

RAJAH SERFOJI GOVERNMENT COLLEGE
(AUTONOMOUS AND NAAC "A" GRADE & DST-FIST College)
THANJAVUR-613005

PG DEPARTMENT OF STATISTICS



UG PROGRAMME: B.Sc., STATISTICS

CBCS- COURSE PATTERN (2022-2023 onwards)
BOARD OF STUDIES
2022-2023 (DATE: 18.08.2022)
SEMESTER WISE DISTRIBUTION OF
PAPERS (COURSES)



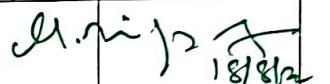
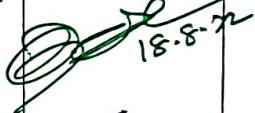
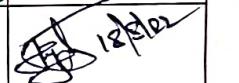
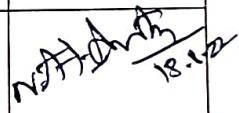
RAJAH SERFOJI GOVT. COLLEGE (AUTONOMOUS), THANJAVUR - 613 005.

Reaccredited of A Grade by NACC
(Affiliated to Bharathidasan University, Tiruchirapalli)
Thanjavur -613 005 , Tamilnadu, India.

BOARD OF STUDIES IN STATISTICS
MINUTES OF THE MEETING HELD ON 18TH AUGUST'2022

The meeting of the Board of Studies in Statistics, for the Academic year 2022 -2023 was held on 18th August at 10.AM at Department of Statistics, Rajah Serfoji Govt. College (Autonomous), Thanjavur -613 005.

The following members attended the meeting:

S.No	NAME	MEMBERS	ADDRESS	SIGNATURE
1.	Prof. V. Murugesan	Chairperson	Asst. Professor and HOD, Department of Statistics, RSGCA, Thanjavur -5	
2.	Dr. H. Alexis Selvaraj	Subject Expert & University Nominee	Asst. Professor and HOD, Department of Statistics, Thanthai Periyar Govt. Arts and Science College (A), Tiruchy - 23	-
3.	Dr. M. Vijayakumar	Subject Expert & Academic Council Nominee	Associate Professor, Department of Statistics, Annamalai University, Chidambaram - 608 002	
4.	Dr. R. Arumugam	Subject Expert	Assistant Professor, Department of Mathematics, Periyar Maniammai University, Thanjavur -613403	
5.	Mr. P. Jayakumar	Industrialist	Survey Supervisor, Ministry of Statistics, NSSO, (FOD) Thanjavur (SR). - 613007	
6.	Mr. N. Arokiya Joseph Antony	Alumini	Statistician & Management, Meenakshi Mission Hospital, Thanjavur - 5	
7.	Prof. M. Rajan	Faculty Member	Department of Statistics, RSGCA, Thanjavur -5	

V.MURUGESAN, Chairperson, BOS and Head, Department of Statistics, Rajah Serfoji Government College, called the meeting to order and the following business was transacted.

1. Discussions for the new structure for B.Sc, M.Sc Programmes, were made in the context of LOCF suggestive syllabus of UGC and proposed syllabus of Integrated Board of Studies of TANSCHE. Due care is taken in framing the syllabus in such a way that 75% of the contents of the mandatory courses as specified by the TANSCHE are included in the present syllabus. Each course content is set by the teacher, who is presently teaching that course or who is specialized in that particular course. They needs of the locality, relevance, and the UGC/LOCF/TANSCHE statutory requirements, are all taken into consideration while framing the syllabus and are counter-checked by the Teacher who is the immediate senior to the teacher who has set the same.

RESOLUTION [No: BOS /STAT/2022-23/1] unanimously resolved to approve the changes made in the course structure and contents of the B.Sc, M.Sc programmes

Which will be implemented from the present academic year 2022-2023

2. Discussions for the reversion of the course credits for the B.Sc /M.Sc Programmes incorporating the Extra Credit Courses for Advanced Learners were made extensively. The extra credit courses were implemented from the academic year 2020-21. These courses were introduced to improve the knowledge base of the students in their own Discipline. These are self study courses and are optional. For UG, two courses with extra credit and for PG, two courses with extra credit are included. There should be no standing arrears for opting Extra Credit Courses and similarly, Students are not permitted to write the course as arrear, if he/she fails in the courses with extra credit. In the 5th &6th semesters of the UG Programmes and PG Programme for 3rd & 4th semesters, these self-study extra credit courses are offered. On par with other part-IV courses, each self-study Extra Credit Courses also carries two credits, instead of four credits, as were awarded so far. For the UG programme, statistical softwares and non parametric techniques are the two self-study courses offered during the 5th and 6th semester respectively which may be pursued to add extra credits. Similarly, for the PG programme, Research methodology and Industrial statistics are self-study courses offered during the 3rd and 4th semester respectively, which may be pursued to add extra credits.

RESOLUTION [No.: BOS/STAT/2022-23/2] Unanimously resolved to introduce two new Extra Credit Courses for Advanced Learners separately for UG and PG

programme which are self-study In nature. Instead of choosing one Major Elective Course as an Extra Credit Course choice, it is resolved to offer two specific Extra Credit Courses, with two credits each, for each programme, from this Academic Year 2022- 23 onwards.

3. Discussion for the revision of three Discipline-specific electives were made. Two Discipline-specific electives are offered in UG the 5th semester and one in 6th semester. The Discipline-specific electives are to be chosen by the students, from the alternate choices. DSE1 set comprises of Operations research, Real analysis and matrix theory and simulation techniques. DSE2 set comprises of Indian official statistics, Econometric methods and Psychological and educational statistics and DSE3 set comprises of Regression analysis, Reliability and survival analysis and Programming C.

RESOLUTION [No.: BOS/STAT/2022-23/3] Unanimously resolved to introduce Discipline-specific electives, as mentioned in the course structure and it is suggested to add more choices in these electives in the next BOS meeting, as the contents are yet to be framed.

4. Discussions regarding the sector specific Skill based electives took place in the meeting. Presently, only one skill based paper in the 3rd 4th and 5th semesters. From the batch 2022-23 onwards, introduction of sector specific skill enhancement electives were suggested. Accordingly, the options are offered in all the three semesters. If a student chooses a skill based electives, in the next two semesters also. In the UGC-LOCF syllabus, there is an option for Statistics for Competitive Examinations, M.S. Excel and Office Automation As we have three field oriented courses as Discipline Specific Electives, three Derivatives papers are given as option C.

RESOLUTION [No.: BOS/STAT/2022-23/4] Unanimously resolved to introduce to specific Skill based elective courses with three sets containing three courses each, to be studied in the three semesters namely 3rd 4th and 5th semesters, in lines with the UGC-LOCF.

5. Discussions were made exhaustively on the feedback of the Students regarding the Curriculum and the need for more Practical papers/internship is understood. In the UG programme, Internship is given as an optional extra credit opportunity, in the fifth semester. In the PG programme, Internship is now made as an essential inbuilt core course component, which is expected to give exposure to the real-world statistics field and hands-on training in the field of the choice of the students.

RESOLUTION [No: BOS/STAT/2022-23/5] Unanimously resolved to recommend more Practical components in all the papers in the curriculum, wherever possible, and to introduce Internship programme as an optional extra credit for the PG programme in the third semester, subject to the approval of the forthcoming Academic Council.

6. Deliberation regarding offering the allied papers was made. From the academic year 2018-19 onwards, three allied courses, namely, Statistics for Mathematics-I and III and Allied statistical practical for as the three allied courses are being offered to the students of first year B.Sc, Mathematics Programme.

The Board of Studies of statistics department may decide to continue with the statistics allied courses or to have three courses again Optimization technique-I and II and Allied statistics practical-II from the batch 2022-23 or to go for three statistics courses for the second year students from the academic year 2024-25. So, whatever be the course of action, the Board of Studies of Statistics, decided to suggest three new allied courses namely, Numerical methods, Vital statistics and Allied practical as the three allied courses to the second-year students.

EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS)

Rajah Serfoji College (Autonomous), Thanjavur-5, a pioneer in higher education in Thanjavur district, Tamil Nadu (India), strives to maintain and uphold the academic excellence. It also enhances academic mobility and enriches employability. The educational system preserves the identity, autonomy and uniqueness of every department and reinforces student centric curriculum designing and skill imparting. **Preamble**

B.Sc., Statistics programme consists of 140 credits spread over six semesters. Each credit has one hour of class room teaching per week. This programme emphasizes both theory and applications of statistics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics.

Nature and Extent of the B.Sc. Statistics Programme

The B.Sc. Statistics Programme has some unique features such as independent projects, a number of elective courses including practical training on realistic problems, and extensive insight into statistical computations using standard statistical packages. Standard statistical packages, SPSS used in all practical courses and project work. The course has been designed in such a way that besides the core courses, a student can opt for outcome based elective courses from the streams such as Vital Statistics, econometrics, Survival Analysis, numerical methods Simulation and inventory control, Psychological and Educational statistics, computational statistics, Programming in C and Actuarial Statistics

B.Sc., Statistics programme is of three years duration, with semester pattern.

1. During first two semesters, students will be given the basic information that includes methods of data representation and summarization. Further, they will be introduced to probability and distributions along with applications, correlation and regression techniques.

2. During third and fourth semesters, students are expected to study distribution theory, optimization techniques statistical inference and major and allied practical.
3. During fifth and sixth semesters, majorly unique papers and practical deal with theoretical as well as applied aspects of statistics

The statistics department adheres to achieve and accomplish the following objectives.

Optimal utilization of resources both human and material for the academic flexibility leading to excellence. Students experience or enjoy their choice of courses and credits for their horizontal mobility.

The existing curricular structures as specified by TANSCHE facilitate the uniqueness of the choice based credit system.

Human excellence in specialized areas

Thrust in internship and / or projects as a lead towards research and

The multi-discipline nature of the curriculum system caters to the needs of stake-holders, especially the employers.

Credit system:

Weightage to a course is given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The credits and hours of each course of a programme are given in the table of Programme Pattern. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For UG courses, a student must earn a minimum of 140 credits as mentioned in the programme pattern table. The total number of minimum courses offered by the Department is given in the Programme Structure.

OUTCOME-BASED EDUCATION (OBE)

LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)

OBE is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student

should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability

Outcome -Based Education (OBE): is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Some important aspects of the Outcome Based Education Course: Outcome based education course is defined as a theory, practical or theory cum practical subject studied in a semester.

Course Outcomes (COs): Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

Programme: is defined as the specialization or discipline of a Degree.

Programme Outcomes (POs): Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

Programme Specific Outcomes (PSOs): PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

Programme Educational Objectives (PEOs): The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

Some important terminologies repeatedly used in LOCF. Core Courses (CC)

A course, which should compulsorily be studied by a candidate as a core

requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order

to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

Discipline Elective Courses (DEC)

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Elective Course (DEC). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

DEC: Four courses are offered, two courses each in semester III and IV

Note: To offer one DEC, a minimum of two courses of equal importance / weightage is a must.

A department with two sections must offer two courses to the students.

One DEC Course may be offered as interdisciplinary course among the departments in a School (Common Core Course) at the PG level.

Generic Elective Courses

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of other disciplines. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Two GE Courses are offered one each in semesters III and IV.

(Open to the students of other Departments)

Self-paced Learning: It is a course for two credits. It is offered to promote the habit of independent/self learning of Students. Since it is a two credit course, syllabus is framed to complete within 45 hours. It is not taught in the regular working hours.

Field Study/Industrial Visit/Case Study: It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester's marks statement.

Internship: Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester's mark statement.

Extra Credit Courses: In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL and etc.

Under Graduate Programme Pattern:

The Post Graduate degree programme consists of the following vital components. They are as follows:

Part-III: Core Course (Theory, Practical, Discipline Electives, Compulsory and optional courses, Project Work and viva-voce, Extra credit courses, Internship and field visit /industrial visit/ Case Study)

Discipline Specific Elective Courses (DSE)

Part-III: DES - Department Electives EG- Generic Electives

Part-IV: Generic Electives

MID-Semester & Model End - Semester Test

Centralized – Conducted by the office of COE

1. Mid-Semester Test (2 Hours each) and Model End-Semester Test: (3 Hours each); will have Objective and Descriptive elements; with the below mentioned question pattern Part-A, Part-B and Part-C.

Duration of Examination must be rational; proportional to teaching hours 90 minute- examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision

QUESTION PATTERN FOR MODEL SEM AND SEMESTER EXAMINATION		
SECTIONS		Marks
SECTION-A -(No choice ,2-Marks)	TWO questions from each unit	(10x2 =20) 20
SECTION-B - (Either/ or type)	(5- Marks) TWO question from each unit	(5x 5 = 25) 25
SECTION-C- (3 out of 5)	(10 Marks) ONE question from each unit	(3x10 =30) 30
Total		75

BLUE PRINT OF QUESTION PAPER	FOR SEMESTER EXAMINATION					
DURATION: 3. 00 Hours.	Max Mark : 100					
K- LEVELS	K1	K2	K3	K4	K5	Total Marks
SECTION-A (2-Marks,Nochoice) (10x2=20)	10					20
SECTION-B (5- Marks)(Either/ or type) (5x2=25)			5			25
SECTION-C (10 Marks) (3 out of 5) (3x10=30) Courses having only K4 and K5 levels				3		30
Total	10	25		30		75

EVALUATION - GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) respectively. These two are calculated by the following formulae:

$$GPA(\text{Grade Point Average}) = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i} \text{ And } WAM(\text{weighted Average Mark}) =$$

$$\frac{\sum_{i=1}^n C_i M_i}{\sum_{i=1}^n C_i}$$

Classification of Final Results

Marks Range	Grade Point	Corresponding Grade	Classification of Final Result
90 and above	10	O	Outstanding
80 and above but below 90	9	A+	Excellent
70 and above but below 80	8	A	Very Good
60 and above but below 70	7	B+	Good
50 and above but below 60	6	B	Above Average
Below 50	N.A	RA	Re-appearance

Credit based weighted Mark System is adopted for the individual semesters and cumulative semesters in the column 'Marks secured' (for 100)

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes (POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment is done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight and the weakest is

This relation is defined by using the following table.

Mapping	<40%	$\geq 40\%$ and $< 70\%$	$\geq 70\%$
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

Mean Scores of COs = Sum of values/Total No.of POs & PSOs		Mean Overall Score = sum of mean scores/ Total No. of Cos.	
Result	Mean Overall Score	< 1.2	# Low
		≥ 1.2 and < 2.2	# Medium
		≥ 2.2	# High

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

VISION

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

MISSION

The department of Statistics aims to instill and inspire the domain knowledge on theoretical and applied aspects of Statistics in a broader spectrum. It intends to impart awareness on the importance of the conceptual framework of statistics across diversified fields and to afford practical training on the applications of statistical methods for carrying out analysis of data using sophisticated statistical software. The curriculum of post-graduate programme of the department is designed in such a way to cater the needs of the stakeholders to get placements in industries and institutions on successful completion of the course and to provide them ample skill and opportunities to meet the challenges at the national level competitive examinations. The departments strive to enhance its potentials and capabilities to provide good quality education in statistics by acquiring recognition of our institution.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

On successful completion of the B. Sc. Statistics program, the graduates will be able to:

1. Get employment in government, public, private, industrial, health, business, banking, agricultural and educational sectors
2. Expand their knowledge to set their career in research and higher studies
3. Comprehend the statistical concepts and principles for interdisciplinary research
4. Nurture advancement in statistical theory and applications
5. Acquire proficiency in adopting statistical software for data analysis

PROGRAMME OBJECTIVES

1. To prepare graduates who are not only statistically sound but also capable of using their appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication, and bio-statistics. As a result, they can pursue their future career either in the core field or in the applied field of Statistics.
2. To familiarize students with computational techniques and software used in the statistical arena.
3. To provide a solid ground in the best practices of collating and disseminating information.
4. To prepare students for undertaking further study.
5. To teach students to construct practical statistical models for several processes in the real-world.

PROGRAMME OUTCOMES (POs)

On successful completion of this course, the graduates will be able to

PO1. Demonstrate the ability to use skills in Statistics and different practicing areas for formulating and tackling Statistics related problems and identifying and applying appropriate principles and methodologies to solve a wide range of problems associated with Statistics.

PO2. Acquire

- i) Fundamental / systematic or coherent understanding of the academic field of Statistics and its different learning areas and applications.
- ii) Procedural knowledge that creates different types of professionals related to subject area of Statistics, including professionals engaged in government/public service and private sectors.
- iii) Skills in areas related to one's specialization area within the disciplinary/subject area of Statistics and emerging developments in the field of Statistics.

PO3. Recognize the importance of statistical modeling and computing, and the role of approximation and mathematical approaches to analyze the real problems using various statistical tools.

PO4. Plan and execute Statistical experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate statistical software including programming languages, and report accurately the findings of the experiment/investigations.

PO5. Demonstrate relevant generic skills and global competencies such as

- i) Problem-solving skills that are required to solve different types of Statistics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries.
- ii) Investigative skills, including skills of independent thinking of Statistics-related issues and problems.

- iii) Communication skills involving the ability to listen carefully, to read texts and reference material analytically and to present information in a concise manner to different groups/audiences of technical or popular nature
- iv) Analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Statistics and ability to translate them with popular language when needed.
- v) ICT skills and personal skills such as the ability to work both independently and in a group.

