



PERIYAR UNIVERSITY

Periyar Palkalai Nagar

Salem – 636 011

Degree of Bachelor of Science

CHOICE BASED CREDIT SYSTEM



— DEPARTMENT OF —
STATISTICS


Syllabus for

B.Sc., STATISTICS

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar
University from 2026-2027 onwards)

Members of the Board

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(From 2026 – 2027 Onwards)

(Semester-wise)

PERIYAR UNIVERSITY, SALEM – 11.

BACHELOR OF SCIENCE BRANCH - STATISTICS

(The Revised Syllabus shall be Effective from the Academic Year 2026-2027 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 Up think 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; analyze 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.
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	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 demonstrating 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.
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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.
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	PO1	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, II	Foundation Course To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analyzing the world through the literary lens gives rise to a new perspective.	➤ Instill confidence among students ➤ Create interest for the subject
III, IV, V	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	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
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	Hr	Sem II	Credit	Hr	Sem III	Credit	Hr	Sem IV	Credit	Hr	Sem V	Credit	Hr	Sem VI	Credit	Hr
1.1 Language	3	6	2.1 Language	3	6	3.1 Language	3	6	4.1 Language	3	6	5.1 Core Course - VI	5	6	6.1 Core Course – IX	5	6
1.2 English	3	6	2.2 English	3	6	3.2 English	3	6	4.2 English	3	6	5.2 Core Course – VII	5	6	6.2 Core Course – X	5	6
1.3 Core Course – I	5	5	2.3 Core Course – III	5	5	3.3 Core Course – IV	5	5	4.3 Core Course – V	4	4	5.3 Core Course – VIII	5	6	6.3 Core Course – XI	5	6
1.4 Core Course – II	5	5	2.4 Core Practical – I	3	3	3.4 Allied – III	4	5	4.4 Core Practical – II	2	2	5.4 Elective – III	4	5	6.4 Core Practical – III	5	5
1.5 Allied - I	4	5	2.5 Allied - II	3	3	3.5 Elective – I	4	4	4.5 Allied - IV	3	3	5.5 SEC – III	2	3	6.5 Core Practical – IV	5	5
1.6 NME - I	2	2	2.6 Allied – Mathematics Practical	2	2	3.6 Skill Enhancement Course SEC - I	2	2	4.6 Allied – OR Practical	2	2	5.6 Internship / Industrial Training	2	-	6.6 Extension Activity	1	-
1.7 Value Education	1	1	2.7 NME – II	2	2	3.7 Health and Wellness	1	-	4.7 Elective – II	3	3	5.7 EVS	2	2	-		
			2.8 Disaster Management	1	1	-			4.8 SEC – II	2	2	-			-		
	23	30		22	28	-	22	28		22	28		25	28		26	28
	Total Credit Points															140	

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 & Allied	15	15
Part-4	NME	2	2
	Value Education	1	1
		24	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 & Allied	13	13
Part-4	NME	2	2
	Disaster Management	1	1
	NMSDC	2	2
		24	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, Allied Courses and Elective	12	14
Part-4	SEC – I	2	2
	Health and Wellness	1	-
	NMSDC	2	2
		23	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 and Allied including laboratory	14	14
Part-4	Skill Enhancement Course -SEC- II	2	2
	NMSDC	2	2
		24	30

Third Year - Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses and Elective Courses	18	23
Part-4	SEC – III	4	3
	Internship / Industrial Visit / Field Visit	2	-
	EVS	1	2
	NMSDC	2	2
		27	30

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses and Core Practical	25	28
Part-4	Extension Activity	1	-
	NMSDC	2	2
		28	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	15	13	12	14	18	25	97
Part IV	3	5	5	4	9	3	29
Part V	-	-	-	-	-	-	-
Total	24	24	23	24	27	28	150

- 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		
	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.

❖ 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 2026-2027 onwards)

PART	PAPER CODE	COURSE	TITLE OF THE PAPER	HOURS	CREDIT	MARKS		TOTAL
						CIA	UE	
SEMESTER – I								
I		Language	Tamil – I	6	3	25	75	100
II		Language	English – I	6	3	25	75	100
III		Core Theory – I	Descriptive Statistics	5	5	25	75	100
		Core Theory – II	Time Series and Index Numbers	5	5	25	75	100
		Allied - I	Mathematics - I	5	4	25	75	100
IV		NME	NME – I	2	2	25	75	100
		Common	Value Education	1	1	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	6	3	25	75	100
III		Core Theory– III	Probability Theory and Random Variables	5	5	25	75	100
		Core Practical – I	Practical – I (Based on Excel)	3	3	40	60	100
		Allied – II	Mathematics – II	3	3	25	75	100
		Allied – Practical	Allied – Mathematics Practical	2	2	40	60	100
IV		NME	NME – II	2	2	25	75	100
		Common	Disaster Management	1	1	25	75	100
		NMSDC		2	2	25	75	100
NO. OF COURSES – 9			TOTAL	30	24	255	645	900

SEMESTER – III								
I		Language	Tamil – III	6	3	25	75	100
II		Language	English – III	6	3	25	75	100
III		Core Theory – IV	Distribution Theory	5	5	25	75	100
		Allied – III	Operations Research – I	5	4	25	75	100
		Elective – I	Numerical Methods	4	4	25	75	100
IV		SEC – I	Demography	2	2	25	75	100
		Common	Health and Wellness	-	1	-	-	-
		NMSDC		2	2	25	75	100
NO. OF COURSES – 8			TOTAL	30	24	175	525	700
SEMESTER – IV								
I		Language	Tamil – IV	6	3	25	75	100
II		Language	English – IV	6	3	25	75	100
III		Core Theory – V	Sampling Techniques	4	4	25	75	100
		Core Practical – II	Practical – II (Based on R)	2	2	40	60	100
		Allied – IV	Operations Research – II	3	3	25	75	100
		Allied – Practical	Allied – Operations Research Practical	2	2	40	60	100
		Elective – II	Regression Analysis	3	3	25	75	100
IV		SEC – II	Non-Parametric Test	2	2	25	75	100
		NMSDC		2	2	25	75	100
NO. OF COURSES – 9			TOTAL	30	24	255	645	900

SEMESTER – V								
III		Core Theory – VI	Theory of Estimation	6	5	25	75	100
		Core Theory – VII	Design of Experiments	6	5	25	75	100
		Core Theory – VIII	Stochastic Processes	6	5	25	75	100
		Elective – III	Econometrics	5	4	25	75	100
IV		SEC – III	Introduction to Python Programming	3	2	25	75	100
		Common	Internship / Industrial Training	Minimum 15 days during summer holidays	2	-	-	-
		Common	EVS	2	2	25	75	100
		NMSDC		2	2	25	75	100
NO. OF COURSES – 8			TOTAL	30	27	175	525	700
SEMESTER – VI								
III		Core Theory – IX	Testing of Statistical Hypothesis	6	5	25	75	100
		Core Theory – X	Statistical Quality Control	6	5	25	75	100
		Core Theory – XI	Actuarial Statistics	6	5	25	75	100
		Core Practical – III	Practical – III (Calculator Based)	5	5	40	60	100
		Core Practical – IV	Practical – IV (Based on Python)	5	5	40	60	100
IV		Common	Extension Activity	-	1	-	-	-
		NMSDC		2	2	25	75	100
NO. OF COURSES – 7			TOTAL	30	28	180	420	600
TOTAL NO. OF COURSES - 48			GRAND TOTAL	180	150	1215	3285	4500
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 2026-27 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 -VI	5	6.1 Core Course –IX	5
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – VII	5	6.2 Core Course – X	5
1.3 Core Course – I	5	2.3 Core Course – III	5	3.3 Core Course – IV	5	4.3 Core Course – V	4	5.3 Core Course – VIII	5	6.3 Core Course – XI	5
1.4 Core Course –II	5	2.4 Core Practical – I	3	3.4 Allied – III	4	4.4 Core Practical – II	2	5.4 Elective – III	4	6.4 Core Practical – III	5
1.5 Allied - I	4	2.5 Allied - II	3	3.5 Elective – I	4	4.5 Allied - IV	3	5.5 SEC – III	2	6.5 Core Practical – IV	5
1.6 NME - I	2	2.6 Allied – Mathematics Practical	2	3.6 Skill Enhancement Course SEC - I	2	4.6 Allied – OR Practical	2	5.6 Internship / Industrial Training	2	6.6 Extension Activity	1
1.7 Value Education	1	2.7 NME – II	2	3.7 Health and Wellness	1	4.7 Elective – II	3	5.7 EVS	2	-	-
		2.8 Disaster Management	1	-	-	4.8 SEC – II	2	-	-	-	-
	23		22	-	22		22		25		26
		Total Credit Points									140

❖ QUESTION PAPER PATTERN AND EVALUATION FOR ALL COURSES

(a) Scheme of Examinations:

EXAMINATIONS	MARKS
CIA (Continuous Internal Assessment)	25 Marks
UE (University Examinations)	75 Marks
TOTAL	100 Marks

(b) 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

(c) 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 Questions from Each Unit)	
Part – C (5 x 10 = 50) Answer ALL questions (One Questions from Each Unit with Internal Choice)	

(d) 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

(e) 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

(f) 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

(g) Question Paper Pattern for Core and SEC Practical:

Time: Three hours	Maximum Marks: 75
Part – A (3 x 20 = 60) Answer Any THREE question out of FIVE	

(h)

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+UE). **Minimum 40% should be secured (30 out of 75) in UE** 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+UE). **Minimum 40% should be secured (24 out of 60) in UE** 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

1. 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.
2. All other successful candidates shall be declared to have passed in the Second Class.
3. 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.
4. 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 UE 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, Allied
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

$$\text{GPA} = \frac{\text{Sum of the Multiplication of Grade Points by the Credits of the Courses}}{\text{Sum of the Credits of the Course in a Semester}}$$

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

For the Entire Programme:

$$\text{CGPA} = \frac{\text{Sum of the Multiplication of Grade Points by the Credits of the Entire Programme}}{\text{Sum of the Credits of the Entire Programme}}$$

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	Time Series and Index Numbers
3	III	Probability Theory and Random Variable
4	IV	Distribution Theory
5	V	Sampling Techniques
6	VI	Theory of Estimation
7	VII	Design of Experiments
8	VIII	Stochastic Processes
9	IX	Testing of Statistical Hypothesis
10	X	Statistical Quality Control
11	XI	Actuarial Statistics

Elective Courses (EC)

S. No.	Elective Course No.	Title of the course
1	I	Numerical Methods
2	II	Regression Analysis
3	III	Econometrics

Skill Enhancement Courses (SEC)

S. No.	Course No.	Title of the course
1	I	Demography
2	II	Non-Parametric Tests
3	III	Introduction to Python Programming

MAXIMUM DURATION FOR THE COMPLETION OF THE UG PROGRAMME

The maximum duration for completion of the UG Programme will not exceed ten semesters.

