PERIYAR UNIVERSITY

Periyar palkalai Nagar

Salem – 636 011

Degree of Bachelor of Science

CHOICE BASED CREDIT SYSTEM

Syllabus for

B.Sc., STATISTICS
(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2023-2024 onwards)

Contents

Scheme of Examination and Course Structure

(From 2023 – 2024 Onwards)

(Semester-wise)

PERIYAR UNIVERSITY, SALEM – 11.

BACHELOR OF SCIENCE BRANCH - STATISTICS

(The Revised Syllabus shall be Effective from the Academic Year 2023-2024 Onwards)

Introduction:

Programme Outcome, Programme Specific Outcome and Course Outcome

Statistics is the study of Data and extracting knowledge in the data using various methods and techniques, analyze and interpret data, taking data driven predictions and decisions. It also helps data collection through sampling techniques, that is to collect data focusing on problem solving, and presenting it with wider scope of application in science, social sciences, medical science, life sciences, country‘s official statistics etc. Statistical methods are used as research methodology in all most all domains. The key core areas of study in Statistics include Descriptive Statistics, Probability Theory, Sampling techniques, Matrix and Linear Algebra, Distribution Theory, Estimation Theory, Testing of Statistical hypotheses, Stochastic processes, Regression analysis, Design of Experiments, Demography and Official Statistics. The Bachelor‘s Degree B.Sc. Statistics is awarded to the students on the basis of knowledge, understanding, skills, attitudes, values and academic achievements expected to be acquired by learners at the end of the Programme. Learning outcomes of Statistics are aimed at facilitating the learners to acquire these attributes, keeping in view of their preferences and aspirations for gaining knowledge of Statistics.

Bachelor‘s degree in Statistics is the culmination of in-depth knowledge in both theoretical and practical methods and techniques of Statistics. This also leads to study of related areas like Computer science, Industrial Statistics, Mathematical Statistics, Business Statistics and many more. Thus, this programme helps learners in building a solid foundation for higher

studies in Statistics. The skills and knowledge gained have intrinsic aesthetics leading to proficiency in analytical reasoning. This can be utilized in Statistical modelling and solving real life problems.

Students completing this programme will be able to present Statistics clearly and precisely, make abstract ideas precise by formulating them in the language of Statistics, describe Statistical ideas from multiple perspectives and explain fundamental concepts of Statistics to those non-Statistics users.

This syllabus is aimed at preparing the students to cope with the latest developments and compete with students from other universities and put them on the right track. Along with this, students are equipped with skill enhancement courses like Research methodology, Statistical packages and R language.

❖ CARRIER IN STATISTICS

After the completion of undergraduate course, students can pursue higher education in the field of statistics, professional courses and research level studies.

Postgraduates	Professional Courses	Statistical Software	Competitive Exams
M. Sc Statistics	M. B. A	STATA	UPSC
M. Stat	M. C. A	SPSS	SSC
M. Sc Data Science/Data Analytics	C.A	Minitab	IAS
M. Sc Operations Research	I.C.W. A	R	IFS
M. Sc Actuarial Science	F. R. M	SAS	ISS
M. Sc in Library and Information Science	C. F. A	SAP	SSS
M. Sc in Quantitative Economics	C. C. A	ERP	CSO
M.A Economics		Python	NSSO
M. Pharm		MATLAB	IAMR
P.G Diploma in Statistical Methods with Applications		MaxStat.	ICMR

❖ JOB OPPURTUNITIES

Jobs opportunities in Statistics Field	Job opportunities in other fields
Statistician	Business Analyst
Statistics Investigator (TNPSC)	Chartered Accountant
Actuarial Analyst	Economist
Block Health Statistician (TNPSC)	Financial Manager
Data Scientist	Financial Trader
Data Analyst	Insurance Underwriter
Market Researcher	Machine Learning Engineer
Operational Researcher	Research Scientist (Maths)
Bio-Statistician	Python Developers
Meteorologist	Assistant Director (DPES)
Statistics Subject Matter Expert	Senior Manager – Research
Statistics at Upthink Expert (Tutor)	Civil Service Fast Streamer
Young professional (Statistics) in MOSPI	Project Technical Officer
Agriculture Statistical Officer	Banking Sectors
Field Officer (Statistics)	Trainee Data Analyst

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**U.G.**
Duration:	**3 years [UG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the

	basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyze, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10: Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO11: Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

	PO12: Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one‘s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demon starting the ability to identify ethical issues related to one‘s work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO15: Lifelong learning:** Ability to acquire knowledge and skills, including learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1**: To enable students to apply basic microeconomic, macroeconomic and monetary concepts and theories in real life and decision making. **PSO2**: To sensitize students to various economic issues related to Development, Growth, International Economics, Sustainable Development and Environment. **PSO3**: To familiarize students to the concepts and theories related to Finance, Investments and Modern Marketing. **PSO4**: Evaluate various social and economic problems in the society and develop answer to the problems as global citizens. **PSO5:** Enhance skills of analytical and critical thinking to analyze effectiveness of economic policies.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
PSO 1	Y	Y	Y	Y	Y	Y	Y	Y
PSO 2	Y	Y	Y	Y	Y	Y	Y	Y
PSO3	Y	Y	Y	Y	Y	Y	Y	Y
PSO 4	Y	Y	Y	Y	Y	Y	Y	Y
PSO 5	Y	Y	Y	Y	Y	Y	Y	Y

3 – Strong, 2- Medium, 1- Low

❖ **Highlights of the Revamped Curriculum**:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Mathematics based problem solving skills are included as mandatory components in the _Training for Competitive Examinations‘ course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in

conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.

- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest - Artificial Intelligence.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analysing the world through the literary lens gives rise to a new perspective.	➢ Instill confidence among students ➢ Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	➢ Industry ready graduates ➢ Skilled human resource ➢ Students are equipped with essential skills to make them employable
		➢ Training on language and communication skills enable the students gain knowledge and exposure in the competitive world.
		➢ Discipline centric skill will improve the Technical knowhow of solving real life problems.
III, IV, V & VI	**Elective papers**	➢ Strengthening the domain knowledge ➢ Introducing the stakeholders to the State-of Art techniques from the streams of multi- disciplinary, cross disciplinary and inter disciplinary nature ➢ Emerging topics in higher education/ industry/ communication network / health sector etc. are introduced with hands-on-training.
IV	Elective Papers	➢ Exposure to industry moulds students into solution providers ➢ Generates Industry ready graduates ➢ Employment opportunities enhanced

V	Elective papers	➢ Self-learning is enhanced ➢ Application of the concept to real situation is conceived resulting in tangible outcome
VI	Elective papers	➢ Enriches the study beyond the course. ➢ Developing a research frame work and presenting their independent andintellectual ideas effectively.
Extra Credits: **For Advanced Learners / Honors degree**		➢ To cater to the needs of peer learners /research aspirants
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course –CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course –CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course –CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course – /Project with viva-voce CC - XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic / Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic / Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement - (Foundation Course)	2	2	2.7 Skill Enhancement Course – SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**22**	**30**		**25**	**30**		**26**	**30**		**21**	**30**
Total – 140 Credits																	

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	**30**

Third Year
Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	26
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	3	24
Part V	-	-	-	-	-	-	-
Total	23	23	22	25	26	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or Overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate	
	between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

❖ ELIGIBILITY CONDITION FOR ADMISSION

Candidates who seek admission to the Degree of Bachelor of Science in Statistics are required to have passed the Higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereto by the Periyar University, with Statistics/ Mathematics/Business Mathematics as one of the subjects.

❖ DURATION OF THE COURSE

a) Each academic year will be divided into two semesters. The first academic year will comprise the first and second semester, the second academic year - the third and fourth semester and the third academic year – the fifth and sixth semester.

b) The odd semesters consist of the duration from June to November of each year and the even semesters consist of the duration from December to April of each year. There won‘t be less than 90 working days for each semester.

❖ COURSE OF STUDY

In the following subjects, the course of study will comprise instruction according to the syllabus and books, prescribed from time to time.

❖EXAMINATIONS

During semester examination for each theory examination three hours is allotted. For practical examination also three hours is allotted. It will be conducted at the end of each the year. The candidate who has failed in any subject will be permitted to attend the arrear subject(s) along with the subsequent examination.

❖ PROJECT

The aim of the course is to initiate students to write and present a statistical report, under the supervision of a faculty, on some area of social interest. The project work will provide hands on training to the students to deal with data emanating from some real – life situation and propel them to do well on so theory or relate it to some theoretical concepts. The project should be prepared based on the own idea and interpretation of the student. It should not be copied from anywhere. A student must consult his/her supervisor for the preparation of the project.

While writing a project, a student must present two seminars before the faculties/ supervisor from the department.

Internal – 25 Marks

Project Viva – Voce – 75 marks

Total – 100 Marks

- **INTERNSHIP**

Students should undergo the internship for a duration of fifteen days at the end of the fourth semester. The eligible agencies to undergo internship shall be reputed multinational companies, Banking organizations, State/ Central government governing agencies. A faculty in- charge from the department will be allotted to such students. The internship result will be declared in the fifth semester mark sheet. The internship programme does not carry any marks. The mark sheet will be showing the report of the guide after the viva-voce examination as Commended or Highly Commended.

❖ SCHEME OF EXAMINATIONS

The scheme of examination for different semesters shall be as follows:

Course structure under OBE (Semester-wise Details)

Branch II STATISTICS

(For the students admitted from the Academic year 2023-2024 onwards)

PART	PAPER CODE	COURSE	TITLE OF THE PAPER	HOURS	CREDIT	MARKS		TOTAL
						CIA	UE	
SEMESTER – I								
I		Part – 1 Language	Tamil – I	6	3	25	75	100
II		Part – 2 Language	English – I	6	3	25	75	100
III	23USTCT01	Core Theory – I	Descriptive Statistics	5	5	25	75	100
	23USTCT02	Core Theory – II	Probability Theory	5	5	25	75	100
	23USTME01	Elective – I	Mathematics for Statistics	4	3	25	75	100
IV		**SEC – I	NME - I	2	2	25	75	100
	23USTFC01	Foundation Course	Elementary Statistics	2	2	25	75	100
NO. OF COURSES – 7			**TOTAL**	**30**	**23**	**175**	**525**	**700**
SEMESTER – II								
I		Language	Tamil – II	6	3	25	75	100
II		Language	English – II	4	3	25	75	100
		NMSDC	Language Proficiency for employability- Overview of English Communication	2	2	-	-	-
III	23USTCT03	Core Theory – III	Matrix and Linear Algebra	5	5	25	75	100
	23USTCT04	Core Theory - IV	Distribution Theory	5	5	25	75	100
	23USTME02	Elective - II	Real Analysis	4	3	25	75	100
	23USTCP01	** SEC – 3	Practical - I	2	2	40	60	100
IV		** SEC – 2	NME - II	2	2	25	75	100
NO. OF COURSES – 7			**TOTAL**	**30**	**25**	**190**	**510**	**700**
SEMESTER – III								
I		Language	Tamil – III	6	3	25	75	100
II		Language	English – III	6	3	25	75	100
III	23USTCT05	Core Theory – V	Estimation Theory	4	4	25	75	100
	23USTCT06	Core Theory – VI	Sampling Techniques	5	5	25	75	100
	23USTME03	Elective III	Numerical Methods	4	3	25	75	100
	23USTCP02	** SEC – 5	Practical - II	2	2	40	60	100
IV		**NMSDC**	**Digital Skills for Employability – Digital Skills**	**2**	**2**	**25**	**75**	**100**
		Common	EVS	1	-	25	75	100
NO. OF COURSES – 8			**Total**	**30**	**22**	**210**	**585**	**800**

SEMESTER – IV								
I		Language	Tamil – IV	6	3	25	75	100
II		Language	English – IV	6	3	25	75	100
III	23USTCT07	Core Theory – VII	Testing of Statistical Hypothesis	5	5	25	75	100
	23USTCT08	Core Theory – VIII	Actuarial Statistics	5	5	25	75	100
	23USTME04	Elective – IV	Economic & official Statistics	3	3	25	75	100
	23USTCP03	** SEC – 6	Practical III	2	2	40	60	100
	23USTSE02	** SEC - 7	Biostatistics	2	2	25	75	100
		Common	EVS	1	2	25	75	100
NO. OF COURSES – 8			**TOTAL**	**30**	**25**	**215**	**585**	**800**
SEMESTER – V								
III	23USTCT09	Core Theory - IX	Stochastic Processes	5	4	25	75	100
	23USTCT10	Core Theory – X	Regression Analysis	5	4	25	75	100
	23USTCP04	Core Theory - XI	Practical – IV	5	4	40	60	100
	23USTPR01	Core Theory - XII	Project (Core with Viva Voce)	5	4	50	50	100
	23USTME05	Elective – V	Operations Research	4	3	25	75	100
	23USTME06	Elective – VI	Econometrics/Population Studies	4	3	25	75	100
IV		Common	Value Education	2	2	25	75	100
		Common	Internship/ Industrial Visit/Field Visit	Minimum 15 days during summer holidays	2			
NO. OF COURSES – 8			**TOTAL**	**30**	**26**	**215**	**485**	**700**
SEMESTER – VI								
III	23USTCT11	Core Theory - XIII	Design of Experiments	6	4	25	75	100
	23USTCT12	Core Theory – XIV	Demography	6	4	25	75	100
	23USTCP05	Core Theory – XV	Practical – V	5	4	40	60	100
	23USTME07	Elective - VII	Statistical Quality Control	6	3	25	75	100
	23USTME08	Elective – VIII	Time Series/Index Numbers	5	3	25	75	100
IV		Common	Extension Activity	-	1	-	-	-
		Professional Competency Skill	Introduction to R Language / Python	2	2	25	75	100
NO. OF COURSES – 7			**TOTAL**	**30**	**21**	**165**	**435**	**600**
TOTAL NO. OF COURSES - 45			**GRAND TOTAL**	**180**	**140**	**1175**	**3125**	**4300**
UE – University Examination					**CIA – Continuous Internal Assessment**			
**** SEC – Skill Enhancement Course**								

*Practical examinations should be conducted at the end of the semester.

Course Structure

BRANCH: STATISTICS

TABLE SHOWING THE COURSES OFFERED WITH CREDITS UNDER VARIOUS PARTS

OBE Pattern With effect from the Academic Year 2023-24 onwards

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language	3	2.1. Language	3	3.1. Language	3	4.1. Language	3	5.1 Core Course – \CC IX	4	6.1 Core Course – CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X	4	6.2 Core Course – CC XIV	4
1.3 Core Course – CC I	5	2.3 Core Course – CC III	5	3.3 Core Course – CC V	5	4.3 Core Course – CC VII Core Industry Module	5	5. 3.Core Course CC -XI	4	6.3 Core Course – CC XV	4
1.4 Core Course – CC II	5	2.4 Core Course – CC IV	5	3.4 Core Course – CC VI	5	4.4 Core Course – CC VIII	5	5. 3.Core Course –/ Project with viva-voce CC -XII	4	6.4 Elective -VII Generic Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	3	2.5 ElectiveII Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/ Discipline Specific	3	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3

1.6 Skill Enhancement Course SEC-1 (NME)	2	2.6 Skill Enhancement Course SEC-2 (NME)	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1
1.7 Skill Enhancement - (Foundation Course)	2	2.7 Skill Enhancement Course – SEC-3	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhancement Course SEC-7	2	5.6 Value Education	2	6.7 Professional Competency Skill	2
				3.8 E.V.S	-	4.8 E.V.S	2	5.8 Summer Internship /Industrial Training	2		
	23		**23**		**22**		**25**		**26**		**21**
	Total Credit Points										**140**

❖ QUESTION PAPER PATTERN AND EVALUATION FOR ALL COURSES

a. Evaluation of Continuous Internal Assessment (CIA):

S.NO	INTERNAL ASSESSMENT	DISTRIBUTION OF MARKS
1	Test	15 Marks
2	Assignments	5 Marks
3	Attendance	5 Marks
TOTAL		**25 Marks**

b. Question Paper Pattern for Core /Elective/SEC Papers (Theory):

Time: Three hours **Maximum Marks: 75**

Part - A (15 x 1 = 15)
Answer ALL questions
(Three Questions from Each Unit)

Part - B (2 x 5 = 10)
Answer any TWO questions
(One Question from Each Unit)

Part - C (5 x 10 = 50)
Answer ALL questions
(One Question from Each Unit with Internal Choice)

c. Distribution of Marks for Core & SEC Practical:

EXAMINATIONS	MARKS
CIA (Continuous Internal Assessment) Including Practical Record	40 Marks
UE (University Examinations)	60 Marks
TOTAL	**100 Marks**

d. Distribution of Marks for Computer Based SEC Software Practical:

University Examinations	Distribution of Marks	
	Written Practical	**Total Marks**
Algorithm	10 Marks	60 Marks
Writing the Program in the Main Answer Book	20 Marks	
Run the Program	20 Marks	
Display the Correct Output	10 Marks	
CIA (Including Practical Record)		40 Marks
Total		**100 Marks**

e. Evaluation of Continuous Internal Assessment (CIA) for Core and Practical:

S.NO	INTERNAL ASSESSMENT	DISTRIBUTION OF MARKS
1	Record	25 Marks
2	Test	10 Marks
3	Attendance	5 Marks
TOTAL		**40 Marks**

f. Question Paper Pattern for Core and SEC Practical:

Time: Three hours **Maximum Marks: 60**

Part - A (3 x 20 = 60)
Answer Any THREE questions out of FIVE

(One question from each unit)

a) (i) PASSING MINIMUM - Theory

The candidate shall be declared to have passed the examination if the candidate **secures not less than 40 marks** put together out of 100 **(CIA+EA). Minimum 40% should be secured (30 out of 75) in EA** of each theory paper.