PO6. Demonstrate professional behavior such as

- i) Being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism.
- ii) The ability to identify the potential ethical issues in work-related situations.
- iii) Appreciation of intellectual property, environmental and sustainability issues.
- iv) Promoting safe learning and working environment.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO-1: Students will be enriched with technical skills used in statistical data science, data analytics through projects including big data

PSO-2: Students are enhanced with the skills of creating taxonomy of cognitive domain

in Statistics(Knowledge, Comprehension, Application, Analysis, Synthesis, evaluation)

PSO-3: Students will learn numerical aptitude applying both qualitative and quantitative knowledge for their future career.

PSO-4: Students are stimulated with self learning skills that help them in research work

in future and also to perform in NET, SLET and GATE.

PSO-5: Students are groomed up with the present and advanced analytical skills that help them to be an entrepreneur or advisor in Data analytics and Predictive Modeler domain.

PSO-6: Students can utilize their statistical skills, computation and comprehensive knowledge in other disciplinary courses and projects.

PSO-7: Students can increase their competency and perform well in government and Central government jobs for statistics like ISS (Indian Statistical Service), UPSC.

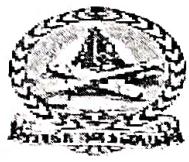
PSO-8: Students can synthesize their statistical expertise in Medical research, Finance and can work as a prominent part in the medical survey, research analytics.

PSO-9: Students will be incorporated with the knowledge of data impurity and handling

them with statistical techniques and well known with the automation of building a new statistical model with the criteria, assumptions and appropriateness

PSO-10: Students will be able to do Statistical softwares which will be very useful for their research programs.

PSO-11: Elective papers in PG Programme enable the students to face the real time applications and more useful for the students to do their research programs in future.



RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
THANJAVUR-613005

B.Sc. STATISTICS COURSE STRUCTURE
(For Candidates admitted from the academic year 2022 -2023 onwards)

Semester	Part	Course	Subject Code	Title of the Paper	Inst. Hrs.	Credit	Exam. Hrs.	Marks		Total
								Int.	Ext.	
I	I	LT	A1T1	Tamil-I	6	3	3	25	75	100
	II	LE	A1E1	English for Communication-I	4	2	3	15	45	60
	II	LE	A1E1P	English Practical - I	2	1		10	30	40
	III	CC1	A1ST1	Descriptive Statistics	6	4	3	25	75	100
	III	CC3	A2STP1	Major Practical- I (Based on CC1&CC2)	3	-	-	-	-	-
	III	Allied 1	A1ASMA1	Mathematics for Statistics-I	4	4	3	25	75	100
	III	Allied 2	A2ASMA2	Mathematics for Statistics-II	3	-	-	-	-	-
	IV	VE	A1VE	Value Education	2	2	3	25	75	100
Total					30	16				500
II	I	LT	A2T2	Tamil-II	6	3	3	25	75	100
	II	LE	A2E2	English for Communication-II	4	2	3	15	45	60
	II	LE	A2E2P	English Practical - II	2	1		10	30	40
	III	CC2	A2ST2	Probability and Random Variable - Discrete distributions	6	4	3	25	75	100
	III	CC3	A2STP1	Major Practical-I (Based on CC1&CC2)	3	4	3	40	60	100
	III	Allied 2	A2ASMA2	Mathematics for Statistics-II	3	4	3	25	75	100
	III	Allied 3	A2ASMA3	Mathematics for Statistics-III	4	4	3	25	75	100
	IV	ES	A2ES	Environmental Studies	2	2	3	25	75	100
Total					30	24				700

III	I	LT	A3T3	Tamil-III	6	3	3	25	75	100
	II	LE	A3E3	English for Communication-III	4	2	3	15	45	60
	II	LE	A3E3P	English Practical – III	2	1		10	30	40
	III	CC4	A3ST3	Probability and Random Variable (Continuous distributions)	6	4	3	25	75	100
	III	CC6	A4STP2	Major Practical -II (Based on CC4 & CC5)	3	-	-	-	-	-
	III	Allied 4	A3AST1	Numerical Methods	4	4	3	25	75	100
	III	Allied 6	A4ASTP	Allied Practical - I (Based on Allied 4 & 5)	3	-	-	-	-	-
	IV	SEC1	A3SB1	Soft Skills	2	2	3	25	75	100
	IV	GEC1		Decision Theory and Games		2				
	Total				30	18				500
IV	I	LT	A4T4	Tamil – IV	6	3	3	25	75	100
	II	LE	A4E4	English for Communication-IV	6	3	3	25	75	100
	III	CC5	A4ST4	Statistical Inference -I (Estimation Theory)	6	4	3	25	75	100
	III	CC6	A4STP2	Major Practical - II (Based on CC4 & CC5)	3	4	3	40	60	100
	III	Allied 5	A4AST2	Vital Statistics	4	4	3	25	75	100
	III	Allied 6	A4ASTP	Allied Practical - I (Based on Allied 4 & 5)	3	4	3	40	60	100
	IV	GEC2		Queueing Theory		2				
	IV	SEC2	A4SB2	Soft Skills	2	2	3	25	75	100
Total				30	26					700

V	III	CC7	A5ST5	Statistical Inference -II (Testing of Hypothesis)	5	4	3	25	75	100
	III	CC8	A5ST6	Sampling Techniques	6	4	3	25	75	100
	III	CC9	A5STP3	Major Practical-III (Based on CC7 & CC8)	3	3	3	40	60	100
	III	DSE1	A5STEL1A	Operations Research	4	4	3	25	75	100
			A5STEL1B	Real Analysis and Matrix Theory						
			A5STEL1C	Simulation Techniques						
	III	DSE2	A5STEL2A	Indian Official Statistics			3	25	75	100
			A5STEL2B	Econometric methods						
			A5STEL2C	Psychological And Educational Statistics						
	IV	NMEC1			4	3	3	25	75	100
	IV	SSD	A5SSD	Soft Skill Development	2	2	3	25	75	100
	IV	SEC3	A5SB3	Soft Skills	2	2	3	25	75	100
	IV	ECC1	A5STEC1		-	2				
	III			Internship (Optional)						
Total					30	28				800
VI	III	CC10	A6ST7	Design of Experiments	6	5	3	25	75	100
	III	CC11	A6ST8	Statistical Quality Control	6	5	3	25	75	100
	III	CC12	A6ST9	Time Series and Index Numbers	5	4	3	25	75	100
	III	CC13	A6STP4	Major Practical- IV (Based on C10,CC11&CC12)	3	3	3	40	60	100
	III	DSE3	A6STEL3A	Regression Analysis	4	4	3	25	75	100
			A6STEL3B	Reliability and Survival Analysis						
			A6STEL3C	Programming in C						
	IV	NMEC2			4	3	3	25	75	100
	IV	GS	A6GS	Gender Studies	2	1	3	25	75	100
	IV	ECC2	A6STEC2		-	2				
	V	Extra Activities		NCC/NSS/SPORTS/RCC/YR C/CCC	-	1				
Total					30	28				700
Grand Total							140			3900

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COURSE STRUCTURE

PART	COURSE	No. of Papers x Credit	Total Credit
Part-I	Tamil	4x3	12
Part -II	English	$3 \times 2 = 6$ & $1 \times 3 = 3$	09
	English Practical	1x3	03
Part -III	Core	$9 \times 4 = 36$ $2 \times 5 = 10$ $2 \times 3 = 06$	52
	DSE(Electives)	3x4	12
	Allied	6x4	24
Part - IV	Non-major elective	2x3	6
	* Extra credit course	2x2	4*
	VE, ES.	2x2	4
	Skill Based	3x2	6
	GEC	2x2	4
	SSD	1x2	2
	GS	1x1	1
Part - V	Ext. Activities	-	1
Total			140

* Not Considered for CGPA

Separate Passing Minimum is prescribed for Internal and External

a) The Passing minimum for CIA shall be 40%

b) The Passing minimum for Autonomous Examinations shall be 40%

DEPARTMENT OF STATISTICS
UG - SYLLABUS CONTAINS

1. Core Course - 13 Papers
2. Major Elective Course - 3(9) Papers
3. Allied Papers - 6 Papers
4. Non Major Elective Course - 2 Papers
5. B.B A., - 1 Allied Paper


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List of Major (Core Course) Papers

- CC1 - Descriptive Statistics
- CC2 - Probability and Random Variable - (Discrete distributions)
- CC3 - Major Practical - I
- CC4 - Probability and Random Variable - (Continuous Distributions)
- CC5 - Statistical Inference - I (Estimation Theory)
- CC6 - Major Practical - II
- CC7 - Statistical Inference II (Testing of Hypothesis)
- CC8 - Sampling Techniques
- CC9 - Major Practical - III
- CC10 - Design of Experiments
- CC11 - Statistical Quality Control
- CC12 - Time Series and Index Numbers
- CC13 - Major Practical - IV

List of Allied Papers

- Allied 1 - Mathematics for Statistics-I
- Allied 2 - Mathematics for Statistics-II
- Allied 3 - Mathematics for Statistics-III
- Allied 4 - Numerical Methods
- Allied 5- Vital Statistics
- Allied 6 - Allied Practical - I

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
I	6	4	English	III	A1ST1
CC 1	DESCRIPTIVE STATISTICS				

Course objectives

1. Learning the preliminary tools and concepts (diagrams and graphs)
2. To make the students aware of different type of data sets
3. To solve graphical representations introducing of descriptive statistical measures, including those for two variables

Course outcomes

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge of Statistics and its scope and importance in various areas. To make the students aware of different type of data sets	K1
CO-2	Learning the preliminary tools and concepts (diagrams and graphs)	K2
CO-3	Compute descriptive statistical measures, including those for two variables to represent real life problems.	K3
CO-4	Compute correlation, regression and curvilinear regression to represent real life problems.	K3
CO-5	Analyse the concept of association of attributes.	K4

Unit I

(15 Hours)

Statistics - Definition - functions and scope of statistics - Primary and Secondary data - Methods of data collection and sources - Merits and demerits. Classifications - definition and types. Tabulation - parts of table - construction of tabulation and types.

Unit II

(15 Hours)

Diagrammatic Representation - Bar diagram and types, Pie diagram. Graphical Representation - Histogram, Frequency curve, Frequency polygon, Ogives. Measures of Central Tendency - Arithmetic Mean, Median, Mode, Geometric mean and Harmonic mean.

Unit III (15 Hours)

Measures of Dispersion - Range, Quartile deviation, Mean deviation, Standard Deviation, Coefficient of Variation - Lorenz curve. Measures of moments, skewness and kurtosis (Concept & Problems).

Unit IV (15 Hours)

Correlation Analysis - Definition and types of Correlation properties (Statement and proof), Methods - Scatter diagram, Karl Pearson's Coefficient of Correlation and Spearman's Rank Correlation Coefficient. Regression lines and Regression coefficient - Properties and problems.

Unit V (15 Hours)

Association of Attributes - Class frequencies - Order of frequencies - 2×2 contingency table - finding missing frequencies - Yule's coefficient of association and Yule's coefficient of colligation.

Text Books and Reference

1. Gupta S.P. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 12th Edition 2020.

Unit-I: Chapter 1 (Sec: 1.1 - 1.4)

Unit-II: Chapter 2 (Sec: 2.1-2.2)

Unit-III: Chapter 2 (Sec: 2.3-2.9), Chapter 3 (Sec:3.1- 3.9, 3.13, 3.14)

Unit-IV: Chapter 10 (Sec: 10.1-10.6), Chapter 11 (Sec:11.1-11.8)

Unit-V: Chapter 10 (Sec: 10.7), Chapter 9 (Sec: 9.1- 9.4)

2. S.P. Gupta, Statistical Methods, Sultan Chand & Sons, Educational Publisher, New Delhi, 46th Edition, 2021

Unit – I: Chapter 1,2 & 3

Unit – II: Chapter 5 & 6

Unit – III Chapter 8

3. R.N.Kapoor and H.C. Saxsena Mathematical Statistics, Sultan Chand & sons, New Delhi.

4. Gun, A.M., Gupta, M.K. and Dasgupta, B. Fundamental of Statistics, Vol. I, World Press, Kolkata, 2013.5.

5. Miller, I. and Miller, M. John E. Freund's Mathematical Statistics with Applications, 7th Edition, Pearson Education, Asia, 2006.

6. Mood, A.M. Graybill, F.A. and Boes, D.C. Introduction to the Theory of Statistics, 3rd Edition, Tata McGraw-Hill Pub. Co. Ltd, 2011.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1 <https://nptel.ac.in/courses/111/105/111105041/>

2 <https://nptel.ac.in/courses/111/106/111106112/>

Question Paper Pattern

Maximum Marks: 75 Exam duration: 3 Hours

The question paper may consist of Theory and Problems in the ratio 50:50.

Part A: $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

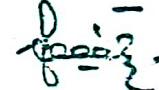
Part B: $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C: $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code		Title of the Course								Hours	Credits
I	A1ST1		CC1: DESCRIPTIVE STATISTICS								6	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	1	3	3	1	2	3	2	3	2	1	2.1	
CO-2	2	2	2	2	3	2	3	3	3	2	2.4	
CO-3	3	2	2	3	3	1	3	2	3	3	2.5	
CO-4	3	2	2	3	3	1	3	2	3	3	2.5	
CO-5	3	2	2	3	3	1	3	2	3	3	2.5	
Mean Overall Score										2.4 (High)		


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
I	4	4	English	III	A1AS1
Allied 1	STATISTICS FOR MATHEMATICS - I				

Course objectives:

1. To develop the students ability to deal with numerical and quantitative issues in mathematics
2. To enable the use of statistical and algebraic techniques wherever relevant.
3. To have a proper understanding of Statistical applications in mathematics

Course Outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge of Statistics and its scope. Learning measures of central tendencies and dispersions.	K1
CO-2	Learning the basic idea probability tools and concepts	K2
CO-3	Aware the discrete and continuous distributions with mathematical functions.	K3
CO-4	Compute correlation, regression and curvilinear regression to represent real life problems.	K4
CO-5	Analyse the concept of correlation and regression concepts.	K4

Unit -I (12 Hours)

Measures of central tendency – Mean, Median, Mode, Geometric Mean, Harmonic Mean and Quartiles. Measures of Dispersion – Quartile deviations and Standard deviation. Measures of Skewness and Kurtosis.

Unit-II (12 Hours)

Probability- Axiomatic and classical probability – Simple Problems. Addition multiplication theorem of Probability – Simple Problems.

Unit-III (12 Hours)

Concept of random variable – discrete and continuous, distribution functions, probability mass function, probability density function, mathematical expectation and Moment generating functions.

Unit -IV (12 Hours)

Bivariate Probability distribution – discrete and continuous, marginal and conditional distributions,

Unit-V

(12 Hours)

Correlation – Definition, Types of Correlation, Karl Pearson's Co-efficient of correlation, Rank Correlation Co-efficient – Linear Regression equations.

Text Books

S.C. Gupta and V.K. Kapoor – Fundamentals of Mathematical Statistics, Sultan & Sons, New Delhi.

S.P. Gupta, *Statistical Methods*, Sultan Chand & Sons, Educational Publisher, New Delhi, 46th Edition, 2021

Reference Books

1. Holcomb, Z. C. (2017). Fundamentals of Descriptive Statistics, Routledge, New York, US
 2. Agarwal, B. L. (2006). Basic Statistics, New Age International Private Limited, New Delhi,
- Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]**
- 1 <https://nptel.ac.in/courses/111/105/111105041/>
 - 2 <https://nptel.ac.in/courses/111/106/111106112/>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

The question paper may consist of Theory and Problems in the ratio 50:50.

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
I	A1AS1					Statistics for Mathematics - I					4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	3	2	2	3	3	3	2	2	3	2.5	
CO -2	2	2	2	2	2	2	2	3	2	2	2.1	
CO -3	3	2	3	3	2	2	2	2	3	2	2.4	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	2	3	2	2.3	
Mean Overall Score											2.34	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
I	6	4	English	III	A1ABA1
Allied 1	STATISTICS FOR MANAGEMENT				

Course objectives:

1. To develop the students ability to deal with numerical and quantitative issues in business.
2. To enable the use of statistical, graphical and algebraic techniques wherever relevant.
3. To have a proper understanding of Statistical applications in Economics and Management.

Course Outcomes

CO No.	CO–Statements On successful completion of this course, students will be able to	Cognitive Levels (K –Levels)
CO-1	Acquire the knowledge of Statistics and its scope and importance in various areas. To make the students aware of different type of data sets.	K1
CO-2	Learning and Compute descriptive statistical measures, including those for two variables to represent real life problems.	K2
CO-3	Compute correlation, regression and curvilinear regression to represent real life problems..	K3
CO-4	To have a proper understanding of Statistical applications in Economics and Management.	K3
CO-5	To develop the students ability to deal with numerical and quantitative issues in business.	K4

Unit-I (18 Hours)

Nature and scope of statistics: Uses of statistics in business; Statistical data - Primary and Secondary- Classification of data - frequency distribution - Histogram, frequency polygon and curve; Graphs and Diagrams, Pie diagram and Lorenz curve.

Unit-II (18 Hours)

Measures of central tendencies - Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean -Uses of averages in Business; Measures of Dispersion - Range, Quartiles Deviation, Mean Deviation and Standard Deviation. Co-efficient of variation.

Unit-III (18 Hours)

Simple Correlation - Karl Pearson's and Spearman's Rank Correlation; Regression lines (concept only), Index numbers - Cost of living index numbers.

