New Revised edition, New Delhi.

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Title of the Course	:	**Collection of Data and its Presentation**
Course Code	:	**SECSTS1**
Nature of the Course	:	**Skill Enhancement**
Total Credits	:	**03**
Distribution of Marks	:	**80 (End Sem) + 20 (In-Sem)**

COURSE OBJECTIVES:
- Understand the importance of data collection and presentation in decision-making processes.
- Identify appropriate data collection methods based on research objectives and constraints.
- Design and conduct surveys, interviews, and observations to collect primary data.
- Evaluate and utilize secondary data from reliable sources.
- Clean, organize, and validate collected data for analysis.
- Apply statistical techniques to analyse data and derive meaningful insights.
- Effectively visualize data using charts, graphs, and other graphical representations.
- Interpret and communicate data findings accurately and concisely.

UNITS	CONTENTS	L	T	P	Total Hours
1 (15 Marks)	Introduction to Data Collection and Presentation, Scientific data and its importance, Importance of data in decision-making, The role of data collection and presentation in research, Qualitative and Quantitative data, primary and Secondary data. Idea of Big Data.	05	01	-	06
2 (15 Marks)	Different Data Collection Methods, 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.	06	01	-	07
3 (15 Marks)	Data Collection Design and Execution, Planning and formulating research questions, Idea of Sampling techniques and sample size determination and interview protocols, Conducting observations and maintaining objectivity, Ethical considerations in data collection, Editing and coding.	07	01	-	08

		L	T	P	Total
4 (15 Marks)	Introduction to statistical analysis techniques, Descriptive statistics: measures of central tendency and dispersion, Exploratory data analysis: data visualization and graphical techniques Choosing appropriate visualization methods, Creating effective charts, graphs, and info graphics. Data Analysis and Interpretation	08	01	-	9
5 (20 Marks)	**Co-requisites** (with simple numerical examples) 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. 7. Problems based on measures of central tendency. 8. Problems based on measures of dispersion.	15	-	-	15
	Total	41	4	-	45

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:
After the completion of this course:
- This course is designed to provide students with the essential knowledge and skills required for effective collection, analysis and presentation of data.
- The course covers various methods and techniques for data collection, including surveys, interviews, observations, and secondary sources.
- Students will learn how to organize, analyze, and visualize data using appropriate tools and techniques to present meaningful insights.

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. O'Neil. C., Schutt . R. (2013): Doing Data Science: Straight Talk from the Frontline. O'Reilly Media; 1st edition .

B.Sc. IN STATISTICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : **Probability Theory and Statistical Distributions**
Course Code : **STSC2**
Nature of the Course : **Major**
Total Credits : **04**
Distribution of Marks : **80 (End Sem) (60T+20P) + 20 (In-Sem)**

COURSE OBJECTIVES:
- To be familiar with probability theory.
- To learn different methods of studying a theoretical distribution.
- To study useful probability distributions and their properties.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.	9	01	-	11
2 (12 Marks)	Random variables: 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. Two dimensional random variables: 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.	9	01	-	11
3 (20 Marks)	Mathematical Expectation and Generating Functions: 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. Conditional expectations.	12	01	-	13
4 (16 Marks)	Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases.	11	01		13
5 (20Marks)	**List of Practicals** 1. Fitting of binomial distribution. 2. Fitting of Poisson distribution. 3. Fitting of geometric distribution.	-	-	15	30

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.				
Total	**41**	**04**	**15**	**75**

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics
  - Debate

LEARNING OUTCOMES:

After the completion of this course:
- Students should have developed knowledge of the role of probability theory in Statistics.
- Students are expected to learn useful probability distributions in statistical analyses.

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.