(ii) PASSING MINIMUM - Practical

The candidate shall be declared to have passed the examination if the candidate **secures not less than 40 marks** put together out of 100 **(CIA+EA). Minimum 40% should be secured (24 out of 60) in EA** of each Practical paper.

The CIA of each practical paper includes evaluation of record. However submission of record for the University Practical Examination is mandatory.

Examinations	**Maximum Marks**		
	CIA	**UE**	**Total**
Theory Paper	25	75	100
Practical Paper	40	60	100

CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who secure not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in the First Class.

All other successful candidates shall be declared to have passed in the Second Class. Candidates who obtained 75% of the marks in the aggregate shall be deemed to have passed the examination in First Class with Distinction provided they pass all the examinations prescribed for the course at the first appearance. Candidates who pass all the examinations prescribed for the course in the first instance and within a period of three academic years from the year of admission to the course only are eligible for University Ranking.

1. **Passing Minimum** is 40% of the **ESE** and 40% of the minimum of the paper/course.
2. **Minimum Credits to be Earned:**

   For THREE - year Programme: Best 140 Credits

   Part I and II **:** Languages
   Part III **:** Major, Elective
   Part IV **:** Soft Skills
   Part V **:** Extension Activities

3. **Marks and Grades:**

   The following table gives the marks, grade points, letter grades and classification to indicate the performance of the candidate.

❖ **Conversion of Marks to Grade Points and Letter Grade (Performance in a Course/Paper)**

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 –100	9.0 - 10.0	O	**Outstanding**
80–89	8.0 - 8.9	D+	**Excellent**
75–79	7.5 - 7.9	D	**Distinction**
70–74	7.0 - 7.4	A+	**Very Good**
60–69	6.0 - 6.9	A	**Good**
50–59	5.0 - 5.9	B	**Average**
40–49	4.0 - 4.9	C	**Satisfactory**
00–39	0.0	U	**Re-appear**
ABSENT	0.0	AAA	**ABSENT**

CALCULATION OF GPA AND CGPA

$$GPA = \frac{Sum\ of\ t\ \ e\ Multiplication\ of\ Grade\ Points\ by\ t\ \ e\ Credits\ of\ t\ \ e\ Courses}{Sum\ of\ t\ \ e\ Credits\ of\ t\ \ e\ Courses\ in\ a\ semester}$$

$$Grade\ Point\ Average\ (GPA) = \frac{\sum_i C_i G_i}{\sum_i C_i}$$

For the Entire Programme:

$$CGPA = \frac{Sum\ of\ t\ \ e\ Multiplication\ of\ Grade\ Points\ by\ t\ \ e\ Credits\ of\ t\ \ e\ Entire\ Programme}{Sum\ of\ t\ \ e\ Credits\ of\ t\ \ e\ Courses\ of\ t\ \ e\ Entire\ Programme}$$

C_i = Credits earned for course ‗i' in any semester
G_i= Grade Point obtained for course ‗i' in any semester
N refers to the semester in which such courses were credited

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O+	First Class with Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.5 and above but below 5.0	C+	Third Class
4.0 and above but below 4.5	C	
0.0 and above but below 4.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed Semester of the UG Programme (Major, Allied and Elective Courses Alone) are eligible.

DIFFERENT TYPES OF COURSES

Core Courses CC

S. No.	Course No.	Title of the course
1	I	Descriptive Statistics
2	II	Probability Theory
3	III	Matrix and Linear Algebra
4	IV	Distribution Theory
5	V	Estimation Theory
6	VI	Sampling Techniques
7	VII	Testing of Statistical Hypothesis
8	VIII	Actuarial Statistics
9	IX	Stochastic Processes
10	X	Regression Analysis
11	XI	Practical – IV
12	XII	Project (Core with Viva Voce)
13	XIII	Design of Experiments
14	XIV	Demography
15	XV	Practical – V

Elective Courses EC

Elective Course No.	Title of the course
I	Mathematics for Statistics
II	Real Analysis
III	Numerical Methods
IV	Economic & Official Statistics
V	Operations Research
VI*	a) Econometrics
	b) Population Studies
VII	Statistical Quality Control
VIII**	a) Time Series
	b) Index Numbers

***Elective VI to be chosen as either (a) or (b) for Semester V**
****Elective VIII to be chosen as either (a) or (b) for Semester VI**

Skill Enhancement Courses (SEC)

S. No.	Course No.	Title of the course
1	I	Practical – I
2	II	Digital Skills for Employability – Digital Skills
3	III	Practical – II
4	IV	Practical – III
5	V	Biostatistics

OTHER COURSES

Foundation course: Elementary Statistics

Professional Competency Skill**
a) Introduction to R language
b) Introduction to Python programming

**Either (a) or (b) to be chosen in Semester VI

COMMENCEMENT OF THIS REGULATION

The OBE regulations shall take effect from the academic year 2023 – 2024 (i.e.) for the students who are admitted in the first year of the course during the academic year 2023 – 2024 and thereafter.

TRANSITARY PROVISION

Candidates who were admitted to the UG course of study prior to 2023-2024 will be permitted to appear for the examination under those regulations for a period of three years (i.e.) up to and inclusive of the examinations of April/May 2026. Thereafter they will be permitted to appear for the examination based on the regulations then in force.

❖ LIST OF COURSES:

<table>
<tr><td colspan="8">(For the candidates admitted from the academic year 2023 -2024 onwards)</td></tr>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Descriptive Statistics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic arithmetic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. It explains the important concepts of statistics and statistical data.
2. It provides to formulate the visualization of frequency distribution.
3. Also they measure the averages, dispersions, lack of symmetry, moments, and relationship among variables.
4. Estimate and predict the unknown and future values.
5. Study of non-linear and consistency of the data.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit-I Statistics
Introduction - Definition – Collection of Data: Primary and secondary data - Methods of collecting primary data - Sources of secondary data. Sampling: Census and Sample methods. Classification-Types - Formation of frequency distribution-Tabulation - parts of a Table - Types. Diagrammatic representation – Types. Graphical representation - Graphs of frequency distributions. Merits and Limitations of diagrams and graphs.</td></tr>
<tr><td colspan="6">Unit-II Measures of Central tendency
Introduction - Definitions - Types - Mean-Median-Mode-Geometric mean-Harmonic Mean-Weighted mean - Merits and Demerits-Measures of Dispersion: Introduction – Definition – Types – Range - Quartile deviation - Mean deviation - Standard deviation - Co-efficient of variation.</td></tr>
<tr><td colspan="6">Unit-III Skewness
Introduction-Definition-Types-Karl Pearson‘s – Bowley‘s - Kelly‘s methods – Their merits and demerits. Kurtosis: Introduction-Definition-Types-Its merits and demerits. Moments: Introduction - Definition-Types - Raw, Central moments and their relations.</td></tr>
<tr><td colspan="6">Unit-IV Correlation analysis
Introduction - Definition - Types – Ungrouped and Grouped data – Probable error – properties - Rank correlation –Regression analysis: Introduction - Definition – Regression Equations -Multiple regression.</td></tr>
<tr><td colspan="6">Unit-V Theory of Attributes
Introduction – Definition-Classes and Class frequencies-Consistency of data-Independence of attributes- Association of attributes-Yule‘s coefficient and -Coefficient of Colligation.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Gupta, S.P. (2017): Statistical Methods, Sultan Chand & Sons Pvt Ltd, New Delhi, 35th Revised Edition. 2. Gupta S. C and Kapoor, V. K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi
Reference Books	**1.** Goon A. M. Gupta. A. K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta **2.** G. U. Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin. **3.** M.R. Spiegel (1961). Theory and problems of Statistics, Schaum's outline series. **4.** Anderson, T.W. and Sclove SL. (1978). An introduction to statistical analysis of data, Houghton Miffin &co. **5.** Pillai, R.S., and Bagavathi (2003): Statistics, S. Chand and Company Ltd., New Delhi.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject https://en.wikipedia.org/wiki/Statistics https://en.wikipedia.org/wiki/Descriptive_statistics https://socialresearchmethods.net/kb/statdesc.php http://onlinestatbook.com/2/introduction/descriptive.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1: Describe the scope, functions, applications and limitations of Statistics.

CLO-2: Also to explain the statistical survey, collection of data, sampling and presentation of data.

CLO-3: Discuss the importance and uses of central values and dispersions for the various types of data.

CLO-4: Also to measure the various measures of averages and scatteredness of the mass of data in a series.

CLO-5: Explain about the lack of symmetry, r^{th} moments and peakedness of the frequency distributions.

CLO-6: Ability to apply in data

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	M	S	S	S	S	S	S	S	M
CLO5	S	S	S	S	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Probability Theory</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">CORE II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT02</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Knowledge on events and set theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To describe the importance and scope of probability theory and to predict the chance of an experimental outcomes.
2. It provides the study of random variable, distribution function, mathematical expectation,
3. Two-dimensional variables and its distributions</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit-I Theory of Probability
Introduction-Basic terminology- Definition - Axiomatic approach – Types of Events - Conditional Probability – Addition and Multiplication theorems of Probability for ‗two‘ events (Statement and Proof) – Bayes theorem of Probability (Statement and Proof)- Simple problems.</td></tr>
<tr><td colspan="6">Unit-II Random variables and Distribution functions
Introduction - Discrete random variable: Probability mass function- Discrete distribution function, Properties. Continuous random variable: Probability density function and properties.</td></tr>
<tr><td colspan="6">Unit-III Two dimensional random variables
Joint probability mass function- Marginal probability function, Conditional probability function. Two dimensional distribution functions- Marginal distribution functions - Joint density function-Marginal density function - Conditional distribution function - Conditional probability density function only.</td></tr>
<tr><td colspan="6">Unit-IV Mathematical Expectations
Introduction- Expected value of a random variable (Discrete and Continuous)-Expected value of function of a random variable - Properties of Expectation-Properties of variance- Covariance.</td></tr>
<tr><td colspan="6">Unit-V Generating functions
M.G.F-Properties-Uniqueness theorem - C.G.F-Properties- P.G.F-Properties. Characteristic Function: Properties– Inversion theorems (Statement only)- Uniqueness theorem (Statement only). Chebychev‘s Inequality (Statement and Proof).</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /othersto be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Gupta S.C. and Kapoor V.K (2015): Fundamentals ofMathematical Statistics, Sultan Chand & Sons.
Reference Books	1. Rohatgi, V.K. (1984): An introduction to probability theory and mathematical statistics. 2. Hogg. R.V. and Craig. A.T. (1978) : Introduction to Mathematical Statistics, McGraw Hill Publishing Co. Inc. New York. 3. Mood A.M. Graybill, F.A. and Bose. D.C. (1974): Introduction to the theory of Statistics, McGraw Hill Publishing Co. Inc. New York. 4. Sanjay Arora and Bansilal (1989): New Mathematical Statistics, Satyaprakashan, New Delhi
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject www.khanacademy.org/math/statistics-probability/random-variables-stats-library https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1: Understand concepts of probability and identify the different approaches of probability theory

CLO-2: Define the random variable and its respective probability values and to compare a discrete and continuous random variable.

CLO-3: Calculate the expected value of a random variable variance, covariance, moments and find the conditional expectation and variance of bi-variate random variable.

CLO-4: Estimate the measures of central values, Dispersions, Skewness and Kurtosis through the generating function

CLO-5: Understand bivariate random variables and its distributions

CLO-6: Application of probability theory in real life

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	S	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Matrix and Linear Algebra</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT03</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic vector and matrix theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To study the basic operations of transpose and inverse of matrices
2. To learn the invariance properties of ranks
3. To know and to apply the concepts of vector space and matrix polynomials.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Matrices-Transpose-Conjugate transpose- Reversal law for the transpose and conjugate transpose. Adjoint of a matrix, Inverse of a matrix, Singular and Non -Singular matrices</td></tr>
<tr><td colspan="6">Unit II
Reversal law for the inverse of product of two matrices. Commutativity of inverse and transpose of matrix, Commutativity of inverse and conjugate transpose of matrix.</td></tr>
<tr><td colspan="6">Unit III
Rank of a matrix, Echelon form, Rank of transpose, Elementary transformations, Elementary matrices, Invariance of rank through elementary transformations, Reduction to Normal form, Equivalent matrices.</td></tr>
<tr><td colspan="6">Unit-IV
Vector space – Linear Dependence - Basis of a vector space – Sub space - Properties of Linearly Independent and Dependent systems, Row and Column spaces, Equality of Row and Column ranks,
Rank of Sum and Product of matrices.</td></tr>
<tr><td colspan="6">Unit-V
Matrix polynomials, Characteristic roots and vectors, Relation between characteristic roots and characteristic vectors, Algebraic and Geometric multiplicity, Cayley- Hamilton theorem.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Vasishtha.A.R (1972) : Matrices, KrishnaprakashanMandir, Meerut.
Reference Books	1. Shanthinarayan, (2012) : A Text Book of Matrices, S.Chand & Co, New Delhi 2. M.L.Khanna (2009), Matrices, Jai Prakash Nath& Co
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject https://samples.jbpub.com/9781556229114/chapter7.pdf https://www.vedantu.com/maths/matrix-rank https://textbooks.math.gatech.edu/ila/characteristic-polynomial.html https://www.aitude.com/explain-echelon-form-of-a-matrix/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Do basic operations of matrices

CLO-2 Understand various transactions of matrices and its applications

CLO-3 Understand various properties of matrices

CLO-4 Able to understand vector space and its applications

CLO-5 Able understand eigen vector and its applications

CLO-6 Able understand vector and matrix applications

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	M	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	S	M	S	M	S	S	M	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Distribution Theory</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT04</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To learn discrete distributions
2. To learn continuous distributions
3. To understand Distributions generated from mathematical functions
4. To learn normal distribution and its properties
5. To understand about sampling distributions</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Binomial distribution – moments, recurrence relation, mean deviation mode, moment generating function, characteristic function, cumulants Fitting of Binomial Distribution. Poisson distribution – moments, mode recurrence relation, moment generating function, characteristic function cumulants. Fitting of Poisson distribution. Negative binomial distribution – m.g.f., cumulants. Fitting of Negative binomial distribution.</td></tr>
<tr><td colspan="6">Unit II
Geometric distribution – lack of memory, moments, m.g.f.- Hypergeometric distribution – mean, variance, approximation to Binomial, recurrence relation – Multinomial distribution – m.g.f., mean and variance.</td></tr>
<tr><td colspan="6">Unit III
Normal Distribution – chief characteristics of the normal distribution and normal probability curve, mean, median, mode, m.g.f. characteristic function, moments, points of inflexion, mean deviation.</td></tr>
<tr><td colspan="6">Unit-IV
Exponential distribution - m.g.f., characteristic function, memory less property – Gamma distribution – m.g.f., cumulants and central moments, reproductive property – Beta distribution – First kind and second kind – constants.</td></tr>
<tr><td colspan="6">Unit-V Functions of Normal random variables leading to t, Chi-square and F-distributions (derivations, properties and interrelationships).</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Gupta, S.C. Kapoor, V.K. (2007) Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi 2. Goon, A.M. Gupta M.K. and Das Gupta B (1977) An Outline of Statistical Theory, Vol I, 6/e, World Press, Calcutta. 3. Hogg, R.V. and Graig, A.T. (1978): Introduction to Mathematical Statistics, A/e, Mc.Graw Hill Publishing Co.Inc., New York.
Reference Books	1. Mood, A.D. Graybill, F.A. and Boes, D.C (1974): Introduction to the Theory of Statistics, 3/e, Mc.Graw Hill, New York.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 identify discrete distributions appeared in real life situations

CLO-2 understand some continuous distributions and its applications

CLO-3 connection between some of the real values mathematical functions and its application in distribution theory

CLO-4 understand normal distribution and its properties

CLO-5 understand sampling distributions and its applications in real life

CLO-6 identify probability models in real data and estimate population parameters