COMMENCEMENT OF THIS REGULATION

The OBE regulations shall take effect from the academic year 2026 – 2027 (i.e) for the students who are admitted in the first year of the course during the academic year 2026 – 2027 and thereafter.

TRANSITARY PROVISION

Candidates who were admitted to the UG course of study prior to 2026-2027 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 2029. Thereafter they will be permitted to appear for the examination based on the regulations then in force.

❖ LIST OF COURSES

S.NO	COURSE	PAPER CODE	TITLE OF THE PAPER	Page No.
1	CORE THEORY		Descriptive Statistics	27
2			Time Series and Index Numbers	30
3			Probability Theory and Random Variable	33
4			Distribution Theory	36
5			Sampling Techniques	39
6			Theory of Estimation	42
7			Design of Experiments	45
8			Stochastic Processes	48
9			Testing of Statistical Hypothesis	51
10			Statistical Quality Control	54
11			Actuarial Statistics	57
12	CORE ELECTIVES		Numerical Methods	60
13			Regression Analysis	63
14			Econometrics	66
15	CORE PRACTICAL		Core Practical I (Based on MS-Excel)	69
16			Core Practical II (Based on R-Programming)	71
17			Core Practical III (Calculator Based)	73
18			Core Practical IV (Based on Python)	75
19	ALLIED THEORY		Mathematics - I	-
20			Mathematics - II	-
21			Operations Research - I	77
22			Operations Research - II	80
23	ALLIED PRACTICAL		Allied Practical I: Mathematics Practical (Based on Allied Theory paper 1&2)	-
24			Allied Practical II: Operations Research (Based on Allied Theory paper 3&4)	83
25	SKILL ENHANCEMENT COURSE		Demography	84
26			Non-Parametric Test	87
27			Introduction to Python Programming	90
28	COMMON		Value Education	-
29			Disaster Management	-
30			Health & Wellness	-
31			EVS	-
32			Extension Activity	-
33			Internship / Industrial Training	-

Title of the Course		Descriptive Statistics					
Paper Number		CORE I					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	I				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		1		-	5
Pre-requisite		A fundamental understanding of high school-level arithmetic calculations, and familiarity with data representation.					
Objectives of the Course		The main objectives of this course are: 1. To know about Data Simplification and Organization. 2. To have an idea on formulating and visualizing of frequency distribution. 3. To compare data from different sources or periods using measures like mean, median, mode, and dispersion. Estimate and predict the unknown and future values. 4. To identify patterns, correlations, and relationships between different variables.					
Course Outline		Unit-I Statistics: Introduction, Definition and scope. Concepts of statistical population and sample. Collection of Data: Primary and secondary data – Sources, Merits and Demerits. Types of Data - quantitative and qualitative, discrete and continuous. Scales of measurement: nominal, ordinal, interval and ratio. Classification and Tabulation-Types, parts of a Table - Formation of frequency distribution-Presentation of data: Diagrams and Graphs- Merits and Demerits – Simple Examples.					
		Unit-II Measures of Central Tendency- Averages: Introduction, Definitions and Types- Mean, Median, Mode, Geometric mean and-Harmonic Mean-Weighted mean - Merits and Demerits. Measures of Dispersion: Range, Mean deviation, Standard deviation, Coefficient of variation, Gini’s Coefficient, Lorenz Curve.					
		Unit-III Moments: Introduction - Definition- Types - Raw, Central moments and their relations. Skewness- Definition and Types- Karl Pearson’s, Bowley’s, Kelly’s methods – merits and demerits, Kurtosis based on moments.					
		Unit-IV Bivariate data: Definition, Correlation - scatter diagram, simple linear correlation- Karl Pearson’s correlation co- efficient-Rank Correlation- Spearman’s and Kendall’s measures. Linear regression, principle of least squares, fitting of polynomial and					

	exponential curves, correlation ratio, correlation index, intra class correlation.
	Unit-V Analysis of Categorical Data: Contingency table, independence and association of attributes, measures of association - odds ratio, Pearson's and Yule's measure, Goodman-Kruskal gamma - Coefficient of Colligation.
Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Hands-on training in R, SPSS, Excel, or Python to find Averages, Dispersion and Correlation measures.
Skills acquired from this Course	Data Interpretation Knowledge, Problem Solving, Analytical ability, Professional and critical evaluation.
Recommended Text	1. Gupta, S.P. (2017): Statistical Methods, Sultan Chand & Sons Pvt Ltd, New Delhi, 35 th 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, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I& II, 8 th Edn. The World Press, Kolkata. 2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7 th Edn.), Pearson Education, Asia. 3. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd. 4. Tukey, J.W. (1977): Exploratory Data Analysis, Addison-Wesley Publishing Co. 5. Agresti, A. (2010): Analysis of Ordinal Categorical Data, 2 nd Edition, Wiley. 6. Freedman, D., Pisani, R. and Purves, R. (2014): Statistics, 4 th Edition, W. W. Norton & Company. 7. 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

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

Title of the Course		Time Series and Index Numbers					
Paper Number		CORE-II					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	I				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		1		-	5
Pre-requisite							
Objectives of the Course		The main objectives of this course are: 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. 4. To compute the different index numbers in real life problems.					
Course Outline		Unit I Time series - Concept - Components of time Series- Uses of Time series -Illustrations of time series -Additive and multiplicative models-- Measurement of trend – free hand method-semi average method-Moving average method - Least square method.					
		UNIT II Measurement of Seasonal Component: Method of simple averages, Ratio to Trend, Ratio to Moving Averages and Link Relative method. Deseasonalization. Cyclic Component: Harmonic Analysis- Cyclic Variation and Irregular fluctuations					
		Unit III Methods of Forecasting a time series. Forecasting by the methods of Exponential smoothing- Modified Exponential Curve and its Fitting – Method of Three Selected Points – Method of Partial Sums – Fitting of Gompertz Curve – Logistic Curve					
		Unit IV Index Numbers - uses, classification of index numbers - Problems in the construction of index numbers - Methods of constructing index numbers - Unweighted index numbers -weighted index numbers.					
		Unit V Production index – Sales index – Export and import index – Employability index - Quantity index numbers - Fixed and chain base index numbers - Optimum test for index numbers - Time reversal test - factor reversal test - cost of living index numbers.					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Hands-on training in R, SPSS, Excel to find Index numbers. 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	Data Interpretation Knowledge, Problem Solving, Analytical ability, Professional and critical evaluation Knowledge, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text Books.	1. Gupta, S.C. and Kapoor, V.K. (2014), Fundamentals of Applied Statistics, Sultan Chand & Co., 4 th Revised Edition, 2019.
Reference Books	1. Garret, H.E., (2005) Education and Psychological Statistics, Paragan International Publications. 2. Pillai RSN and Bagavathi V, (2010), Statistics, S. Chand & Co. 3. Box, G.E.P., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. (2015), Time Series Analysis: Forecasting and Control, 5th Edition, John Wiley & sons, Inc. 4. Brockwell, P.J. and Davis, R.A. (2003), Introduction to Time Series Analysis. Springer. 5. Gupta, S.P. (2002), Statistical Methods, Sultan & Sons, New Delhi. 6. Croxton, F.E & Cowdon, D.J. (1967), Applied general statistics, Prentice Hall, (3 rd Edition).
Website and e-Learning Sources	NPTEL – Time series and Index Numbers ❖ https://swayam.gov.in ❖ Search: “Time Series” – Free video lectures with certification, Coursera -Index numbers ❖ https://www.coursera.org/learn/timeseries-modeltt

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.

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

Title of the Course		Probability and Random Variables					
Paper Number		CORE III					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		--		5
Pre-requisite		Basic Knowledge on events and set theory					
Objectives of the Course		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. To learn the concepts of marginal and conditional distributions. 3. To understand the method of analysing a bivariate distribution. 4. To apply Chebychev’s inequality in real life problems.					
Course Outline		Unit-I Theory of Probability Concept of Random experiment – Trial, Sample point, Sample space, Event, Algebra of Events, Mutually exclusive events, Exhaustive events – Definition of Probability – Classical, Statistical and Axiomatic approach – Properties of Probability – Theorems on Probability – Addition and Multiplication theorem of probabilities – Conditional probability – Bayes theorem - Simple Problems.					
		Unit-II Random variables and Distribution functions Concept of Random experiment – Trial, Sample point, Sample space, Event, Algebra of Events, Mutually exclusive events, Exhaustive events – Definition of Probability – Classical, Statistical and Axiomatic approach – Properties of Probability – Theorems on Probability – Addition and Multiplication theorem of probabilities – Conditional probability – Bayes theorem - Simple Problems.					
		Unit-III Bivariate Random Variables and Distribution Functions Joint probability functions - Joint probability mass functions - Joint probability density functions – Marginal and conditional probability functions – Distribution functions of bivariate random variables and its properties – Marginal, Conditional distribution functions and density functions – Independence of Random variables – Properties of joint distribution functions.					
		Unit-IV Mathematical Expectations Meaning and definitions of Expectation (discrete and continuous) – Properties – Moments – Variance – Properties – Conditional expectation and Conditional variance – Theorems on expectations – Chebychev’s Inequality – Simple Problems.					