Unit-IV (18 Hours)

Time series analysis - components - graphical method, semi average method, moving average and fitting a straight line trend by the method of least squares.

Unit-V (18 Hours)

Multiplication of matrices, Transpose of Matrix; Elementary Operations, Inverse of matrix (simple problems).

Text books

1. J.D.Gupta P.K.Gupta, Man Mohan (TMH) - Mathematics for business and Economics

2. V.K. Kapoor and S.C. Gupta - Fundamentals of Applied statistics, sultan and sons Newdelhi.

Reference Books

1. Agarwal, B. L. (2006). Basic Statistics, New Age International Private Limited, New Delhi,
2. S.P.Gupta , Statistical Methods , sultan and sons New delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.sultanchandandsons.com/images/bookimages/chapters/59_statistical%20methods.com
2. <https://www.statisticssolutions.com>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

The question paper may consist of Theory and Problems in the ratio 50:50.

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course				Hours	Credit
I	A1ABA1					Statistics for Management				6	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO -1	3	3	2	2	2	3	3	2	2	3	2.5
CO -2	2	2	2	2	3	2	2	3	2	2	2.2
CO -3	3	2	3	3	2	2	3	2	3	2	2.5
CO -4	2	3	2	2	3	2	2	3	2	3	2.4
CO -5	2	2	3	2	2	3	2	2	3	2	2.3
Mean Overall Score											2.38


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
II	6	4	English	III	A2ST2
CC 2	PROBABILITY AND RANDOM VARIABLES (DISCRETE DISTRIBUTIONS)				

Course objectives

The main objectives of this course are to:

1. Introduce the concept of random variable and its types.
2. Define generating functions and characteristic functions
3. Define law of large numbers and central limit theorem

COURSE OUTCOMES

CO No.	CO–Statements	Cognitive Levels (KLevels)
	On successful completion of this course, students will be able to	
CO-1	Understand the basic probability theorems and its applications. Match the real life situations with probability concepts.	K1
CO-2	Acquire the knowledge of univariate, bivariate random variables and its mathematical functions.	K2
CO-3	To introduce the notion of probability, random variable and expectation, Demonstrate the moment generating and characteristic functions.	K2
CO-4	To learn adapt to the distributions in the various fields (especially chance factors in all disciplines)	K3
CO-5	Acquire the knowledge of high level discrete distributions with their properties.	K4

Unit I (18 Hours)

Events - Types of events - Sample Space - definition and Axioms of Probability. Addition theorem on Probability. Conditional Probability - Multiplication theorem on Probability - Independent events - Mutual and pair wise events- Baye's theorem and its applications.

Unit II (18 Hours)

Random variables - Definition - Univariate Discrete random Variable - Definition. Probability mass functions - Distribution function, properties. Bivariate random variables - Definition - Joint Probability mass function - marginal and Conditional distribution functions and their Properties.

Unit III (18 Hours)

Mathematical expectations - Definition - Properties - Measures of A.M, S.D, Moments, and Correlation Coefficient for discrete random Variables. Moment generating functions, Characteristics function, Cumulant generating function - Definition and their Properties (Univariate and bivariate discrete distributions).

Unit IV (18 Hours)

Discrete distributions: Binomial, Poisson and Geometric distributions- Constants and Properties - Fitting of Binomial, Poisson distributions (Simple problem only)

Unit V (18 Hours)

Hyper Geometric, Negative Binomial, and discrete Uniform distributions Constants and Properties.

Text Books

1. S.C. Gupta and V.K. Kapoor - Fundamentals of Mathematical Statistics, Sultan and sons.
2. Johnson and Kotz - Discrete distribution. John Wiley Publications, New York.
3. Dudewicz, E.J. and Mishra, S.N. Introduction to Mathematical Statistics, John Wiley, 1988

Reference Books

1. Hogg, R.V. and Craig, A.T.: Introduction to Mathematical Statistics, Prentice Hall, England, 7th Edition, 2013.
2. Rohatgi, V.K. and Saleh, A.E. An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern, 2008.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/106/111106112/>
2. <https://nptel.ac.in/courses/111/105/111105090/>
3. <https://nptel.ac.in/courses/111/105/111105042/>

Question Paper Pattern

Maximum Marks: 75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

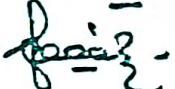
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code		Title of the Course					Hours	Credits		
II	A2ST2		CC2-Probability And Random Variables (Discrete Distributions)					6	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Scores of COs	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	3	3	1	1	3	2	3	2	1	2.1
CO-2	2	3	3	2	3	3	3	2	3	2	2.6
CO-3	2	3	3	2	3	3	3	2	3	2	2.6
CO-4	3	1	1	3	3	1	2	1	3	3	2.1
CO-5	3	1	1	3	3	1	2	1	3	3	2.1
Mean Overall Score										2.3 (High)	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
II	3	4	English	III	A2STP1
CC 3	MAJOR PRACTICAL-I [Based on CC1 and CC2]				

Course objectives

1. To understand types of the diagrammatic and the graph
2. Practiced to the realized concept of preliminary tools for univariate and bivariate distributions
3. To calculate correlation and regressions (two variables only)

COURSE OUTCOMES

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Learn variables and select the suitable data types and understand types of the diagrams and the graphs	K1
CO-2	Identify the correct and efficient ways of solving problems	K1
CO-3	Practiced to the realized concept of preliminary tools for univariate and bivariate distributions	K2
CO-4	To calculate correlation and regressions (two variables only)	K3
CO-5	Analyse the Mathematical and Statistical functions and fitting the discrete distributions.	K4

List of Experiments (Using Excel and Calculator Lab)

1. Construction of Univariate and Bivariate Frequency Distributions.
 - (i). Diagrammatic representations – Bar and Pie diagrams.
 - (ii). Graphical representations – Histogram, Frequency curve, Frequency Polygon, Ogive curves
2. Measures of Central Tendencies – Arithmetic Mean, Median, Mode, Geometric mean and Harmonic mean.
3. Measures of Dispersions – Mean Deviation, Quartile Deviation, Standard deviation and Co-efficient of variation.
4. Moments, Measures of Skewness – Bowley's and Karl Pearson's method.
5. Computation of Karl Pearson's Co-efficient of Correlation and Spearman's Rank Correlation.
6. Regression equations (two variables only). Calculation of Yule's Co-efficient of association and Yule's Co-efficient of Colligation.
7. Marginal and Conditional distribution - Expectation – Mean, Variance, and Correlation Co-efficient for Bivariate Distribution only.
8. Fitting of Binomial and Poisson distribution.

Pattern of Practical

Practical Exam duration: Three Hours

Internal Marks: (Model Practical :25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : $4 \times 15 = 60$ Marks

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific

Outcomes

Semester	Course Code	Title of the Course					Hours	Credits			
II	A2STP1	CC3 - MAJOR PRACTICAL-I [Based on CC1 and CC2]					3	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3			
CO-1	1	3	3	1	2	3	2	3	2	1	2.1
CO-2	2	3	3	2	2	3	3	3	2	1	2.4
CO-3	3	2	2	1	3	2	3	2	3	2	2.3
CO-4	2	1	2	2	3	1	3	1	3	3	2.1
CO-5	3	2	2	3	3	1	2	2	3	3	2.4
Mean Overall Score										2.3	(High)

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	RAJAH SERFOJI GOVT. COLLEGE (AUTONOMOUS) (NAAC "A" GRADE & DST-FIST College) B.Sc., STATISTICS Programme (Under CBCS & LOCF) (Syllabus for students admitted from 2022-2023 onwards)				
Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
II	4	4	English	III	A2AS2
Allied 2	STATISTICS FOR MATHEMATICS - II				

Course objectives:

1. To construct probability distribution for discrete random variables (Binomial and Poisson distributions)
2. To use normal distribution to find probabilities for continuous random variables.
3. To compute estimations for a mean and proportions (large or small samples)

Course Outcomes

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able To	
CO-1	Practiced to the discrete distributions and match the real life situations with probability concepts.	K1
CO-2	Distinguish between discrete and continuous random variables.	K2
CO-3	Learn to sampling distributions and special continuous distributions.	K3
CO-4	Test of Significance for large Samples match the real life situations.	K4
CO-5	Practiced the test of Significance for small Samples match the real life situations.	K4

Unit-I:

(12 Hours)

Discrete Distributions – Binomial and Poisson Distributions – Constants and M.G.F. (Simple Problems).

Unit-II

(12 Hours)

Continuous Distributions – Normal, Exponential and Uniform Distributions – Constants and M.G.F.

Unit-III

(12 Hours)

Beta, Gamma – Definition, Mean and Variances. 't', F and Chi-square distribution – (Definitions and Derivation of the distribution)

Unit-IV

(12 Hours)

Test of Significance for large Samples – Single mean, difference between mean, single proportion and difference between proportion.

Unit-V

(12 Hours)

Test of Significance for Small Samples – ‘t’ test for Single mean, Difference between means, Paired ‘t’ test and Simple Correlation, Chi-square test for goodness of fit and independence of attributes.

Text Books and Reference

1. Gupta S.C. and V.K. Kapoor – Fundamentals of Mathematical Statistics, Sultan & Sons, New Delhi.
2. V.K Kapoor and H.C. Saxena – Mathematical Statistics, Chand & Co, New Delhi.
3. Dudewicz, E.J. and Mishra, S.N. *Introduction to Mathematical Statistics*, John Wiley, 1988
4. Hogg, R.V. and Craig, A.T.: *Introduction to Mathematical Statistics*, Prentice Hall, England, 7th Edition, 2013.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/102/111102111/>
2. <https://nptel.ac.in/courses/111/104/111104079/>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

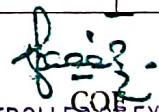
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code		Title of the Course							Hours	Credits
II	A2AS2		Statistics for Mathematics - II							4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	3	3	1	1	3	2	3	2	1	2.1
CO-2	2	3	3	2	3	3	3	2	3	2	2.6
CO-3	2	3	3	2	3	3	3	2	3	2	2.6
CO-4	3	1	1	3	3	1	2	1	3	3	2.1
CO-5	3	1	1	3	3	1	2	1	3	3	2.1
Mean Overall Score										2.3 (High)	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
II	3	4	English	III	A2ASPI
Allied 3	ALLIED STATISTICS PRACTICAL - I [Based on Allied-1 and Allied-2]				

Course objectives:

1. To provide students with demonstrate their understanding of descriptive statistical data
2. Demonstrate knowledge of probability and the standard statistical distributions.
3. Demonstrate knowledge of fixed-sample and large-sample statistical properties of point and interval estimators.

Course Outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Learn variables and select the suitable data types and understand types of the diagrams and the graphs	K1
CO-2	Identify the correct and efficient ways of solving problems	K1
CO-3	Practiced to the realized concept of preliminary tools for univariate and bivariate distributions	K2
CO-4	Practiced to fitting of discrete and continuous distributions	K3
CO-5	Demonstrate knowledge of fixed-sample and large-sample statistical properties of point and interval estimators.	K4

List of Experiments:

1. Measure of Central Tendency
 - Arithmetic Mean, Median, Mode,
 - Geometric Mean,
 - Harmonic Mean and
 - Quartiles.
2. Measure of Dispersions
 - Computation Coefficients of M.D,
 - Standard Deviation and
 - Co-efficient of variation.
 - Karl Pearson's and Bowley's Co-efficient of Skewness.

3. Correlation and Regression Analysis

- Computation of Karl Pearson's co-efficient of correlation
- Spearman's rank correlation and
- Regression lines.

4. Fitting of Binomial, Poisson and Normal distributions.

5. Test of significance based on Normal Distribution and

- Student's t – distribution for mean,
- proportions, and simple correlation.
- Chi-square test.
- Test of goodness of fit and
- Test for independence of attributes.

Pattern of Practical

Practical Exam duration: Three Hours

Internal Marks: (Model Practical : 25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : 4 X 15 = 60 Marks

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	A2ASP1	ALLIED STATISTICS PRACTICAL - I [Based on Allied-1 and Allied-2]									3	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of Cos	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	1	3	3	1	2	3	2	3	2	1	2.1	
CO-2	2	3	3	2	2	3	3	3	2	1	2.4	
CO-3	3	2	2	1	3	2	3	2	3	2	2.3	
CO-4	2	1	2	2	3	1	3	1	3	3	2.1	
CO-5	3	2	2	3	3	1	2	2	3	3	2.4	
Mean Overall Score											2.3	(High)


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
III	6	4	English	III	A3ST3
CC 4	PROBABILITY AND RANDOM VARIABLES (Continuous Distributions)				

Course objectives:

1. The students should have understood the applications and nature of the probability distributions such as Normal, t, χ^2 and F.
2. To compute of Partial, Multiple Correlation Coefficients and Multiple Linear Regression line

Course Outcomes

CO No.	CO-Statements On successful completion of this course, students will be able To	Cognitive Levels (K -Levels)
CO-1	Acquire the knowledge of important continuous distributions	K1
CO-2	Acquire the knowledge about memory less property of exponential distribution	K1
CO-3	Understand the relationship between t, f and χ^2 distributions	K2
CO-4	Apply the standard continuous probability distributions to different situations	K3
CO-5	Understand Convergence in probability and De Moivre's Laplace theorem.	K4

Unit I (18 Hours)

Univariate and Bivariate continuous Random variables - Definitions - Distribution Function, Joint, marginal and conditional density functions. Expectations - Additive property only. Covariance and Correlation.

Unit II (18 Hours)

Continuous Distributions- Uniform and Normal Distributions. M.G.F, C.G.F, Mode, Moments, characteristics functions, Additive property (on using M.G.F).

Unit III (18 Hours)

Exponential, Gamma and Beta Distributions - definition, M.G.F, C.G.F, Mode, Moments, characteristics functions, Additive property (on using M.G.F).

Unit IV (18 Hours)

Sampling Distributions - Chi square Distribution - definition, M.G.F, Mode, Additive Property - Student's- 't' and F-distributions - definition and derivation of density Functions.

Unit V (18 Hours)

Convergence in probability-definition. Chebychev's inequality and weak law of large numbers (with proof) and Statement of strong law of large numbers - Central limit theorems (statement only)- De Moivre's Laplace theorem.

Text Books and Reference

1. S.C Gupta and V.K. Kapoor -Fundamentals of Mathematical Statistics,sultan & sons.
2. Johnson and Kotz - Continuous Distributions -I, John Wiley Publications, New York.
3. Johnson, N.L, Kotz,S.:*Continuous univariate Distributions*,Vol. I& Vol.II, John Wiley & Sons.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/104/111104032/>
2. <https://nptel.ac.in/courses/111/105/111105041/>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
III	A3ST3					CC4 - Probability and Random Variable (Continuous Distributions)					6	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO 4	PO 5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	2	3	3	2	3	2	2	2	2.3	
CO -2	2	3	3	2	2	2	2	3	3	3	2.5	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	3	3	3	3	2	2	2.5	
CO -5	2	2	2	2	2	2	2	3	2	3	2.2	
Mean Overall Score											2.36	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
III	3	4	English	III	A4STP2
CC 6	CC 6 – MAJOR PRACTICAL-II (Based on CC4 and CC5)				

Course objectives:

1. Practiced to the realized concept of preliminary tools
2. To understand to types of the distributions functions

Course outcomes:

At the end of the course the student will be able to		Knowledge level
CO1	Learn to obtain and sketch densities of order statistics	K3
CO2	Students will be able to implement methods estimation and testing by using appropriate methods and computing formulae.	K4
CO3	Practiced into the basic level statistical tools	K5

List of Experiments

- Continuous distribution function:
- Marginal density function and
- Conditional density function
- Expectation
- Covariance and correlation.

Drawing samples (of size not exceeding 25) from

- Uniform distribution
- Normal distribution and
- Exponential distribution

Computation of partial and multiple correlation coefficients and
Multiple linear regression equation (3 variables)

Interval estimation

Confidence interval and confidence limits for proportions, mean and variance

Large sample test:

Test of significance for single mean

- Single proportions,
- Difference of proportions and
- Standard deviations (known and unknown)

Pattern of Practical

Practical Exam duration: Three Hours

Internal Marks: (Model Practical :25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : $4 \times 15 = 60$ Marks

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
IV	A4STP2					MAJOR PRACTICAL-II					3	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	2	3	3	2	3	2	2	2	2.3	
CO -2	2	3	3	2	3	2	2	3	3	3	2.5	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	3	3	3	3	2	2	2.5	
CO -5	2	2	2	2	2	2	2	3	2	3	2.2	
Mean Overall Score											2.34	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
III	4	4	English	III	A3AST1
Allied 4	NUMERICAL METHODS				

Course objectives:

1. To development of the computer technology with numerical methods.
2. To develop efficient algorithms for solving problems in science and technology.

Course Outcomes

CO No.	CO-Statements On successful completion of this course, students will be able To	Cognitive Levels (K -Levels)
CO-1	Understand the uses of interpolation in various fields.	K1
CO-2	Explain the numerical differentiation and Integration problems.	K2
CO-3	Solve the solution of algebraic equations.	K3
CO-4	Categorize the usage of interpolation techniques.	K3
CO-5	Compute the Numerical solution of Ordinary differential equation.	K4

Unit I

(12 Hours)

Finite differences – Forward and Backward difference operators 'E' and 'And' their basic properties – Interpolation with equal intervals – Newton's forward and backward difference methods – simple problems.