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	M	M	S	M
CLO4	S	S	S	M	S	S	S	M	M
CLO5	S	M	M	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Estimation Theory</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core – V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT05</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Number theory and Arithmetic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To Emphasize on the Concept of Point Estimation and Interval Estimation.
2. To learn properties of a good estimator
3. To understand various methods of estimation</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Point estimation – Estimator – Consistency and Unbiasedness – Efficiency and asymptotic efficiency – Estimators based on sufficient statistics – Neyman Factorization theorem (statement only) – Simple Illustrations</td></tr>
<tr><td colspan="6">Unit II
Minimum variance unbiased estimators – Cramer – Rao Inequality – Rao Blackwell theorem – Simple illustrations</td></tr>
<tr><td colspan="6">Unit III
Methods of Estimation – Methods of Maximum likelihood and moments – Properties of estimators obtained by these methods – Simple illustrations</td></tr>
<tr><td colspan="6">Unit-IV
Method of Minimum Chi-Square-Method of Minimum Variance-Methods of moments -Methods of Least squares- Interval estimation.</td></tr>
<tr><td colspan="6">Unit-V
Notion of Bayes estimation – concept of prior, posterior and conjugate priors. Simple problems involving quadratic error loss function – Notion of Minimax estimation – Simple illustrations.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Gupta S.C. and Kapoor V.K. (2007) : Fundamentals of Mathematical Statistics, Sultan Chand Sons, New Delhi.
2. P.R. Vittal(2002) : Mathematical Statistics, Margham Publications, Chennai.</td></tr>
</table>

	3. Ashok K. Bansal (2007): Bayesian Parametric Inference, Narosa Publishing House. 4. Mood, A.M. Graybill, F.A. and Boes D.C. (1974): Introduction to Theory of Statistics, McGraw – Hill.
Reference Books	1. Rohatgi, V. (1976) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern. 2. Goon A.M. Gupta M.K. and Das B. (1980): An Outline of Statistical Theory, Vol II, World Press, Calcutta 3. Sanjay Arora and Bansi Lal (1989) : New Mathematical Statistics, Satya Prakasam, New Delhi. 4. Hodges, J.L. and Lehman, E.L (1964): Basic Concepts of Probability and Statistics, Holden Day. 5. Dr. A. Santhakumaran(2004): Probability Models and their Parametric Estimation
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 estimate population parameters

CLO-2 identify good estimators and its properties

CLO-3 derive interval estimators of a parameter

CLO-4 estimate parameters using various estimation methods and identify the best among the estimators

CLO-5 handle data and can estimate population parameters

CLO-6 realize the application of different types of estimators

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	S	S	M
CLO2	S	S	S	S	M	S	S	S	M
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Sampling Techniques</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core – VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT06</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Descriptive statistics and Probability theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To know the basic operations of sampling
2. To study the theory and applications of SRS
3. To learn practical uses of Stratification
4. To apply Systematic and PPS Sampling in real time problems.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">Unit I
Basic concepts of sample surveys – Advantages of Sampling – Principal steps in Sample survey, Sampling unit – Sampling frame – Census – Probability Sampling, Alternatives to probability sampling, Mean Square Error.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit II
Simple random sampling, Methods of selection, Sampling with and without replacement – Properties of estimates, Finite population correction, Estimation of Standard error, Confidence limits.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit III
Stratified random sampling, principles of stratification, Notations – Estimation of population mean and its variance – Estimated variance and confidence limits, Allocation techniques -equal allocation, proportional allocation, Neyman allocation and optimum allocation, Estimation of gain due to stratification.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit-IV
Systematic sampling –Relation to cluster sampling, Estimation of population mean and its sampling variance – Comparison of systematic sampling with stratified random samples.</td></tr>
<tr><td colspan="2"></td><td colspan="6">Unit-V
Varying Probability sampling, Selection of one unit with PPS, PPS Sampling with replacement, Estimator for population total and its variance.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Cochran, W.G. (1978) : Sampling Techniques, JohnWiley Eastern 2. Murthy M.N. (1967):Sampling Theory and Methods, Statistical Publishing Society, Calcutta
Reference Books	1. Singh. D. and Chaudry F.S. (1986) : Theory and Analysis of Sample Surveys Design Wiley Eastern Ltd. 2. Sampath.S, (2001), Sampling Theory and Methods, CRC Press.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject http://ocw.jhsph.edu/courses/statmethodsforsamplesurveys/pdfs/lectur e2.pdf https://www.questionpro.com/blog/stratified-random-sampling/ https://www.scribbr.com/methodology/systematic-sampling/ http://home.iitk.ac.in/~shalab/sampling/chapter7-sampling-varying-probability-sampling.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Know the difference between census and sampling.
CLO-2 Understand basic operations and advantages of sampling
CLO-3 Understand widely used sampling techniques
CLO-4 Know to estimate population information using sampling
CLO-5 Apply sampling techniques in real time problems
CLO-6 identify suitable sampling technique for a real life survey

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	S	S	M
CLO2	S	S	S	S	M	S	S	S	M
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Testing of Statistical Hypothesis</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT07</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Estimation theory and distribution theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To make familiar with testing concepts
2. To understand the concept of Most Powerful test
3. To understand the Likelihood ratio tests and their uses
4. To apply tests for samples from unknown distributions</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Statistical Hypothesis – Null and Alternative Hypothesis – Simple and Composite hypothesis – Critical region – Type-I and Type-II error – Most Powerful test – Uniformly Most powerful test – Neyman Pearson Lemma – Simple problems.</td></tr>
<tr><td colspan="6">Unit II
Likelihood ratio test – Tests of mean of a normal population – Equality of two means of normal populations – test for variance of a normal population – Equality of variances of two normal populations.</td></tr>
<tr><td colspan="6">Unit III
Chi-square tests, Distribution of quadratic forms, Test of equality of several means, Analysis of Variance. Correlation and Regression testing.</td></tr>
<tr><td colspan="6">Unit-IV
Exact tests based on t distribution – One sample tests - one sided and two sided tests – Variance known and Variance unknown – Two sample tests – One sided and two sided - Variance known and Variance unknown.</td></tr>
<tr><td colspan="6">Unit-V
Nonparametric methods – Confidence interval for distribution quantiles – Tolerance limits for distributions. Sign test, Wilcoxon test.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. Robert V. Hogg and Allen T.Craig (1978), Introduction to Mathematical Statistics, 4th edition, Macmillan Publishing Co., Inc. New York 2. An Introduction to Probability and Statistics (2001), Rohatgi.V.K, and A.K.Md.EhsanesSaleh, John Wiley & Sons
Reference Books	1. Gupta S.C. and Kapoor V.K. (1991) : Fundamentals ofMathematical Statistics, Sultan Chand & Sons. 2. Goon A.M. Gupta M.K. and Das Gupta B (1980) : An outline of Statistical Theory, Vol.II World Press Calcutta. 3. Mood A.M. Graybill F.A. and Boes D.C.B (1980) : Introduction to the Theory of Statistics 3/e, McGraw Hill, New York. 4. Gibbons, J.D. (1971) : Non-Parametric Statistical Inference, McGraw Hill.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject http://fisher.stats.uwo.ca/faculty/kulperger/SS3858/Handouts/np-lemma.pdf https://www.sciencedirect.com/topics/mathematics/uniformly-most-powerful-test https://www.probabilitycourse.com/chapter8/8_4_5_likelihood_ratio_tests.php https://www.statisticshowto.com/probability-and-statistics/statistics-definitions/parametric-and-non-parametric-data/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 frame hypotheses about population in real life research
CLO-2 identify suitable testing procedure for given hypotheses
CLO-3 compare two populations using samples taken from them
CLO-4 Compare populations in its means and variances separately
CLO-5 identify situations to apply parametric and nonparametric tests
CLO-6 interpret results of a hypothesis testing

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	S	M	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Actuarial Statistics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT08</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">1</td><td>--</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic arithmetic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. It develops a greater understanding of statistical principles and their application in actuarial statistics.
2. Describe the core areas of actuarial practice and relate to those areas actuarial principles, theories and models.
3. It gives the understanding of the application knowledge of the life insurance environment.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Simple and compound interest, present value and accumulated values of fixed rate, varying rate of interest</td></tr>
<tr><td colspan="6">Unit II
Mortality : Gompertz - Makeham laws of mortality - life tables.
Annuities: Endowments, Annuities, Accumulations, Assurances, Family income benefits.</td></tr>
<tr><td colspan="6">Unit III
Policy Values: Surrender values and paid up policies, industrial assurances, Joint life and last survivorship, premiums.</td></tr>
<tr><td colspan="6">Unit-IV
Contingent Functions: Contingent probabilities, assurances. Decrement tables. Pension funds: Capital sums on retirement and death, widow‘s pensions, benefits dependent on marriage.</td></tr>
<tr><td colspan="6">Unit-V
Principles of insurance, pure endowment, whole life assurance, Net premium for assurance and annuity plans-level annual premium under temporary assurance.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /IAII/ IFoA there to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Hooker,P.F., Longley, L.H.-Cook (1957) : Life and other contingencies,Cambridge.</td></tr>
</table>

	2. Alistair Neill(1977) : Life contingencies, Heinemann professional publishing. 3. Gupta and Kapoor (2001) Fundamentals of Applied Statistics
Reference Books	1. Study material of IAI/IFoA of Actuarial Societies 2. Hosack,I.B., Pollard, J.H. and Zehnwirth, B.(1999) : introductory statistics with applications in generalinsurance, Cambridge University.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO1 : To explain the utility theory and insurance terminologies.

CLO2: To articulate the insurance and annuity benefits through multiple life functions evaluation for special mortality laws.

CLO3 : To describe the various types of premium and their numerical evaluations.

CLO4 : To explain implementation of the Life insurance policies.

CLO5: To describe Insurance payable at the moment of death and at the end of the year of death-level benefit insurance.

CLO6: To understand real life problems related to insurance

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	S	M	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Stochastic Processes</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT09</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Probability theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To study the basic concepts of theory of Stochastic Processes, the most important types of Stochastic Processes, various properties and characteristics (Poisson, Markov and others).
2. To learn the notions of ergodicity, stationarity and applications.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Notion and specification of Stochastic Processes – Stationary Process – Markov Chains – Definition and examples – Higher transition probabilities: Chapman – Kolmogorov equations. Classification of States and Chains</td></tr>
<tr><td colspan="6">Unit II
Markov Chains – Determination of Stability of a Markov System –Limiting Behaviour – Ergodic theorem. One dimensional random walk</td></tr>
<tr><td colspan="6">Unit III
Markov Processes with discrete state space: Poisson Process – Postulates of Poisson process Properties of Poisson Process – Poisson process and related distributions. Pure Birth process – Yule-Furry process. Pure Death Process.</td></tr>
<tr><td colspan="6">Unit-IV
Renewal Process – Definition, related concepts and examples – Renewal equation – Elementary Renewal Theorem – Basic Renewal Theorem.</td></tr>
<tr><td colspan="6">Unit-V
Applications in Stochastic Models: Queuing Systems and Models: Simple queuing models M/M/1, M/M/s queuing systems (finite and infinite) steady state solution-simple problems with finite and infinite capacities.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. Medhi, J. (2019): Stochastic Processes, New Age International Publishers. 2. KantiSwarup, Gupra.P.K. Man Mohan.,(2010): Operations Research, Sultan Chand & Sons
Reference Books	1. Karlin ,S. and Taylor, H.M.(1975): A first Course in Stochastic Processes, Academic Press, New York. 2. Ross, S.M. (1983): Stochastic Processes. John Wiley Eastern Ltd., New York.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject http://www.randomservices.org/random/ https://www.britannica.com/science/stochastic-process

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand stochastic nature of random variable and different stochastic processes
CLO-2 know about transition matrix and its calculations
CLO-3 understand Markov chain and its applications
CLO-4 understand Markov process and its applications
CLO-5 understand renewal process and its applications
CLO-6 know about various stochastic modeling and its applications

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	S	M	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	M	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	M	M	S	M	S	M
CLO6	S	S	M	S	M	S	S	M	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Regression Analysis</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core X</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT10</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Linear regression analysis, Estimation theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To understand linear and nonlinear relationships between variables and training the students in applications oriented.
2. To teach Linear Regression models, its assumptions and its properties.
3. To perform model adequacy check before using Linear Regression models</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">Unit I
Simple linear regression-Assumptions, estimation of model parameters, standard error of estimators, testing of hypotheses on slopeand intercept (β‘s), interval estimation of model parameters, prediction interval of a new observation, coefficient of determination, regression through origin.</td></tr>
<tr><td colspan="6">Unit II
Standard Gauss Markov setup, least square estimation of model parameters, variance covariance of least squares estimators, estimation of error variance.</td></tr>
<tr><td colspan="6">Unit III
Model adequacy checking - residual plots for checking normality homoscedasticity and detection of outliers. Test for Lack of fit of the model. Durbin – Watson test for autocorrelation.</td></tr>
<tr><td colspan="6">Unit-IV
Multicollinearity – sources, effects, diagnostics, Methods of dealing with multi collinearity (collection of additional data, model respecification, Ridge regression).</td></tr>
</table>

	Unit-V Nonlinear regression – transformation to a linear model, their use and limitations, initial estimates (starting values), parameter estimation using iterative procedures – Gauss-Newton, steepest Descent.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003): Introduction to Linear regression analysis, third edition, John Wiley and Sons, Inc. 2. Zar, J.H. (2006): Biostatistical Analysis, fourth edition, Pearson education. 3. Douglas C. Montgometry (2012)Introduction to Linear Regression Analysis. 4. Iain Pardoe (2012): Applied regression Modeling, second edition, Wiley
Reference Books	1. Draper, N.R. and Smith, H. (2003): Applied Regression Analysis, third edition, John Wiley and Sons, Inc. 2. Johnston, J. (1984): Econometric methods, third edition, McGraw Hill International. 3. A. Sen, M. Srivastava, Regression Analysis — Theory, Methods, and Applications, Springer-Verlag, Berlin, 2011.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject http://home.iitk.ac.in/~shalab/regression/Chapter2-Regression-SimpleLinearRegressionAnalysis.pdf http://www.mit.edu/~6.s085/notes/lecture3.pdf https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/Procedures/ NCSS/Nonlinear_Regression.pdf https://data.princeton.edu/wws509/notes/c4.pdf http://home.iitk.ac.in/~shalab/regression/Chapter15 Regression- PoissonRegressionModels.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Estimating model parameters and testing it
CLO-2 understand linear and nonlinear models assumptions
CLO-3 check model adequacy
CLO-4 know about variable selection
CLO-5 know about nonlinear regression model**s**
CLO-6 choose model if some of the basic assumptions are violated also

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	S	M	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	M	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	M	M	S	M	S	M
CLO6	S	S	M	S	M	S	S	M	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Core XI - Practical – IV (Core – IX & X)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core XI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCP04</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td>5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To enable the students to gain practical knowledge stochastic processes problems.
2. Demonstrate the fitting of linear regression models for real time data.
3. Infer model adequacy through various model selection process.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT I
Transition probability Matrix – Stationarity of Markov Chain and graphical representation of Markov Chain.</td></tr>
<tr><td colspan="6">Unit II
Poisson Process – probabilities of birth and death Process – Yule – Furry Process.</td></tr>
<tr><td colspan="6">Unit III
Queuing Systems – Single server exponential queuing system – Single server exponential queuing system having finite capacity.</td></tr>
<tr><td colspan="6">Unit-IV
Simple linear regression – Confidence interval estimation of simple linear regression</td></tr>
<tr><td colspan="6">Unit –V
Normality of residuals – Multicollinearity in simple and multiple linear regression – Heteroscedasticity and auto correlation in simple and multiple regression.</td></tr>
</table>

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.
Any 3 questions are to be answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Design of Experiments</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core XIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT11</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Linear models</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To get theoretical knowledge in Statistical Design of Experiments and analysis of variance
2. To build strong theoretical foundation in Orthogonal Latin squares, Hyper Graeco Latin squares, factorial and fractional factorial experiments, PIBD, inter and intra blocks, split plot, analysis covariance, Response surface methodology
3. To develop analytical thinking in problem solving skills</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Fundamental Principles of Experiments – Replication, Randomization and Local Control techniques – Size of experimental unit – Methods of determination of experimental units – (Maximum curvature method – Fairfield Smith‘s variance law).</td></tr>
<tr><td colspan="6">Unit II
Analysis of variance – One way, Two way, classification (without interaction) – Multiple range test; Newman-Keul‘s test – Duncan‘s multiple range test – Tukey‘s test – Transformation – Square root, angular and log transformations.</td></tr>
<tr><td colspan="6">Unit III
Completely Randomized Design (CRD) and its analysis – Randomized block design (RBD) – RBD – More than one but equal number of observations per cell – Latin Square Design (LSD) and its analysis.</td></tr>
<tr><td colspan="6">Unit-IV
Missing plot techniques – Meaning – Least Square method of estimating one missing observation – RBD and LSD – Twoobservations missing in RBD and LSD – Analysis of covariance technique in CRD and RBD (without derivation).</td></tr>
<tr><td colspan="6">Unit-V
Factorial experiment – Definition – 2^2, 2^3 and 3^2factorial experiments and their analysis – Principles of confounding – Partial and complete confounding in 2^3 – Split plot design and its analysis.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Das, M.N. and Giri N.C (1979) : Design and Analysis of Experiments, Wiley Eastern, New Delhi. 2. Gupta S.C. and Kapoor V.K (2007) : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
Reference Books	1. Kempthorne, (1956): Design and Analysis of Experiments, John Wiley, New York. 2. Montgomery . D. (1985): Design of Experiments, John Wiley and Sons.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 To understand analysis of variance and experimental designs