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Title of the Course   :   **Basic Probability Theory and Distributions**
Course Code   :   **MINSTS2**
Nature of the Course   :   **Minor**
Total Credits   :   **04**
Distribution of Marks   :   **80 (End Sem) (60T+20P) + 20 (In-Sem)**

COURSE OBJECTIVES:
- To be familiar with probability theory.
- To learn different methods of studying a theoretical distribution.
- To study useful probability distributions and their properties.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability– classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.	08	01	-	09
2 (16 Marks)	Random variables: 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. Two dimensional random variables: 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.	10	02	-	12
3 (16 Marks)	Mathematical Expectation and Generating Functions: 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. Conditional expectations.	10	02	-	12
4 (16 Marks)	Standard probability distributions: 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 (20Marks)	**List of Practicals** 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.	-	-	15	30

	6. Fitting of normal distribution. 7. Fitting of exponential distribution.				
	Total	38	07	15	60

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

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics
  - Debate

LEARNING OUTCOMES:
After the completion of this course:
- Students should have developed knowledge of the role of probability theory in Statistics.
- Students are expected to learn useful probability distributions in statistical analyses.

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.

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Title of the Course	:	**Basics of Statistical Distributions and Inference Course**	
Code	:	**GECSTS2**	
Nature of the Course	:	**Generic Elective**	
Total Credits	:	**03**	
Distribution of Marks	:	**80 (End Sem) + 20 (In-Sem)**	

COURSE OBJECTIVES:
- To study useful probability distributions and their properties.
- To study useful sampling distributions and their properties.
- To make informative decision using statistical tests.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f.	07	01	-	08
2 (15 Marks)	Idea of mathematical expectation and generating functions. Basic statistical distributions: Binomial, Poisson, Normal. Basic sampling distributions: Chi-square, t and F (Definition and use only). Idea of population and sample. Idea of parameter and statistic. The basic idea of significance test. Null and alternative hypotheses. Type I & Type II errors, level of significance, concept of p-value.	06	01	-	07
3 (25 Marks)	Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems). Tests for the significance of correlation coefficient. Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi- square test, Yates' correction. Analysis of Variance (one way classification only).	12	02		14
4 (20 Marks)	**Co-requisites** (with simple numerical examples) 1. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems). 2. Chi-square test of proportions. 3. Chi-square tests of association. 4. Chi-square test of goodness-of-fit. 5. Test for correlation coefficient. 6. Analysis of Variance of a one way classified data	15	-	-	15

	7. Checking consistency of data and finding association among attributes.				
	Total	41	04	-	45

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:

After the completion of this course:
- Students should posses skills concerning the small sample and large sample tests.
- Students are expected to analyze and interpret the data vis-à-vis statistical inference in data analysis.

SUGGESTED READINGS:

1. Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).
2. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).
3. Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences.(1964, 1977) by John Wiley.
4. Bancroft, Holdon Introduction to Bio-Statistics (1962) P.B. Hoebar New York.
5. Goldstein, A Biostatistics-An introductory text (1971). The Macmillion New York.

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Title of the Course	:	**Data Science using MS EXCEL**			
Course Code	:	**SECSTS2**			
Nature of the Course	:	**Skill Enhancement**			
Total Credits	:	**03**			
Distribution of Marks	:	**80 (End Sem) + 20 (In-Sem)**			

COURSE OBJECTIVES:
- To be familiar with basic tools MS EXCEL and data analytic techniques.
- To apply the tools for real-life data analysis projects and reporting.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	Layout of Excel Worksheet: Variable Name; Data Types; Freezing panes, Splitting Data sheets, Hiding operations; Wrapping, Merging, Alignments. Cell operations: Conditional Formatting; Sorting; Filtering, Custom Filtering; Insert, Delete, Format Cells; Data Tools: Remove Duplicates, Data Validation; Data Table Formatting Operations (Table Styles)	-	-	09	18
2 (12 Marks)	Simple Cell Functions: SUM, Average, MAX, MIN, Count; Column/Row Operations (Arithmetic): Adding, Subtracting, Multiplying, Dividing, Powering, Finding percentage. Transforming Raw Data to Frequency Table (Discrete, Continuous). Cumulative Frequency Table. Data Visualization using Charts – Bar, Column, Line, Pie, Scatter, etc.	-	-	09	18
3 (16 Marks)	Excel Functions: 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)	-	-	12	24