	Unit-V Moment Generating functions Definition of Moment generating function – Properties and uses – Characteristic functions – Cumulants - Properties – Simple problems – Inversion theorem on Characteristic function (statement only) – Statement and Applications of Weak Law of Large Numbers.
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.C. and Kapoor V.K (2015): Fundamentals of Mathematical Statistics, Sultan Chand & Sons. 2.Bhat B.R. (2014), Modern Probability Theory (Fourth Edition), New Age International Publishers, New Delhi. 3.Spiegel M.R. and Ray M (1980), Theory and Problems of Probability and Statistics, Schaum's Outline Series, McGraw Hill, New York.
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

Title of the Course		Distribution Theory					
Paper Number		Core IV					
Category	Core	Year	II	Credits	5	Course Code	
		Semester	III				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		1		--	5
Pre-requisite		Under Graduate Level					
Objectives of the Course		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					
Course Outline		Unit I Discrete distributions – Bernoulli, Uniform, Binomial, Poisson, Geometric, Hyper geometric, Multinomial and Negative binomial distributions –Limiting form of Binomial and Poisson distribution – Fitting of Binomial distribution and Poisson distribution.					
		Unit II Continuous distributions – Uniform – Normal – Exponential-Cauchy – Gamma and Rectangular Distribution - Beta distribution of First and Second kind – Concepts of lognormal distributions – their properties - simple applications – Fitting of Normal distribution.					
		Unit III Bivariate normal distributions – marginal and conditional distributions and their properties – Sampling distributions – Standard error					
		Unit-IV Functions of Normal random variables leading to t, Chi – square and F – distributions (derivations, properties and interrelationships).					
		Unit-V Order Statistics – Distribution function of maximum and minimum order statistics – Simple applications – Distribution of r^{th} order statistics and sample median – Simple problems – uses of order statistics.					

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.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. 2. V.K. Rohatgi, (1985), An introduction to probability theory and mathematical statistics, Wiley Eastern Ltd., New Delhi.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject https://www.statisticsshowto.datasciencecentral.com/ https://online.stat.psu.edu/stat504/node/209/

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 value's 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

Title of the Course		Sampling Techniques					
Paper Number		Core – V					
Category	Core	Year	II	Credits	5	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		--		5
Pre-requisite		Descriptive statistics and Probability theory					
Objectives of the Course		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.					
Course Outline		Unit I Sample Survey Basic concept of Sample Survey - Census and Sample Survey - Population and Sample – Parameter and Statistic – Preparation of Questionnaire and Schedules – Principle steps in Sample Survey – Pilot survey – Sampling Distribution - Standard Error - Sampling and Non-sampling Errors – Advantages over Complete Enumeration – Limitations of sampling.					
		Unit II Simple Random Sampling Procedures of Selecting a Random sample – Simple Random Sampling with and without Replacement (Lottery method, Random number tables) – Estimation of Mean, Variance and Proportion of the Estimated Sample Mean – Determinations of Sample size – Confidence Limits – Simple Random Sampling for Attributes.					
		Unit III Stratified Random Sampling Meaning and Principles of Stratification – Advantages of Stratification – Estimation of Mean and Variance of the Estimated Sample Mean – Allocation of Sample Size in Different Strata – Equal Allocation, Neyman Allocation, Optimum Allocation and Proportional Allocation – Relative Precision of Stratified Random Sampling with Simple Random Sampling.					
		Unit-IV Systematic Random Sampling Concept of Systematic Random Sampling – Selection Procedures, Advantages and Disadvantages, Estimation of Mean and Variance of the Estimated Sample Mean – Comparison of Simple Random Sampling and Stratified Random Sampling with Systematic Sampling.					

	Unit-V Cluster Sampling and Non - Probability Sampling Cluster Sampling with Equal Sized Clusters – Estimation of Population Mean and Variance – Concepts of Convenience, Judgement, Quota and Snowball Sampling – Merits and Demerits – Applications.
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	Cochran, W.G. (1978): Sampling Techniques, John Wiley Eastern 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. 3. Desraj (1976), Sampling Theory, Tata McGraw Hill, New York. (Reprint 1979). 4. Murthy M. N (1977), Sampling Theory and Statistical Methods, Statistical Publishing Society.
Websites	e-books, tutorials on MOOC/SWAYAM courses on the subject ❖ http://ocw.jhsph.edu/courses/statmethodsforamplesurveys/pdfs/lecture2.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

Title of the Course		Theory of Estimation					
Paper Number		Core – VI					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	V				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		--		6
Pre-requisite		Number theory and Arithmetic					
Objectives of the Course		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					
Course Outline		Unit I Point Estimation – Distinction between Estimator and Estimate – Properties of Estimators – Concept of Unbiasedness, Consistency, Efficiency and Sufficiency – Statement of Neyman – Factorization theorem – Simple Applications.					
		Unit II Minimum Variance Unbiased Estimator (MVUE) – Uniqueness property of MVUE – Proof – Lower bound for variance of estimator – Regularity conditions – Cramer Rao inequality – Statement and proof – Simple problems – Asymptotic efficiency.					
		Unit III Sufficient statistic and its properties – Concept of complete sufficient statistics – Simple illustrations – Minimum Variance Bound Estimator (MVBE) – Concept of Blackwellisation – Statement and proof of Rao – Blackwell theorem.					
		Unit-IV Methods of estimation – Maximum likelihood estimator (MLE) and their properties – Simple problems on MLE – Method of moments – Methods of minimum Chi-square and modified minimum Chi-square – Method of Least square method – simple problems.					
		Unit-V Interval estimation – Distinction between point estimation and interval estimation - Confidence interval and confidence limits – Construction of confidence intervals for parameters of Binomial, Poisson, Normal and Exponential distribution.					

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.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. 3. 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

Title of the Course		Design of Experiments					
Paper Number		Core VII					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	V				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		5		1		--	6
Pre-requisite		Linear models					
Objectives of the Course		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					
Course Outline		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).					
		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.					
		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.					
		Unit-IV Missing plot techniques – Meaning – Least Square method of estimating one missing observation – RBD and LSD – Two observations missing in RBD and LSD – Analysis of covariance technique in CRD and RBD (without derivation).					
		Unit-V Factorial experiment – Definition – 2 ² , 2 ³ and 3 ² factorial experiments and their analysis – Principles of confounding – Partial and complete confounding in 2 ³ – Split plot design and its analysis.					

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. 3. Fisher R.A (1953), Design and Analysis of Experiments, Oliver and Boyd, London. 4. Goon A.M, Gupta M.K and Das Gupta B (1994), Fundamentals of Statistics V – 11, the world press Ltd., Calcutta.
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
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	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

Title of the Course		Stochastic Processes						
Paper Number		Core VIII						
Category	Core	Year	III	Credits	5	Course Code		
		Semester	V					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		5		1		--		6
Pre-requisite		Probability Theory						
Objectives of the Course		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 periodicity, stationarity and applications.						
Course Outline		Unit I Stochastic Processes – Definition, Classification of Stochastic Processes according to time parameter space and state space – examples. Stationary processes and time series – Strict and wide Sense stationary models of time series – Concept of spectrum of time series.						
		Unit II Markov Chains – Definitions and examples – Higher transition probabilities – Chapman - Kolmogorov equation – Classification of States – Limiting behavior (concept and applications only).						
		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.						
		Unit-IV Markov process with continuous state space – Brownian movement – Wiener process – Differential equation for a Wiener process – Kolmogorov equations – first passage time distribution for Wiener process - Distribution of the maximum of a Wiener process – Distribution of the first passage time to a fixed point.						
		Unit-V Renewal Process – Definition, related concepts and examples – Renewal equation – Elementary Renewal Theorem – Basic Renewal Theorem.						

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. Medhi, J. (2019): Stochastic Processes, New Age International Publishers. 2. KantiSwarup, Gupta.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 Markov process with continuous state space.

	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

Title of the Course		Testing of Statistical Hypothesis					
Paper Number		Core IX					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		5	1		--		6
Pre-requisite		Estimation theory and distribution theory					
Objectives of the Course		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 learn about hypotheses and derive test statistic based on large samples and small samples. 4. To apply tests for samples from unknown distributions					
Course Outline		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.					
		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.					
		Unit III Test of significance – Sampling distributions, Standard error – Large sample tests based on Mean, Proportion - Difference between Means, difference between Proportions and Standard deviation.					
		Unit-IV Student’s t – test based on Mean, Difference of Two Means, Paired t – test - Test for coefficient of correlation – F test for variance ratio, Chi – square test, Test of equality of several means.					
		Unit-V Nonparametric methods – Confidence interval for distribution quantiles – Tolerance limits for distributions. Sign test, Wilcoxon test.					
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. 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. Ehsanes Saleh, John Wiley & Sons
Reference Books	1. Gupta S.C. and Kapoor V.K. (1991): Fundamentals of Mathematical 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

Title of the Course		Statistical Quality Control					
Paper Number		Core X					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		5		1		--	6
Pre-requisite		Estimation theory and Distribution theory					
Objectives of the Course		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 learn to be able to construct control charts for defects number of defects (c-chart); and control chart for number of defects per unit (u-chart). 3. To understand 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 consumers risk for an acceptance sampling plan. 5. To apply various sampling plans in industrial environment to study analyze and control the quality of products. 6. To understand sequential and multiple sampling methods.					
Course Outline		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 (x bar- chart), range chart (r- chart), standard deviation chart (s-chart)					
		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 chart for number of defects (c-chart) and control chart for number of defects per unit (u-chart).					

	Unit III Acceptance sampling plans for attributes –types of acceptance sampling plans, sampling inspection, advantages and limitations of acceptance sampling. Terms used in acceptance sampling plans: lot, lot size, 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 Sequential sampling plan procedure – estimation of parameters – OC, AOQ, ASN curves, multiple sampling, comparison between single, double and multiple sampling.
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. 4. D.C. Sancheti and V.K. Kapoor – Statistics (Theory, Methods and Applications), Sultan Chand and Sons.
Reference Books	1. Gupta, R.C. (1974): Statistical Quality Control. 2. Ekamparam, S K. (1963): Statistical basis of Acceptance sampling, Asia Publishing House. 3. 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

Title of the Course		Actuarial Statistics						
Paper Number		Core XI						
Category	Core	Year	III	Credits	5	Course Code		
		Semester	VI					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		5		1		-		6
Pre-requisite		Undergraduate Level						
Objectives of the Course		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.						
Course Outline		Unit I Simple and compound interest, present value and accumulated values of fixed rate, varying rate of interest – effective rate of interest corresponding to a nominal rate of interest and vice versa – simple problems.						
		Unit II Mortality: Gompertz – Makeham’s laws of mortality - life tables. Annuities: Endowments, Annuities, Accumulations, Assurances, Family income benefits – simple problems.						
		Unit III Policy Values: Surrender values and paid-up policies, industrial assurances, Joint life and last survivorship – Definition of premium, natural premium level, annual premium, net premium and office premium – simple problems.						
		Unit-IV Contingent Functions: Contingent probabilities, assurances. Decrement tables. Pension funds: Capital sums on retirement and death, widow’s pensions, benefits dependent on marriage.						
		Unit-V Principles of insurance – Types of assurance – temporary assurance - pure endowment assurance, endowment assurance and whole life assurance, Double endowment assurance, increasing temporary assurance – simple problems.						