CLO-2 To have strong theoretical knowledge in Orthogonal latin squares, Hyper Graeco Latin squares

CLO-3 Know factorial and fractional factorial experiments, PIBD, inter and intrablocks, split plot, analysis co-variance

CLO-4 To understand clinical trial concepts and Response surface methodology

CLO-5 To do numerical problems and able to get critical thinking to solve problems

CLO-6 To choose suitable experiment and do it for real life problems

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	S	S	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	M	S	M
CLO6	S	S	M	S	M	S	S	M	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Demography</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Core – XIV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCT12</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>5</td><td colspan="2">1</td><td colspan="2">--</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Demographic Studies</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. Learn population and demographic registration
2. To learn fertility and mortality measurements
3. To understand Life table uses
4. To learn migration effect</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Sources of demographic data – civil registration – population census registers – errors in demographic data.</td></tr>
<tr><td colspan="6">Unit II
Fertility and mortality measurements – general and specific rates – standardized rates – age pyramid of sex composition gross and net reproduction rates.</td></tr>
<tr><td colspan="6">Unit III
Life table – structure – construction – relationship between the function of a life table – abridged life table – population estimation – growth rates – forces of mortality – Gompertz and Makeham‘s law – logistic curve fitting and its use.</td></tr>
<tr><td colspan="6">Unit-IV Spatial distribution of population –migration – kinds of migration – factors important in migration analysis – migration defining period and boundary.</td></tr>
<tr><td colspan="6">Unit-V
Components
of population growth and change – Demographic transition theory – Methods of population projection – component method of projection, Leslie matrix.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Berclay, G.W.(1959) : Techniques of Population Analysis
2. Benjamin, B (1968) : Health and Vital Statistics, Allen & Unwin</td></tr>
</table>

	Srivastava, 3. O.S.(1983) : A text book of Demography , Vikas Publishing. 4. Bogue , Donald J: Principles of Demography (1976) John Willey, New York
Reference Books	1. Pathak. K.B. and Ram. F (1992): Techniques of Demography, Wiley Eastern. 2. Ram Kumar R (1986): Technical Demography, Wiley Eastern
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 to understand need of population study and its registration system
CLO-2 to understand fertility and mortality effect on population
CLO-3 to understand life table and its usage to real problems
CLO-4 to get effect of migration in population
CLO-5 to understand population growth and its effect
CLO-6: to understand the need of population study for a government

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	S	S	S	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	S	S
CLO4	S	S	S	S	S	S	S	S	M
CLO5	S	S	M	M	M	S	M	M	M
CLO6	S	S	M	S	M	S	S	M	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course		Practical – V (Statistical software using Python)					
Paper Number		Core XV					
Category	Core	Year	III	Credits	4	Course Code	23USTCP05
		Semester	VI				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		1	1	4	6		

Objectives:

The main objectives of this course are:

1. Apply the theoretical concepts and solve the problems based on one missing observation and two missing observations in RBD and LSD.
2. Analyse and interpret data for 2^2, 2^3 and factorial experiments by using Yates Algorithm.
3. Apply the methods of estimating net migration rates.
4. Execute the various fertility measures sources of demographic data.

Programming Exercises :

1. One Way ANOVA in Python – Loading and preparing data , Conducting python functions,Interpreting the results & Visualizing one way ANOVA.
2. Two Way ANOVA in Python – Preparing data, performing two way ANOVA using libraries, Interpreting main effects , Conducting post-hoc tests for factorial design – Visualizing two way ANOVA with results.
3. Repeated Measures ANOVA in Python – Understanding repeated measures designs, preparing and analyzing data with repeated measures in Python & Interpreting and visualizing repeated measures ANVOA results.
4. Missing plot techniques – Estimating One missing observation, Two missing observations in LSD.
5. Estimating One missing observation, Two missing observations in RBD.
6. Factorial Experiments - Analysis of 2^2 factorial experiments using Yates algorithm.
7. Analysis of 2^3 factorial experiments using Yates algorithm.
8. Analysis of 3^2 factorial experiments.
9. Measures of Population size, growth and composition.
10. Age – sex distribution analysis
11. Fertility and mortality analysis
12. Demographic Modeling Using Life tables, modeling fertility and mortality rates.

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.
Any 3 questions are to be answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Mathematics for Statistics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Calculus – Basic arithmetic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. The overall objective of the study is to create deep interest in learning mathematics which develop broad and balance knowledge and understanding definitions, concepts, principles and theorems.
2. It helps the students to enhance the ability of learners to apply the knowledge and skill acquired by them to solve specific theoreticaland applied problems in mathematics.
3. It also encourages the students to develop a range of generic skill helpful in employment, internships in social activities.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit-I Rational fractions: Proper and improper rational fractions. Partial fractions: Forms of partial fractions.</td></tr>
<tr><td colspan="6">Unit-II Series: Summation and approximations related to Binomial, Exponential and Logarithmic series.</td></tr>
<tr><td colspan="6">Unit-III Theory of equations: Polynomial equations with real coefficients-imaginary and irrational roots-solving equations with related roots-equation with given numbers as roots.</td></tr>
<tr><td colspan="6">Unit-IV Differential calculus: Functions – Different types – simple valued and many valued – Implicit and Explicit functions, Odd and even functions periodic functions.</td></tr>
<tr><td colspan="6">Unit-V Successive differentiation: Leibnitz‘s theorem, nth derivatives of standard functions – simple problems.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Duraipandian, P. and Udaya Baskaran, S. (2014): Allied Mathematics, Vol. – I&II,S.Chand & Company Pvt. Ltd. 2. Vittal, P.R(2012). Allied Mathematics, Margham Publications. 3. Narayanan,S Manickavachagam Pillai(1993): Ancillary Mathematics, Book II : (Containing Differential Calculus) S.Viswanathan Pvt, Ltd .
Reference Books	1. Narayanan,S and ManickavachagamPillai (1993): Ancillary Mathematics (Vol. II,Part I) : (Containing Trignometry) S. Viswanathan Pvt. Ltd . 2. Narayanan, S and ManickavachagamPillai (1993): AncillaryMathematics, Book I : (Containing Algebra). S. Viswanathan Pvt.Ltd . 3. S.J.Venkatesan (2019), Algebra,Sri Krishna Publications, Chennai-77 , skhengg1999@gmail.com
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Distinguish between proper and improper fractions. Express an algebraic fraction as the sum of its partial fractions.

CLO-2 Demonstrate the knowledge to determine the sums, expansion and approximation of series including binomial, exponential, logarithmic.

CLO-3 Solve problems about polynomials with real coefficients, imaginary and irrational roots.

CLO-4 Calculate limits of a function.

CLO-5 Obtain the nth derivative in successive differentiation.

CLO-6 Obtain the mathematical knowledge and skills for the better understanding of statistics as a mathematical science

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	M	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Real Analysis</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME02</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Number theory and Arithmetic</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To study the basic operations of sets and functions
2. To know the structure of the real sequence and its convergence
3. To learn series and its convergence
4. To learn the limits, continuity and derivative of real valued functions.
5. To know and to apply the Riemann integration</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Operations on sets, Functions, Real valued functions, Equivalence, Countability, Real Numbers, Least Upper Bounds, Greatest Lower Bound.</td></tr>
<tr><td colspan="6">Unit II
Definition of Sequence, Subsequence, Limit of a sequence, Convergent and Divergent sequences, Bounded and Monotone sequences, Operations on convergent sequences, Limit Infimum, Limit Supremum, Cauchy sequences.</td></tr>
<tr><td colspan="6">Unit III
Definition of Series, Convergent and Divergent series, series with Non negative terms, alternating series, conditional convergence, absolute convergences and test for absolute convergence.</td></tr>
<tr><td colspan="6">Unit-IV
Limit of a function on the real line, Increasing and Decreasing functions, Continuous function, Rolle‘s Theorem, Lagrange’s Mean value theorem, Taylor‘s theorem.</td></tr>
<tr><td colspan="6">Unit-V
Concept of Riemann Integral, Upper and Lower sums, Upper integral and Lower Integral Riemann integrability, Necessary and Sufficient condition for Riemann integrable.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Recommended Text	1. Goldberg . R R(1976): Methods of Real Analysis, Oxford &IBH.
Reference Books	1. Shanthinarayan, (2012) : Real Analysis, S.Chand& Co, New Delhi 2. Walter Rudin (2017), Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject https://tutorial.math.lamar.edu/classes/calci/thelimit.aspx https://www.mathsisfun.com/calculus/derivatives-introduction.html https://www.math.ucdavis.edu/~hunter/m125b/ch1.pdf https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/single-variable-calculus/taylors-theorem/ http://www.ms.uky.edu/~droyster/courses/fall06/PDFs/Chapter06.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 do basic operations of sets and understand set functions
CLO-2 understand sequence and its convergence
CLO-3 understand series and its convergence
CLO-4 identify real valued functions and its discontinuity
CLO-5 understand integration concepts
CLO-6 understand probability functions as set functions and get knowledge on discrete and continuous nature of it

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	S	S	M
CLO2	S	S	S	S	M	S	S	S	M
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Numerical Methods</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – III (Discipline Specific)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME03</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Arithmetic and calculus</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To introduce the study of algorithms that used numerical approximation for the problems of Mathematical analysis.
2. To solve mathematical problems numerically</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
The Solution of Numerical Algebraic and Transcendental Equations: Iteration method, Bisection Method, Regula Falsi Method, Newton –Raphson Method.</td></tr>
<tr><td colspan="6">Unit II
Interpolation for Equal intervals:Newton‘s Forward Interpolation Formula and Newton‘s Backward Interpolation Formula, Evaluation of missing terms.</td></tr>
<tr><td colspan="6">Unit III
Central Difference Interpolation Formula For Equal Intervals: Gauss Forward Interpolation Formula, Gauss Backward Interpolation Formula, Sterling’s Formula. Interpolation with Unequal Intervals: Lagrange‘s Interpolation Formula.</td></tr>
<tr><td colspan="6">Unit-IV
Numerical Differentiation: Numerical Differentiation based on Newton‘s Forward and Backward Interpolation Formula – Computation of Second order derivatives.</td></tr>
<tr><td colspan="6">Unit-V
Numerical Integration: General Quadrature formula for equidistant ordinates, Trapezoidal Rule, Simpson‘s $1/3^{rd}$ Rule, Simpson‘s $3/8^{th}$ Rule and Weddle‘s Rule.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Kandasamy, P., Thilagavathy, K. (2003): Calculus of Finite Differences and Numerical Analysis, S.Chand Publications.</td></tr>
</table>

	2. Balasubramaniam and Venkatraman(1972): Numerical mathematics part I and II by Rochouse and Sons
Reference Books	1. Kalavathy, S., and Thomson. (2004): Numerical Methods, Vijay Nico::le Publications. 2. Gupta, B.D. (2004): Numerical Analysis, Konark Publications. 3. Venkatachalapathy, S.G. (2004): Calculus of Finite Differences and Numerical Analysis, Margam Publications. 4. Gerald Wheatley, (1970): Applied Numerical Analysis, Pearson Education Publications. 5. Jain, M.K., Iyengar, S.R., Jain, R.K., (1994): Numerical Methods Problems and Solutions, New Age International Publishers.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject www.nptel.com

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Solve numerically equations that cannot have direct solution

CLO-2 solve system of linear equations

CLO-3 understand the need of interpolation

CLO-4 handle numerical differentiation

CLO-5 do integration numerically

CLO-6 get a foundation on algorithms to solve a mathematical problem

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	S	S	M
CLO2	S	S	S	S	M	S	S	S	M
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Economic & Official Statistics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME04</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">--</td><td>--</td><td colspan="2">3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic Concepts of Economic and official statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To understand Indian official statistical system and data collection
2. To know Indian economic and agricultural surveys
3. To know index numbers and consumer price index
4. To know time series analysis
5. To learn demand analysis and its concepts</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Indian Statistical System: Data Collection for Governance – NSSO and its role in national data collection. NSSO reports and publications</td></tr>
<tr><td colspan="6">Unit II
Economic Statistics: Information collection for Socio-Economic Survey – Agricultural, Industrial, Crime Statistics and Statistical methods applied to analyse large volumes of data</td></tr>
<tr><td colspan="6">Unit III
Index numbers: Basic problems in construction of index numbers Methods- Simple and Weighted aggregate-Average of price relatives-Chain base method. Criteria of goodness-Unit test, Time Reversal Factor Reversal and Circular tests.</td></tr>
<tr><td colspan="6">Unit-IV
Time Series: Measurement of Trend: Graphic, Semi-averages, Moving averages. Least Squares – Straight line, Second degree parabola, Exponential curve, Modified Exponential curve, Gompertz curve and Logistic curve. Measurement of Seasonal variation by Ratio-to-Moving average method.</td></tr>
<tr><td colspan="6">Unit-V Demand Analysis: Introduction-Demand and Supply Price elasticity of demand and supply, partial and cross elasticities of demand.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC IES-ISS/ TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Gupta S.C. and Kapoor V.K. (2007) :Fundamentals of Applied Statistics , 4th edition ,Sultan Chand &Sons Publishers, New Delhi. 2. Gupta S.P. (2011) :Statistical Methods , Sultan Chand &Sons Publishers, NewDelhi. 3. Spyros Makridakis, Steven C. Wheelwright and Rob J .Hyndman (2003):Forecasting Methods and Applications , 3rd Edition ,John Wiley and Sons Inc. 4. Websites of Government of India – Ministry of Statistics & Programme Implementation
Reference Books	1. Spyros Makridakis, Steven C. Wheelwright and Rob J .Hyndman (2003) :ForecastingMethods and Applications ,3rd Edition ,John Wiley and Sons Inc. . 2. Irving W. Burr (1974): Applied Statistical Methods, Academic Press.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 :understand Indian official statistics and offices related to it
CLO-2 understand Indian surveys for collecting official statistics
CLO-3 know uses of index numbers
CLO-4 know demand analysis and its need
CLO-5 to understand economic India by knowing agricultural and economic surveys
CLO-6 to know the time series and prediction

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	S	M	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	M	M	S	S	S	M
CLO6	S	S	M	S	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Operations Research</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME05</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Linear algebra</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. Optimization techniques
2.Transportation problems
3. Game theory
4. Replacement problems
5. Network analysis</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I
Formulation of Linear programming models – Graphical solution of LPP in two variables – LPP in standard form – Principles of Simplex method – Algorithm – Need for artificial variables - Charne‘s M-Technique – Concept of degeneracy.</td></tr>
<tr><td colspan="6">Unit II
Transportation problem(TP) – TP formulation- North-West Corner, Least cost, Vogel‘s Approximation method – UV-method – Assignment problem and algorithm.</td></tr>
<tr><td colspan="6">Unit III
Theory of Games – Basic definition – Maximin and Minimax criterion – Solution of Games with saddle points – Two–by–Two (2x2) Games without saddle point – principle of dominance – problems based on dominance rule – Graphical method for (2xn) and (mx2) games.</td></tr>
<tr><td colspan="6">Unit-IV
Replacement problems – Replacement policy for items whose maintenance cost increases with time and the value of money remains constant – Replacement policy for items whose maintenance cost increases with time and the value of money also changes with time.</td></tr>
<tr><td colspan="6">Unit-V
Network analysis by CPM/PERT: Basic Concept – Constraints in Network – Construction of the Network – Time calculations –Concept of slack and float in Network Analysis – Finding optimum project duration and minimum project cost.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Kanti Swarup, P.K. Gupta and Manmohan (2007) Operations Research, Sultan Chand Sons, New Delhi. 2. S.D. Sharma (2002) : Operations Research: Kedarnath and Ramnath, Meerut. 3. J.K. Sharma (2002) : Operations Research: Theory and application , Macmillan, India Ltd.
Reference Books	1. Taha : Operations Research, PHI. 2. F.S. Hiller and Liberman (1994): Operations Research, CBS Publishers and Distributions, New Delhi.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 understand optimization techniques and solving set of equations with constraints
CLO-2 solve problems of linear programming
CLO-3 understand transportation problems and its applications
CLO-4 solve problems using games theory
CLO-5 do replacement problems and solve it
CLO-6 do network analysis and get problem solving skills

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	S	M	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	M	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	S	M	M	S	M	S	M
CLO6	S	S	M	S	M	S	S	M	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Econometrics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">21USTME06</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>3</td><td colspan="2">1</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1.To identify the appropriate models for econometrics
2. To understand the demand analysis
3. To analyze and testing the econometric theory</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Definition – Scope – Objectives of Econometrics – Limitations – Divisions of Econometrics.</td></tr>
<tr><td colspan="6">UNIT II
Single equation model two variable case – Reasons for introducing error term in the model – Estimation of error variance – Simple problems.</td></tr>
<tr><td colspan="6">Unit III
General Linear model - Assumptions- Least square method of estimation and testing of parameters of the model – problems under failure of assumptions.</td></tr>
<tr><td colspan="6">Unit IV
Concepts of price, Demand, supply, elasticity of demand, elasticity of price,elasticity of supply – simple problems.</td></tr>
<tr><td colspan="6">Unit V Multicollinearity
Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity, specification error.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.</td></tr>
</table>

	3. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited, 4. Maddala, G.S. and Lahiri, K. (2009):Introduction to Econometrics, 4th Edition, John Wiley & Sons. 5. Gupta S.P. & Kapoor V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons, 2019. 6. Peter R Cox, Demography, 5th Edition, Vikas Publishing House,1979. 7. Agarwal S.N, India`s Population Problems, Tata McGraw Hill, 1981. 8. Srinivasan, K, Basic Demographic Techniques and Applications, Sage Publications, New Delhi, 1998.
Website	https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section1.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Distinguish between proper and improper fractions. Express an algebraic fraction as the sum of its partial fractions.