4 (20 Marks)	Excel Add-ins: Data Analysis Tool Pack (Descriptive Statistics, Histogram, Correlation, Regression, t-test, F-test, z-test, ANOVA), Perform Chi-Square Test using Raw Data and Excel Formulas.	-	-	15	30
5 (20Marks)	**Co-requisites and problem solving:** Reporting from Excel Outputs. Project Compilation. Real life Data Analysis.	-	-	15	30
	Total	-	-	60	120

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (20 Marks)
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:
After the completion of this course:
- Students are expected to develop a clear understanding of the fundamental concepts of descriptive Statistics.
- Students will also learn MS EXCEL tools, handling various types of data and their graphical representation.
- Students are expected to apply different data analytic tools in real life problems.

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.

B.Sc. IN STATISTICS PROGRAMME (NEP)
DETAILED SYLLABUS OF 3rd SEMESTER

Title of the Course : **Sampling Distributions**
Course Code : **STSC3**
Nature of the Course : **Major**
Total Credits : **04**
Distribution of Marks : **80 (End Sem) (60T+20P) + 20 (In-Sem)**

COURSE OBJECTIVES:
- To study different sampling distributions and their properties.
- To gain mathematical knowledge and build foundation for further study of Statistical inference.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	mit laws: convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution and their inter relations, Chebyshev's inequality, W.L.L.N., S.L.L.N. and their applications, De-Moivre Laplace theorem, Central Limit Theorem (C.L.T.) for i.i.d. variates, applications of C.L.T. and Liapunov Theorem. Order Statistics: Introduction, distribution of the rth order statistic, smallest and largest order statistics. Joint distribution of rth and sth order statistics.	08	01	-	09
2 (14 Marks)	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. 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.	10	02	-	12
3 (14 Marks)	Exact sampling distribution: Definition and derivation of p.d.f. of χ^2 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 χ^2 distribution. Tests of significance and confidence intervals based on distribution.	10	02	-	12
4 (15 Marks)	Exact sampling distributions: Student's and Fishers 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. Snedecore's F-distribution: Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode. Distribution of $1/F(n_1,n_2)$. Relationship between t, F and χ^2 distributions. Test of significance and confidence Intervals based on t and F distributions.	10	02	-	12
5 (20Marks)	**List of Practicals** 1. Testing of significance and confidence intervals for single proportion	-	-	15	30

and difference of two proportions					

2. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.
3. Testing of significance and confidence intervals for difference of two standard deviations.
4. Exact Sample Tests based on Chi-Square Distribution.
5. Testing if the population variance has a specific value and its confidence intervals.
6. Testing of goodness of fit.
7. Testing of independence of attributes.
8. Testing based on 2 X 2 contingency table without and with Yates' corrections.
9. Testing of significance and confidence intervals of an observed sample correlation coefficient.
10. Testing and confidence intervals of equality of two population variances.

		L	T	P	
Total		38	07	15	60

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics
  - Debate

LEARNING OUTCOMES:
After the completion of this course:
- Student will be able to understand the basic concepts of sampling distributions, the Central Limit Theorem and when to apply it.
- The students are expected to gain knowledge of useful sampling distributions, namely chi-square, Student –t, and Snedecor's F-distributions and use them to make conclusions about problems that arise in applied statistics.
- The students will develop knowledge about the distributions of various order statistics.

SUGGESTED READINGS:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003): *An Outline of Statistical Theory*, Vol. I, 4th 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*, 4th Edn. John Wiley and Sons.
5. 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.

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Title of the Course	:	**Mathematics for Statistics**		
Course Code	:	**STSC4**		
Nature of the Course	:	**Major**		
Total Credits	:	**04**		
Distribution of Marks	:	**80 (End Sem) (60T+20P) + 20 (In-Sem)**		

COURSE OBJECTIVES:
- To learn necessary mathematical concepts and tools to strengthen understanding of statistical theory.