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 /IAII/ IFoA there 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. Hooker,P.F., Longley, L.H.-Cook (1957): Life and other contingencies, Cambridge. 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 Zehnworth, B.(1999): introductory statistics with applications in general insurance, Cambridge University. 3. Mathematical Basis of Life Assurance (IC – 81), Published by Insurance Institute of India, Bombay. 4. S.C.Gupta and V.K.Kapoor (2001), Fundamentals of Applied Statistics, Sultan Chand and Sons, 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

- CLO1:** Understand the fundamentals of simple and compound interest, present value, and accumulated value under fixed and varying interest rates.
- CLO2:** Explain mortality concepts including Gompertz–Makeham’s laws, life tables, and compute survival and death probabilities using LIC mortality tables.
- CLO3:** Analyse different types of annuities, assurances, and policy values such as surrender value and paid-up policies.
- CLO4:** Apply concepts of contingent probabilities, decrement tables, and pension benefits in actuarial contexts.
- CLO5:** Understand and evaluate principles of insurance, and compute net premiums for various assurance and annuity plans.
- CLO6:** To Evaluate increasing temporary assurance.

	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

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		Numerical Methods						
Paper Number		Elective - I						
Category	Core	Year	II	Credits	3	Course Code		
		Semester	III					
Instructional Hours Per Week		Lecture		Tutorial		Lab Practice		Total
		3		1		-		4
Prerequisite		Undergraduate Level Numerical Methods						
Objectives of the Course		The main objectives of this course are: 1. Understand the concept of curve fitting. 2. Apply methods of interpolation and Newton’s formula. 3. Analyze the computation of central difference interpolation. 4. Extend the interpolation to equal intervals and unequal intervals. 5. Evaluate numerical integration and problems.						
Course Outline		Unit – I Curve Fitting - Principles of Least Squares-Fitting the curves of the form $Y = a + bx$, Fitting second degree parabola $Y = a + bx + cx^2$. Fitting an exponential curve $Y = ax^b$, $Y = ab^x$ and $Y=a.e^{kx}$ – Simple problems.						
		Unit – II Interpolation with Equal Intervals - Finite Differences - Operators – Forward and Backward Difference Operators – Operator E and their basic Properties (without proof) - Interpolation with Equal Intervals - Newton’s Forward and Backward Difference Formulae – Equidistant Terms with One or More Missing Values (No Derivations) – Simple problems.						
		Unit – III Central Difference Interpolation - Central Difference Interpolation Formula – Gauss Forward Interpolation Formula – Gauss Backward Interpolation Formula – Stirling’s Formula – Bessel’s formula – (No derivations)-Simple problems.						
		Unit – IV Interpolation with Unequal intervals – Divided Difference and their properties (without proof) – Newton Divided Difference Formula – Lagrange’s Formula – Inverse Interpolation using Lagrange’s formula- (No derivations) – Simple problems.						
		Unit – V Numerical Integration - Trapezoidal Rule, Simpson’s 1/3 rd , Simpson’s 3/8 th rule and, Weddle’s Rule – (No derivations)-Simple problems.						

Extensional Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Hands-on training in statistical tools such as R, Python, MATLAB or Excel to implement numerical algorithms.
Skills Acquired from this course	1. Modelling and application: Apply numerical methods to real-world problems science, engineering and applied mathematics. 2. Computation skills: Gain proficiency in using programming tools to perform numerical computations. 3. Problem Solving: Ability to solve complex mathematical problems using numerical technique.
Recommended Text Books	1. Numerical Methods, P. Kandasamy, K.Thilagavathy and K.Gunavathi, (2007), Sultan Chand Company Ltd, New Delhi. 2. Introductory Methods of Numerical Analysis, S. S. Sastry, (2012), PHI Learning Pvt. Ltd..
Reference Books	1. Numerical Methods, Kalavathy, S., and Thomson. (2008), Vijay Nicole Publications, Chennai. 2. Numerical Analysis, G. Shanker Rao (2007), New Age International (P) Ltd., New Delhi.
Website and e-Learning Sources	❖ https://www.geeksforgeeks.org/least-square-method ❖ https://atozmath.com/CONM/LeastSquare.aspx?q=1 ❖ https://atozmath.com/Menu/ConmMenu.aspx ❖ https://atozmath.com/CONM/NumeDiff.aspx?q=DD ❖ https://nptel.ac.in/courses/127/106/127106019/

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

Title of the Course		Regression Analysis					
Paper Number		Elective II					
Category	Core	Year	II	Credits	3	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		2		1		--	3
Pre-requisite		Linear regression analysis, Estimation theory					
Objectives of the Course		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					
Course Outline		Unit I Introduction - Concept of Correlation, Partial Correlation – Types and Methods of Correlation - Partial correlation coefficient – Zero order, First order and Second order Partial correlation coefficient – Partial correlation coefficient in case of three variables – Characteristics - Limitations – Simple problems.					
		Unit II Meaning and definition – Coefficient of Multiple Correlation - Advantages and Limitations of Multiple Correlation Analysis - Relationships among simple, partial and multiple correlation coefficients – Simple Problems.					
		Unit III Concept of Regression - Simple Linear and Non-Linear Regression - Least square estimation of regression coefficients and its Properties - Regression equation - Fitting a straight line by least squares - Curve fitting - Fitting of Power Curve and Exponential Curve - Simple problems.					
		Unit-IV Concept of Multiple Regression – Objectives of multiple regression analysis – Multiple regression coefficients – Multiple linear regression equation (three variables only) - Normal equations for the least square regression plans – Simple problems.					
		Unit-V Restricted regression estimation under exact, stochastic and mixed restrictions - models with stochastic regressors - errors in variable model - instrumental variable estimator.					

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. Montgomery (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 (2011) — Theory, Methods, and Applications, Springer-Verlag, Berlin.
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/Chapter15Regression-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 model's assumptions

CLO-3 Check model adequacy

CLO-4 Know about variable selection

CLO-5 Know about nonlinear regression models

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

Title of the Course		Econometrics					
Paper Number		Elective – III					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		--		5
Pre-requisite		Basic of Econometrics					
Objectives of the Course		The main objectives of this course are: 1.To understand Micro Economics and Macro Economics 2. To identify the appropriate models for econometrics 3. To understand the demand analysis 4. To analyze and testing the econometric theory					
Course Outline		Unit I Definition, Scope and Importance of Micro Economics – Law of Demand – Elasticity of Demand – Utility Analysis – Consumer Surplus – Production Function – Factor of Production – Producer’s Surplus.					
		UNIT II Definition, Nature and Scope of Macro Economics – Circular flow of Income in an Open Economy – National Income Accounting – Definition – Concepts: GNP, NNP, GDP, NDP, Personal Income, Per Disposable Income.					
		Unit III Definition – Scope – Objectives of Econometrics – Limitations – Divisions of Econometrics. Single equation model two variable case – Reasons for introducing error term in the model – Estimation of error variance – Simple problems.					
		Unit IV General Linear model - Assumptions- Least square method of estimation and testing of parameters of the model – problems under failure of assumptions. Concepts of price, supply, elasticity of price, elasticity of supply – simple problems.					
		Unit V Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity, specification error.					

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
Reference Books	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. 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. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited, 6. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wiley & Sons. 7. Gupta S.P. & Kapoor V.K., (2019) Fundamentals of Applied Statistics, Sultan Chand & Sons. 8. Peter R Cox, (1979) Demography, 5th Edition, Vikas Publishing House. 9. Agarwal S.N, (1981) India's Population Problems, Tata McGraw Hill. 10. Srinivasan, K, (1998) Basic Demographic Techniques and Applications, Sage Publications, New Delhi.
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 To Understand Micro Economics and Law of Demand.

CLO-2 To Understand consumer surplus and producer's surplus.

CLO-3 To Analyze Macro Economics and Open Economy.

CLO-4 To Understand GNP, NNP, GDP and NDP.

CLO-5 To apply price, demand and supply.

CLO-6 To interpret Multicollinearity and Specification error.

	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		Practical I						
Category	Core	Year	I	Credits	3	Course Code		
		Semester	II					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		-		-		3		3

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. Fitting of Normal distribution - Direct Method using MS Excel.
11. Problems based on univariate probability distributions.
12. Problems based on simple, conditional and Binomial probability.
13. Calculating Inverse matrix using MS Excel.
14. Calculating Transpose matrix using MS Excel.
15. Calculating Rank matrix using MS 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.

Examinations Distribution of Marks

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

Title of the Course		Practical – II (Statistical Software Using R)					
Paper Number		Practical – II					
Category	Core	Year	II	Credits	2	Course Code	
		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 discrete and continuous distribution.
2. To provide practical application of Trapezoidal and Simpson's Rules.
3. To apply Analysis of Life Tables.
4. To provide practical application knowledge of Systematic and Cluster Sampling methods.
5. Understand the methods of Non-parametric test.