CLO-2 Demonstrate the knowledge to determine the sums, expansion and approximation of series including binomial, exponential, logarithmic and fourier.

CLO-3 Solve problems about polynomials with real coefficients, imaginary and irrational roots. Explain the relationship between the derivative of a function as a function and the notion of the derivative.

CLO-4 Calculate limits of a function.

CLO-5 Obtain the nth derivative in successive differentiation. Apply Euler‘s theorem on homogenous function

CLO-6 Obtain the mathematical knowledge and skills for the better understanding of statistics as a mathematical science

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	M	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Population Studies</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">21USTME06</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To identify appropriate sources of data with basic vital statistics analyses
2. To relate the population with standardized death rates
3. To utilize the mortality table to find the survival and death rates
4. To analyze the birth rate used to describe fertility in the populations</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Introduction
Definition, nature and scope of Population Studies, relationship of other social sciences with population studies - Advantages of Population Study.</td></tr>
<tr><td colspan="6">UNIT II
Concept of Natural Increase of Population and Growth of Population - Measurement and Indicators of Demographic Determinants: Fertility, Mortality, Migration, Marriage.</td></tr>
<tr><td colspan="6">Unit III Vital Statistics
Definition, Nature, Scope and Methods of vital statistics data - Measurement of Population – Development of Population Studies in India.</td></tr>
<tr><td colspan="6">Unit IV Risk Measures
Ratios, Proportions, and Rates – its properties, uses and simple problems; Morbidity Rates: Incidence proportions, Incidence rates, Prevalence rates – Definition, properties, uses and simple problems.</td></tr>
<tr><td colspan="6">Unit V Fertility Rates
Crude Birth Rate - General Fertility Rate - Age Specific Fertility Rate – Total Fertility Rate - Gross Reproduction Rate (GRR) - Net Reproduction Rate(NRR) - Replacement level Fertility - Birth order statistics - Child Women ratio - OrderSpecific Fertility Measures – Theory and simple Problems.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition,McGraw Hill Companies.
2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.</td></tr>
</table>

	3. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited, 4. Maddala, G.S. and Lahiri, K. (2009):Introduction to Econometrics, 4th Edition, John Wiley & Sons. 4. Gupta S.P. & Kapoor V.K., Fundamentals of Applied Statistics, Sultan Chand& Sons, 2019. 5. Peter R Cox, Demography, 5th Edition, Vikas Publishing House,1979. 6. Agarwal S.N, India`s Population Problems, Tata McGraw Hill, 1981. 7. Srinivasan, K, Basic Demographic Techniques and Applications, Sage Publications, New Delhi, 1998.
Website	https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section1.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Distinguish between proper and improper fractions. Express an algebraic fraction as the sum of its partial fractions.

CLO-2 Demonstrate the knowledge to determine the sums, expansion and approximation of series including binomial, exponential, logarithmic and fourier.

CLO-3 Solve problems about polynomials with real coefficients, imaginary and irrational roots. Explain the relationship between the derivative of a function as a function and the notion of the derivative.

CLO-4 Calculate limits of a function.

CLO-5 Obtain the nth derivative in successive differentiation. Apply Euler‘s theorem on homogenous function

CLO-6 Obtain the mathematical knowledge and skills for the better understanding of statistics as a mathematical science

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	M	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Statistical Quality Control</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME07</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2"></td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Estimation theory and Distribution theory</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To impart basic theoretical knowledge about terminologies, need of control charts for quality control, construct control limits of variables and attributes.
2. To educate the learner to be able to construct control charts for defects number of defects (c-chart); and control chart for number ofdefects per unit (u-chart).
3. To educate acceptance sampling plan and discuss the procedure of its implementation, compute the probability of accepting or rejecting a lot.
4. To define acceptance quality level (AQL) and lot tolerance percent defective (LTPD) of the lot; and compute the producer‘s risk and consumer‘s risk for an acceptance sampling plan.
5. To facilitate the learner to understand the difference between attributes and variables sampling plans, the advantages and disadvantages of variables sampling.</td></tr>
<tr><td colspan="2" rowspan="3">Course Outline</td><td colspan="6">Unit I
Importance and need for Statistical Quality Control techniques in Industry – Causes of variations in Quality – Uses of Shewart‘s Control charts –Terminologies: Specification limits, Tolerance limits, 3σ limits. Advantages and Limitations of SQC - Control charts variables Control Chart for Mean (Xbar- Chart) ,Range Chart (R- Chart) , Standard Deviation Chart (S-Chart)</td></tr>
<tr><td colspan="6">Unit II
Control Charts for Attributes: Control Chart for Fraction Defective (p-Chart),p-Chart for Variable Sample Size , Control Chart for Number of Defectives (np-Chart). Control Charts for Defects: Control Chartfor Number Of Defects (C-Chart) and Control Chart for Number Of Defects Per Unit (U-Chart).</td></tr>
<tr><td colspan="6">Unit III
Acceptance sampling plans for attributes –Types of Acceptance Sampling plans, Methods of Inspection: 100% Inspection and Sampling Inspection, Advantages and Limitations of Acceptance Sampling. Terms used in acceptance sampling plans: Lot, Lot Size,</td></tr>
</table>

	Sample Size, Lot Quality, Acceptance Number , Probability of accepting a lot (Pa) ,Acceptance Quality Level (AQL), Lot Tolerance Percent Defective (LTPD), Producer‘s Risk, Consumer‘s Risk, AOQ, AOQL, ATI and ASN.
	Unit-IV Rectifying Sampling Plans. Single and Double sampling plans. OC, AOQ, ATI and ASN curves for Single and Double sampling plans.
	Unit-V Acceptance sampling for variables known and unknown sampling plans (one sided specification only) -Determination of n and k for one sided specification of OC curve
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	1. Douglas C. Montgomery (2005) : Introduction to Statistical Quality Control, John Wiley & Sons, New York. (Unit V: Chapter 16 (pages 670 to 680) 2. Gupta S.C and V.K.Kapoor (2007): Fundamentals of Applied Statistics, Sultan Chand Sons, New Delhi 3. Mahajan, M (1998) : Statistical Quality Control, Dhanpat Rao& Co,New Delhi.
Reference Books	1. Gupta, R.C.(1974): Statistical Quality Control. 2.Ekambaram, S K. (1963): Statistical basis of Acceptance sampling, Asia Publishing House. Grant, E,L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 understand Industrial applications of Statistics
CLO-2 understand statistical process control and methods for it
CLO-3 understand attribute and variable control chart and interpret process based on it
CLO-4 understand the situations using special purpose control charts
CLO-5 know various product control techniques
CLO-6 To do numerical problems and able to get critical thinking to solve problems
To explore real life problems

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	S	S	S	S	S	S	S
CLO2	S	S	S	S	M	S	S	S	S
CLO3	S	S	S	S	S	M	S	S	S
CLO4	S	S	S	S	S	S	S	S	M
CLO5	S	S	M	M	M	S	M	M	M
CLO6	S	S	M	S	M	S	S	M	M

CO-PO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">Time Series</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">Elective – VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME08</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">1</td><td colspan="2">--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="8"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="8">1. On successful completion of this course, students will be able to acquire the knowledge of time series data and its applications.
2. Outline the growth curves and their fitting.
3. To calculate the seasonal indices by various methods.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="8">Unit I Time Series
Definition, uses, Additive Model, Multiplicative Models, Components - Secular Trend, Seasonal variation – Simple problems.</td></tr>
<tr><td colspan="8">UNIT II Measurement of Trend:
Graphical method, Method of Semi - Averages, Method of Moving Averages and Method of Least Squares.</td></tr>
<tr><td colspan="8">Unit III Measurement of Seasonal Variations
Method of Simple Averages, Ratio to Moving Average method, Ratio to Trend Method and Link Relative Method - Cyclic Variationand Irregular fluctuations.</td></tr>
<tr><td colspan="8">Unit IV Growth Curves
Modified Exponential Curve and its Fitting – Method of Three Selected Points – Method of Partial Sums – Fitting of Gompertz Curve – Logistic Curve.</td></tr>
<tr><td colspan="8">Unit V
De-Seasonalisation of data – Cyclic components : Harmonic analysis. Random component – Variate difference method. Weak Stationarity, autocorrelation function and the Correlogram.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the</td><td colspan="8">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

External Examination question paper)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Books.	Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics, Sultan Chand & Co., 4 th Revised Edition, 2019.
References Books	1. Garret, H.E., Education and Psychological Statistics, Paragan International Publications, 2005. 2. Pillai RSN and Bagavathi V, Statistics, S. Chand & Co., 2010. 3. Box, G.E.P., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. Time Series Analysis: Forecasting and Control, 5th Edition, John Wiley & sons, Inc., 2015. 4. Brockwell, P.J. and Davis, R.A., Introduction to Time Series Analysis. Springer, 2003.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the time series concept

CLO-2 estimate the trend values using various methods

CLO-3 concept and purposes of index numbers

CLO-4 understand the notation and formulae concerning the use.

CLO-5 understand time series data its components and its application in various fields.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Index Numbers</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Elective – VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTME08</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2">-</td><td>--</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. On successful completion of this course, students will be able to acquire the knowledge of index number and its applications.
2. To compute the different index numbers in real life problems.
3. To analyse the importance of a good index number.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Index Numbers
Definition, Uses, Types, Problems involved in the construction of Index Numbers – Construction of Index Numbers.</td></tr>
<tr><td colspan="6">UNIT II
Simple aggregate method and Simple average of Price relatives method. Weighted Index Numbers – Laspeyre‘s, Paasche‘s, Dorbish Bowley‘s, Marshall Edge worth‘s Index Numbers and Fisher‘s Ideal Index Number.</td></tr>
<tr><td colspan="6">Unit III
Tests for adequacy -Time Reversal Test, Factor Reversal Test, Unit test and Cyclic test.Definition of Deflation, Splicing, Inflation, and Real wages.</td></tr>
<tr><td colspan="6">Unit IV
Construction of Weighted Average of Price relatives Index Numbers using A.M & G.M. Fixed Base Index Numbers and Chain Base Index Numbers.</td></tr>
<tr><td colspan="6">Unit V Price and Quantity index numbers – Consumer Price index(CPI) – Producer Price Index (PPI) – Wholesale Price Index – Retail Price Index (RPI) – Production index – Sales index – Export and import index – Employability index.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
</table>

External Examination question paper)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Books.	Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics, Sultan Chand & Co., 4 th Revised Edition, 2019.
References Books	1. Garret, H.E., Education and Psychological Statistics, Paragan International Publications, 2005. 2. Pillai RSN and Bagavathi V, Statistics, S. Chand & Co., 2010.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the time series concept

CLO-2 estimate the trend values using various methods

CLO-3 concept and purposes of index numbers

CLO-4 understand the notation and formulae concerning the use.

CLO-5 understand time series data its components and its application in various fields.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">Foundation Course – Elementary Statistics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">Foundation Course</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTFC01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Uses and its basics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="7">1. To enable the students to understand the basic concepts of set theory.
2. Appreciate the basics of functions and relations.
3. Understand the types of functions and relations.
4. To acquire knowledge the Sequence and series of Arithmetic and Geometric. Find useful applications in commercial problems among others.
5. To know the difference between permutation and combination for the purpose of arranging different objects.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">Unit – I
Set Theory – Subset, Types of Sets, Relations, Functions – Simple problems.</td></tr>
<tr><td colspan="7">Unit – II
Sequence and Series of Arithmetic and Geometric Progressions – Introduction to Sequence, Series, Arithmetic Progression, Geometric Progression – Simple Problems.</td></tr>
<tr><td colspan="7">Unit – III
Basic Concepts of Permutations & Combination – Fundamental Principles of Counting, Factorial, Permutations, Circular Permutations, Permutation with Restrictions, Combinations – Simple Problems.</td></tr>
<tr><td colspan="7">Unit – IV
Logical Reasoning – Number Series, Coding and decoding and odd man out.</td></tr>
<tr><td colspan="7">Unit – V
Statistics – Importance of statistics, concept of statistical population and a sample – quantitative and qualitative data. Collection of primary and secondary data, Measurement scales – nominal, ordinal interval and ratio.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)</td><td colspan="7">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
</table>

Reference Books	1. V.K. Kapoor and S.C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi. 2. Charles C.Pinter : A Book of Set Theory –Dover Publications, Inc, Mineola, New York. 3. Dr. R.S. Aggarwal : A Modern Approach to Logical Reasoning, Sultan & Chand - 2018.
Website and e-Learning Source	https://www.icai.org/post.html?post_id=17790

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 : Describe the rule that definition, relations and functions of set theory.

CLO-2 : To develop the skill of computation with real sequences and series.

CLO-3 : Students should be able to determine the number of outcomes in a problem.

CLO-4 : Students should be able to apply the fundamental principle of counting to find out the total number of outcomes in problem.

CLO-5 : Understand of data and its relevance in business and develop an understanding of quantitative techniques.

CLO-6 : Ability to apply in data.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	M	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

Title of the Course		Practical I (Data Analysis Using MS – Excel)					
Paper Number		SEC III					
Category	Core	Year	I	Credits	2	Course Code	23USTCP01
		Semester	II				

Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total
	-	-	2	2

Objectives:

1. To enable the students to gain computer practical knowledge about the concepts of statistics.
2. To apply the measures of descriptive statistics and probability in real life situations using MS excel
3. To provide practical knowledge in random variables, probability distributions, expectation, moment generating function, matrices, Rank of matrices.

Practical Exercises:

1. Computation of Measures of Central Tendency for discrete data using MS Excel (Mean, Median, Mode, Geometric Mean, Harmonic Mean)
2. Computation of Measures of Central Tendency for Continuous data using MS Excel (Mean, Median, Mode, Geometric Mean, Harmonic Mean)
3. Computation of Measures of dispersion for discrete data using MS Excel ()
4. Computation of Measures of dispersion for Continuous data using MS Excel ()
5. Graphical Presentation of data (Histogram, Frequency Polygon, Ogives) Using MS Excel.
6. Computation of Co-efficient of Skewness and Kurtosis – Karl Pearson‘s and Bowley‘s data using MS Excel
7. Fitting of Binomial distribution – Direct Method using MS Excel.
8. Fitting of Poisson distribution – Direct Method using MS Excel.
9. Fitting of Exponential distribution – Direct Method using MS Excel.
10. Problems based on univariate probability distributions.
11. Problems based on probability.
12. Calculating Inverse matrix in Excel.
13. Calculating Transpose matrix in Excel.
14. Calculating Rank matrix in Excel.

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.
Any 3 questions are to be answered in 3 hours duration out of 5.

Examinations Distribution of Marks

University Examinations (Computer Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Practical – II (Calculator Based)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">SEC– V (Discipline specific)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTCP02</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td>--</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are:
1. To enable the students to gain practical knowledge of estimation of parameters and its interval.
2. To know the basic operations of sampling
3. To study the theory and applications of SRS
4. To learn practical uses of Stratification
5. To apply Systematic and PPS Sampling in real time problems.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Estimation of parameters of statistical model – Multinomial distribution, exponential, binomial and Poisson distribution –Construction of Confidence intervals for mean and variance</td></tr>
<tr><td colspan="6">Unit II Method of maximum likelihood and method of moments.</td></tr>
<tr><td colspan="6">Unit III Simple random Sampling
Drawing Sample from the Population with and without Replacement – Estimation of Population Mean, Total Variance and its Standard Error.</td></tr>
<tr><td colspan="6">Unit IV Stratified random Sampling
Estimation of Mean, Variance of the Population Means – Variance of the estimator of Mean under Proportional and Optimal allocations.</td></tr>
<tr><td colspan="6">Unit V Systematic random sampling
Estimation of Mean and Variance – Comparison of Simple Random Sampling, Stratified Random Sampling and Systematic Random Sampling.</td></tr>
</table>

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.
Any 3 questions are to be answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

Title of the Course		Practical – III (Statistical Software Using R)					
Paper Number		SEC – VI					
Category	Core	Year	II	Credits	2	Course Code	23USTCP03
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		-	-	2	2		

Objectives:

The main objectives of this course are:

1. To enable the students to gain practical knowledge of test of significance in large and small samples.
2. To provide practical application of hypothesis testing based on single sample and two samples, using averages and proportions.
3. To provide practical application knowledge of the life insurance environment.
4. Understand the methods of computing assurance benefits and premiums of various insurance plans and to apply the various methods in framing mortality tables.