UNITS	CONTENTS	L	T	P	Total Hours
1 (18 Marks)	al Analysis: 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, limit superior and limit inferior of a bounded sequence.	11	02	-	13
2 (12 Marks)	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.	08	01	-	09
3 (12 Marks)	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 and nilpotent matrices.	08	01	-	09
4 (18 Marks)	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, Vector Space: basis, dimension, span, linear dependency (Basic ideas)	11	02	-	13
5 (20 Marks)	**List of Practicals** 1. Problems related to linearly independence and dependence. 2. Determination of rank of a matrix of order 4x4. 3. Inverse of a matrix of order 4x4. 4. Solution of system of equations. 5. Problems related to quadratic forms. 6. Determination of eigen values and vectors.	-	-	15	30
	Total	38	07	15	75

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics
  - Debate

LEARNING OUTCOMES:

After the completion of this course:
- Students should have developed a clear understanding of the fundamental concepts of real analysis.
- Students should have developed a clear understanding of the fundamental concepts of linear algebra.

SUGGESTED READINGS:
1. Malik S.C. and Savita Arora, (1994): Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delh.
2. Somasundram D. and Chaudhary B. (1987): A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi,.
3. Gupta S.L. and Nisha Rani, (1995): Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., New Delhi.
4. Appostol T.M. (1987): Mathematical Analysis, Second Edition, Narosa Publishing House, New Delhi.
5. Shanti Narayan, (1987): A course of Mathematical Analysis, 12th revised Edition, S. Chand & Co. (Pvt.) Ltd., New Delhi.
6. Singal M.K. and Singal A.R., (2003): A First Course in Real Analysis, 24th Edition, R. Chand & Co., New Delhi.
7. Bartle, R. G. and Sherbert, D. R. (2002): Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore.
8. Ghorpade, Sudhir R. and Limaye, Balmohan V. (2006): A Course in Calculus and Real Analysis,Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint.
9. Jain,M. K., Iyengar, S. R. K. and Jain, R. K. (2003): Numerical methods for scientific and engineering computation, New age International Publisher, India.
10. Mukherjee, Kr. Kalyan (1990): Numerical Analysis. New Central Book Agency.
11. Lay David C.: Linear Algebra and its Applications, Addison Wesley, 2000.
12. Schaum's Outlines : Linear Algebra, Tata McGraw-Hill Edition, 3rdEdition, 2006.
13. Krishnamurthy V., Mainra V.P. and Arora J.L.: An Introduction to Linear Algebra (II, III, IV, V).
14. Jain P.K. and Khalil Ahmad: Metric Spaces, Narosa Publishing House, New Delhi, 1973
15. Biswas, S. (1997): A Textbook of Matrix Algebra, New Age International, 1997.
16. Gupta S.C.: An Introduction to Matrices (Reprint). Sultan Chand & Sons, 2008.
17. Artin M.: Algebra. Prentice Hall of India, 1994.
18. Datta K.B.: Matrix and Linear Algebra. Prentice Hall of India Pvt. Ltd., 2002.
19. Hadley G.: Linear Algrbra. Narosa Publishing House (Reprint), 2002.
20. Searle S.R.: Matrix Algebra Useful for Statistics. John Wiley & Sons., 1982.

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	Title of the Course	:	Statistical Inference
	Course Code	:	**MINSTS3**
	Nature of the Course	:	**Minor**
	Total Credits	:	**04**
	Distribution of Marks	:	**80 (End Sem) (60T+20P) + 20 (In-Sem)**

COURSE OBJECTIVES:
- To study useful sampling distributions and their properties.
- To make informative decision using statistical tests.