Programming Exercises:

1. Simulation of Binomial, Poisson, and Normal Distributions Using R
2. Estimation of Binomial and Normal Distribution Parameters Using Maximum Likelihood Method Using R
3. Goodness of Binomial and Poisson fit Tests for Statistical Distributions Using R
4. Solution of Binomial, Poisson, and Normal Algebraic Equations Using Bisection and Newton–Raphson Methods Using R
5. Numerical Integration Using Trapezoidal and Simpson's Rules Using R
6. Construction and Analysis of Life Tables Using R
7. Calculation of Fertility, Mortality, and Population Growth Rates Using R
8. Simple Random Sampling and Estimation of Population Parameters Using R
9. Stratified Sampling Techniques and Allocation Methods Using R
10. Systematic and Cluster Sampling Methods Using R
11. Simple Linear Regression Analysis Using R
12. Fitting a Trend Line for Time Series Data Using R
13. Moving Average Method for Basic Forecasting Using R
14. Sign Test for One-Sample Median Using R
15. Wilcoxon Signed-Rank Test for Paired Samples Using R

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 (Calculator Based)					
Paper Number		Practical III					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		3		5
Objectives of the Course		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 learn problems of Transition probability matrix and Markov chain. 4.Draw $\bar{X}$, R and σ control charts for variables and p, np and c charts for attributes to interpret them. 5.Apply the theoretical concepts and solve the problems based on one missing observation and two missing observations in RBD and LSD. 6.Analyze and interpret data for 2^2 and 2^3 factorial experiments by using Yates Algorithm					
Course Outline		Unit I Testing of hypothesis on the parameters of Binomial, Normal, Exponential and Cauchy distributions – Construction of confidence interval for mean and variance.					
		Unit II Transition probability matrix-stationarity of Markov chain and graphical representation of Markov chain.					
		Unit III Test of significance: Large sample - Single proportion- difference of proportions – Single mean – difference of two means – correlation coefficient – Chi square test for independence of attributes					
		Unit IV Construction of control charts for variables: $\bar{X}$, R and S charts. Control charts for attributes of fixed and varying sample size – p, np and C charts.					
		Unit V Analysis of CRD, RBD and LSD - Missing plot techniques in RBD and LSD with one missing observation – Analysis of factorial experiments 2^2 and 2^3 of Yates Algorithm.					

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 Mark

Title of the Course		Practical – IV (Statistical software using Python)						
Paper Number		Practical – IV						
Category	Core	Year	III	Credits	5	Course Code		
		Semester	VI					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		2		-		3		5

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. Apply the theoretical concepts and solve the problems based on one missing observation on LSD.
3. To enable the students to gain practical knowledge of transition probability matrix.
4. Apply the methods of estimating net migration rates.
5. Execute the various fertility measures sources of demographic data.
6. To apply acceptance sampling plan.

Programming Exercises:

1. Large Sample tests for means, proportions in Python.
2. Large Sample tests for standard deviations and correlation coefficient in Python.
3. Small sample tests for single mean in Python.
4. Small sample tests for difference of means and correlation coefficient in Python.
5. One Way ANOVA in Python – Loading and preparing data, conducting Python functions, Interpreting the results & Visualizing one way ANOVA in Python.
6. 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 in Python.
7. Missing plot techniques – Estimating One missing observation, Two missing observations in LSD in Python.
8. Transition probability matrix in Python.
9. Probabilities of birth and death process in Python.
10. Creating an Actuarial table to input interest rate in Python.
11. Creating functions Increasing and Decreasing life insurances in Python.
12. Increasing and decreasing annuities both due and immediate in Python.

13. Calculates the values of risk-free rate in Python.
14. Analysis of single sampling plan with OC, AOQ, ATI and ASN curve in Python.
15. Analysis of double sampling plan with OC, AOQ, ATI and ASN curve in Python.

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		Operations Research - I					
Paper Number		Allied – III					
Category	Core	Year	II	Credits	4	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		--		5
Pre-requisite		Linear algebra					
Objectives of the Course		The main objectives of this course are: 1. To introduce the concepts, models and problem-solving techniques in optimization problems. 2. To solve the linear programming problems using various methods. 3. To implement operation research models for solving transportation and assignment problems. 4. To learn and understand sequencing problems with n-jobs and m-machines. 5. To acquire knowledge in application of queuing models in business for making decisions.					
Course Outline		Unit I Origin – Nature of OR – Characteristics of OR – Models in OR – Phases of OR – Uses and Limitations of OR – Mathematical Formulation of LPP – Solution of LPP by Graphical Method.					
		Unit II Solution of LPP by Simplex Method – Big-M method – Duality in LPP – Dual Simplex Method - Simple Problems.					
		Unit III Transportation Problem – Formulation – Balanced, Unbalanced Transportation Problem – Initial Basic Feasible Solution – North West Corner Rule – Least Cost Method – Vogel’s Approximation Method – Optimum solution – MODI method.					
		Unit-IV Solution of Balanced and Unbalanced Assignment Problems – Sequencing Problem – Problems with n - jobs through two machines – n-jobs through three machines – Problems with n-jobs and m-machines.					
		Unit-V Basic concepts of queueing theory - Characteristics of a queueing model – classification of queueing models- Average waiting time, expected queue length - variance of queue length - Expression for probability of n customers in the system p(n) for the queueing models (M/M/1: ∞/FIFO) and (M/M/1: N/FIFO) - Simple problems.					

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.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. 3.Gupta, P.K., and Man Mohan. (1979). Operations Research: Linear Programming and Theory of Games, Third Edition, Sultan Chand and Sons, New Delhi. 4.Dr. B. S. Goel & Dr. S. K. Mittal, Operations Research, Pragathi Prakasam Publishers. 5.Nita H. Shah, Ravi M. Gor, Hardik Soni (2010), Operations Research, PHI Learning Private Limited, New Delhi.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject ❖ http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf ❖ http://www.uky.edu/~dsianita/300/online/LP.pdf ❖ http://web.tecnico.ulisboa.pt/mcasquilho/compute/_linpro/Taylor B_module_b.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Gain knowledge about various optimization techniques.

CLO-2 Solve the problems related to business and industries by using linear programming techniques.

CLO-3 Execute operations research techniques for finding the optimum solution in real life situations.

CLO-4 Solve the sequencing and transportation

CLO-5 Solve the assignment problems

CLO-6 Understand the characteristics of a queuing system.

	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

Title of the Course		Operations Research - II					
Paper Number		Allied – IV					
Category	Core	Year	II	Credits	3	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	1		--		3
Pre-requisite		Linear algebra					
Objectives of the Course		The main objectives of this course are: 1. To enable the students to gain knowledge about various decision techniques. 2. To learn Pure Strategic and mixed Strategic game methods for solving game theory problems. 3. To acquire knowledge in various techniques of network planning. 4. To understand the methods of analysing replacement problems. 5. To impart the applications of operations research in management.					
Course Outline		Unit I Game Theory Basic definitions – Two person’s zero sum games – Pure strategic game – Maximin and Minimax Principles – Mixed strategic game – Dominance property – Graphical solutions of 2 x n and n x 2 games.					
		Unit II Network Analysis Network Analysis – Basic concepts – Construction of Network – Time calculations – Critical Path Method (CPM) – Program Evaluation Review Technique (PERT) – Finding optimum project duration and cost consideration in project scheduling.					
		Unit III Replacement Problems Replacement policy of items whose maintenance cost increases with time and the value of money remains constant – Replacement policy of items whose maintenance cost increases with time and the value of money also changes with time – Replacement of items that fail completely – Group replacement policy.					
		Unit-IV Inventory Control Concept of Inventory Model – Types of Inventories – Inventory decisions – Costs associated with inventories – Inventory models – Factors affecting inventory control – Deterministic inventory problems with no shortages and shortages.					
		Unit-V Decision Theory Introduction – Types of decision-making environment – Decision making under uncertainty – Maximin criterion, Maximax criterion, Minimax criterion, Laplace criterion and Hurwitz criterion – Decision making under risk – EMV, EOL and EVPI – Decision tree analysis.					

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	4. Kanti Swarup, P.K. Gupta and Manmohan (2007) Operations Research, Sultan Chand Sons, New Delhi. 5. S.D. Sharma (2002): Operations Research: Kedarnath and Ramnath, Meerut. 6. J.K. Sharma (2002): Operations Research: Theory and application, Macmillan, India Ltd.
Reference Books	6. Taha: Operations Research, PHI. 7. F.S. Hiller and Liberman (1994): Operations Research, CBS Publishers and Distributions, New Delhi. 8. Gupta R. K (1985), Operations Research, Krishna Prakashan, Mandir Meerut. 9. Gupta, P.K., and Man Mohan. (1979). Operations Research: Linear Programming and Theory of Games, Third Edition, Sultan Chand and Sons, New Delhi. 10. Dr. B. S. Goel & Dr. S. K. Mittal, Operations Research, Pragathi Prakasam Publishers.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject ❖ https://www.cs.umd.edu/~nau/cmssc421/game-theory.pdf ❖ http://www.yorku.ca/ptryfos/ch3000.pdf

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Take appropriate decisions for solving the problems of game theory.

CLO-2 Solve the problems based on deterministic inventory model.

CLO-3 Apply PERT and CPM techniques in research and construction projects.

CLO-4 Know the decision-making environments and methods.

CLO-5 Know various O.R. techniques and to apply them in real life problems.