Programming Exercises :

1. Large Sample tests for means, proportions
2. Large Sample tests for standard deviations and correlation coefficient.
3. Small sample tests for single mean.
4. Small sample tests for difference of means and correlation coefficient.
5. Paired t –test.
6. Chi – square test for goodness of independence of attributes.
7. Non parametric test for single and related samples

a. Sign Test , b. Wilcoxon signed rank test

8. Non parametric test for two independent samples

a. Median test, b. Wilcoxon Mann Whitney U – test

9. Creating an Actuarial table to input interest rate.
10. Creating functions Increasing and Decreasing life insurances.
11. Increaing and decreasing annuities both due and immediate.
12. Calculates the values of risk free rate.

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.
Any 3 questions are to be answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">SEC 7 - Biostatistics</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTSE04</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basics of distribution theory and
Regression analysis</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are to:
1. Initiate the awareness of Biostatistics and its need.
2. Make the students have a clear understanding of special kinds of various statistical tools used in biostatistics.
3. Be knowledgeable about the potential applications of these tools.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I - Introduction to Bio statistics – Various types of studies – Ethics – Measures of disease frequency and disease burden. Clinical trials – Goals of Clinical trials – Phases of clinical trials – Classification of clinical trials</td></tr>
<tr><td colspan="6">Unit II – Randomization : Fixed Allocation, Simple , Blocked, Stratified, Baseline Adaptive and Response Adaptive – Blinding: Single, Double andtriple- Designs for clinical Trials : Parallel Groups Design, Cluster Randomization Designs, Crossover Designs.</td></tr>
<tr><td colspan="6">Unit III –Multiple Regression – Assumptions – Uses – Estimation and interpretation of regression coefficients – Testing the regression coefficients – Coefficient of determination.</td></tr>
<tr><td colspan="6">Unit IV –Logistic Regression : Introduction – Logistic regression model –Relative risk – Logit – odds Ratio – Properties of odds ratio – the relationship between the odds ratio and relative risk.</td></tr>
<tr><td colspan="6">Unit V –Maximum likelihood estimates and interpretation of coefficients – Test for coefficients – Test for overall regression and goodness of fit using Maximum Likelihood technique – Deviance Statistics , Wald Test, LR Test and score test.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Recommended Books</td><td colspan="6">1. Chow, S. C., and Liu, J. P. (2013). Design and Analysis of Clinical Trials: Concepts and Methodologies, Third Edition, Wiley – Interscience, John Wiley & Sons, NJ.
2. Friedman, l. M., Furberg, C. D., and DeMets, D. L. (2015), Fundamentals of Clinical Trials, Fifth edition, Springer – Verlag,NY</td></tr>
</table>

	3. Van Belle, G., Fisher, L. D., Heagerty, P. J., and Lumley, T. (2004). Bio-Statistics – A Methodology for the Health Science, Second Edition, Wiley, NY. 4. Daniel, W. W. and Chad L. Cross(2018). Bio-Statistics: A foundation for analysis in the Health Sciences, Eleventh Edition, John Wiley & Sons, NY. 5. Kleinbaum, D. G., and Klein, M. (2012): Logistic regression: A Self-Learning Text, Third Edition, Springer – Verlag, NY.
Reference Books	1. Hosmer, Jr. D. W., Lemeshow, S., and Sturdivant, R. X. (2013). Applied Logistic Regression, Third Edition, John Wiley & Sons, Inc., NY. 2. Rossi, R. J. (2010). Applied Biostatistics for Health Sciences, John Wiley & Sons, Inc., NY
Website and e-Learning Source	1. Prof.Shamik Sen, Department of Bioscience and Bioengineering, IIT Bombay, ‒Introduction to Biostatistics‖, NPTEL. [https://97wayam.gov.in/nd1_noc20_bt28/preview] 2. Dr.Felix Bast, Central University of Punjab, Bathinda, 2020, ‒Biostatistics and Mathematical Biology‖, (NPTEL). [https://97wayam.gov.in/nd2_cec20_ma05/preview]

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO-1 Understand the concepts and statistical tools used in Biostatistics

CLO-2 Effectively apply these tools on solving the biological problems occurring in real life

CLO-3 Analyze the given Bio-statistical data as per the objectives of the problem

CLO-4 Interpret the outcomes of the analyses meaningfully

CLO-5 Create research problems of his own and able to proceed with them

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Introduction to R language</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Professional Competency Skill</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Knowledge of R/Python</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Upon completing this course, students will be able to:

1. Develop a regular workflow to execute reproducible research and analysis using R and R Studio and communicate the results and implications to others.
2. Install and use R packages for specific applications
3. Import data from a variety of external sources
4. Write basic R functions using control and data structures
5. Employ R functions to conduct statistical analysis and inference
6. Generate research or analytical reports and presentations using R Markdown
7. Deliver an oral presentation describing your data science analysis to an audience.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – I
Installation of R – Features of R –Variables in R-Constants in R-Operators in R. Creating data frame-Operations on data frames – Accessing data frames-Creating data frames from various sources. Creating lists-Manipulating list elements-Merging lists</td></tr>
<tr><td colspan="6">Unit – II
Datatypes and R Objects-Accepting Input from keyboard-Important Built-in functions. Creating Vectors-Accessing elements of a Vector-Operations on Vectors-Vector Arithmetic-Converting lists to vectors. Creating arrays-Accessing array elements-Calculations across array elements.</td></tr>
<tr><td colspan="6">Unit – III
Creating matrices-Accessing elements of a Matrix-Operations on Matrices-Matrix transpose.R Programming Structures, Control Statements, Loops, - Looping Over Nonvector Sets- if…else statement-if else() function-switch() function-repeat loop-while loop-for loop-break statement-next statement</td></tr>
<tr><td colspan="6">Unit – IV
Need for data visualization-Bar plot-Plotting categorical data-Stacked bar plot-Histogram-plot() function and line plot-pie chart / 3D pie chart-Scatter plot-Box plot- Customizing Graphs, Saving Graphs to Files.</td></tr>
<tr><td colspan="6">Unit – V
Probability Distributions, Binomial Distribution- Poisson Distributions, Normal Distribution- Other Distribution. Correlation-Regression. Chi –Square test. T-Test – Analysis of Variance –Non-Parametric Tests.</td></tr>
</table>

Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
References Books	1.Hadley Wickham : ―R Packages ― Latest Edition – Shroff /O'Reilly Publisher 2. William N. Venables and David M. Smith, An Introduction to R. 2nd Edition. Network Theory Limited. 2009. 3. Norman Matloff, The Art of R Programming –A Tour of StatisticalSoftware Design, No Starch Press. 2011. 4. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition (chapter 3 only)

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO-1 Students will able to install, code and use basic R programming & Python

CLO-2 Describe key terminologies, concepts and techniques employed in statistical analysis

CLO-3 Understand how to write simple coding

CLO-4 Compile and run the program

CLO-5 Interpret the result

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">Introduction to Python Programming</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">4</td><td colspan="2">-</td><td>--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Knowledge of R/Python</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">Upon completing this course, students will be able to:
1. Develop a regular workflow to execute reproducible research and analysis using Python programming.
2. Install and use Python language for specific application.
3. Import data from a variety of external sources
4. Write basic python functions using control and data structures
5. To know the basic concepts of Python.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I
Introduction to python – Data types, Variables, Basic Input – Output Operations, Basic Operators</td></tr>
<tr><td colspan="6">UNIT – II
Control statements, if statements, while loop, for loop, infinite loop, nested loop, else suit, break, continue, pass, assert, return statements, command line arguments.</td></tr>
<tr><td colspan="6">UNIT – III
Arrays in python, advantages using arrays, creating arrays, importing the array module, indexing and slicing on arrays, Processing the arrays, Comparing arrays.
Strings in Python, Creating strings, Length of a string, Indexing in strings, Slicing strings, Concatenation and Comparing Strings.</td></tr>
<tr><td colspan="6">Unit – IV
Functions in Python, Define a function, Calling a function, return from function, pass by object reference, Positional arguments, Default arguments, excursive functions. Introduction to OOP, features of OOP, Creating classes, the self-variable, constructor, types of variables.</td></tr>
<tr><td colspan="6">Unit – V
Inheritance: Define inheritance, types of inheritance, constructors in inheritance, overriding super class constructors & methods, the super() method.
Exceptions: Errors in a python program, Exceptions, Exception handling, Type of Exceptions, The Exception block, the assert statement, user defined exceptions.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist: learning with Python, Freely available online. 2012</td></tr>
</table>

Website Links	Python Tutorial/Documentation www.python.or 2015 http://docs.python.org/3/tutorial/index.html http://interactivepython.org/courselib/statis/pythonds http://www.ibiblio.org/g2swap/byteofpython/read/

Course Learning Outcome (for Mapping with Pos and PSOs)

Students will be able to

CLO-1 Students will able to install, code and use basic Python
CLO-2 Describe key terminologies, concepts and techniques employed in statistical analysis
CLO-3 Understand how to write simple coding
CLO-4 Compile and run the program
CLO-5 Interpret the result

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

ALLIED PAPERS FOR OTHER MAJORS

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied - Statistical Methods – I
(For B.Sc ., Mathematics/ B.Sc., Mathematics (CA))</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT01</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td>--</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To introduce the basic concepts of probability theory, random variables, probability distribution.
2. To introduce t the statistical concepts and develop analytical skills.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Probability, Random Variable and Mathematical ExpectationDefinitions – Addition and Multiplication Theorem of Probability – Conditional probability – Random variable (discrete and continuous) – Distribution functions – Marginal and Conditional Distributions – Mathematical Expectation – Moment generating function - Characteristic
function (concept only) – Tchebychev‘s inequality - Simple Problems.</td></tr>
<tr><td colspan="6">UNIT II Discrete and Continuous Distributions
Binomial and Poisson Distributions – Derivations – Properties and Applications - Simple Problems – Normal distribution – Derivations – Properties and Applications - Simple Problems.</td></tr>
<tr><td colspan="6">Unit III Measures of Central Tendency, Measures of Dispersion andSkewness
Definitions – Mean , Median , Mode , Geometric mean , Harmonic mean – Merits and demerits – Range , Quartile deviation , Mean deviation and their coefficients - Standard deviation – Co-efficient of Variation - Merits and demerits – Measure of Skewness – Karl Pearson‘s and Bowley‘s Coefficient of Skewness.</td></tr>
<tr><td colspan="6">Unit IV Curve Fitting
Method of least square – Fitting of a straight line and second degree Parabola,Fitting of Power Curve and Exponential Curves – Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Correlation and Regression
Definition – Types and methods of measuring correlation – Scatter diagram , Karl Pearson‘s correlation coefficient and Spearman‘s rank correlation coefficient - Regression lines - Regression coefficients – Properties – Regressionequations .</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Gupta S. C and Kapoor V. K (2004), Fundamentals of Mathematical Statistics, (11th edition), Sultan Chand & Sons, New Delhi.
2. Gupta. S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi.</td></tr>
</table>

	3. Sancheti D. C and Kapoor V. K (2005), Statistics (7th Edition), Sultan Chand & Sons, New Delhi. 4. Robert V. Hogg, Allen T. Craig, Joseph W. McKean , Introduction to mathematical statistics, Pearson Education. 5. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 6. Marek Fisz, Probability theory and Mathematical Statistics, John Wiley and Sons. 7. Rohatgi V. K, An Introduction to Probability theory and Mathematical Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 8. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 9. Vittal P. R, Mathematical Statistics, Margham Publications, Chennai. 10. Hoel P. G, Introduction to Mathematical Statistics, Asia Publishing House, New Delhi.
Weblinks	https://seeing-theory.brown.edu/probability-distributions/index.html https://www.kullabs.com/classes/subjects/units/lessons/notes/note-detail/9557 https://www.stat.berkeley.edu/~stark/SticiGui/Text/location.html https://www.originlab.com/index.aspx?go=Products/Origin/DataAnalysis/CurveFitting https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the random experiments in real life situations

CLO-2 Understand the axioms of probability in real life situations.

CLO-3 Compute Bernoulli trials and understand the rare case population

CLO-4 Learn the usage of central tendencies, dispersion and skewness.

CLO-5 Obtain the relationship between two random variables.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – Statistical Methods - II
(For B.Sc ., Mathematics/ B.Sc., Mathematics (CA))</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT02</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To equip students with theoretical knowledge for estimating unknown parameters.
2. To introduce the concepts of testing the hypothesis, significance and chi-square test..</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I Point Estimation
Population and Sample – Parameter and Statistic – Point Estimation – Consistency – Unbiasedness – Efficiency (Cramer – Rao inequality) and Sufficiency (Rao – Blackwell Theorem).</td></tr>
<tr><td colspan="6">UNIT – II Methods of Estimation and Interval Estimation
Maximum likelihood Estimator (MLE) and Methods of Moments – Properties of these estimators – Interval estimation (concept only).</td></tr>
<tr><td colspan="6">UNIT – III Test of Significance
Concept of Statistical Hypothesis – Simple and Composite Hypothesis – Null and Alternative Hypothesis – Critical region – Type I and Type II Errors – Power of a test – Neyman-Pearson Lemma.</td></tr>
<tr><td colspan="6">UNIT – IV Test of Significance (Large Sample Tests)
Sampling distribution – Standard error – Large sample tests with regard to Mean, Difference of Means, Proportions and Difference of Proportions – Simple Problems.</td></tr>
<tr><td colspan="6">UNIT – V Test of Significance (Small Sample Tests)
Exact sample test based on ‗t‘ and F Distributions with regard to Means, Variance and Correlation coefficient – Chi-square test , Goodness of fit and independence of attributes.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Gupta. S. C. and Kapoor. V. K. (2004) – Fundamentals of Mathematical Statistics – (11th Edition), Sultan Chand & Sons, New Delhi.
2. Saxena H.C, Statistical Inference, S. Chand & Company Private Ltd, New Delhi.
3. Goon A M, Gupta M K, Das Gupta B: Fundamentals of Statistics (Vol-I), The World Press Pvt. Ltd., Kolkata.
4. Mood A. M, Graybill F. A and Boes D. C (1983), Introduction to the theory of Statistics, McGraw Hill, New Delhi.</td></tr>
</table>

	5. Sancheti. D. C. and Kapoor. V. K. Statistics (7th Edition), Sultan Chand & Sons, New Delhi. 6. Snedecor G.W and Cochran W.G., Statistical Methods, Oxford Press and IBH. 7. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 8. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 9. Vittal P. R, Mathematical Statistics, Margham Publications, Chennai. 10. Robert V. Hogg, Elliot A. Tanis, Probability and statistical inference, Macmillan.
Weblinks	http://www.sjsu.edu/faculty/gerstman/StatPrimer/estimation.pdf https://www.tutorialspoint.com/statistics/ https://www.statisticshowto.datasciencecentral.com/ https://www.investopedia.com/terms/c/chi-square-statistic.asp http://onlinestatbook.com/2/introduction/inferential.html

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Know the importance of good estimators.

CLO-2 understand the importance of maximum likelihood estimator

CLO-3 know the difference types of estimators Cramer Rao inequality.

CLO-4 Learn the importance of statistical hypothesis for large samples.

CLO-5 Learn the importance of statistical hypothesis for small samples.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – Statistics Practical - I
(For B.Sc ., Mathematics/ B.Sc., Mathematics (CA))</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAP01</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I Random variables and Mathematical Expectation
Random variable- Distribution Functions – Mathematical Expectation- Simple Problems</td></tr>
<tr><td colspan="6">UNIT – II Theoretical Distributions
Distributions – Fitting of Binomial distribution, Poisson distributions and Normal distribution – Testing the Goodness of fit.</td></tr>
<tr><td colspan="6">UNIT – III Measures of Central Tendency and Dispersion Computation of Measures of Central Tendency – Measures of Dispersion (absolute and relative measures) -Coefficient of Skewness.</td></tr>
<tr><td colspan="6">UNIT – IV
Method of Least Square
Curve fitting - Method of least square – Fitting of a straight line ($y=a+bx$), Second degree parabola($y=a+bx+cx^2$), Fitting of Power Curve and ($y=ax^b$), Exponential Curve ($y=ae^{bx}$ and $y = ab^x$)– Simple Problems.</td></tr>
<tr><td colspan="6">UNIT – V Correlation and Regression
Computation of Karl Pearson‘s co-efficient of correlation – Spearman‘srank correlation coefficient – Regression equations.</td></tr>
</table>

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.