Unit II

(12 Hours)

Interpolation with unequal intervals – Divided differences and their properties – Newton's divided difference methods – Lagrange's methods- simple problems

Unit III

(12 Hours)

Central difference interpolation formula – Gauss forward and backward differences formulae – Stirling's, Bessel's and Everett's central difference formulae.

Unit IV

(12 Hours)

Inverse interpolation – Lagrange's method – Interaction of successive approximation method – simple problems. Numerical differentiation - Numerical differentiation up to second order only - simple problems.

Unit V

(12 Hours)

Numerical integration - Trapezoidal rule - Simpson's 1/3rd and 3/8th rules - Weddle's rule - Euler's summation formula - Numerical method of solution of ordinary differential equations - Taylor's series method - Euler method and Runge Kutta up to second order - simple problems only.

Text Books

1. Gupta P.P. & Malik G.S. Calculus of Finite Differences and Numerical Analysis. S chand.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi - *Numerical Methods*, S.Chand Company Ltd,

Reference Books

1. Gerald, C.F. and Wheatley, P.O.: *Applied Numerical Analysis*, Addison-Wesley, 2007.
2. Atkinson. K, *Elementary Numerical Analysis*, John Wiley & Sons, 2003.
3. Sastry.S.S. : *Introductory Methods of Numerical Analysis*, PHI, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/107/111107105/>
2. <https://nptel.ac.in/courses/111/106/111106101/>
3. <https://nptel.ac.in/courses/111/101/111101003/>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific outcomes

Semester	Course Code					Title of the Course					Hours	Credit
III	A3AST1					NUMERICAL METHODS					4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	3	3	2	2	2	3	3	2	2	3	2.5	
CO -2	2	2	2	2	3	2	2	3	2	2	2.2	
CO -3	3	2	3	3	3	2	3	2	3	2	2.6	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	2	3	2	2.3	
Mean Overall Score											2.4	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
III	2	2	English	IV	A3SB1
SEC -1	STATISTICS FOR COMPETITIVE EXAMINATIONS				

Course Objectives

1. To prepare the students for competitive examinations in the field of statistics.
2. Improving the leaning ability of students.

Course Outcomes

CO No.	CO-Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able To	
CO-1	recognize the benefits and pre-preparations of competitive exams	K1
CO-2	understand the pattern and techniques to solve the questions	K2
CO-3	develop a scientific aptitude and sense of reasoning	K3
CO-4	utilize the mathematical, statistical, and quantitative information	K3
CO-5	apply the quantitative methods to solve the real-life problems	K4

Unit-I (6-Hours)

Data Interpretation by Tabulation & Graph reading

Unit-II (6-Hours)

Averages – Combined Averages – Ratios, Proportions and Percentages

Unit-III (6-Hours)

Permutation and Combinations - Probability

Unit-IV (6-Hours)

Sampling Methods

Unit-V (6-Hours)

Testing Parametric Hypothesis

Books for Study

1. R. S. Aggarwal, Quantitative Aptitude, S. Chand & Co., New Delhi, 2017.
 Unit-I Section-II (Chapter 36-39)
 Unit-II Chapter 6 (pp: 139-160), Chapter 21 (pp:445-465) Chapter 12 (pp: 294- 310), Chapter 10 (pp:208-250)
 Unit-III Chapter 30 (pp: 613-620), Chapter 31 (pp:621-631)
2. B. L. Agarwal, Programmed Statistics, New Age International

Publishers, New Delhi, 2nd Edition, Reprint 2005.

Unit-IV Chapter 9 (pp: 202 - 211)

Unit-V Chapter 11 (pp: 277 - 289)

**Relationship matrix for Course outcomes, Programme outcomes
/Programme Specific Outcomes**

Semester	Course Code	Title of the Course					Hours		Credits		
III	A3SB1	SEC -1 : Statistics for Competitive Examinations					2		2		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	2	3	3	1	1	3	2	3	2	1	2.1
CO-2	1	3	3	2	1	3	3	3	2	1	2.2
CO-3	2	2	2	3	3	2	3	1	3	2	2.3
CO-4	2	3	2	2	3	1	3	2	3	3	2.4
CO-5	3	1	1	3	3	1	2	1	3	3	2.1
Mean Overall Score										2.2 (High)	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
III		2	English	IV	
GEC -1	DECISION THEORY AND GAMES				

Course objective

1. Decision making techniques applied in the industrial sectors.
2. To develop efficient algorithms for solving problems in science and technology

Course outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Identify the uses of decision theory and their applications	K1
CO-2	Understand decision making under condition of risk	K2
CO-3	Utilize the applications of relate the types of games..	K3
CO-4	Understand graphical solution of $2 \times n$ and $m \times 2$ games	K4
CO-5	Inspect the kinds of general linear models	K4

Unit-I

(6-Hours)

Decision Theory – definition- steps in decision theory approach -Maximax criterion –maximin criterion.

Unit-II

(6-Hours)

Decision making under condition of risk – expected value criterion EOL -EVPI.

Unit-III

(6-Hours)

Game theory -Introduction -basic definitions -Two person zero sum Games- Games without saddle points

Unit-IV

(6-Hours)

Graphical solution of $2 \times n$ and $m \times 2$ Games - Dominance property

Unit-V

(6-Hours)

General solution of $m \times n$ games by Linear programming method.

Books for Study

1. Kanti Swarup, Gupta, P.K. and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi, 13th ed., 2014.

Books for Reference

1. Philips, D.T., Ravindran, A and Solberg, J.J., Operations Research Principle and Practice, 2007.
2. Taha, H.A., Operations Research – An Introduction, PHI, 2014.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code	Title of the Course								Hours	Credits
III		GEC:1 - Decision Theory And Games									2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO-1	3	3	3	2	2	1	2	1	2	2	2.1
CO-2	1	2	2	2	3	2	3	2	2	2	2.1
CO-3	2	1	1	2	2	2	2	2	3	1	1.8
CO-4	3	3	3	3	3	2	2	2	2	3	2.6
CO-5	3	2	3	3	3	3	2	2	1	3	2.5
Mean Overall Score											2.2 (High)


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Semester	Hours/ Week	Credit	Medium of Instruction	Part	Sub. Code
IV	6	4	English	III	A4ST4
CC 5	STATISTICAL INFERENCE -I (Estimation Theory)				

Course objectives:

1. To gain on statistical concept to include measurements of probability distribution
2. knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts

Course Outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Identify and understand the characteristics of a good estimator	K1, K2
CO-2	Outline the different methods of point estimation	K2
CO-3	Solve problems to find a good estimator using MLE and MVUE	K3
CO-4	Construct interval estimates for small and large samples	K3
CO-5	Calculate the prior and posterior distributions	K4

Unit I

(15 Hours)

Point Estimation: Definition , Parameter Space, Statistic, Estimator, Estimate Characteristics of Estimators - Unbiasedness, Consistency, Efficiency, and Sufficiency , (Simple Problems) - Neymann Factorization Theorem (Statement Only) - Cramer -Rao Inequality.

Unit II

(15 Hours)

Complete family of distribution: Definition, Rao - Blackwell theorem, Methods of Estimation - Method of maximum likelihood estimation, Method of Minimum Variance, Method of Moments, Method of Least Square.

Unit III

(15 Hours)

Interval Estimation: Confidence interval and confidence limits, Confidence intervals for proportions, Mean, Variance, and Variance ratio based on Chi- square, Students 't' , F and Normal distributions.

Unit IV (15 Hours)

Large Sample Theory: Parameter and Statistic - Sampling Distribution of a Statistic - Standard Error, Test of Significance - Null and Alternative hypothesis, Errors in sampling, Critical Region, Level of Significance, One-tailed and Two-tailed test, Critical value.

Unit V (15 Hours)

Large Sample test: Test of Significance for single proportion and difference of proportion, Test of significance for single mean and difference of Mean and Standard Deviation (Known and Unknown Variance).

Text Books

1. S.C .Gupta and V.K . Kapoor - Fundamentals of Mathematical Statistics sultan &sons.
2. Goon A.M. Gupta M.A and Das Gupta B (1980) – An Outline of Statistical Theory, Volume 2
3. D.P. Gupta, & Vishal Sharma., *Mathematical Statistics*, Mohan Print Media (P) Ltd, Meerut, Revised Edition 2019.

Reference Books

1. Kendall, M. and Stuart, A., *The advanced theory of Statistics*, Vol. II, Charles Griffin.
2. Rohatgi, V.K., *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern, 1984.
3. Alexander M. Mood, Franklin A. Graybill, Duane C. Boes, *An Introduction to the Theory of Statistics*, McGraw Hill, 3rd Edition, 1974.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/102/111102112/>
2. <https://www.digimat.in/nptel/courses/video/111105124/L01.html>

Question Paper Pattern

Maximum Marks: 75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
IV	A4ST4					STATISTICAL INFERENCE -I (Estimation Theory)					6	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	3	3	3	2	3	2	2	2		2.4
CO -2	2	3	3	2	2	2	2	3	3	3		2.5
CO -3	3	2	3	3	2	2	2	2	2	2		2.3
CO -4	2	3	2	2	3	3	3	3	2	2		2.5
CO -5	2	2	2	2	2	2	2	3	2	3		2.2
Mean Overall Score												2.38


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
IV	3	4	English	III	A4STP2
CC 6	MAJOR PRACTICAL-II (Based on CC4 and CC5)				

Course objectives:

1. Practiced to the realized concept of preliminary tools
2. To understand to types of the distributions functions

Course Outcomes

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	Learn to obtain and sketch densities of order statistics	K3
CO-2	Students will be able to implement methods estimation and testing by using appropriate methods and computing formulae.	K4
CO-3	Practiced into the basic level statistical distributions	K5
CO-4	Computations partial and multiple correlation and regression coefficients.	K3
CO-5	Practiced various large sample tests.	K4

List of Experiments

- Continuous distribution function:
- Marginal density function and
- Conditional density function
- Expectation
- Covariance and correlation.

Drawing samples (of size not exceeding 25) from

- Uniform distribution
- Normal distribution and
- Exponential distribution

Computation of partial and multiple correlation coefficients and
Multiple linear regression equation (3 variables)

Interval estimation

Confidence interval and confidence limits for proportions, mean and variance

Large sample test:

Test of significance for single mean

- Single proportions,
- Difference of proportions and
- Standard deviations (known and unknown)

Pattern of Practical

Practical Exam duration: Three Hours

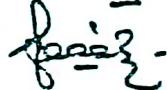
Internal Marks: (Model Practical :25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : $4 \times 15 = 60$ Marks

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
IV	A4STP2					MAJOR PRACTICAL-II (BASED ON cc4 and cc5)					3	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	2	3	3	2	3	2	2	2	2.3	
CO -2	2	3	3	2	3	2	2	3	3	3	2.5	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	3	3	3	3	2	2	2.5	
CO -5	2	2	2	2	2	2	2	3	2	3	2.2	
Mean Overall Score											2.34	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
IV	4	4	English	III	A4AST2
Allied 5	VITAL STATISTICS				

Course objectives:

1. The main purpose is to enhance the knowledge about the data that deals with the laws of human mortality and morbidity.
2. To gain the knowledge of vital events of fertility, mortality migration and life tables and their theory and practical situations.

Course Outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	identify appropriate sources of data with basic vital statistics analyses	K1
CO-2	relate the population with standardized death rates	K2
CO-3	utilize the mortality table to find the survival and death rates	K3
CO-4	analyze the birth rate used to describe fertility in the populations	K3
CO-5	distinguish between Incidence and Prevalence rates	K4

Unit I **(12 Hours)**

Introduction – Definition of Vital statistics, Uses of Vital statistics, methods of obtaining Vital statistics. Registration method, Census enumeration - Analytical method.

Unit II **(12 Hours)**

Measurement of Fertility - CBR (crude birth rate) - SFR (specific fertility rate) - ASFR (age specific fertility rate) - GFR (general fertility rate) - TFR (total fertility rate)

Unit III **(12 Hours)**

Reproduction Rate - Gross Reproduction Rate - Net Reproduction Rate.

Unit IV **(12 Hours)**

Measurement of Mortality - Specific death rate - Standardized death rate - Infant Mortality.

Unit V **(12 Hours)**

Life Tables –definition– Construction of a life table, Uses of Life table (simple problems)

Text Books and Reference

S.C. Gupta and V.K.Kapoor - Fundamentals of Applied Statistics, Sultan Chand and Sons New Delhi.

S.P.Gupta -Statistical Methods, Sultan Chand and Sons New Delhi.

Reference Books

1. Peter R Cox, *Demography*, 5th Edition, Vikas Publishing House,1979.

2. Agarwal S.N, *India's Population Problems*, Tata McGraw Hill, 1981.

3. Srinivasan, K, *Basic Demographic Techniques and Applications*, Sage Publications, New Delhi, 1998.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.stat.berkeley.edu/~bartlett/courses/153-fall2010/lectures/1.pdf>

2.. <http://www.gdcboysang.ac.in/About/droid/uploads/EconomicsPart4.pdf>

3. <http://ocw.jhsph.edu/courses/demographicmethods/PDFs/idm-sec1.pdf>

4. <https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section1.html>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
IV	A4AST2					VITAL STATISTICS					4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of Cos	
	PO - 1	PO - 2	PO - 3	PO - 4	PO - 5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	3	3	2	2	2	3	3	2	2	3	2.5	
CO -2	2	2	2	2	3	2	2	3	2	2	2.2	
CO -3	3	2	3	3	3	2	3	2	3	2	2.6	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	2	3	2	2.3	
Mean Overall Score											2.4	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
IV	3	4	English	III	A4ASTP2
Allied 6	ALLIED PRACTICAL-I (Based on Allied 4 and Allied 5)				

Course objectives:

- To provide students with demonstrate their understanding of Numerical analysis
- Demonstrate practical knowledge of various industrial oriented numerical methods.
- Demonstrate knowledge of important vital events are related to fertility and mortality

Course Outcomes

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	name the types of censoring	K1
CO-2	summarize the failure rates	K2
CO-3	explain one sample Non parametric methods	K2
CO-4	develop Gehan test problems	K3
CO-5	analyze the conditional likelihood	K4

NUMERICAL METHODS:

- Newton's forward and backward difference methods
- Newton's divided difference methods -Lagrange's methods.
- Trapezoidal rule - Simpson's 1/3rd and 3/8th rules
- Weddle's rule
- Euler's summation methods.

VITAL STATISTICS:

Measurement of Fertility

- CBR (crude birth rate)
- SFR (specific fertility rate)-
- ASFR (age specific fertility rate) .
- GFR (general fertility rate)
- TFR (total fertility rate) Reproduction Rate - Gross Reproduction Rate

Net Reproduction Rate.

- Measurement of Mortality
 - crude death rate
 - Specific death rate
 - Standardized death rate
- Life Tables – Construction of a life table.

Pattern of Practical

Practical Exam duration: Three Hours

Internal Marks: (Model Practical :25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : $4 \times 15 = 60$ Marks

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
IV	A4ASTP					ALLIED PRACTICAL-I					3	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO1	PO2	PO 3	PO 4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO -1	3	3	2	2	2	3	3	2	2	3	2.5	
CO -2	2	2	2	2	2	2	2	3	2	2	2.1	
CO -3	3	2	3	2	3	2	3	2	2	2	2.4	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	2	3	2	2.3	
Mean Overall Score											2.34	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
IV	2	2	English	IV	A4SB2
SEC2	OFFICE AUTOMATION				

COURSE OBJECTIVES

1. To provide an in-depth training in use of office automation tools. The course also helps the candidates to get acquainted with IT
2. Office tools course would enable the students in crafting professional word documents, excel spread sheets, power point presentations using the Microsoft suite of office tools.
3. To familiarize the students in preparation of documents and presentations with office automation tools

COURSE OUTCOMES

CO No.	CO-Statements	Cognitive Levels (K - Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge on design text, pictures with ms-word and powerpoint	K1
CO-2	Understand the windows operating system	K2
CO-3	Understand the printing and data results	K2
CO-4	Compute statistical measures	K3
CO-5	Learn to draw the statistical diagrams and analyse the data using excel function.	K4

Unit -I

(6 Hours)

Windows OS: Installing MS office 2010 – File tab, Title bar, Status bar, Quick access toolbar, Windows Explorer – My Computer - My Documents - Folder Creation – Creating, Copying, Editing and Deleting a File – Find and Replace Facility – Desktop Configuration – File Compression and extraction.

Unit-II

(6 Hours)

MS Word: Basics - Creating, saving, Previewing and Printing a Word document - Editing: cut, copy, paste, find, replace, undo, redo, and book working – Applying Basic formatting: changing font and font size – bold, italic and under line features - color selection – alignment - Bullet and Numbered Lists.

Unit-III

(6 Hours)

MS Word: Designing and reviewing - Adding a Table to a document – deleting, merging and splitting cells – Adding and deleting columns and rows. Inserting a Picture – clip Art, Shape and Smart Art, Capturing a screenshot, Compressing and

Cropping an image, Removing background from an image – Designing and reviewing a word document – Headers and Footers – Page margins, page orientation, page breaks – Performing Spelling and grammar checks.

Unit-IV

(6 Hours)

MS Excel Worksheet Basics & Statistical Applications: Data Entry on the Worksheet – Built-in functions – Operations on Table – printing the data and results. Construction of Line charts, Bar charts, Pie charts and scatter diagrams, Summary Statistics (Measures of central Tendency, Variation) Descriptive Statistics – Data Analysis PAK in Excel –Frequency Distribution, Histogram, Cross Tabulation and Pivot Tables.