UNITS	CONTENTS	L	T	P	Total Hours
1 (16 Marks)	eful sampling distributions: Chi-square, t and F. Estimation: Concepts of estimation, unbiasedness, consistency and efficiency. Sufficiency. Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE).	10	02	-	12
2 (12 Marks)	Methods of Estimation: Method of moments, method of maximum likelihood estimation, method of minimum Chi-square, basic idea of Bayes estimators.	08	01	-	09
3 (16 Marks)	Critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test, Neyman Pearson Lemma (statement and applications to construct most powerful test). Likelihood ratio test, properties of likelihood ratio tests (without proof).	10	02	-	12
4 (16 Marks)	Sequential Analysis: Sequential probability ratio test (SPRT) for simple null vs simple alternative hypotheses. Fundamental relations among α, β, A and B, determination of A and B in practice. Wald's fundamental identity (sans proof) and the derivation of operating characteristics (OC) and average sample number (ASN) functions, examples based on normal, Poisson, binomial and exponential distributions.	10	02	-	12
5 (20 Marks)	**List of Practicals** 1. Maximum likelihood estimators for the binomial, Poisson, exponential, normal distributions. 2. Estimation by method of moments for the binomial, Poisson, exponential, normal distributions. 3. Comparison of method of moments and maximum likelihood estimators for the continuous uniform distribution. 4. Computation of Type- I and Type-II errors. 5. Application of NP lemma: construction of MP and UMP tests. 6. Drawing power curves for the tests of equality of normal mean (s). 7. Likelihood ratio test: Single-sample and two-sample testing problems. 8. Sequential testing procedure: Construction of OC, ASN function and drawing of OC, ASN curve.	-	-	15	30
	Total	38	07	15	75

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
    - Group Discussion
    - Seminar presentation on any of the relevant topics
    - Debate

LEARNING OUTCOMES:

After the completion of this course:
- Students should posses skills concerning the small sample and large sample tests.
- Students are expected to analyze and interpret the data vis-à-vis statistical inference in data analysis.
- Students should gain working knowledge of sequential analysis.

SUGGESTED READINGS:

1. Goon A.M., Gupta M.K.: Das Gupta.B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta.
2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
3. Miller, I. and Miller, M. (2002) : John E. Freund's Mathematical Statistics (6th addition, low price edition), Prentice Hall of India.
4. Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley & Sons.
5. Mood A.M, Graybill F.A. and Boes D.C,: Introduction to the Theory of Statistics, McGraw Hill.
6. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997) Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
7. Snedecor G.W and Cochran W.G.(1967) Statistical Methods. Iowa State University Press.

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	Title of the Course	:	Applied Statistics
	Course Code	:	GECSTS3
	Nature of the Course	:	Generic Elective
	Total Credits	:	03
	Distribution of Marks	:	80 (End Sem) + 20 (In-Sem)

COURSE OBJECTIVES:
- To understand useful applications of statistics in Economics, Industry and Society.

UNITS	CONTENTS	L	T	P	Total Hours
1 (18 Marks)	Index numbers: 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.	06	01	-	07
2 (20 Marks)	Statistical Quality Control: 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: p and c-charts.	09	02	-	12
3 (22 Marks)	Demographic Methods: 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: definition of its main functions and uses. Measurement of fertility and reproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR	10	02	-	12
4 (20 Marks)	**Co-requisites** (with simple numerical examples) 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	15	-	-	15
	Total	40	05	-	45

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
    - Group Discussion
    - Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:

After the completion of this course:

- Students should have a clear understanding of index numbers.
- Students should have a clear understanding of statistical quality control.
- Students should have clear understanding demographic methods.

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, 9th Edition World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4th Edition(Reprint), Sultan Chand & Sons
4. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

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Title of the Course	:	Calculus
Course Code	:	AECSTS3
Nature of the Course	:	Ability Enhancement Class
Total Credits	:	02
Distribution of Marks	:	40 (End Sem) + 10 (In-Sem)

COURSE OBJECTIVES:

- To learn necessary mathematical concepts and tools to strengthen understanding of statistical theory.