Any 3 questions are to be answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – Statistics Practical - II
(For B.Sc ., Mathematics/ B.Sc., Mathematics (CA))</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAP02</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I Estimation
Consistency – Unbiasedness – Efficiency – Sufficiency – Simple Problems</td></tr>
<tr><td colspan="6">UNIT – II Method of Estimation and Interval Estimation
Maximum Likelihood Estimation for Binomial distribution, Poisson distributions - Interval Estimation for Normal distribution.</td></tr>
<tr><td colspan="6">UNIT – III Test of Significance
Simple and Composite Hypothesis – Nulland Alternative Hypothesis – Critical region – Type I and Type II Errors –Power of a test- Simple Problems</td></tr>
<tr><td colspan="6">UNIT – IV Large Sample Tests
Large sample tests with regard to Mean, Difference between Means, Proportions and Difference of Proportions.</td></tr>
<tr><td colspan="6">UNIT – V Small Sample Tests
Small sample tests with regard to Mean, Difference between Means and Paired_t‘ test , F –test, Chi-square test for independence of attributes.</td></tr>
</table>

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.

Any 3 questions are to be answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td>Title of the Course</td><td colspan="6">Allied – Bio – Statistics
(For B.Sc ., Biotechnology and Bio – Chemistry)</td></tr>
<tr><td>Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT03</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td>--</td><td colspan="2">4</td></tr>
<tr><td>Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td>Objectives of the Course</td><td colspan="6">1. The students will be able to understand and apply the statistical methods like measures of location, dispersion and the relationship between two variables in bio-statistics.
2. To understand large and small samples in laboratory study to apply it in real life problems.</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="6">Unit I Collection and Presentation of Statistical Data
Biostatistics Definition – Types of data – Primary and secondary data – Methods of Collection of data – Sources of data in life science – Limitations and Uses of Statistics – Classification and Tabulation of data – Diagrammatic and Graphical representation of data.</td></tr>
<tr><td colspan="6">UNIT II Measures of Central Tendency
Definitions – Mean – Median – Mode – Geometric mean – Harmonic mean – Characteristics of a good average – Merits and demerits.</td></tr>
<tr><td colspan="6">Unit III Measures of Dispersion Range
Quartile deviation – Mean deviation and their co-efficients – Standard deviation – Co-efficient of variation – Merits and demerits.</td></tr>
<tr><td colspan="6">Unit IV Correlation and Regression
Definitions – Types and Methods of Correlation –Karl Pearson‘s coefficient of correlation – Spearman‘s Rank correlation coefficient
Regression: Simple regression equations (two variables) – Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Test of Significance Sampling distribution
Standard error – Test of Hypothesis: Simple hypothesis, Null hypothesis and Alternative Hypothesis – Test of significance: Large sample tests based on Mean, Differences of Means, Proportion and Difference of Proportions - Small sample test based on Mean, Difference of Means, Paired _t‘ test - F-test - Chi-square test.</td></tr>
<tr><td>Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td>References Books</td><td colspan="6">1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi.
2. Pillai R. S. N. And Bagavathi. V. (2005), Statistics, S. Chand & Company Ltd., New Delhi.
3. P.S.S. Sundar Rao, J. Richard (2012). Introduction to Bio-Statistics and Research methods, Prentice Hall of India Pvt Ltd, New Delhi.
4. Gurumani. N (2005), An introduction to Bio-Statistics, 2nd Revised Edition, MJP Publishers.</td></tr>
</table>

	5. Daniel. W. W, (1987), Bio-Statistics, John Wiley and Sons, New York. 6. Beth Dawson, Robert G Trapp (2004), Basic and Clinical Biostatistics, McGraw Hill, New Delhi. 7. Zar J, Bio Statistical Analysis, Prentice Hall, India. 8. Bernard Rosner, Fundamentals of Biostatistics, (8th edition), Cengage Learning, USA. 9. Rossi R. J (2010), Applied Biostatistics for Health Science, John Wiley, New York. 10. Rao C. R, Advanced Statistical Methods in Biometric Research, John Wiley, New York.
Weblinks	https://faculty.franklin.uga.edu/dhall/sites/faculty.franklin.uga.edu.dhall/files/lec1.pdf https://www.tutorialspoint.com/statistics/ http://www.stat.yale.edu/Courses/1997-98/101/sigtest.htm http://biostat.jhsph.edu/~jleek/teaching/2011/754/lecture1.pdf http://homepage.divms.uiowa.edu/~dzimmer/applied-multivariate/lecturenotesold.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the statistical methods measures of location

CLO-2 Understand the statistical methods measures of dispersion

CLO-3 Apply the statistical methods of dispersion and location

CLO-4 understand the relationship between two variables in bio statistics

CLO-5 Understand large and small samples in laboratory study to apply it in real life problems.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – Statistics Practical
(For B.Sc ., Biotechnology/ B.Sc., Biochemistry)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAP03</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">➢ To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I Collection and Presentation of Statistical Data
Diagrammatic and Graphical Representation of Statistical Data (Histogram, Frequency Polygon, Frequency curves and Ogive).</td></tr>
<tr><td colspan="6">UNIT – II Measures of Central Tendency and Dispersion
Computation of Measures of Central Tendency (Mean, Median, Mode, Geometric Mean & Harmonic Mean)</td></tr>
<tr><td colspan="6">UNIT – III Measures of Dispersion
Computation of Measures of Dispersion (absolute and relative measures) - Coefficient of Variation.</td></tr>
<tr><td colspan="6">UNIT – IV Correlation and Regression
Computation of Karl Pearson‘s Coefficient of Correlation and Spearman‘s Rank Correlation Coefficient – Regression equations (two variables only).</td></tr>
<tr><td colspan="6">UNIT – V Large and Small Sample Tests
Large sample tests with regard to Mean(s) and Proportion(s) – Small sample tests with regard to Mean(s) Variance - Chi-square test for independence of attributes.</td></tr>
</table>

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks. Any 3 questions and answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – For ALL UG (Computer Science)
Common for B.Sc. (Information Science) and
B.C.A., B.Sc., (A.I with D.S.,)
STATISTICAL METHODS AND ITS APPLICATIONS – I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I/II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT04</td></tr>
<tr><td>Semester</td><td>I/ III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. Analyse the sample data and its usage in different ways such as locations, dispersion.
2. Understand the relationship between variables and forecasting the future values.
3. Understand the concept of sampling, sampling errors, and types of sampling.</td></tr>
<tr><td colspan="2" rowspan="5"></td><td colspan="6">Unit I
Collection and Presentation of Statistical Data
Nature and Scope of Statistics – Limitations – Types of data – Classification and Tabulation of Data – Construction of Frequency Distribution – Diagrammatic and Graphical Representation of Data.</td></tr>
<tr><td colspan="6">UNIT II Measures of Central Tendency
Mean, Median, Mode, Geometric mean, Harmonic mean – Characteristics of a good average – Merits and demerits.</td></tr>
<tr><td colspan="6">Unit III Measures of Dispersion
Range – Quartile deviation – Mean deviation and their coefficients – Standard deviation – Coefficient of variation – Merits and demerits.</td></tr>
<tr><td colspan="6">Unit IV Correlation and Regression
Types and Methods for Measuring Correlation - Scatter diagram – Karl Pearson‘s co-efficient of correlation – Spearman‘s rank correlation coefficient – Regression equations of two variables – Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Probability
Definition of Probability – Addition and Multiplication Theorems – Conditional probability – Simple Problems.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi.
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5. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi.
6. Murthy M. N (1978), Sampling Theory and Methods, Statistical Publishing</td></tr>
</table>

	Society, Kolkata. 7. Pillai R. S. N. And Bagavathi. V. (1987), Practical Statistics, S. Chand & Company Ltd., New Delhi. 8. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 9. Gupta C. B (1978), An Introduction to Statistical Methods, Vikas Publishing House, New Delhi. 10. Snedecor G.W and Cochran W.G., Statistical Methods, Oxford Press and IBH.
Weblinks	➢ https://www.tutorialspoint.com/statistics/data_collection.htm ➢ https://www.surveysystem.com/correlation.htm ➢ https://www.investopedia.com/terms/r/regression.asp ➢ https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression ➢ https://course-notes.org/statistics/sampling_theory

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the statistical methods measures of location

CLO-2 Understand the statistical methods measures of dispersion

CLO-3 Apply the statistical methods of dispersion and location

CLO-4 Understand the relationship between variables and forecasting the future values.

CLO-5 Understand the concept of sampling, sampling errors and types of sampling.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – For ALL UG (Computer Science)
Common for B.Sc. (Information Science) and
B.C.A., B.Sc., (A.I with D.S.,)
STATISTICAL METHODS AND ITS APPLICATIONS – II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I/II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT05</td></tr>
<tr><td>Semester</td><td>II/IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">-</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To impart statistical concepts with rigorous mathematical treatment.
2. To introduce concepts of statistical hypothesis.</td></tr>
<tr><td colspan="2" rowspan="5"></td><td colspan="6">Unit I Random Variable and Mathematical Expectation
Definitions – Random variable – Discrete and Continuous Random variable – Distribution functions and Density function – Mathematical Expectation and its Properties - Simple Problems.</td></tr>
<tr><td colspan="6">UNIT II Discrete Probability Distribution
Binomial and Poisson Distributions – Mean and Variance of Distributions – Recurrence formula – Fitting of Binomial and Poisson Distributions - Simple Problems.</td></tr>
<tr><td colspan="6">Unit III Continuous Probability Distribution and Curve Fitting
Definition of Normal distribution – Characteristics of Normal distribution (Simple Problems) – Curve fitting – Fitting of Straight line and Second degree Parabola - Simple Problems.</td></tr>
<tr><td colspan="6">Unit IV Test of Significance (Large Samples Tests)
Concept of Statistical Hypothesis – Simple and Composite Hypothesis – Null and Alternative Hypothesis – Critical region – Type I and Type II Errors – Sampling distribution and Standard Error – Test of Significance: Large Sample Tests for Proportion, Difference of Proportions, Mean and Difference of Means - Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Test of Significance (Small Samples Tests)
Small sample tests with regard to Mean, Difference between Means and Paired ‗t' test , F-test - Definition of Chi-square test – Assumptions – Characteristics – Chi-square tests for Goodness of fit and Independence of attributes – Simple Problems.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi.
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	6. Murthy M. N (1978), Sampling Theory and Methods, Statistical Publishing Society, Kolkata. 7. Pillai R. S. N. And Bagavathi. V. (1987), Practical Statistics, S. Chand & Company Ltd., New Delhi. 8. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 9. Gupta C. B (1978), An Introduction to Statistical Methods, Vikas Publishing House, New Delhi. 10. Snedecor G.W and Cochran W.G., Statistical Methods, Oxford Press and IBH.
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Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the concept of random variables and expected average

CLO-2 Compute Bernoulli trials and understand the rare case population.

CLO-3 Learn the usage of normal curve and curve fitting by using the method of least squares.

CLO-4 Learn about the large samples

CLO-5 Learn the basic concepts of theory of attributes.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied Statistics Practical –
For ALL UG (Computer Science)
Common for B.Sc. (Information Science) and
B.C.A., B.Sc., (A.I with D.S.,)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I / II</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAP04</td></tr>
<tr><td>Semester</td><td>II /IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I Collection and Presentation of Statistical Data Construction of Uni-variate frequency distribution – Diagrammatic andGraphical Representation of Statistical Data.</td></tr>
<tr><td colspan="6">UNIT – II Measures of Central Tendency and Dispersion
Computation of Measures of Central Tendency – Computation of Measures of Dispersion (absolute and relative measures) – Coefficient of Variation.</td></tr>
<tr><td colspan="6">UNIT – III Correlation and Regression
Computation of Karl Pearson‘s Coefficient of Correlation and Spearman‘s Rank Correlation Coefficient – Regression equations (two variables only).</td></tr>
<tr><td colspan="6">UNIT – IV Theoretical Distributions and Methods of Least Squares
Fitting of Binomial and Poisson Distributions – Test for Goodness of fit – Fitting of a Straight line (y=a+bx) , Second degree Parabola ($y=a+bx+cx^2$) by the method of least square.</td></tr>
<tr><td colspan="6">UNIT – V Large and Small Sample Tests
Large sample tests with regard to Mean(s) and Proportion(s) – Small sample tests with regard to Mean(s)
Variance - Chi-square test for independence of attributes.</td></tr>
</table>

Note:

Question Paper Setting:

5 questions are to be set without omitting any unit. All questions carry equal marks.
Any 3 questions and answered in 3 hours duration.

Examinations Distribution of Marks

University Examinations (Written Practical)	60 Marks
CIA (Including Practical Record)	40 Marks
Total	100 Marks

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">For B.A. (Economics)</td></tr>
<tr><td colspan="2"></td><td colspan="6">STATISTICAL METHODS FOR ECONOMICS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I/II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT06</td></tr>
<tr><td>Semester</td><td>I/ III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To introduce statistical concepts and develop analytical skills through economic barometers.</td></tr>
<tr><td colspan="2" rowspan="5"></td><td colspan="6">UNIT – I Collection, Classification and Tabulation of Data
Nature and scope of statistics - Limitations – Types of data – Primary data and secondary data – Methods of collection of data – Classification and tabulation of data.</td></tr>
<tr><td colspan="6">UNIT – II Diagrammatic Representation of Data
Formation of frequency distribution – Diagrammatic representation – Simple bar diagram – Multiple bar diagram – Subdivided bar diagram – Percentage bar diagram – Pie diagram.</td></tr>
<tr><td colspan="6">UNIT – III Graphical representation of Data
Graphical representation – Histogram – Frequency polygon – Frequency curve – Ogives curve and Lorenz curve.</td></tr>
<tr><td colspan="6">UNIT – IV Measures of Central Tendency
Definitions – Arithmetic Mean, Median, Mode, Geometric mean, Harmonic mean, weighted arithmetic mean and their uses in Economics – Simple Problems.</td></tr>
<tr><td colspan="6">UNIT – V Measures of Dispersion
Definitions - Absolute and Relative Measures of Dispersion – Range , Quartile deviation , Mean deviation and their coefficients – Standard deviation and co-efficient of variation.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
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7. Pillai R. S. N. And Bagavathi. V. (1987), Practical Statistics, S. Chand &</td></tr>
</table>

	Company Ltd., New Delhi. 8. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 9. Gupta C. B (1978), An Introduction to Statistical Methods, Vikas Publishing House, New Delhi. 10. P.A. Navanithan (2007), Business Statistics, Jai Publishers, Trichy.
Weblinks	➢ https://www.tutorialspoint.com/statistics/ ➢ http://pages.intnet.mu/cueboy/education/notes/statistics/presentationofdata.pdf ➢ https://www3.nd.edu/~dgalvin1/10120/10120_S17/Topic15_8p2_Galvin_2017_short.pdf ➢ https://www3.nd.edu/~dgalvin1/10120/10120_S16/Topic16_8p3_Galvin.pdf ➢ https://www.toppr.com/guides/economics/statistics-for-economics/statistics-in-economics/

Note: The question paper 20% theory and 80% problems to be considered.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the scope and functions of statistics

CLO-2 Emphasis the necessity of data collection

CLO-3 Understand the various types of diagrams and graphs.

CLO-4 Understand the relationship between variables and forecasting the future values.

CLO-5 Compute mathematical averages, positional averages and dispersion.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td>Title of the Course</td><td colspan="6">For B.A. (Economics)</td></tr>
<tr><td></td><td colspan="6">APPLIED STATISTICS FOR ECONOMICS</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I/II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT07</td></tr>
<tr><td>Semester</td><td>II/ IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">To enable the students to understand the elementary concepts in statistical analysis</td></tr>
<tr><td colspan="2" rowspan="5"></td><td colspan="6">UNIT – I Correlation
Definition of Correlation – Types of Correlation – Measures of Correlation – Scatter diagram – Karl Pearson‘s correlation coefficient – Spearman‘s rank correlation coefficient and their interpretation.</td></tr>
<tr><td colspan="6">UNIT – II Regression
Meaning of Regression – Fitting of Regression lines – Regression Equations – Uses in Economics.</td></tr>
<tr><td colspan="6">UNIT – III Time Series
Time series analysis – Definition – Uses – Components of Time series – Measures of Trend – Graphic method – Semi-average method – Moving average method – Least square method – Measure of Seasonal variation - Simple average method.</td></tr>
<tr><td colspan="6">UNIT – IV Index Number
Definition – Uses of Index Number – Types of Index Number – Methods of construction – Simple index number - Weighted index number –Time Reversal and Factor Reversal Test – Cost of living index number.</td></tr>
<tr><td colspan="6">UNIT – V Sampling Methods
Basic sampling methods – Probability sampling - Simple Random Sampling – Systematic Sampling – Stratified Random Sampling – Non Probability sampling - Quota Sampling – Purposive Sampling - Errors – Difference between probability and non- probability sampling.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi.
2. Gupta. S. C. and Kapoor. V. K. Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi
3. Pillai R. S. N. And Bagavathi. V. (2005), Statistics, S. Chand & Company Ltd., New Delhi.
4. Sancheti D. C. And Kapoor. V. K (2005), Statistics (7th Edition), Sultan Chand & Sons, New Delhi.
5. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi.
6. Murthy M. N (1978), Sampling Theory and Methods, Statistical Publishing</td></tr>
</table>

	Society, Kolkata. 7. Pillai R. S. N. And Bagavathi. V. (1987), Practical Statistics, S. Chand & Company Ltd., New Delhi. 8. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 9. Gupta C. B (1978), An Introduction to Statistical Methods, Vikas Publishing House, New Delhi. 10. P.A. Navanithan (2007), Business Statistics, Jai Publishers, Trichy.
Weblinks	➢ https://www.surveysystem.com/correlation.htm ➢ https://www.investopedia.com/terms/r/regression.asp ➢ https://www.academia.edu/2191454/Chapter5_Index_number ➢ https://www.itl.nist.gov/div898/handbook/pmc/section4/pmc4.htm

Note: The question paper 20% theory and 80% problems to be considered.