Unit-V

(6 Hours)

MS PowerPoint: Introduction to MS-Power point, changing the layout of slides, Applying themes to a presentation, organization charts, graphs – working with slides, slide show and printing presentation.

Books for Study

1. Office 2010 in simple steps, Kogent solutions Team, Dream Tech., 2010.

Unit-I-Chapter 1, 2; Unit-II: Chapter 2; Unit-III-Chapter 4

Unit-IV-Chapter 5, 6 and 7; Unit-V-Chapter 8 & 9

Books for Reference

1. K.V.S. Sharma, Statistics made simple, PHI, 2006 (chapters 4 to 7 and 9).

2. Peter Weverka, Microsoft Office 2016 All-In-One for Dummies, John Wiley & Sons

Relationship matrix for Course outcomes, Programme outcomes /Programme

Specific Outcomes

Semester	Course Code		Title of the Course							Hours	Credits
IV	A4SB2		SEC2- OFFICE AUTOMATION							2	2
Course outcomes (COs)	Programme Outcomes					Programme Specific Outcomes					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO-1	2	2	3	2	3	3	2	2	2	2	2.3
CO-2	1	3	2	2	2	2	2	2	1	3	2.0
CO-3	2	2	2	2	2	2	2	2	3	3	2.2
CO-4	2	2	2	3	2	2	3	2	3	2	2.3
CO-5	3	2	2	2	2	2	2	3	2	2	2.2
Mean Overall Score										2.2 (High)	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
IV		2	English	IV	
GEC2	QUEUEING THEORY				

COURSE OBJECTIVE:

1. To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
2. To find out the optimum service rate and the number of servers so that the average cost of being in queuing system and the cost of service are minimized.

COURSE OUTCOMES

CO No.	CO-Statements	Cognitive Levels (K - Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge on basic models	K1
CO-2	Understand the deterministic queueing system	K2
CO-3	Understand the classification of queueing system	K2
CO-4	Compute statistical probability distributions models	K3
CO-5	Learn to Non- Poisson Queueing systems	K4

UNIT-I (6 Hours)

Queueing system -Elements of a Queueing system - Operating characteristics of Queueing systems.

UNIT-II (6 Hours)

Deterministic queueing system – probability distributions in queueing system

UNIT-III (6 Hours)

Classification of Queueing models – transient and steady states

UNIT-IV (6 Hours)

Poisson Queueing systems - $(M / M / 1) : (\square / FIFO) \square$ - problems

UNIT-V (6 Hours)

Non- Poisson Queueing systems- models I and II –problems

Books for Study

1. Kanti Swarup, Gupta, P.K. and Man Mohan, *Operations Research*, Sultan Chand & Sons, New Delhi, 13th ed., 2014.

Books for Reference

3. Philips, D.T., Ravindran, A and Solberg, J.J., *Operations Research Principle and Practice*, 2007.
4. Taha, H.A., *Operations Research – An Introduction*, PHI, 2014.

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code		Title of the Course								Hours	Credits
IV			GEC2 - Queueing Theory									2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of Cos	
	PO-1	PO-2	PO-3	PO-4	PO-5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO-1	3	3	3	2	2	1	2	1	2	2	2.1	
CO-2	1	2	2	2	3	2	3	2	2	2	2.1	
CO-3	2	1	1	2	2	2	2	2	3	1	1.8	
CO-4	3	3	3	3	3	2	2	2	2	3	2.6	
CO-5	3	2	3	3	3	3	2	2	1	3	2.5	
Mean Overall Score											2.2 (High)	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	6	5	English	III	A5STS5
CC 7	STATISTICAL INFERENCE -II (Testing of Hypothesis)				

Course objectives:

1. On completion of this paper, students will be able to understand the general principles and methods involved in doing Testing of Hypothesis and familiarizes
2. The students with methodological tools and statistical techniques, explaining large sample test
3. To understand small sample test will help them to undertake empirical research independently.

Course Outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Identify both the parameter and statistic in the hypothetical study	K1
CO-2	Extend the statistical test with interpretation	K2
CO-3	Summarize the results of Small and Large sample tests	K2
CO-4	Provide the significance evidence with the likelihood of the hypothetical events	K3
CO-5	Distinguish between the parametric and non-parametric tests	K4

Unit I (18 Hours)

Statistical Hypothesis : Definition , sample and composite hypothesis . Test of statistical hypothesis – Null hypothesis and Alternative hypothesis Critical Region, two types of errors , Levels of significance , Power of the test.

Unit II (18 Hours)

Optimum Test : Most powerful test and (mp test) , Uniformly most powerful test (UMP test) , Neyman Pearson Lemma (with proof) , Unbiased test and Unbiased critical region , optimum regions and UMP critical region.

Unit III (18 Hours)

Likelihood ratio test - Definition, Properties . Test for the mean and variance of a normal population and equally of two normal population , several normal population .

Unit IV (18 Hours)

Small sample test - 't' test for single mean and difference of means ,paired 't' test for difference of mean , observed sample correlation , chi-square test - goodness of fit , independent of attributes and F - test.

Unit V (18 Hours)

Non - Parametric tests - Definition , advantages and disadvantages - Run , Median , Sign , and Mann - Whitney tests (one sample and two sample problems)

Text Books

S.C. Gupta and Kapoor V.K - Fundamentals of Mathematical Statistics, sultan and sons.

Goon A.M. Gupta M.A and Das Gupta B (1980) - An Outline of Statistical Theory, Vol.2

Hoel, P. G. (1984). Introduction to Mathematical Statistics, 5 th Edition, Wiley, NY.

Hogg, R., McKean, J., and Craig, A. (2012). Introduction to Mathematical Statistics, 7th Edition, Pearson, New York, US.

Reference Books

Brunk, H. D. (1965). An Introduction to Mathematical Statistics, Blaisdell Publishing Company,

Conover, W. J. (1998). Practical Non-parametric Statistics, 3rd Edition, Wiley International, NY

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/102/111102112/>
2. <https://www.digimat.in/nptel/courses/video/111105124/L01.html>
- 3 <https://nptel.ac.in/courses/103/106/103106120/>
4. https://nptel.ac.in/content/storage2/courses/103106120/LectureNotes/Lec3_1.pdf
5. https://nptel.ac.in/content/storage2/courses/103106120/LectureNotes/Lec3_4.pdf

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5ST5					Statistical Inference -II (testing of hypothesis)					6	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO1	PSO-2	PSO-3	PSO4	PSO5		
CO -1	2	3	3	3	3	2	3	2	2	2	2.5	
CO -2	2	3	3	2	2	4	2	3	3	3	2.7	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	3	3	3	3	2	2	2.5	
CO -5	2	2	2	3	2	2	2	3	2	3	2.3	
Mean Overall Score											2.46	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V CC 8	5	5	English	III	A5ST6
SAMPLING TECHNIQUES					

Course objectives:

1. The main objective is to provide the knowledge of concept of sample and population in statistics and also the various sampling schemes and estimation of population parameters and their respective standard errors.
2. To equip students with Sampling Techniques used in conducting sample surveys.

Course Outcomes

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge of conducting sample survey	K1
CO-2	Identify the notations and terminology for sampling techniques	K1
CO-3	Understand the concept of sampling and non-random sampling	K2
CO-4	Choose appropriate sampling techniques	K3
CO-5	Compare various sampling techniques	K4

Unit I

(15 Hours)

Design, Organization, and execution of the sample surveys – principal steps in sample survey – pilot survey – sampling and non – sampling errors – Advantages of sampling over Complete enumeration – Limitations of sampling.

Unit II

(15 Hours)

Sampling from finite population – simple random sampling – unbiased estimate of the mean and variance – Estimation of standard error from a sample – Determination of sample size.

Unit III

(15 Hours)

Stratified random sampling – properties of the unbiased estimate of the mean and Variances – optimum and proportional allocation –Relative precision of a stratified sampling and simple random sampling – Estimation of gain due to stratification

Unit IV

(15 Hours)

Systematic sampling – Estimation of mean and variance – comparison of simple random sampling and stratified random sampling with systematic sampling

Unit V

(15 Hours)

Ratio – estimators – Variance of the ratio estimate – comparison of the ratio estimate with the mean per unit – Bias of the ratio estimate – Regression estimators – linear regression estimate – Regression estimators with pre-assigned ratio estimator. Large sample comparison with the ratio estimate and the mean per unit

Text Books

1. William G.Cohran (1984) – sampling Techniques. John Wiley 3rd Edition
2. Kapoor V.K. and Gupta S.C. - Fundamentals of Applied statistics. sultan and sons
3. Des Raj (1978), Sampling Theory, Tata-McGraw Hill, New Delhi.
- 4.3 Singh D., and Chowdhary, F. S. (2018). Theory and Analysis of Sample Survey Design, New Age International Private Ltd., New Delhi
5. Goon A.M. Gupta M.A and Das Gupta B (1980) - An Outline of Statistical Theory, Volume 2

Reference Books

- 1 Murthy, M. N. (1967). Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
- 2 Sukhatme, P. V., and Sukhatme, B. V. (1970). Sampling Theory of Surveys with Applications, Asia Publishing House, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/104/111104073/>
2. <https://nptel.ac.in/content/storage2/courses/111104073/Module14/Lecture42.pdf>
3. <https://www.mooc-list.com/tags/sampling-methods>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5ST6					Sampling Techniques					5	5
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of Cos	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	3	3	3	3	3	2	3	2	2	2	2.6	
CO -2	2	3	3	2	2	3	2	3	3	3	2.6	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	3	3	3	3	2	2	2.5	
CO -5	2	2	3	3	2	2	2	3	2	3	2.4	
Mean Overall Score											2.48	

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Semester V CC 9	Hours / Week 3	Credit 3	Medium of Instruction English	Part III	Sub. Code A5STP3 <small>(Based on CC7 and CC8)</small>

Course objectives:

1. Concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions
2. Concept of small sample test.
3. Concept about non-parametric method and some important non-parametric tests

Course outcomes

Testing of Hypothesis: Small sample test : Student's - t test for single mean and difference of means, paired 't' test for difference of mean, observed sample correlation, chi-square test - goodness of fit, independent of attributes and F - test.

Non - Parametric tests: Run, Median, Sign, and Mann - Whitney U tests (one sample and two sample problems)

Sampling Techniques: Estimation of mean and variance of the population and variance of the estimator of the mean using simple random sampling and stratified random sampling with optimum and proportional allocations, Estimation of sample size.

Ratio and linear regression methods of estimation of population mean and total estimation of mean and variance of the population and variance of the estimator of mean using systematic random sampling.

Pattern of Practical : Practical Exam duration: Three Hours

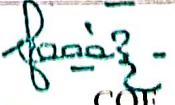
Internal Marks: (Model Practical :25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : 4 X 15 = 60 Marks

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5STP3					MAJOR PRACTICAL-III					3	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of Cos	
	PO 1	PO 2	PO 3	PO-4	PO 5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	3	3	3	3	3	2	3	2	2	2	2.6	
CO -2	2	2	3	2	2	3	2	3	3	3	2.5	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	2	3	3	3	2	2	2.4	
CO -5	2	2	3	3	2	2	2	3	2	3	2.4	
Mean Overall Score											2.44	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	4	4	English	III	A5STEL1A
DSE1	OPERATIONS RESEARCH				

Course objectives:

1. To provide the students with knowledge on the application of various optimization techniques
2. Which can help making decisions for practical problems in industries.

Course outcomes

CO No.	CO-Statements	Cognitive Levels (K -Levels)
CO-1	On successful completion of this course, students will be able to understand the theory of elements of operations research	K2
CO-2	Learn optimization techniques for solving decision making problems	K2, K3
CO-3	Formulate the optimization problems	K3, K4
CO-4	Construct network diagram and perform network analysis	K3, K4
CO-5	Learn Method to solve an Assignment problem	K4, K5

Unit - I

(12 Hours)

Origin and development of OR -Definition, scope of OR , Phase in OR, model in OR, classification of models.

Unit - II

(12 Hours)

Linear programming problem(LPP) -General form, Standard form and Canonical form, Basic Solution ,Basic feasible solution, Optimum Solution. Linear programming problem: Introduction -Mathematical formulation of LPP-Graphical solution methods.

Unit - III

(12 Hours)

Simple method: formation of LPP and its solution by Simplex method,Big-M method and Two-phase method.

Unit-IV

(12 Hours)

Transportation problem - Meaning, Balanced and Unbalanced T.F. Initial basic feasible solution - North West Corner Rule - Least Cost Method (LCM) and Vogel's Approximation method .

Unit-V

(12 Hours)

Assignment problem - Meaning, Balanced and Unbalanced Assignment problem- Hungarian Method to solve an Assignment problem .Maximization case in Assignment problem.

Text Books

Kanti Swarup, P.K.Gupta, and Manmohn (1980) - Operations Research, Sultan Chand and sons, New Delhi.

J.K. Sharma (1997), "operations research" and application, mc. Millan and company.
Reference Books

Nita H. Shah, Ravi M. Gor and Hardik Soni (2010) - "Operations Research", PHI Learning Private Limited, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://nptel.ac.in/courses/111/107/111107128/>
2. <https://nptel.ac.in/courses/112/106/112106134/>
3. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5STEL1A					OPERATIONS RESEARCH					4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of Cos	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	2	2	3	3	3	2	3	2	2.4	
CO -2	2	2	3	2	2	3	2	3	2	2	2.3	
CO -3	3	2	3	2	2	2	2	2	2	2	2.2	
CO -4	2	3	2	3	3	2	2	3	2	2	2.4	
CO -5	2	2	3	3	2	2	2	3	3	3	2.5	
Mean Overall Score											2.36	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	4	4	English	III	A5STEL1B
DSE1	REAL ANALYSIS AND MATRIX THEORY				

UNIT-I

(12 Hours)

Limits, continuity and uniform continuity of functions - Algebra of continuous functions - Differentiability - Algebra of Derivatives - Maxima and Minima of functions - Mean value theorems - Taylor's theorem - Functions of several variables.

UNIT-II

(12 Hours)

Boundedness and limit of a sequence - Convergence of sequences and series of real numbers - absolute and conditional convergence - Point - wise and uniform convergence - Tests for absolute, conditional and uniform convergence - Properties of uniform convergence

UNIT-III

(12 Hours)

Upper and lower R-S integrals. Necessary and sufficient condition for R-S integrability. Algebra of R-S integrable functions. Class of R-S integrable functions. Integration by parts. First mean value theorem and Cauchy's mean value theorem for R-S integrals.

UNIT-IV

(12 Hours)

Cayley-Hamilton theorem. Minimum polynomial, similar matrices, algebraic and geometric multiplicities of a characteristic root. Spectral decomposition of a real symmetric matrix.

UNIT-V

(12 Hours)

Congruent transformations, congruence of symmetric matrices. Canonical reduction and orthogonal reduction of real quadratic forms. Nature of quadratic forms. Sylvester's law of inertia. Simultaneous reduction of a pair of quadratic forms.

Books for Study

1. Goldberg, R.R., *Methods of Real Analysis*, Oxford & IBH, 2017.
2. Narayanan and Manickavasagam pillai, *Ancillary Mathematics*, 2009.
3. Rudin, W. (1985). *Principles of Mathematical Analysis*, McGraw-Hill, New York

Reference Books

1. Goldberg, R. R. (1976). *Methods of Real Analysis*, Oxford & IBH Publishing Company.
2. Ranjit Singh and Arora, *First course in Real Analysis*, Sultan Chand, 1974.
3. Ajit Kumar and Kumaresan, S. (2014). *A Basic Course in Real Analysis*, Chapman and Hall/CRC Press.
4. Arora, S. (1988). *Real Analysis*, Satya Prakashan Mandir, New Delhi.
5. Malik, S.C., and Arora, S. (2009). *Mathematical Analysis*, Second Edition, New Age International.
6. Rao, A. R., and Bhimasankaram, P. (2000). *Linear Algebra*, Second Edition, Hindustan Book.
7. Graybill, F.A. (1983). *Matrices and Applications in Statistics*, Wadsworth Publishing Company, Belmont, California, USA.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.jirka.org/ra/realanal.pdf>
2. <http://synechism.org/primer/primer-real-analysis.pdf>
3. [http://www.astronomia.edu.uy/progs/algebra/Linear_Algebra,_4th_Edition\(2009\)LipschutzLipson.pdf](http://www.astronomia.edu.uy/progs/algebra/Linear_Algebra,_4th_Edition(2009)LipschutzLipson.pdf)
4. <https://nptel.ac.in/courses/111/101/111101134/>
5. <https://nptel.ac.in/courses/111/106/111106051/>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

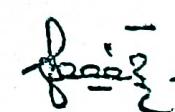
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Semester	Course Code					Title of the Course				Hours	Credit
V	A5STPELIB					Real Analysis and Matrix Theory				4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Course of Cos	
	PO1	PO 2	PO 3	PO 4	PO5	PSO1	PSO2	PSO3	PSO4	PSO-5	
CO -1	2	2	2	2	3	3	3	2	3	2	2.4
CO -2	2	2	3	2	2	3	2	3	2	2	2.3
CO -3	3	2	3	2	2	2	2	2	2	2	2.2
CO -4	2	3	2	3	3	2	2	3	2	2	2.4
CO -5	2	2	3	3	2	2	2	3	3	3	2.5
Mean Overall Score										2.36	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V DSE1	4	4	English	III	A5STELIC DSE1- SIMULATION TECHNIQUES

Course objectives:

1. Explain the meaning and objective; describe the meaning and objective of inventory management
2. Know the factor affecting the level of inventory
3. Also understand the various techniques of inventory control

Course outcomes:

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Discuss the role information technology in managing inventories	K1, K2
CO-2	Learn optimization techniques and determine in the order quantity	K2, K3
CO-3	Formulate the optimization problems	K3, K4
CO-4	Describe the function and costs of an inventory system	K3, K4
CO-5	Learn Method to solve an Probabilistic model	K4, K5

UNIT-I (12 Hours)

Definition of inventory - objectives of an inventory model - Reasons for maintaining inventories-types of inventories- inventory cost-variables involved in the inventory - factors affecting inventory control.