UNITS	CONTENTS	L	T	P	Total Hours
1 (22 Marks)	fferential Calculus: Limits of function, continuous functions, properties of continuous functions, partial differentiation and total differentiation. Indeterminate forms: L-Hospital's rule, Leibnitz rule for successive differentiation. Euler's theorem on homogeneous functions. Maxima and minima of functions of one and two variables, constrained optimization techniques (with Lagrange multiplier) along with some problems. Jacobian, concavity and convexity, points of inflexion of function, singular points.	14	04	-	28
2 (18 Marks)	Integral Calculus: Review of integration and definite integral. Differentiation under integral sign(Leibnitz rule with examples only), double integral, change of order of integration, transformation of variables. Beta and Gamma functions: properties and relationship between them.	10	02	-	12
	Total	24	06	-	30

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(15 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **05 Marks**
    o Group Discussion
    o Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:

After the completion of this course:

- Students will be able to compute limits and derivatives.
- Students will be able to compute proper and improper integrals.

SUGGESTED READINGS:

1. Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad (14th Edition - 1997).
2. Gorakh Prasad: Integral Calculus, Pothishala Pvt. Ltd., Allahabad (14th Edition -2000).
3. Piskunov, N: Differential and Integral Calculus, Peace Publishers, Moscow.

Title of the Course : **Data Science using SPSS**
Course Code : **SECSTS3**
Nature of the Course : **Skill Enhancement**
Total Credits : **03**
Distribution of Marks : **80 (End Sem) + 20 (In-Sem)**

COURSE OBJECTIVES:
- To be familiar with basic tools of SPSS and data analytic techniques.
- To apply the tools for real-life data analysis projects and reporting.

UNITS	CONTENTS	L	T	P	Total Hours
1 (12 Marks)	Starting SPSS, Working with data file, Different data types, Scale of measurements, Dialogue boxes. Preparing the Data file, Creating data file, Entering data, Variable types in SPSS, Defining the variables, Modifying data file, Import data. Screening and cleaning data, Manipulation of data.	-	-	09	18
2 (12 Marks)	Variable Transformation/Recoding, Recoding Categorical String Variables using Automatic Recode, Grouping or Splitting Data, Replacing missing values, Computing new variables, Selecting cases, Sorting cases, Merging files, Generating random number.			09	18
3 (20 Marks)	Descriptive statistics: Graphs- Creating and editing graphs and charts, Categorical variables, continuous variables, Frequencies, Descriptive, Explore, Cross Tabulation, Checking normality, Outliers checking, Correlation: Pearson product moment correlation, Spearman rank correlation, Partial correlation, Simple linear regression, Multiple regression analysis, One sample and two Independent sample t test, Paired sample t test, One way Analysis of variance, Two way ANOVA, Analysis of Covariance	-	-	17	34
4 (16 Marks)	Chi square Test, Mann- Whitney test, Kruskal- Wallis test, Wilcoxon signed rank test. One sample and Two sample Kolmogorov – Smirnov test, Median Test.	-	-	10	20

5	**Co-requisites and problem solving:**	-	-	15	30
(20 Marks)	Reporting from SPSS outputs Project compilation Real life Data Analysis				
	Total	**-**	**-**	**60**	**120**

Where,   L: Lectures   T: Tutorials   P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: **(20 Marks)**
- One Internal Examination   -   **10 Marks**
- Others (Any one)   -   **10 Marks**
  - Group Discussion
  - Seminar presentation on any of the relevant topics

LEARNING OUTCOMES:
After the completion of this course:
- Students are expected to develop a clear understanding of the fundamental concepts of Data Analytics.
- Students will also learn SPSS tools, handling various types of data and their graphical representation.
- Students are expected to apply different data analytic tools in real life problems.

SUGGESTED READINGS:
1. Performing Data Analysis using IBM SPSS, Lawrence S. Meyers, Glenn C. Gamst, A. J. Guarino, Wiley Publication
2. SPSS for Windows Step by Step A Simple Guide and Reference, Darren George and Paul Malley.
3. SPSS in Simple Steps, Kiran Pandya, Smruti Bulsari, Sanjay Sinha, Dreamtech Press.

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