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the correlation coefficient from different methods of measurements.

CLO-2 Concept of regression lines

CLO-3 Understand the concept of time series and estimate the trend values using various methods.

CLO-4 Understand the concept, purpose and its types of index numbers.

CLO-5 Understand the concept of sampling, sampling errors and types of sampling.

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied – Statistics - I
For B.Sc. Geography</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT08</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">-</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To introduce concepts of statistical hypothesis
2. To introduce the statistical concepts and develop analytical skills.</td></tr>
<tr><td colspan="2" rowspan="5"></td><td colspan="6">Unit I Collection and Presentation of Statistical Data
Nature and scope of statistical methods – Limitations – Types of data – Classification and tabulation of data – Construction of frequency distribution – Diagrammatic and graphical representation of data.</td></tr>
<tr><td colspan="6">UNIT II Measures of Central Tendency
Definitions – Mean – Median – Mode – Geometric mean – Harmonic mean – Characteristics of a good average – Merits and demerits.</td></tr>
<tr><td colspan="6">Unit III Measures of Dispersion
Range – Quartile deviation – Mean deviation and their coefficients – Standard deviation – Coefficient of variation – Merits and demerits.</td></tr>
<tr><td colspan="6">Unit IV Correlation and Regression
Definitions – Types and methods of measuring correlation - Scatter diagram – Karl Pearson’s coefficient of correlation – Spearman’s rank correlation co-efficient – Regression - Regression equations of two variables – Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Probability
Definition of probability – Addition and multiplication theorems – Conditional probability - Simple Problems .</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Gupta S. C and Kapoor V. K (2004), Fundamentals of MathematicalStatistics, (11th edition), Sultan Chand & Sons, New Delhi.
2. Gupta. S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi.
3. Sancheti D. C and Kapoor V. K (2005), Statistics (7th Edition), Sultan Chand& Sons, New Delhi.
4. Robert V. Hogg, Allen T. Craig, Joseph W. McKean , Introduction tomathematical statistics, Pearson Education.
5. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi.
Marek Fisz,
6. Probability theory and Mathematical Statistics, John Wiley andSons.
Rohatgi V. K,
7. An Introduction to Probability theory and MathematicalStatistics, Wiley Eastern Ltd., Publishers, New Delhi.
8. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, NewDelhi.
9. Vittal P. R, Mathematical Statistics, Margham Publications, Chennai.
10. Hoel P. G, Introduction to Mathematical Statistics, Asia Publishing House,New Delhi.</td></tr>
</table>

Weblinks	https://www.tutorialspoint.com/statistics/data_collection.htm https://www.surveysystem.com/correlation.htm https://www.investopedia.com/terms/r/regression.asp https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression https://course-notes.org/statistics/sampling_theory

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the random experiments in real life situations

CLO-2 Understand the axioms of probability in real life situations.

CLO-3 Compute Bernoulli trials and understand the rare case population

CLO-4 Learn the usage of central tendencies, dispersion and skewness.

CLO-5 Obtain the relationship between two random variables.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Allied - Statistics – II
(For B.Sc ., Geography)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23USTAT09</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>4</td><td colspan="2">-</td><td colspan="2">--</td><td>4</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basis of Statistics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To introduce the concepts of probability theory, statistical hypothesis, chi-square test, analysis of variance and time series analysis.
2. To introduce the statistical concepts and develop analytical skills.</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Sampling Methods
Definitions – Sampling methods – Simple, Stratified and Systematic Sampling (concept only) – Merits and demerits – Concept of sampling and Non - Sampling errors.</td></tr>
<tr><td colspan="6">UNIT II Test of Significance (Large sample test)
Sampling distribution and Standard error – Hypothesis - Types of hypothesis - Types of errors - Test of Significance: Large sample tests for proportion, difference of proportions, mean and difference of means - Simple problems.</td></tr>
<tr><td colspan="6">Unit III Test of Significance (Small Sample Test)
Small sample tests with regard to Mean(s) t-test – Chi-square test – Assumptions – Characteristics and its Applications – Chi-square test for independence of attributes - Simple Problems.</td></tr>
<tr><td colspan="6">Unit IV Analysis of Variance
F-test – Analysis of Variance (ANOVA) – Test procedure for One way and Two way classifications – Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Time Series
Analysis of Time Series – Definition – Components and Uses of Time Series – Measures of Secular trend – Measure of Seasonal variation – Method of Simple average only.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">3. Gupta S. C and Kapoor V. K (2004), Fundamentals of Mathematical Statistics, (11th edition), Sultan Chand & Sons, New Delhi.
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	11. Sancheti D. C and Kapoor V. K (2005), Statistics (7th Edition), Sultan Chand& Sons, New Delhi. 12. Robert V. Hogg, Allen T. Craig, Joseph W. McKean , Introduction tomathematical statistics, Pearson Education. 13. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 14. Marek Fisz, Probability theory and Mathematical Statistics, John Wiley andSons. 15. Rohatgi V. K, An Introduction to Probability theory and MathematicalStatistics, Wiley Eastern Ltd., Publishers, New Delhi. 16. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, NewDelhi. 17. Vittal P. R, Mathematical Statistics, Margham Publications, Chennai. 18. Hoel P. G, Introduction to Mathematical Statistics, Asia Publishing House, New Delhi.
Weblinks	https://www.tutorialspoint.com/statistics/data_collection.htm https://www.surveysystem.com/correlation.htm https://www.investopedia.com/terms/r/regression.asp https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression https://course-notes.org/statistics/sampling_theory

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the random experiments in real life situations

CLO-2 Understand the axioms of probability in real life situations.

CLO-3 Compute Bernoulli trials and understand the rare case population

CLO-4 Learn the usage of central tendencies, dispersion and skewness.

CLO-5 Obtain the relationship between two random variables.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

NME FOR OTHER MAJOR

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Basic Statistics – I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">NME – I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">NME</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTNE01</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Uses and its basics</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">1. To enable the students to understand the basic concepts of statistics, collection of data, presentation of data and analysis of data.
2. To acquire knowledge of statistics and its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences etc.,</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit I Introduction Meaning and Scope
Statistics – Definition – Scope – Limitations – Population and Sample – Concepts of Random sampling and Non-random sampling – Basic concepts only.</td></tr>
<tr><td colspan="6">Unit II Collection of Data
Primary and Secondary data – Methods of collecting primary and secondary data - sources of data – Preparation of Questionnaire and Schedule.</td></tr>
<tr><td colspan="6">Unit III Presentation of Data
Classification of data – Types – Frequency distributions for discrete and continuous data – Construction of tables with one, two factors of classification.</td></tr>
<tr><td colspan="6">Unit IV Diagrammatic Representation of Data
Bar Diagrams: Types of one dimensional and two dimensional bar diagrams - Pie-diagrams – Uses.</td></tr>
<tr><td colspan="6">Unit –V Graphical Representation of Statistical Data
Histogram – Frequency Polygon – Frequency curve and Cumulative frequency curve – Ogive curves – Lorenz curve – Uses.</td></tr>
<tr><td colspan="2">Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</td><td colspan="6">Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved
(To be discussed during the Tutorial hour)</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Gupta. S. P. (2001), Statistical methods, Sultan Chand & Company Ltd., New Delhi.
2. Pillai. R. S. N. And Bagavathi. V. (2005), Statistics, S. Chand & Company Ltd., New Delhi.
3. Sancheti. D. C. and Kapoor. V. K, Statistics (7th Edition), Sultan Chand & Sons, New Delhi.</td></tr>
</table>

	4. Arora P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 5. Agarwal B. L, Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 6. Vittal P. R, Business Statistics, Margham Publications, Chennai. 7. Shukla M. C and Gulshan S. S, Statistics, Sultan Chand & Sons, New Delhi. 8. Simpson G and Kafka F, Basic Statistics, Oxford and IBH, Calcutta. 9. Freud J. E, Modern Elementary Statistics, Prentice Hall of India, New Delhi. 10. Saxena H. C (1983), Elementary Statistics, Sultan Chand & Sons, New Delhi.
Website and e-Learning Source	❖ https://www.tutorialspoint.com/statistics/ ❖ https://www.emathzone.com/tutorials/basic-statistics/collection-of-statistical-data.html ❖ https://byjus.com/commerce/meaning-and-objectives-of-classification-of-data/ ❖ https://byjus.com/commerce/diagrammatic-presentation-of-data/ ❖ https://byjus.com/maths/graphical-representation/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO -1 Distinguish between population and sample.

CLO-2 Know the concepts of random sampling and non – sampling

CLO-3 Frame a questionnaire and collect primary and secondary data.

CLO-4 Easy to understand the basic concepts.

CLO-5 Analyze statistical data and draw graphs, histograms, frequency polygons and Ogives.

CLO-6 Obtain the mathematical knowledge and skills for the better understanding of statistics.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	S	S	S	M	S	S	M	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Basic Statistics – II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">NME – II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">NME</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTNE02</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td>--</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Statistics and its basics</td></tr>
<tr><td colspan="2" rowspan="6">Objectives of the Course Outline</td><td colspan="6">1. To enable the students understand and compute the measures of central tendency and dispersion.
2. To learn the concepts of time series, evaluation of trend and measurement of seasonal variations by using various methods.
3. Acquire knowledge about index numbers, cost of living index numbers and calculate an indices from real life problems.</td></tr>
<tr><td colspan="6">Unit I Measures of Central Tendency
Definitions and concepts of Arithmetic mean Median and Mode – Merits and Demerits – Uses - Simple Problems.</td></tr>
<tr><td colspan="6">UNIT II Measures of Dispersion
Range, Quartile deviation and their relative measures - Standard deviation and Coefficient of variation - Simple Problems.</td></tr>
<tr><td colspan="6">Unit III Correlation
Karl Pearson‘s coefficient of correlation and Spearman‘s rank correlation coefficient – Simple Problems.</td></tr>
<tr><td colspan="6">Unit IV Time series
Measures of trend – Graphic method – Semi average method and Moving average method - Simple Problems.</td></tr>
<tr><td colspan="6">Unit V Index Numbers
Unweighted and Weighted Index Numbers: Laspeyre‘s, Paasche‘s and Fisher‘s method – Cost of living index numbers – Simple Problems.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2"></td><td colspan="6">❖ https://byjus.com/maths/central-tendency/
❖ https://byjus.com/maths/dispersion/
❖ https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square- one/11-correlation-and-regression
❖ http://www.stat.columbia.edu/~rdavis/lectures/Session6.pdf
❖ https://www.civilserviceindia.com/subject/Management/notes/index-numbers.html</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Analyze statistical data using measures of central tendency.
CLO- 2 Analyze statistical data using measures of central dispersion.
CLO-3 Understand and compute various statistical measures of correlation.
CLO-4 Gain knowledge about the sources of time series
CLO-5 Gain knowledge about the sources of measure secular trend.
CLO-6 understand the concepts of index numbers, optimum tests and its construction.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	S	S	M
CLO2	S	S	S	S	M	S	S	S	M
CLO3	S	S	S	M	S	M	S	S	M
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M
CLO6	S	M	M	S	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">Genetical Statistics</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">NME</td><td>Year</td><td>I or II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTNE03</td></tr>
<tr><td>Semester</td><td>I or III</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">-</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Basic level on mathematical computation</td></tr>
<tr><td colspan="2">Objectives of theCourse</td><td colspan="7">The main objectives of this course are to:
1. Know the Elements of Genetics
2. Understand Mandel‘s Law of inheritance and Use of $\chi 2$ (chi-square) tests in testing the Mendel‘s segregation law
3. Know the Method of maximum likelihood and other methods of estimation</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="7">UNIT – I
Elements of Genetics: Physical basis of heredity-cell structure chromosomes and genes – Interaction of genes concept of genotypes and phenotypes –Linkage and crossing over-Genetic maps.</td></tr>
<tr><td colspan="7">UNIT – II
Mandel‘s Law of inheritance –Laws of segregation and independent assortment –concept over generation.</td></tr>
<tr><td colspan="7">UNIT – III
Use of $\chi 2$ (chi-square) tests in testing the Mendel‘s segregation law-Sex linked genes –Concept of gene frequency –concept of random mating detection and estimation of linkage from back cross, F2,& F3 Data.</td></tr>
<tr><td colspan="7">Unit – IV
Method of maximum likelihood and other methods of estimation-Planning of experiments.</td></tr>
<tr><td colspan="7">Unit – V
Multiple allelic systems-Elementary aspects of the study of human blood group.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="7">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="7">1.Kempthorne, O. (1957). An Introduction to Genetic Statistics, John Wiley & Sons, New York, US.
2. Mackay, T. F. C., and Falconer, D. S. (1995). Introduction to Quantitative Genetics, Longman (Publisher)</td></tr>
<tr><td colspan="2">Website Links</td><td colspan="7">1 https://en.wikipedia.org/wiki/Mobile_genetic_elements
2 https://byjus.com/biology/mendel-laws-finheritance/#:~:text=Mendel%27s%20Laws%20of%20Inheritance%20Inheritance%20can%20be%20defined,that%20the%20offsprings%20are%20similar%20to%20the%20parents
3 https://www.encyclopedia.com/science-and-</td></tr>
</table>

	technology/biology-and-genetics/genetics-andgenetic-engineering/multiplealleles#:~:text=multiple%20alleles%20Three%20or%20more%20alternative%20forms%20of,present%20in%20an%20individual.%20A%20Dictionary%20of%20Biology

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Understand the correlation coefficient from different methods of measurements.

CLO-2 Concept of regression lines

CLO-3 Understand the concept of time series and estimate the trend values using various methods.

CLO-4 Understand the concept, purpose and its types of index numbers.

CLO-5 Understand the concept of sampling, sampling errors and types of sampling.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

CLO-PSO Mapping (Course Articulation Matrix) S-Strong, M-Medium, W-Weak

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
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CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Indian Official Statistics</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">NME</td><td>Year</td><td>I or II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">23USTNE04</td></tr>
<tr><td>Semester</td><td>II or IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">-
-</td><td>2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Basic level on statistical computation</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">The main objectives of this course are to:
1. know the population and agricultural statistics
2. understand industrial statistics and price statistics
3. know the National sample survey</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I Population Statistics: Statistical organization – Population Statistics – Agricultural Statistics – Indices of Agricultural production – Miscellaneous Agricultural Statistics.</td></tr>
<tr><td colspan="6">UNIT – II
Industrial statistics – ASI – Indices of Industrial Production and profits.</td></tr>
<tr><td colspan="6">UNIT - III
Price statistics – Price index numbers – Labour Bureau; Index number of Retail prices – Indices of security price</td></tr>
<tr><td colspan="6">Unit – IV
Wage statistics – trade statistics – Financial statistics – National income statistics.</td></tr>
<tr><td colspan="6">Unit – V
National sample surveys – Activities and publications of CSO and the Department of Statistics, Government of Tamil Nadu. National Income compilation.</td></tr>
<tr><td colspan="2">Skills acquired from this Course</td><td colspan="6">Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</td></tr>
<tr><td colspan="2">References Books</td><td colspan="6">1. Central Statistical Organisation, Guide to Official Statistics 1979 Ed
Department of Statistics, Ministry of Planning, India</td></tr>
<tr><td colspan="2">Website Links</td><td colspan="6">1 https://agriculture.uk.gov.in/pages/show/221-agriculture-statistics-Data
2 http://labourbureau.gov.in/CPIW05%20Methodolgy.html
3 https://byjus.com/free-ias-prep/nsso</td></tr>
</table>

Course Learning Outcome (for Mapping with POs and PSOs)

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	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CLO1	S	S	M	M	M	S	M	S	M
CLO2	S	S	S	S	M	S	M	S	M
CLO3	S	S	S	M	S	S	M	S	S
CLO4	S	S	S	M	S	S	S	S	M
CLO5	S	S	M	M	M	S	S	S	M

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CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

Level of Correlation between PSO's and CO's