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

Title of the Course		Allied Practical - II					
Paper Number		Operations Research					
Category	Core	Year	II	Credits	2	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		-	-		2	2	
Objectives of the Course		The main objectives of this course are: 1. To enable the students to gain practical knowledge of Optimization techniques. 2. To apply the Transportation Problem. 3. To Provide Practical Knowledge in Game Theory, Decision Theory and Replacement Problems.					
Course Outline		UNIT I Linear programming problem – Graphical Method – Simplex Method – Big M – Method (Not more than three constraints)					
		Unit II Transportation Problem – Basic feasible solutions – By NWC rule – Matrix minima – Vogel’s Approximation Method – Optimum solution by MODI Method – Balanced & Unbalanced TP. Assignment Problem – Balanced.					
		Unit III Game Theory – Pure and Mixed Strategy situation with and without saddle point - Dominance rule – Graphical method for 2 x n and n x 2 Game.					
		Unit-IV Decision theory - Decision making under deterministic & probabilistic situations – EMV. Sequencing problem n jobs on two machines and n jobs on three machines					
		Unit –V Replacement problem – Items that deteriorate gradually and money value constant with time – Money value changing with time. Network analysis – Critical Path Method (CPM and PERT)					

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		Demography					
Paper Number		SEC - I					
Category	Core	Year	II	Credits	2	Course Code	
		Semester	III				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		2		-		-	2
Pre-requisite		Demographic Studies					
Objectives of the Course		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					
Course Outline		Unit I Sources of Demographic data – civil registration – Population Census registers – errors in demographic data.					
		Unit II Fertility and mortality measurements – general and specific rates – standardized rates – age pyramid of sex composition gross and net reproduction rates.					
		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.					
		Unit-IV Spatial distribution of population –migration – kinds of migration – factors important in migration analysis – migration defining period and boundary.					
		Unit-V Components of population growth and change – Demographic transition theory – Methods of population projection – component method of projection, Leslie matrix.					
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. Berclay, G.W. (1959): Techniques of Population Analysis 2. Benjamin, B (1968): Health and Vital Statistics, Allen & Unwin Srivastava 3. O.S. (1983): A text book of Demography, Vikas Publishing. 4. Bogue, Donald J: Principles of Demography (1976) John Willey, New York 5. K.Srinivasan, (1998), – Basic Demographic Techniques and Applications, Sage Publications, Thousand Oaks, California.
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 ❖ https://censusindia.gov.in ❖ https://nptel.ac.in

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		NON-PARAMETRIC TESTS						
Paper Number		SEC - II						
Category	Core	Year	II	Credits	2	Course Code		
		Semester	IV					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		2		-		-		2
Pre-requisite		Basic knowledge of statistics, probability, sampling methods, and hypothesis testing.						
Objectives of the Course		The main objectives of this course are: 1. To learn what non-parametric tests are and how they differ from parametric methods. 2. To choose suitable tests when data is not normal, small, or based on ranks. 3. To develop knowledge of statistical tests 4. To use appropriate non-parametric tests to analyze practical problems. 5. To compare different statistical methods 6. To analyze relationships between variables						
Course Outline		Unit I Introduction to Non-Parametric Test: Definition, Assumptions and when to use non-parametric tests - limitations, advantages and disadvantages of Non- parametric Methods, areas of applications, Parametric versus Non – parametric.						
		Unit II Sign test – one sample and two sample test, Wald-Wolfowitz runs test, One – Sample Location Test, Mann-Whitney U test.						
		Unit III Wilcoxon Signed – Ranks Test, Median Test, Kolmogorov - Smimov one and two sample test, Normal Score Test.						
		Unit-IV Kruskal – Wallis Test: A Test for equality of locations of k (> 2) Independent Populations (Non-Parametric One Way ANOVA), Friedman Test (Non-Parametric Two Way ANOVA), Assumptions and procedures - Applications in real data.						
		Unit-V Chi-Square Test - Goodness of fit -Test of independence, Measures of Association for Bivariate Samples: definition of measures of association in a bivariate population, Kendall's Tau coefficient, Spearman' s coefficient of rank correlation.						

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. J. D. Gibbons (1976): Non-parametric methods for quantitative analysis, New York. 2. J. V. Desphande, A. P. Gune and A. Shanubhogur, (1995), Statistical Analysis of Nonnormal Data. John Wiley & Sons, New York. 3. Richard I. Lerin: (2008), Statistics for Management, Practice Hall of India, New Delhi.
Reference Books	1. Siegel, S. (1988). Non parametric Statistics for the behavioral sciences, (2nd Edition), McGraw-Hill. 2. Kloeke, J. and McKean. J.W(2024). Non parametric Statistical methods using R, (2nd Edition), CRC Press.
Website and e-Learning Source	e-books, tutorials on MOOC/SWAYAM courses on the subject ❖ https://www.researchgate.net/publication/353444454_Chapter_4_Non-Parametric_Tests ❖ https://statsmasters.com/lessons/non-parametric-tests/ ❖ https://vrcacademy.com/tutorials/non-parametric-tests-comprehensive-guide/

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Ability to analyse data without assuming normal distribution

CLO-2 Work with ordinal and rank-based data.

CLO-3 To Understand correct decisions based on data conditions.

CLO-4 Application of tests like Sign Test, Mann–Whitney U Test, Wilcoxon Test, Kruskal–Wallis Test, Chi-Square Test.

CLO-5 To Apply with non-normal, small, or incomplete datasets.

CLO-6: Identify different statistical methods.

	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		Introduction to Python Programming					
Paper Number		SEC III					
Category	Core	Year	III	Credits	2	Course Code	
		Semester	V				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	1		--		3
Pre-requisite		Knowledge of R/Python					
Objectives of the Course		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.					
Course Outline		UNIT – I Introduction to Python – Data types, Variables, Basic Input – Output Operations, Basic Operators					
		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.					
		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.					
		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.					
		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.					
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					

References Books	1. Allen Downey, Jeffrey Elkner, Chris Meyers, how to think like a computer scientist: learning with Python, freely available online. 2012
Website Links	❖ Python Tutorial/Documentation www.python.org 2015 ❖ http://docs.python.org/3/tutorial/index.html ❖ http://interactivepython.org/courselib/statistics/python/ ❖ 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 be 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

S. No.	Paper code	Title of the Course	Page No.
1.		Allied Statistical Methods I	95
2.		Allied Statistical Methods II	98
3.		Allied Statistics Practical	101
4.		Allied Bio - Statistics – I	102
5.		Allied Bio - Statistics - II	105
6.		Allied Statistics Practical	108
7.		Statistical methods & its applications I	109
8.		Statistical methods & its applications II	112
9.		Allied Statistics Practical	115
10.		Statistical methods for Economics - I	116
11.		Statistical methods for Economics - II	119
12.		Allied Statistics – I	122
13.		Allied Statistics – II	125
14.		Business Statistical Methods – I	128
15.		Business Statistical Methods – II	131

Title of the Course		Allied - Statistical Methods – I (For B.Sc., Mathematics/ B.Sc., Mathematics (CA))					
Paper Number							
Category	Allied	Year	I / II	Credits	4	Course Code	
		Semester	I / III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	-		--		4
Pre-requisite		Basis of Statistics					
Objectives of the Course		1. Understand the concept of Probability and Random variables. 2. Apply the methods of Mathematical expectation, Averages, Correlation and Regression. 3. Analyse the probability distributions. 4. Extend the applications of probability distributions, statistical tools. 5. Evaluate the numerical examples.					
Course Outline		Unit I Probability, Random Variable and Mathematical Expectation Definitions – 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.					
		UNIT II Discrete and Continuous Distributions Binomial and Poisson Distributions – Derivations – Properties and Applications - Simple Problems – Normal distribution – Derivations – Properties and Applications - Simple Problems.					
		Unit III Measures of Central Tendency, Measures of Dispersion and Skewness Definitions – Mean, Median, Mode, Geometric mean, Harmonic mean – Merits and demerits – Range, Quartile deviation, Mean deviation and their Co-efficient - Standard deviation – Co-efficient of Variation - Merits and demerits – Measure of Skewness – Karl Pearson’s and Bowley’s Co-efficient of Skewness.					
		Unit IV Curve Fitting Method of least square – Fitting of a straight line and second degree Parabola, Fitting of Power Curve and Exponential Curve – Simple Problems.					

	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 – Regression equations.
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
References Books	1. Gupta S. C and Kapoor V. K (2004), Fundamentals of Mathematical Statistics, (11 th 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 (7 th Edition), Sultan Chand & Sons, New Delhi. 4. Hogg R. V., Allen T. Craig, Joseph W. McKean, (2013) Introduction to mathematical statistics, Pearson Education. 5. Agarwal B. L. (2006) Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 6. Marek Fisz, (1963) Probability theory and Mathematical Statistics, John Wiley and Sons, New York. 7. Rohatgi V. K, (1976) An Introduction to Probability theory and Mathematical Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 8. Arora P. N. and Malhan, P.K. (2014) Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 9. Vittal P. R. (2004) Mathematical Statistics, Margham Publications, Chennai. 10. Hoel P. G. (1971) Introduction to Mathematical Statistics, (4 th Edition) Asia Publishing House, New Delhi.
Web links	❖ 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/ Curve Fitting ❖ 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

Title of the Course		Allied – Statistical Methods - II (For B.Sc., Mathematics/ B.Sc., Mathematics (CA))						
Paper Number								
Category	Allied	Year	I / II	Credits	4	Course Code		
		Semester	II / IV					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		--		4
Pre-requisite		Basis of Statistics						
Objectives of the Course		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.						
Course Outline		UNIT – I Point Estimation Concept of Population and Sample – Parameter and Statistic – Point Estimation – Consistency – Unbiasedness – Efficiency (Cramer – Rao inequality) and Sufficiency (Rao – Blackwell Theorem).						
		UNIT – II Methods of Estimation and Interval Estimation Maximum likelihood Estimator (MLE) and Methods of Moments – Properties of these estimators – Interval estimation (concept only).						
		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.						
		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.						
		UNIT – V Test of Significance (Small Sample Tests) Exact sample test based on t and F Distributions with regard to Mean, Variance and Correlation coefficient – Chi-square test, Goodness of fit and independence of attributes.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.						
References Books		1. Gupta. S. C. and Kapoor. V. K. (2004) – Fundamentals of Mathematical Statistics – (11 th Edition), Sultan Chand & Sons, New Delhi. 2. Saxena H.C. (2006) Statistical Inference, S. Chand & Company Private Ltd, New Delhi. 3. Goon A. M, Gupta M. K, Das Gupta, B. (2008) 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.						

	5. Sancheti. D. C. and Kapoor. V. K. (2007) Statistics (7 th Edition), Sultan Chand & Sons, New Delhi. 6. Snedecor G.W. and Cochran W.G. (1989) Statistical Methods, Oxford Press and IBH Publishing Co., New Delhi. 7. Agarwal B. L. (2006) Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 8. Arora P. N. and Malhan, P.K. (2014) Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 9. Vittal P. R. (2004) Mathematical Statistics, Margham Publications, Chennai. 10. Robert V. Hogg and Elliot A. Tanis, (2010) Probability and Statistical inference, (8 th Edition) Pearson Education, Boston.
Web links	❖ 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

Title of the Course		Allied – Statistics Practical (For B.Sc., Mathematics)					
Paper Number							
Category	Allied	Year	I / II	Credits	4	Course Code	
		Semester	II / IV				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		-		-		2	2
Objectives of the Course		To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.					
Course Outline		UNIT – I Random variables and Mathematical Expectation Random variables - Distribution Functions – Mathematical Expectation- Simple Problems.					
		UNIT – II Theoretical Distributions Distributions – Fitting of Binomial distribution, Poisson distributions and Normal distribution – Testing the Goodness of fit.					
		UNIT – III Measures of Central Tendency and Dispersion Computation of Measures of Central Tendency – Measures of Dispersion (absolute and relative measures) – Co-efficient of Skewness.					
		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 ($y=ax^b$) and Exponential Curve ($y=ae^{bx}$ and $y=ab^x$)– Simple Problems.					
		UNIT – V Correlation and Regression Computation of Karl Pearson’s co-efficient of correlation – Spearman’s rank correlation coefficient – Regression equations.					