UNIT-II (12 Hours)

Deterministic inventory model (EOQ Model): Definition types Model -I: Derivation of EOQ Model with uniform rate of demand infinite production rate, no shortage & lead time is zero - simple problems .probabilistic inventory model - definition distinguish between deterministic model and probabilistic model.

UNIT-III (12 Hours)

Model-II: Derivation of EOQ model with several productions runs of unequal length no shortage and lead time is zero - simple problems. Model-III: Derivation of EOQ model with uniform rate of demand, finite production rate, No shortage and lead time is zero-simple problems.

UNIT-IV

(12 Hours)

Model-IV: Derivation of EOQ model with infinite production and variable order cycle time, shortage allowed and lead time is zero-simple problems. Model-V: Derivation of EOQ model with finite production, shortage allowed and lead time is zero -simple problems.

UNIT-V

(12 Hours)

Model-VI: Probabilistic model -single period model with uniform rate of demands without set-up cost (Discrete & continuous unit)-simple problems. Model-VII: Probabilistic model-single period model with instantaneous demand without set up cost (Discrete & continuous units).

Text Books and Reference

1. Kanthi swarup, Gupta, P.K.&Manmohan: operations research -sultan and chand & sons - New Delhi.
2. Sundarresan.V, Ganapathy Subramanian K.S, Ganasen .k A.R.Publication Re-Print 2002

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

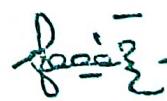
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code				Title of the Course					Hours	Credit
V	A5STELIC				SIMULATION TECHNIQUES					4	4
Course Outcomes (COs)	Programme Outcomes (POs)				Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO-1	PSO2	PSO3	PSO4	PSO5	
CO -1	2	2	2	2	3	3	3	2	3	2	2.4
CO -2	2	2	3	2	2	3	2	3	2	2	2.3
CO -3	3	2	2	2	2	2	2	2	2	2	2.1
CO -4	2	3	2	3	3	2	2	2	2	2	2.3
CO -5	2	2	3	3	2	2	2	3	3	2	2.4
Mean Overall Score											2.3


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	4	4	English	III	A5STEL2A
DSE2					DSE2 - Indian Official Statistics

Course Objectives:

The main objectives of this course are to:

1. Know the population and agricultural statistics
2. Understand industrial statistics and price statistics
3. Know the National sample survey

Course outcomes:

CO No.	CO-Statements	Cognitive Levels (K - Levels)
	On successful completion of this course, students will be able to	
CO-1	Know the population and agricultural statistics	K1, K2
CO-2	Know the industrial statistics and price statistics	K2, K3
CO-3	Know the Indices of Industrial Production and profits	K3, K4
CO-4	Know the trade and financial statistics	K3, K4
CO-5	Know the National sample surveys and National Income compilation	K4, K5

- Unit:1 (12 hours)
 Population Statistics Statistical organization – Population Statistics – Agricultural Statistics – Indices of Agricultural production – Miscellaneous Agricultural Statistics.
- Unit:2 (12 hours)
 Industrial statistics Industrial statistics – ASI – Indices of Industrial Production and profits.
- Unit:3 (12 hours)
 Price statistics Price statistics – Price index numbers – Labour Bureau; Index number of Retail prices – Indices of security prices.
- Unit:4 (12 hours)
 Financial statistics Wage statistics – trade statistics – Financial statistics – National income statistics.
- Unit:5 (12 hours)
 National Income compilation National sample surveys – Activities and publications of CSO and the Department of Statistics, Government of Tamil Nadu. National Income compilation.

Text Books

1. Gupta, S. P. (2011). Statistical Methods, Sultan Chand & Sons, New Delhi, India
2. Saluja, M. R. (1972). Indian Official Statistical System, Statistical Publishing Society, Kolkata

- Knowledge Books
1. Central Statistical Organisation, Guide to Official Statistics 1979 Ed Department of Statistics, Ministry of Planning, India

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://agriculture.uk.gov.in/pages/show/221-agriculture-statistics-Data>
2. <http://labourbureau.gov.in/CPIW05%20Methodology.html>
3. <https://byjus.com/free-ias-prep/nss>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5STEL2A					Indian Official Statistics					4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	2	2	3	2	3	2	3	2	2.3	
CO -2	2	2	2	2	2	3	2	3	2	2	2.2	
CO -3	3	2	2	2	2	2	2	2	2	2	2.1	
CO -4	2	3	2	3	3	2	2	2	2	2	2.3	
CO -5	2	2	3	3	2	2	2	3	3	2	2.4	
Mean Overall Score											2.26	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	4	4	English	III	A5STEL2B
DSE2	Econometric Methods				

Course objectives:

1. The purpose of this course is to give students a solid foundation in econometric techniques, various functions for economic analysis and future forecasting.
2. Many of the methods introduced in this course are also useful in business, finance and many other disciplines.

Course outcomes:

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Understand the basic knowledge econometrical methods	K1, K2
CO-2	Understand the regression model	K2, K3
CO-3	Know the method of least square	K3, K4
CO-4	Understand Regression analysis and analysis of variance	K3, K4
CO-5	Regression through functional forms, log linear model and semi log models	K4, K5

Unit I (12 Hours)

Econometrics – Introduction, methodology of Econometrics Interpretation on regression – statistical versus deterministic – nature ad sources of data – Accuracy of data – Measurement of scales of variables – the role of computers.

Unit II (15 Hours)

Two variate regression model: Concept of population regression function – the meaning of the term linear – stochastic specification of PRF - significance of the stochastic disturbance term – sample regression function.

Unit III (12 Hours)

The method of least square – classical linear regression model properties of LS estimates – Gauss-Markov theorem (without proof) – C efficient of determination.

Unit IV**(12 Hours)**

Regression analysis and analysis of variance - using application of Regression analysis, Prediction - reporting the results of Regression analysis - evaluating the results of Regression analysis.

Unit V**(12 Hours)**

Regression through origin - Regression on standard variables - functional forms - log linear model - semi log models - reciprocal models - Choice of functional form.

Text Book and Reference

Gujarati, D.N. and Sangeetha (2008), Basic Econometrics , McGraw Hill Co, New Delhi.

J.Johnston (1984), Economic methods , M cGraw Hill Co, New Delhi.

Ronald J. Wonnacott and Thomas H. Wonnacott (1979) Econometrics, Wiley Series.

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5STEL2B					Econometric Methods					4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	3	2	2	3	2	3	2	2	3	2.4	
CO -2	2	2	2	2	2	3	2	3	2	2	2.2	
CO -3	3	2	3	2	2	2	2	2	2	2	2.2	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	2	3	2	2.3	
Mean Overall Score											2.3	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	4	4	English	III	A5STEL2C
DSE2	Psychological And Educational Statistics				

Course objectives:

1. To provide an understanding for the graduates educational students
2. Statistical concepts distribution, sampling, regression and correlation analysis, multiple regressions and forecasting.

Course outcomes:

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Know the Psychological statistics	K1,K2
CO-2	Normalised Scores – Calculation of for a given frequency distribution	K2, K3
CO-3	Know the Scaling of Rankings in term of Normal probability curve	K3, K4
CO-4	Understand Split-half method and various methods of estimating Reliability.	K3, K4
CO-5	Know the Effect of different ranges upon Reliability of a test	K4, K5

Unit- I (12 Hours)

Psychological statistics- Definition – scaling individual test items in terms of difficulties (σ -scalling) – scaling of score on a test-Z (or σ) Score and Z (or σ)scalling- Standard scores.

Unit - II (12 Hours)

Normalised Scores – Calculation of for a given frequency distribution –Uses of T- Scores – Comparison of T- Scores and Standard scores. Percentiles Scores – Definition – Advantages and disadvantages of Percentiles Scores.

Unit- III (12 Hours)

Scaling of Rankings in term of Normal probability curve. Reliability of test scores. Reliability – Definition – error variance or standard error of measurement. Index reliability -Parallel tests – Method of determining test reliability – T test-Retest method- Alternate or Parallel forms method.

Unit- IV

(12 Hours)

Split-half method -Definition - Advantages and disadvantages-The Rulon method of estimating Reliability - Method of Rational equivalence or Kuder - Richardson method.

Unit -V

(12 Hours)

Effect of test length on Reliability of the test -Lengthening a test of attain desired Reliability - Effect of different ranges upon Reliability of a test. Validity of test Scores - Calculation of validity - validity and test length.

Text Books and Reference

S.C. Gupta and V.K.Kapoor - Fundamentals of Applied Statistics. Sultan Chand and Sons New Delhi.

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
V	A5STEL2C					Psychological and Educational Statistics					4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO - 1	PO - 2	PO - 3	PO - 4	PO - 5	PSO-1	PSO -2	PSO-3	PSO-4	PSO-5		
CO -1	2	2	2	2	3	2	3	2	3	3	2.4	
CO -2	2	2	2	2	2	3	2	3	2	2	2.2	
CO -3	3	2	3	3	2	2	3	2	3	2	2.5	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	3	3	2	2.4	
Mean Overall Score										2.38		

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
V	4	3	English	III	A5STEL01
NMEC1	BIO STATISTICS				

Course objectives:

1. The course gives the application of statistics in handling survival data.
2. The course introduces the concept of censoring and the various distributions used to analyse such data.
3. Various models are also suggested to deal with survival data.

Course outcomes:

CO No.	CO-Statements	Cognitive Levels
		(K -Levels)
CO No.	On successful completion of this course, students will be able to	
CO-1	Understand the basic concepts of Bio statistics	K1, K2
CO-2	Understand the classification and tabulation	K2, K3
CO-3	Formation a frequency distributions biological data	K3, K4
CO-4	Understand measures of central tendencies	K3, K4
CO-5	Learn correlation analysis and applications	K4, K5

Unit-I

(12 Hours)

Bio statistics: definition - scale- function of statistics - characteristics of statistics - collection of data- primary and secondary data - sources - merits, demerits-uses and limitations of statistics.

Unit-II

(12 Hours)

Classification: definition- types of classification-uses- tabulation - definition-types of tabulation rules of construction of tabulation- Diagrammatic representation- bar diagram - Pie diagram. Advantages and Disadvantages

Unit-III

(12 Hours)

Frequency distribution: formation - discrete and continuous data - Graphical representation - Histogram- Frequency polygon - Frequency curve- Ogive curves - Merits and Demerits- Comparison of Diagrammatic and Graphical Representations.

Unit -IV

(12 Hours)

Measures of central tendency: Arithmetic mean - median - mode - Merits and Demerits. Measures of Dispersion: range, coefficient of range - standard deviation - coefficient of variation- Merits and Demerits (Simple Problems).

Unit-V**(12 Hours)**

Correlation - definition and types of correlation, properties (Statement Only)-
 Methods -Scatter diagram- Karl Pearson's coefficient of correlation and Spearman's
 Rank Correlation coefficient - Merits and Demerits (Simple Problems).

Text Books and Reference

W.W. Daniel – Bio Statistics Basic concepts and Methodology for health sciences 9th edition, Wiley India Pvt. Ltd.

S.P. Gupta: Statistical Methods, Sultan chand and Sons, New Delhi.

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Semester	Course Code					Title of the Course				Hours	Credit
V	A5STEL01					Biostatistics				4	3
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Course of COs	
	PO - 1	PO - 2	PO - 3	PO - 4	PO - 5	PSO-1	PSO -2	PSO-3	PSO-4		
CO -1	2	2	2	2	3	2	3	2	3	3	2.4
CO -2	2	2	2	2	2	3	2	3	2	2	2.2
CO -3	3	2	3	3	2	2	3	2	3	2	2.5
CO -4	2	3	2	2	3	2	2	3	2	3	2.4
CO -5	2	2	3	2	2	3	2	3	3	2	2.4
Mean Overall Score										2.38	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code	
VI	6	5	English	III	A6ST7	
CC 10	DESIGN OF EXPERIMENTS					

Course objectives:

1. To provide orientation of statistics while designing statistical experiments, particularly in agricultural set-up and in pharmaceutical production processes.
2. Exposure to various statistical designs leading to the analysis of variance, eliminating heterogeneity of the data, construction of designs will be provided.

Course Outcome

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge about the factorial experiments	K1
CO-2	Understand the basic concepts in design of experiments	K2
CO-3	Carry out one way and two way Analysis of Variance	K3
CO-4	Use appropriate experimental designs to analyze the experimental data	K4
CO-5	Give statistical interpretation of the experimental results obtained	K5

Unit I (18 Hours)

Analysis of variance – Definition and assumptions Cochran's theorem (statement only) ANOVA – One way and Two way classification

Unit II (18 Hours)

Design of Experiments – Terminology and principles of experiments Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD) Estimation of one and two missing values in RBD and LSD.

Unit III (18 Hours)

Factorial Experiments – main effects and interactions, Definition of contrast and orthogonal contrast, Analysis of 2^2 and 2^3 factorial Experiments.

Unit IV (18 Hours)

Confounding in Factorial design – Confounding in 2^2 and 2^3 Experiment, merits and demerits of confounding.

Unit V (18 Hours)

Split – plot design – Analysis, advantages and disadvantages, Analysis of Covariance for a one – way layout with one concomitant variable and an RBD with one concomitant variable.

Text Books and Reference

S.C. Gupta and V.K.Kapoor - Fundamentals of Applied Statistics, Sultan Chand & sons

Goon A.M. Gupta M.A and Das Gupta, B - Fundamentals of Statistics, Sultan Chand & Sons, New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
2. <https://www.win.tue.nl/~adibucch/2WS10/SPClecturenotes.pdf>
3. <https://nptel.ac.in/courses/116/102/116102019/>
4. https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_5_Lecture_3_final.pdf

Question Paper Pattern

Maximum Marks: 75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

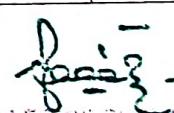
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
VI	A6ST7					Design of Experiments					6	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	3	2	2	3	2	3	2	2	2	2.3	
CO -2	2	2	3	2	2	3	2	3	3	3	2.5	
CO -3	3	2	3	3	2	2	2	2	2	2	2.3	
CO -4	2	3	2	2	2	3	3	3	2	2	2.4	
CO -5	2	2	3	3	2	2	2	3	2	3	2.4	
Mean Overall Score											2.38	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	6	5	English	III	A6ST8
CC 11	STATISTICAL QUALITY CONTROL				

Course objectives:

1. The objective of this course is to equip the students with knowledge of industrial statistics as well as applications of various industries.
2. This paper gives an exposure to quality control and its concepts and also explains the reliability concept.

Course Outcome

CO No.	CO-Statements On successful completion of this course, students will be able to	Cognitive Levels (K -Levels)
CO-1	Understand need for SQC.	K1
CO-2	Understand control chart for attributes np, p, c and u chart.	K2, K3
CO-3	Know the acceptance sampling for attributes – single, double and sequential sampling plans.	K2, K3,K4
CO-4	Use appropriate experimental designs to analyze the experimental data	K5
CO-5	Understand Sequential sampling and methods	K3,K4

Unit I

(18 Hours)

Concept of SQC - Chance and Assignable causes of variation, Uses of SQC, Process and product control - Natural tolerance limits and Specification limits - control chart for variables - \bar{X} and R-charts, Revised control charts.

Unit II

(18 Hours)

Control charts for attributes, definition OC, ASN function - Control chart for fraction defectives (p-chart), control chart for number of defectives (d-chart) (for fixed and variable sample sizes), control chart for number of defects per unit (c - chart).

Unit III

(18 Hours)

Acceptance sampling by attributes: definition OC, ASN functions - Acceptance Quality level (A.Q.L), - Lot tolerance percent defectives (L.T.P.D), process average fraction defectives (P), producer's and consumer's risks. Rectifying inspection plans. Average outgoing quality limit (A.O.Q.L).

Unit IV

(18 Hours)

Operating Characteristic (O.C) curve - Average sample number (A.S.N) single sample plans: Determination of n and c A.O.Q.L - O.C and A.O.Q curves - Double sampling plans: O.C. curve, A.S.N and A.T.I curves - comparison with single sampling plan.

Unit V

(18 Hours)

Sequential sampling - Sequential Probability Ratio Test (S.P.R.T) O.C. of sequential sampling plans, A.S.N function of sequential sampling plans.

Text Books

S.C.Gupta. & V.K Kapoor, Fundamentals Applied statistics , Sultan Chand & sons.
Duncan A.J, Statistical Quality control, Mc Graw Hill, New York.
Montgomery, D. C. (2009). Introduction to Statistical Quality Control, Sixth Edition,
Wiley India, New Delhi.

Books for Reference

Grant, E. L., and Leavenworth, R. S. (2000). Statistical Quality Control, Seventh Edition,
Tata McGraw Hill, New Delhi.
Biswas, S. (2011). Statistics of Quality Control: Sampling Inspection and Reliability, New
Central Book Agency, New Delhi, India.
Bain, L.J and Englehard, M. (1991). Statistical Analysis of Reliability and Life Testing
Models, 6th Edition, Marcel Dekker, Inc., New York, US

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
2. <https://www.win.tue.nl/~adibucch/2WS10/SPClecturenotes.pdf>
3. <https://nptel.ac.in/courses/116/102/116102019/>
4. https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_5_Lecture_3_final.pdf

Unit III (18 Hours)

Acceptance sampling by attributes: definition OC, ASN functions - Acceptance Quality level (A.Q.L), - Lot tolerance percent defectives (L.T.P.D), process average fraction defectives (P), producer's and consumer's risks. Rectifying inspection plans. Average outgoing quality limit (A.O.Q.L).

Unit IV (18 Hours)

Operating Characteristic (O.C) curve - Average sample number (A.S.N) single sample plans: Determination of n and c A.O.Q.L - O.C and A.O.Q curves - Double sampling plans: O.C. curve, A.S.N and A.T.I curves - comparison with single sampling plan.

Unit V (18 Hours)

Sequential sampling - Sequential Probability Ratio Test (S.P.R.T) O.C. of sequential sampling plans, A.S.N function of sequential sampling plans.

Text Books

S.C.Gupta. & V.K Kapoor, Fundamentals Applied statistics , Sultan Chand & sons.
Duncan A.J, Statistical Quality control, Mc Graw Hill, New York.
Montgomery, D. C. (2009). Introduction to Statistical Quality Control, Sixth Edition, Wiley India, New Delhi.

Books for Reference

Grant, E. L., and Leavenworth, R. S. (2000). Statistical Quality Control, Seventh Edition, Tata McGraw Hill, New Delhi.
Biswas, S. (2011). Statistics of Quality Control: Sampling Inspection and Reliability, New Central Book Agency, New Delhi, India.
Bain, L.J and Englehard, M. (1991). Statistical Analysis of Reliability and Life Testing Models, 6th Edition, Marcel Dekker, Inc., New York, US

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
2. <https://www.win.tue.nl/~adibucch/2WS10/SPClecturenotes.pdf>
3. <https://nptel.ac.in/courses/116/102/116102019/>
4. https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_5_Lecture_3_final.pdf

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

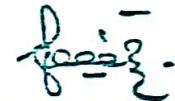
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific outcomes.

Semester	Course Code					Title of the Course					Hours	Credit
VI	A6ST8					STATISTICAL QUALITY CONTROL					6	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	3	2	2	3	2	3	2	2	2	2	2.3
CO -2	2	2	3	2	2	3	2	3	3	3	3	2.5
CO -3	3	2	3	3	2	2	2	2	2	2	2	2.3
CO -4	2	3	2	2	3	3	3	3	2	2	2	2.5
CO -5	2	2	3	3	2	2	2	3	3	3	3	2.5
Mean Overall Score											2.42	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	5	4	English	III	A6ST9
CC 12	TIME SERIES AND INDEX NUMBERS				

Course Objectives:

1. The objective of this course is to equip the students of with knowledge of Time series in real life.
2. The students with some important but useful concepts on topics in time series analysis

Course outcomes:

CO No.	CO-Statements	Cognitive Levels (K -Levels)
	On successful completion of this course, students will be able to	
CO-1	Acquire the knowledge about the time series analysis	K1
CO-2	Fitting of trend by Moving Average method	K2
CO-3	Carry out the time series data, its applications to various fields and components of time series	K3
CO-4	Use appropriate experimental data an index numbers	K4
CO-5	Give statistical interpretation of the business statistics	K5

Unit - I (15 hours)

Analysis of Time Series – definition and uses, Additive and Multiplicative Models in Time Series, Components of Time Series - Secular Trend, Seasonal variation, Cyclic Variations and Irregular fluctuations- Definition and Concepts.

Unit - II (15 hours)

Measurement of Trend – Graphic method, Method of Semi-Averages, Method of Moving Averages and Method of Least Squares. Fitting of Straight line trend and Parabolic trend (theory and problems).

Unit-III (15 hours)

Measurement of Seasonal Variations – Method of Simple Averages, (problems) Ratio to Moving Average method by additive and multiplicative model (problems). Ratio to Trend Method and Link Relative Method (concepts and procedure only).

Unit-IV (15 hours)

Index Numbers – Definition and Uses, Types of Index Numbers, Problems involved in the construction of Index Numbers. Construction of Simple Index Numbers. – Simple aggregate method and Simple average of Price Relatives using A.M & G.M. Construction of Weighted Index Numbers – Laspeyres, Paasches, Dorbish and Bowley, Marshall - Edge worth and Fisher's Ideal Index Numbers(Problems).

Unit - V**(15hours)**

Construction of Weighted Average of Price relatives Index Numbers using A.M & G.M. Fixed Base Index Numbers and Chain Base Index Numbers. Tests of adequacy of a good Index Number – Time Reversal Test, Factor Reversal Test, Unit test and Cyclic test.

Text Books and Reference

S.C .Gupta and V.K. Kapoor (2013): Fundamental of Applied Statistics. - Sultan Chand & Sons, New Delhi.

Gupta S.P (1995) , Statistical Methods, Sultan Chand & Sons, New Delhi.

Goon A.M, Gupta M.A and Das Gupta (1987) , Fundamentals of Statistics, Sultan Chand & Sons, New Delhi.

Related E- Resources [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.stat.berkeley.edu/~bartlett/courses/153-fall2010/lectures/1.pdf>

2. <http://www.gdcboysang.ac.in/About/droid/uploads/EconomicsPart4.pdf>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
VI	A6ST9					Time Series And Index Numbers					5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO 1	PO 2	PO -3	PO -4	PO5	PSO1	PSO2	PSO3	PSO4	PSO-5		
CO -1	2	3	2	2	3	2	3	2	2	2	2.3	
CO -2	2	2	3	2	2	3	2	3	3	2	2.4	
CO -3	3	2	3	2	2	2	2	2	2	2	2.2	
CO -4	2	3	2	2	3	2	3	3	2	2	2.4	
CO -5	2	2	3	3	2	2	2	3	3	3	2.5	
Mean Overall Score											2.36	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	3	3	English	III	A6STP4
CC 13	MAJOR PRACTICAL-IV (Based on CC10, CC11 and CC12)				

Course objectives:

1. Determine trend in time-series data by using linear regression trend analysis, quadratic model trend analysis
2. Differentiate among simple index numbers, unweighted aggregate price index numbers, weighted aggregate price index numbers
3. Benefits of understanding Statistical Quality Control (SQC)
4. Analysis of design of experiments

Course outcomes:

CO No.	CO-Statements	Cognitive Levels
		(K - Levels)
	On successful completion of this course, students will be able to	
CO-1	Practiced real life data in the time series analysis	K4,K5
CO-2	Fitting of trend by Moving Average method	K4,K5
CO-3	Practiced determination of seasonal variation its applications to various fields and components of time series	K4,K5
CO-4	Experiment data in statistical quality control techniques	K4,K5
CO-5	Practiced field experimental design models	K4,K5

Time series: Fitting of linear, Quadratic and Exponential trend by the least square method, finding trend values by method of moving averages. Determination of seasonal variation by simple average method, moving average method (Additive and Multiplicative model) and Link relative method.

Index Numbers: Construction of fixed and chain base numbers, Laspeyre's, Paasche's, Bowley's, Fisher's and Marshall-Edgeworth index numbers.

Time Reversal Test - Factor Reversal Test Construction of Cost of living index numbers.

Construction of \bar{X} , R, p, c and np charts, OC curves for single sampling plan.

Analysis of one way and two way, CRD, RBD, LSD layouts. Missing plot techniques in RBD and LSD (one missing observations), Analysis of 2^2 and 2^3 factorial design.

Pattern of Practical

Practical Exam duration: Three Hours

Internal Marks: (Model Practical :25 + Observation :10 + Record Note: 5 = 40 Marks)

Practical Exam (Lab) : $4 \times 15 = 60$ Marks

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
VI	A6STP4					MAJOR PRACTICAL -IV					3	3
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5		
CO -1	2	3	2	2	3	3	3	2	3	2	2.5	
CO -2	2	2	3	2	2	3	2	3	3	2	2.4	
CO -3	3	2	3	2	2	2	2	2	2	2	2.2	
CO -4	2	3	2	3	3	2	3	3	2	2	2.5	
CO -5	2	2	3	3	2	2	2	3	3	3	2.5	
Mean Overall Score											2.42	

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	4	4	English	III	A6STEL3A
DSE3	REGRESSION ANALYSIS				

Course objectives:

1. To develops a deeper understanding of the linear and non-linear regression model and its limitations.
2. To learn how to develop regression model and apply for the specific perspective data appropriate manner.
3. To understand the practical applications of the various regression models and Time series.
4. Regression analysis is the most common statistical modeling approach used in data analysis and it is the basis for advanced statistical modeling.
5. In this course, students will learn the use of different useful tools used in regression analysis. They will learn about simple and multiple linear regression, non-linear regression and generalize linear models (GLM) including logistic regression.

Course Outcomes:

CO No.	CQ–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	Understand multiple linear regression models with applications. Apply simple linear regression model to real life examples.	K1
CO-2	Apply Multiple linear Regression models and its implementation in real life situation	K2
CO-3	Understand the concept and real life applications of Multicollinearity and autocorrelation.	K3
CO-4	Gaining the knowledge for generalized and weighted least squares and Robust regression models	K4
CO-5	Develop a deeper understanding of the linear regression model and validation of Regression Models	K5

Unit I (12 hours)

Simple regression models with one independent variable, assumptions, estimation of parameters, standard error of estimator, testing the significance of regression coefficients, standard error of prediction.

Unit II (12 hours)

Fitting of straight line by matrix method (General Linear model), Analysis of variance, General linear hypothesis testing in regression situation weighted least squares bias in regression estimates.

Unit III (12 hours)
Multiple regression analysis: Estimation of parameters. Partial regression Coefficient, OLS and ML estimation, Coefficient of multiple R² and adjusted R². Polynomial regression model.

Unit IV (12 hours)
Multiple regression analysis: Hypothesis testing about individual regression coefficients, testing the overall significance of the sample regression, testing the equality of two regression coefficients, prediction with multiple regression.

Unit V (12 hours)
Dummy variable regression models: ANOVA and ANACOVA models. Selection of variables in regression. Forward, backward & optimum method

Text Books

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 – Theory, Methods, and Applications, Springer- Verlag, Berlin, 2011.

E - LEARNING RESOURCES:

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <http://home.iitk.ac.in/~shalab/regression/Chapter2-Regression Analysis.pdf> Simple Linear Regression
2. <http://www.mit.edu/~6.s085/notes/lecture3.pdf>
3. https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/Procedures/NCSS/Nonlinear_Regression.pdf
4. <https://data.princeton.edu/wws509/notes/c4.pdf>
5. <http://home.iitk.ac.in/~shalab/regression/Chapter15-Regression- Poisson Regression Models.pdf>

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

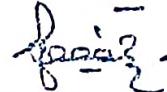
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course					Hours	Credit
VI	A6STEL3A					REGRESSION ANALYSIS					4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs	
	PO1	PO 2	PO 3	PO 4	PO 5	PSO-1	PSO2	PSO-3	PSO-4	PSO5		
CO -1	2	2	2	2	3	2	3	2	3	3	2.4	
CO -2	2	2	2	2	2	3	2	3	2	2	2.2	
CO -3	3	2	3	2	2	2	3	2	2	2	2.3	
CO -4	2	3	2	2	3	2	2	3	2	3	2.4	
CO -5	2	2	3	2	2	3	2	3	3	2	2.4	
Mean Overall Score											2.34	


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	4	4	English	III	A6STEL3B
DSE3	RELIABILITY AND SURVIVAL ANALYSIS				

Course objectives:

1. The objective of this course is to provide the applications of statistics in handling survival data.
2. This course introduces the concept of censoring and various life time distributions used to analyze such data.

Course outcomes:

CO No.	CO–Statements	Cognitive Levels (K –Levels)
	On successful completion of this course, students will be able to	
CO-1	Analyze survival data and interpret results using parametric regression models.	K1,K2
CO-2	Compute sample size for survival analysis study.	K2,K3
CO-3	Assess models for fulfillment to proportional hazards and other aspects of model.	K2,K3,K4
CO-4	Estimation of survival functions	K4,K5
CO-5	Understand Cox proportional hazards regression models	K4,K5

Unit I (12 Hours)

Introduction to Survival concepts, Survival functions and hazard rates, concepts of Type I, Type II errors. Random and other types of censoring, likelihood in these cases.

Unit II (12 Hours)

Life distributions-Exponential, Weibull, Gamma, Lognormal, Pareto distribution.

Unit III (12 Hours)

Linear failure rate, estimation / testing under censoring setup. Life tables, failure rate, mean residual life and their elementary properties.

Unit IV**(12 Hours)**

Estimation of survival functions-actuarial estimator, Product-limit (Kaplan-Meier) estimator, properties.

Unit V**(12 Hours)**

Cox proportional hazards regression models with one and several covariates, exponential, Weibull, lognormal regression.

Text Book and Reference

Miller, R.G. (1981) : Survival analysis, John Wiley.

Cox, D.R. and Oakes, D.(1984) : Analysis of survival data, Chapman & Hall, New York.

Gross, A.J. and Clark, V.A.(1975) : Survival distribution: Reliability applications in the Biomedical sciences, John Wiley and Sons.

Elandt-Johnson,R.E. Johnson, N.L. : Survival models and data analysis, John Wiley & sons.

Kalbfleish, J.D. and Prentice R.L.(1980) : The statistical analysis of failure time data, John Wiley.

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course				Hours	Credit
VI	A6STEL3B					Reliability and Survival Analysis				4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Course of COs
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO -1	2	3	2	2	3	2	3	2	3	3	2.5
CO -2	2	2	2	2	2	3	2	3	2	2	2.2
CO -3	3	2	3	3	2	2	3	2	2	2	2.4
CO -4	2	3	2	2	3	2	2	3	2	3	2.4
CO -5	2	2	3	2	2	3	2	3	3	2	2.4
Mean Overall Score											2.38

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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	4	4	English	III	A6STEL3C
DSE3	PROGRAMMING IN C				

Course objectives:

1. To learn the features and syntax of the C - programming language and train the students to write the efficient program in C.
2. To understand the practical Training in C - programming language and problems occurred in a systems.
3. To explore the concepts of information technology and communication via computers

Course outcomes:

CO No.	CO-Statements	Cognitive Levels (K - Levels)
	On successful completion of this course, students will be able to	
CO-1	various basic concepts, features and components related to C programming language, and structure of C program	K1
CO-2	various operators used like logical, assignment, conditional, bitwise in C program	K2
CO-3	Control statements, conditional statements, break and continue statements, arrays, etc. in C program	K3
CO-4	Experiment data in statistical quality control techniques	K4,K5
CO-5	Practiced field experimental design models	K4,K5

Unit -I (12 hours)

Introduction to C, Characters set, Variables, Data types - Declaration, Type conversions, Increment And Decrement operators, Bitwise, logical and Assignment operators.

Unit -II (12 hours)

Expression and conditional expressions, Control structures If - Else, Switch, While, For, Do-While loop structures. Break, Continue, Go and label statement Functions, Function Returning, Non-integers, function argument State and register variables.

Unit -III (12 hours)

Arrays and strings – Array Declaration – Multi Dimensional arrays, Strings / Character Arrays, Array initialization – Pointers and addresses. Pointers and Arrays – Pointer to Functions

Unit -IV (12 hours)

Structures and Functions, Arrays of Structures, Fields Unions – type definition – standard input and output – formatted output – Output – Access to the standard library.

Unit -V (12 hours)

File access, File handling in C – File descriptions – Error handling – “Low level I / O – Read and Write”. Open, Create, Close, Unlink – Random Access – seek and I seek.

Text Books and Reference

E. Balagurusamy – Programming in C. Tata McGraw-Hill Publishing Co.Ltd.New Delhi.

Question Paper Pattern

Maximum Marks: 75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

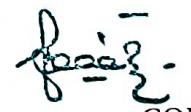
Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course				Hours	Credit
VI	A6STEL3C					PROGRAMMING IN C				4	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Course of COs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO-1	PSO2	PSO-3	PSO-4	PSO-5	
CO -1	2	2	2	3	3	2	3	2	2	2	2.3
CO -2	2	3	3	2	2	3	2	3	2	3	2.5
CO -3	3	2	3	3	3	2	2	2	2	2	2.4
CO -4	2	3	2	2	3	3	3	2	2	2	2.4
CO -5	2	2	2	2	2	2	2	3	2	3	2.2
Mean Overall Score											2.34


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Semester	Hours / Week	Credit	Medium of Instruction	Part	Sub. Code
VI	4	3	English	III	A6STEL02
NMEC2	STATISTICAL DATA ANALYSIS				

Course objectives:

1. To develop the students ability to deal with numerical and quantitative issues in business
2. To enable the use of statistical, graphical and algebraic techniques wherever relevant.
3. To have a proper understanding of Statistical applications in Economics and Management.