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		Allied – Bio – Statistics - I (For B.Sc., Biotechnology / Bio – Chemistry / Micro Biology)						
Paper Number								
Category	Allied	Year	I / II	Credits	4	Course Code		
		Semester	I / III					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		--		4
Pre-requisite		Basis of Statistics						
Objectives of the Course		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.						
Course Outline		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.						
		UNIT II Measures of Central Tendency Definitions – Mean – Median – Mode – Geometric mean – Harmonic mean – Characteristics of a good average – Merits and demerits.						
		Unit III Measures of Dispersion Range - Quartile deviation – Mean deviation and their co-efficient – Standard deviation – Co-efficient of variation – Merits and demerits.						
		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.						
		Unit V Probability Definition of Probability – Addition and Multiplication Theorems – Conditional Probability – Simple Problems.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						

References Books	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. 5. Daniel. W. W, (1987), Bio-Statistics, John Wiley and Sons, New York. 6. Beth Dawson and Robert G Trapp (2004), Basic and Clinical Biostatistics, McGraw Hill, New Delhi. 7. Zar J.H. (2010) Bio Statistical Analysis, Prentice Hall of India, New Delhi. 8. Bernard Rosner, (2016) 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, (1952) Advanced Statistical Methods in Biometric Research, John Wiley, New York.
Web links	❖ 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

Title of the Course		Allied – Bio – Statistics -II (For B.Sc., Biotechnology / Bio – Chemistry / Micro Biology)					
Paper Number							
Category	Allied	Year	I / II	Credits	4	Course Code	
		Semester	II / IV				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		-		--	4
Pre-requisite		Basis of Statistics					
Objectives of the Course		1. To impart statistical concepts with rigorous mathematical treatment. 2. To introduce concepts of statistical hypothesis.					
Course Outline		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.					
		UNIT II Discrete Probability Distribution Binomial and Poisson Distributions – Mean and Variance of Distributions – Recurrence formula – Fitting of Binomial and Poisson Distributions - Simple Problems.					
		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.					
		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.					
		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.					
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					

References Books	1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014), 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 and Malhan, P.K. (2014), Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 6. Murthy M. N (1978), Sampling Theory and Methods, Statistical Publishing Society, Kolkata. 7. Pillai R. S. N. and Bagavathi. V. (1987), Practical Statistics, Sultan Chand & Company Ltd., New Delhi. 8. Agarwal B. L, (2006), 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., (1989), Statistical Methods, Oxford Press and IBH Publishing Co., New Delhi.
Web links	❖ https://www.tutorialspoint.com/statistics/data_collection.htm ❖ https://seeing-theory.brown.edu/probability-distributions/index.html ❖ https://statisticsbyjim.com/regression/curve-fitting-linear-nonlinear-regression/ ❖ https://www.investopedia.com/terms/c/chi-square-statistic.asp

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

Title of the Course		Allied – Statistics Practical (For B.Sc., Biotechnology / B.Sc., Biochemistry / Micro Biology)					
Paper Number							
Category	Allied	Year	II	Credits	4	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		-	-		2		2
Objectives of the Course		To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.					
Course Outline		UNIT – I Collection and Presentation of Statistical Data Diagrammatic and Graphical Representation of Statistical Data (Histogram, Frequency Polygon, Frequency curves and O-give).					
		UNIT – II Measures of Central Tendency and Dispersion Computation of Measures of Central Tendency (Mean, Median, Mode, Geometric Mean & Harmonic Mean) - Computation of Measures of Dispersion (absolute and relative measures) - Coefficient of Variation.					
		UNIT – III Correlation and Regression Computation of Karl Pearson’s Coefficient of Correlation and Spearman’s Rank Correlation Coefficient – Regression equations (two variables only).					
		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.					
		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.					

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		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						
Category	Allied	Year	I/II	Credits	3	Course Code		
		Semester	I/ III					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		2		2		-		4
Pre-requisite		Basis of Statistics						
Objectives of the Course		1. Analyze 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.						
Course Outline		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.						
		UNIT II Measures of Central Tendency Mean, Median, Mode, Geometric mean, Harmonic mean – Characteristics of a good average – Merits and demerits.						
		Unit III Measures of Dispersion Range – Quartile deviation – Mean deviation and their coefficients – Standard deviation – Coefficient of variation – Merits and demerits.						
		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.						
		Unit V Probability Definition of Probability – Addition and Multiplication Theorems– Conditional probability – Simple Problems.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.						
References Books		1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014) Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi						

	3. Pillai R. S. N. and Bagavathi. V. (2005), Statistics, Sultan Chand & Company Ltd., New Delhi. 4. Sancheti D. C. and Kapoor. V. K (2005), Statistics (7 th Edition), Sultan Chand & Sons, New Delhi. 5. Arora, P. N and Malhan, P.K, (2014) Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 6. Murthy M. N (1978), Sampling Theory and Methods, Statistical Publishing Society, Kolkata. 7. Pillai R. S. N. and Bagavathi. V. (1987), Practical Statistics, Sultan Chand & Company Ltd., New Delhi. 8. Agarwal B. L, (2006) 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., (1989) Statistical Methods, Oxford Press and IBH.
Web links	❖ 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.

CLO-6 Understand the concept of Probability.

	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		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						
Category	Allied	Year	I/II	Credits	3	Course Code		
		Semester	II/IV					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		-		4
Pre-requisite		Basis of Statistics						
Objectives of the Course		1. To impart statistical concepts with rigorous mathematical treatment. 2. To introduce concepts of statistical hypothesis.						
		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.						
		UNIT II Discrete Probability Distribution Binomial and Poisson Distributions – Mean and Variance of Distributions – Recurrence formula – Fitting of Binomial and Poisson Distributions - Simple Problems.						
		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.						
		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.						
		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.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						

References Books	1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014) 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. and Malhan, P.K. (2014) Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 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, (2006) 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., (1989) Statistical Methods, Oxford Press and IBH Publishing Co., New Delhi.
Web links	❖ https://www.tutorialspoint.com/statistics/data_collection.htm ❖ https://seeing-theory.brown.edu/probability-distributions/index.html ❖ https://statisticsbyjim.com/regression/curve-fitting-linear-nonlinear-regression/ ❖ https://www.investopedia.com/terms/c/chi-square-statistic.asp

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

Title of the Course		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.,)					
Category	Allied	Year	I / II	Credits	4	Course Code	
		Semester	II /IV				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		-		-		2	2
Objectives of the Course		To impart knowledge about the basis of data analysis related to various activities like production, consumption, distribution, bank transactions, insurance and transportation.					
Course Outline		UNIT – I Collection and Presentation of Statistical Data Construction of Uni-variate frequency distribution – Diagrammatic and Graphical Representation of Statistical Data.					
		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.					
		UNIT – III Correlation and Regression Computation of Karl Pearson’s Coefficient of Correlation and Spearman’s Rank Correlation Coefficient – Regression equations (two variables only).					
		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.					
		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.					

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

Title of the Course		For B.A. (Economics) STATISTICAL METHODS FOR ECONOMICS - I					
Category	Allied	Year	I/II	Credits	3	Course Code	
		Semester	I/ III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	-		--		4
Pre-requisite		Basis of Statistics					
Objectives of the Course		To introduce statistical concepts and develop analytical skills through economic barometers.					
		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.					
		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.					
		UNIT III Graphical representation of Data Graphical representation – Histogram – Frequency polygon – Frequency curve – Ogives curve and Lorenz curve.					
		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.					
		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.					
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.					
References Books		1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014) 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, and Malhan, P.K. (2014), Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi.					

	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, (2006) 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.
Web links	❖ 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

Title of the Course		For B.A. (Economics) STATISTICAL METHODS FOR ECONOMICS - II					
Category	Allied	Year	I/II	Credits	3	Course Code	
		Semester	II/ IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	-		--		4
Pre-requisite		Basis of Statistics					
Objectives of the Course		To enable the students to understand the elementary concepts in statistical analysis					
		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.					
		UNIT II Regression Meaning of Regression – Fitting of Regression lines – Regression Equations – Uses in Economics.					
		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.					
		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.					
		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.					
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
References Books		1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014) 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, and Malhan, P.K. (2014) Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 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, (2006) 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.
Web links	❖ 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

Title of the Course		Allied – Statistics - I (For B.Sc. Geography)						
Category	Allied	Year	I / II	Credits	3	Course Code		
		Semester	I / III					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		-		4
Pre-requisite		Basis of Statistics						
Objectives of the Course		1. To introduce concepts of statistical hypothesis 2. To introduce the statistical concepts and develop analytical skills.						
Course Outline		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.						
		UNIT II Measures of Central Tendency Definitions – Mean – Median – Mode – Geometric mean – Harmonic mean – Characteristics of a good average – Merits and demerits.						
		Unit III Measures of Dispersion Range – Quartile deviation – Mean deviation and their coefficients – Standard deviation – Coefficient of variation – Merits and demerits.						
		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.						
		Unit V Probability Definition of probability – Addition and multiplication theorems – Conditional probability - Simple Problems.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						
References Books		1. Gupta S. C and Kapoor V. K (2004), Fundamentals of Mathematical Statistics, (11 th 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, (2013) Introduction to mathematical statistics, (7 th Editon) Pearson						

	Education, New Delhi. 5. Agarwal B. L, (2006) Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. Marek Fisz, 6. Rohatgi, V.K. (1976) An Introduction to Probability theory and Mathematical Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 7. Arora P. N, and Malhan, P.K. (2014) Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi. 8. Vittal P. R, (2004) Mathematical Statistics, Margham Publications, Chennai. 9. Hoel P. G, (1971) Introduction to Mathematical Statistics, Asia Publishing House, New Delhi.
Web links	❖ 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