Course outcomes:

CO No.	CO–Statements On successful completion of this course, students will be able to	Cognitive Levels (K –Levels)
CO-1	Describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis	K1,K2
CO-2	Critically evaluate the underlying assumptions of analysis tools	K2,K3
CO-3	Conduct basic statistical analysis of data	K3
CO-4	Understand scatterness using skewness	K3,K4
CO-5	Understand the correlation analysis and its types	K4,K5

Unit-I (12 Hours)

Collection of Statistical data - Primary and Secondary – Methods -Preparation of Questionnaire and Schedules.

Unit-II (12 Hours)

Classification and tabulation - Bar diagrams - Pie diagram – Histogram - Frequency polygon - Frequency Curve - Merits and Demerits.

Unit-III (12 Hours)

Measures of central tendency-mean, median, mode-measures of dispersion-range, mean deviation, standard deviation and coefficient of variation.

Unit-IV (12 Hours)

Measures of Skewness – Definition – types – methods – Karl Pearson's Skewness – Bowley's Skewness - Merits and Demerits. (Simple problems only)

Unit -V**(12 Hours)**

Correlation analysis – Karl Pearson's Coefficient of Correlation – Spearman's Rank Correlation Coefficient. (Simple problems only)

Text Book

S.P. Gupta: Statistical Methods, sultan chand and sons, New Delhi

Question Paper Pattern

Maximum Marks:75 Exam duration: Three Hours

Part A $10 \times 2 = 20$ Answer All Questions (Two questions from each unit)

Part B $5 \times 5 = 25$ Answer All Questions (Either or type-Two questions from each unit)

Part C $3 \times 10 = 30$ Answer Any Three Questions (One question from each unit)

Relationship matrix for Course Outcomes, Programme Outcomes, Programme Specific Outcomes

Semester	Course Code					Title of the Course				Hours	Credit
VI	A6STEL02					Statistical Data Analysis				4	3
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				Mean Course of COs	
	PO -1	PO -2	PO -3	PO -4	PO -5	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	
CO -1	2	2	2	2	3	3	3	2	3	2	2.4
CO -2	2	2	3	2	2	3	2	3	2	2	2.3
CO -3	3	2	3	2	2	2	2	2	2	2	2.2
CO -4	2	3	2	3	3	2	2	3	2	2	2.4
CO -5	2	2	3	3	2	2	2	3	3	3	2.5
Mean Overall Score											2.36

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Extra Credit Courses

INTRODUCTION TO DATA MINING

Unit I

Data mining: Introduction - Challenges- Other issues. Data: Types of data- Data quality - Data pre - processing.

Unit II

Classification: Problem definition - General approach - Decision tree induction - Rule based classifiers - Nearest neighbour classifiers - Bayesian classifiers - Artificial neural networks - Support vector machine - Ensemble methods - Model evaluation.

Unit III

Association analysis: Problem definition - Frequent item set generation - Rule generation - Challenges - Interestingness measures - Generalization of association patterns.

Unit IV

Cluster analysis: Introduction - Similarity and distance - Density - Characteristics of clustering algorithms - Center based clustering techniques - Hierarchical clustering - Density based clustering - Other clustering techniques - Scalable clustering algorithms - Cluster evaluation.

Unit V

Visualization: Introduction - General concepts - Visualization techniques.

Books for Study

1. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, *Introduction to Data Mining*, ([Introduction to Data Mining \(umn.edu\)](http://www.umn.edu)), 2005

Books for Reference

1. Jiawei Han and Micheline Kamber, *Data Mining: Concepts and Techniques*, 2000

Web Resources

Unit I [Data Mining Tutorial: What is | Process | Techniques & Examples](http://guru99.com/ch4.pdf)
[\(guru99.com\)ch4.pdf \(umn.edu\)](http://guru99.com/ch4.pdf)

Unit II [ch4.pdf \(umn.edu\)](http://guru99.com/ch4.pdf) **Unit III** [ch6.pdf \(umn.edu\)](http://guru99.com/ch6.pdf) **Unit IV** [ch8.pdf \(umn.edu\)](http://guru99.com/ch8.pdf)

Unit V [Data Visualization - A Complete Introduction | OmniSci](http://omnisci.com/)

SURVIVAL ANALYSIS

Unit-I

Introduction to Survival Concepts: Survival functions and Hazard rates - Types of censoring - Type-II censoring - Random censoring - other types of censoring.

Unit -II

Parametric Models: Weibull distribution, Raleigh distribution, lognormal distribution, Pareto distribution - Increasing failure rate (IFR) - increasing failure rate average (IFRA) -Maximum likelihood estimation

Unit III

One sample Non-Parametric methods: Life tables -Actuarial method - Types of life tables - Product -limit (Kaplan - Meier) Estimator - Redistribute to the Right Algorithms - Self- Consistency - Generalized Maximum likelihood estimator.

Unit -IV

Two samples Non-Parametric methods: Gehan test-mean and variance of u - Mantel Haenszel test- sequence of 2×2 tables- Asymptotic Normality- Tarone - ware class of tests.

Unit V

k-samples Non -Parametric methods : Generalised Gehan test - Test for trend-Generalized Mantel - Haenszel test- Non parametric methods Regression - conditional likelihood analysis - justification of the conditional likelihood.

Books for Study

1. Rupert G. Miller, JR, *Survival Analysis*, Willey CBS Publishers & Distributors PVT Ltd 2014

Unit I -Chapter I - (sec 1.1, 1.2, 1.3, 2.2, 2.3, 2.4,)

Unit II *Chapter II-* (sec 1.3, 1.4, 1.5, 1.6, 1.7., 2.1, 2.2)

Unit III *Chapter III -*(sec 1.1, 1.2, 1.4, 2, 2.1, 2.2, 2.3)

Unit IV *Chapter IV-* (sec 1, 1.1, 2.1, 2.2, 3)

Unit V *Chapter V, VI -* (sec (5)1,2, (6)1,1.1, 1.2)

Books for Reference

1. Elandt-Johnson, *Survival models and Data Analysis*, John Wiley and sons 1976.


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BIG DATA ANALYTICS

Unit-I

Machine Learning: Introduction - Machine Learning Algorithms - Regression Model - Clustering - Collaborative Filtering - Association Rule Mining - Decision Tree.

Unit-II

Introduction: Big data - Characteristics, Evolution, Definition, Challenges - Classification of Analytics - Challenges in collecting and validating big data - Terminologies used in big data environments.

Unit-III

Interacting with Hadoop ecosystem: NoSQL - Uses, Types, Databases, Advantages, and Use in industry - NoSQL vendors, SQL versus NoSQL - NewSQL - Comparison of SQL, NoSQL and NewSQL.

Unit-IV

Mango DB : Introduction - Using Java Script Object Notation - Creating a Unique key - Support for Dynamic Queries - Storing Binary data - Replication - Sharing - Updating Information In - Place.

Unit-V

Python: Introduction - Basic Elements - Objects, Expressions and Numerical Types - Variables and Assignment - Python IDE's - Branching Programs - Strings and Input -A Digression about Character Encoding - Iteration

Books for Study

1. Seema Acharya & Subhashini Chellappan, *Big Data and Analytics*, Bhushan Print line, 2018.
 2. John V. Guttag, *Introduction to Computation and Programming Using Python with Application to Understanding Data*, The MIT Press, Cambridge, Massachusetts, London, England, 2016.
- Books for Reference**
1. Multiple Authors, *Big data analysis for Dummies*, Dummies Press, 2011.
 2. Anurag Srivatsava, *Hadoop Blueprints*, PACKT, 2014.
 3. Dipayan Dev, *DL with Hadoop*, PACKT, 2015.
 4. Multiple Authors, *Hadoop Fundamentals*, Packet Publications, 2012.

QUANTITATIVE TECHNIQUES FOR MANAGERIAL DECISIONS

Course Objectives:

1. understand Tools of financial analysis
2. know the Analysis of operating and financial leverages
3. know the Basic principles of accountancy

Unit-I: Principles of accountancy- Basic principles of accountancy and analysis of balance sheets

Unit-II: Financial analysis - Tools of financial analysis-Flow of funds, analysis-Cost, Volume,

Profit analysis

Unit-III: Financial leverages- Analysis of operating and financial leverages.

Unit-IV: Financial forecasting - Approaches to financial forecasting.

Unit-V: Project analysis Project analysis.

Text Books

1. Kuchhal, S. C. (1972). Financial Management, 2nd Edition, Chaitanya Publishing House
2. Development : Manual of Industrial Project Analysis in Centre of the Developing countries.

Organization for Co-operation and Development, Paris

3. Foreign and : Project Appraisal: check Lists and Discounting Common Wealth Tables. Office
(London)

Reference Books

Basu, A. (2000). Principles and Application of Financial Accounting, Tee Dee Publications

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.myaccountingcourse.com/accounting-principles>
2. https://en.wikipedia.org/wiki/Financial_analysis
3. <https://www.examples.com/business/project-analysis-examples-pdf.html>

DATA ANALYTICS USING R

The main objectives of this course are to:

1. know the concept and types of Data Analytics
2. understand R features
3. know the Data Summarization & Visualization

UNIT-I : Data Analytics- Introduction Data Analytics - Data Analysis VsData Analytics - Data Analytics - Types - Data Analytics - Framework - Data Analytics - Tool - R language - Understanding R features - Installing R and RStudio - Packages and Library - Importing and Exporting Files: CSV File - JSON File - txt File -Excel File - Xml File - Command Line Vs. Scripts. - Data Pre-Processing - Missing Value - Omitting Null Values - Data Transformation - Data Selection - Data Integration -

UNIT-II : R features- Understanding R features - Installing R and RStudio - Packages and Library - Importing and Exporting Files: CSV File - JSON File - txt File -Excel File - Xml File - Command Line Vs.Scripts Data Manipulation: Slicing - Subscripts and Indices - Data Subset - Dplyr Package: Select Function - Filter Function - Mutate Function - Arrange Function

UNIT-III : Data Summarization & Visualization : Data Summarization & Visualization - Mean - Median - Mode - Variability Measures - Variance - Range - IQR - Standard Deviation - Sum of Squares -Identifying Outliers using IQR. Data Visualization - Introduction - Datasets - Exploratory Data Analytics - Univariate Analysis - Histogram - Bivariate Analysis - Box Plot - Multivariate Analysis - Scatter Plot - MASS Package -Categorical Variable -Bar Chart - Mosaic Plot.

UNIT-IV : Analysing Gathering Information- Reporting Tool - Analysing Gathering Information - Story Telling - R Markdown - R Markdown- Framework - rmarkdown package - Knit for Embedded Code: knitr package - Convert File:HTML, PDF, MS Word - Markdown Formatted Text - ShinyApp - shiny package: Built Shiny app - Control Widgets - Customize Reactions - Reactive Expressions - Customize Appearance - Deploy Shiny app.

UNIT-V : Data Analytics Case Studies- Data Analytics Case Studies - Marketing - Logistic Management Insurance - Behavioural Analytics - Data Analytics on Diamond Dataset

Text Book

1. Bhuvaneswari, V. (2016). Data Analytics with R Step by Step, Scitech Publisher
2. Peng, R. D. (2014). R Programming for Data Science, Lean Publishing.
3. Prajapati, V. (2013). Big Data Analytics with R and Hadoop, Packt Publishing

Reference Books

1. Analysing Unstructured Data, Cambridge University Press, Feldman, r., and Sanger, J. (2006).

GENETICAL STATISTICS

Course Objectives

The main objectives of this course are to:

1. know the Elements of Genetics
2. understand Mandel's Law of inheritance and Use of χ^2 (chi-square) tests in testing the Mendel's segregation law
3. know the Method of maximum likelihood and other methods of estimation

Unit:1-Elements of Genetics- Elements of Genetics: Physical basis of heredity-cell structure chromosomes and genes - Interaction of genes concept of genotypes and phenotypes -Linkage and crossing over-Genetic maps

Unit:2-Mandel's Law of inheritance - Mandel's Law of inheritance -Laws of segregation and independent assortment -concept over generation.

Unit:3 Use of χ^2 (chi-square) tests in testing the Mendel's segregation law - Use of χ^2 (chi-square) tests in testing the Mendel's segregation law-Sex linked genes -Concept of gene frequency -concept of random mating detection and estimation of linkage from back cross, F₂,&F₃ Data

Unit:4-Maximum likelihood estimation Method of maximum likelihood and other methods of estimation- Planning of experiments

Unit:5Multiple allelic systems Multiple allelic systems-Elementary aspects of the study of human blood group.

Text Book

1. Sinott, E. (1958). Principles of Genetics, 5th Edition, McGraw Hill.
2. Mather, K., and Jinks, J. L. (1977). Introduction to Biometrical Genetics. Springer, US
3. Mather, K. (1963). Measurement of Linkage in Heredity, John Wiley & Sons, New York, US.

Reference Books

1. Kempthorne, O. (1957). An Introduction to Genetic Statistics, John Wiley & Sons, New York, US.
2. Mackay, T. F. C., and Falconer, D. S. (1995). Introduction to Quantitative Genetics, Longman (Publisher)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://en.wikipedia.org/wiki/Mobile_genetic_elements
2. <https://byjus.com/biology/mendel-laws-of-inheritance/#:~:text=Mendel%27s%20Laws%20of%20Inheritance%20Inheritance%20can%20be%20defined,that%20the%20offsprings%20are%20similar%20to%20the%20parents>

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POPULATION STUDIES

Unit-I

Vital Statistics: Definition, Nature, Scope and Methods of vital statistics data - Measurement of Population - Development of Population Studies in India.

Unit-II

Risk Measures: Ratios, Proportions, and Rates - its properties, uses and simple problems; **Morbidity Rates:** Incidence proportions, Incidence rates, Prevalence rates - Definition, properties, uses and simple problems.

Unit-III

Fertility Rates: Crude Birth Rate - General Fertility Rate - Age Specific Fertility Rate - Total Fertility Rate - Gross Reproduction Rate (GRR) - Net Reproduction Rate (NRR) - Replacement level Fertility - Birth order statistics - Child Women ratio - Order Specific Fertility Measures - Theory and Problems.

Unit-IV

Mortality Rates: Crude Death Rate - Specific death rates by Age - Sex - Causes of Death - Marital Status and other Characteristics - Infant Mortality Rate - Standardization of Death Rates (Direct and Indirect methods) - Theory and Problems.

Unit-V

Life Tables: Meaning - Uses - Expectation of life - Stationary and Stable Population - Assumptions, Description of columns and Construction of life tables - Problems on Life tables. Lotka-Dublin's Model (concept only) - Central Mortality Rate, Force of Mortality.

Books for Study

1. Gupta S.P. & Kapoor V.K., *Fundamentals of Applied Statistics*, Sultan Chand & Sons, 2019.

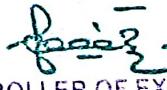
Books for Reference

1. Peter R Cox, *Demography*, 5th Edition, Vikas Publishing House, 1979.
2. Agarwal S.N, *India's Population Problems*, Tata McGraw Hill, 1981.
3. Srinivasan, K, *Basic Demographic Techniques and Applications*, Sage Publications, New Delhi, 1998.

Web Resources

<https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section1.html>


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CONTROLLER OF EXAMINATIONS
RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
THANJAVUR - 613 005.

ACTUARIAL STATISTICS

Unit-I : Calculation of Interests; Elements of simple & compound interest - Nominal rate and effective rate of interest - Force of interest - Accumulated value and present value with different rates of interest - Annuity - Classifications of annuities - Present accumulated values of annuities - Immediate annuity due and deferred annuity - Simple problems.

Unit-II : Insurance: Amortization Table and Sinking Funds - Discounting: Basic terms, Bill of exchange, True and Banker's Discounts - Bankers Gain - Simple problems; Role of probability distribution in general insurance (Weibull, Exponential).

Unit-III : Vital Statistics: Definition and uses- Measures of mortality - C.D.R., S.D.R., A.S.D.R. - measures of fertility - C.B.R., G.F.R., A.S.F.R., T.F.R., G.R.R. and N.R.R - Simple problems on Mortality and Fertility

Unit-IV : Mortality: Stationary and Stable population- Simple theorems on vital quantities - Central Mortality rate - Force of mortality - Assumption, Description and construction of mortality table

- Uses of Mortality table - Completing an incomplete mortality table- Simple problems.

Unit-V : Premium: Definition, Natural Premium level, Annual Premium, Net Premium and Office Premium - Expressions for level annual premium under temporary assurance, pure endowment assurance, endowment assurance and whole life assurance plans - simple problem involving the calculations of level annual present annual premium, office premium and the four types of plans only.

Books for Study

1. P.A. Navanitham, *Business Mathematics and Statistics*, Jai publishers, 2012.
2. Gupta, S.C. and Kapoor, V.K., *Fundamentals of Applied Statistics*, Sultan Chand & Co, 4th Revised Edition, 2019.
3. *Mathematical basis of Life Assurance (IC-81)*, Published by Insurance Institute of India, Mumbai, 2020.

Books for Reference

1. Perna, C., & Sibillo, M, *Mathematical and statistical methods for actuarial sciences and finance*, Springer, 2012.
2. Klugman, S. A., Beckley, J. A., Scahill, P. L., Varitek, M. C., & White, T. A., *Understanding actuarial practice*, Society of Actuaries, 2012.
3. Frees, E. W., *Regression modeling with actuarial and financial applications*, Cambridge University Press, 2009.