Title of the Course		Allied - Statistics – II (For B.Sc., Geography)						
Paper Number								
Category	Allied	Year	I / II	Credits	3	Course Code		
		Semester	II / IV					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		--		4
Pre-requisite		Basis of Statistics						
Objectives of the Course		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.						
Course Outline		Unit I Sampling Methods Definitions – Sampling methods – Simple, Stratified and Systematic Sampling (concept only) – Merits and demerits – Concept of sampling and Non-sampling errors.						
		UNIT II Test of Significance (Large sample test) Sampling distribution and Standard error – Hypothesis - Types of hypotheses - Types of errors - Test of Significance: Large sample tests for proportion, difference of proportions, mean and difference of means - Simple problems.						
		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.						
		Unit IV Analysis of Variance F-test – Analysis of Variance (ANOVA) – Test procedure for One way and Two-way classifications – Simple Problems.						
		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.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill						
References Books		1. Gupta S. C and Kapoor V. K (2004), Fundamentals of Mathematical Statistics, (11 th 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, (2013) Introduction to mathematical statistics, Pearson Education, New Delhi. 5. Agarwal B. L, (2006) Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 6. Marek Fisz, (1963) Probability theory and Mathematical Statistics, John Wiley and Sons, New York. 7. Rohatgi V. K, (1976) An Introduction to Probability theory and Mathematical Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 8. Vittal P. R, (2004) Mathematical Statistics, Margham Publications, Chennai. 9. Hoel P. G, (1971) Introduction to Mathematical Statistics, Asia Publishing House, New Delhi.
Web links	★ 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

Title of the Course		Allied – For ALL UG Commerce Common for B. Com / B. Com (CA) / B. Com (A & F) / B. Com (FMA) Business Statistical Methods - I						
Category	Allied	Year	I/II	Credits	3	Course Code		
		Semester	I/ III					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		--		4
Pre-requisite		Undergraduate Level Distribution Theory						
Objectives of the Course		1. On successful completion of this course, students will be able to acquire knowledge of measures of central tendency, dispersion, and skewness. 2. To apply and compute correlation, regression, and statistical measures in real-life data analysis. 3. To analyse and interpret index numbers and time series data for practical decision-making.						
Course Outline		Unit I Measures of Central Tendency: Arithmetic Mean, Median, Mode-Geometric Mean - Harmonic Mean.						
		UNIT II Measures of Dispersion: Range- Quartile Deviation – Mean Deviation about Mean and its Coefficient – Standard Deviation and Variance - Coefficient of Variation. Measures of Skewness- Karl Pearson’s Coefficient of Skewness and Bowley’s Coefficient of Skewness.						
		Unit III Correlation and Regression: Karl Pearson’s coefficient of Correlation – Spearman’s Rank Correlation coefficient. Regression Analysis- Regression lines and regression equations.						
		Unit IV Index Numbers- Definition and uses of Index numbers- Construction of Index numbers- Simple and Weighted Index numbers – Time Reversal and Factor reversal tests- Fixed and Chain Base Index- Cost of Living Index numbers.						
		Unit V Time Series-Definition- Uses of Time Series- Measure of Secular trend- Measure of Seasonal Variation – Method of simple Averages only.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.						

References Books	1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014) Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi 3. Pillai R. S. N. and Bagavathi. V. (2005), Statistics, Sultan Chand & Company Ltd., New Delhi. 4. Pillai R. S. N. and Bagavathi. V. (1987), Practical Statistics, Sultan Chand & Company Ltd., New Delhi. 5. Prof P. A. Navanitham and Lakshmi M.S.V. (2007) Business Statistics, Jai Publishers, Chennai. 6. Gupta C. B (1978), An Introduction to Statistical Methods, Vikas Publishing House, New Delhi.
Website and e-Learning Sources	❖ https://www.coursera.org ❖ https://nptel.ac.in ❖ https://swayam.gov.in ❖ https://www.edx.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Apply measures of central tendency.

CLO-2 Analyze measures of dispersion.

CLO-3 Evaluate skewness of data.

CLO-4 Apply correlation and regression techniques.

CLO-5 Construct and interpret index numbers.

CLO6: Analyze time series components.

	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		Allied – For ALL UG Commerce Common for B. Com / B. Com (CA) / B. Com (A & F) / B. Com (FMA) Business Statistical Methods - II						
Category	Allied	Year	I/II	Credits	3	Course Code		
		Semester	II/ IV					
Instructional Hours per week		Lecture		Tutorial		Lab Practice		Total
		4		-		--		4
Pre-requisite		Undergraduate Level Distribution Theory						
Objectives of the Course		1. To expose the students on the application of mathematical techniques in business. 2. To enable the students to apply the techniques of operations research in solving complex business problems.						
Course Outline		Unit I Matrix: Definitions – Operations on Matrix – Determinant of Matrix. Inverse of a Matrix (Adjoint method only) – Application: Solving Linear Equations – Matrix Inverse Method; Crammers Method.						
		UNIT II Sequence and Series – Arithmetic Progression and Geometric Progression (Simple problems only). Interpolation: Binomial Expansion Method; Newton's Forward and Backward Method, Lagrange's Method.						
		Unit III Probability: Definition – Addition and Multiplication Theorems – Conditional Probability (Simple problems only).						
		Unit IV Linear Programming: Formation of LPP, Solution to LPP- Graphical Simplex Method – BIG – M Method.						
		Unit V Transportation Problem: North West Corner Method – Matrix minima (or) Least Cost Method – Vogel's Approximation Method – MODI Method.						
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.						
References Books		1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014), 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. Prof P. A. Navanitham and Lakshmi, M.S.V. (2007), Business Statistics, Jai Publishers, Chennai. 5. Kapoor V. K, (2009), Problems and Solutions in Operations Research, S. Chand & Company LTD., New Delhi. 6. Sharma A. K, (2005), Text Book of Linear Programming – I, Discovery Publishing House, New Delhi.
Website and e-Learning Sources	❖ https://www.coursera.org ❖ https://nptel.ac.in ❖ https://swayam.gov.in ❖ https://www.edx.org

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO-1 Apply Matrix and Inverse of a Matrix.

CLO-2 Analyze Sequence and Series.

CLO-3 Evaluate Binomial Expansion Method.

CLO-4 Apply Addition and Multiplication Theorems.

CLO-5 Construct Linear Programming Problem.

CLO-6 Analyze Transportation 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
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

NME FOR OTHER MAJOR

S. No.	Title of the Course	Page No.
1	Basic Statistics I	135
2	Basic Statistics II	138

Title of the Course		Basic Statistics – I					
Paper Number		NME – I					
Category	NME	Year	I / II	Credits	2	Course Code	
		Semester	I / III				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		2		-		--	2
Pre-requisite		Uses and its basics					
Objectives of the Course		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.,					
Course Outline		Unit I Introduction Meaning and Scope Statistics – Definition – Scope – Limitations – Population and Sample – Concepts of Random sampling and Non-random sampling – Basic concepts only.					
		Unit II Collection of Data Primary and Secondary data – Methods of collecting primary and secondary data - sources of data – Preparation of Questionnaire and Schedule.					
		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.					
		Unit IV Diagrammatic Representation of Data Bar Diagrams: Types of one dimensional and two dimensional bar diagrams - Pie-diagrams – Uses.					
		Unit –V Graphical Representation of Statistical Data Histogram – Frequency Polygon – Frequency curve and Cumulative Frequency curve – Ogive curves – Lorenz curve – Uses.					
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					

Reference Books	1. Gupta. S. P. (2001), Statistical methods, Sultan Chand & Company Ltd., New Delhi. 2. Pillai. R. S. N. and Bagavathi. V. (2005), Statistics, Sultan Chand & Company Ltd., New Delhi. 3. Sancheti. D. C. and Kapoor. V. K, (2007) Statistics (7th Edition), Sultan Chand & Sons, New Delhi. 4. Arora P. N, and Malhan, P.K. (2014), Comprehensive Statistical Methods, Sultan Chand & Sons, () New Delhi. 5. Agarwal B. L, (2006), Basic Statistics, Wiley Eastern Ltd., Publishers, New Delhi. 6. Vittal P. R, (2004), Business Statistics, Margham Publications, Chennai. 7. Shukla M. C and Gulshan S. S, (2008), Statistics, Sultan Chand & Sons, New Delhi. 8. Simpson G, and Kafka F, (1965), Basic Statistics, Oxford and IBH Publishing Co., Calcutta. 9. Freud J. E, (1992), Modern Elementary Statistics, (8th Edition) 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

Title of the Course		Basic Statistics – II					
Paper Number		NME – II					
Category	NME	Year	I / II	Credits	2	Course Code	
		Semester	II / IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		--		2
Pre-requisite		Statistics and its basics					
Objectives of the Course Outline		The main objectives of this course are: 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.					
		Unit I Measures of Central Tendency Definitions and concepts of Arithmetic mean Median and Mode – Merits and Demerits – Uses - Simple Problems.					
		UNIT II Measures of Dispersion Range, Quartile deviation and their relative measures - Standard deviation and Coefficient of variation - Simple Problems.					
		Unit III Correlation Karl Pearson’s coefficient of correlation and Spearman’s rank correlation coefficient – Simple Problems.					
		Unit IV Time series Measures of trend – Graphic method – Semi average method and Moving Average method - Simple Problems.					
		Unit V Index Numbers Un weighted and Weighted Index Numbers: Laspeyre’s, Paasche’s and Fisher’s method – Cost of living index numbers – Simple Problems.					
Skills acquired from this Course		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill					
Reference Books		1. Gupta S. P. (2001), Statistical Methods, Sultan Chand & Sons, New Delhi. 2. Gupta. S. C. and Kapoor. V. K. (2014) Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi 3. Pillai R. S. N. and Bagavathi. V. (2005), Statistics, Sultan Chand & Company Ltd., New Delhi. 4. Pillai R. S. N. and Bagavathi. V. (1987), Practical Statistics, Sultan Chand & Company Ltd., New Delhi. 5. Prof P. A. Navanitham and Lakshmi M.S.V. (2007) Business Statistics, Jai Publishers, Chennai.					

	6. Gupta C. B (1978), An Introduction to Statistical Methods, Vikas Publishing House, New Delhi.
Website and e-Learning Source	❖ 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

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