

  
**Annamalai University**  
**DEPARTMENT OF STATISTICS**  
**M.Sc. Statistics (Five Year Integrated) Programme**  
**Programme Code: SSTA51**

**Programme Structure**  
**(For students admitted from the academic year 2019-2020)**

**REGULATIONS**

**1. Name of the Programme:**

Annamalai University offers a five year M. Sc. Degree Programme (Semester Pattern) in **Statistics** with provision for a research project in the fifth year. The term 'credit' is used to describe the quantum of syllabus for various programmes in terms of hours of study. Core courses are a set of compulsory courses required for each programme. The minimum credit requirement for five year Masters Programme in **Statistics** is 225.

**2. Eligibility for admission :** Candidates for admission to the First year of the 5-Year Integrated M.Sc. Statistics Degree Programme shall be required to have passed in higher Secondary Course examinations (HSC) (10+2 level) or equivalent thereto with a minimum of 50% marks in any one of the following three combinations.

1. Maths, Physics, Chemistry and Biology
2. Maths, Physics, Chemistry and Computer Science
3. Maths, Statistics, Economics and Computer Science
4. Economics, Statistics, Commerce and Accountancy

**3. Duration of the programme:**

The five year Programme for the degree of Master of Science in STATISTICS shall consists of Ten semesters, two semesters in every year.

The academic year shall be divided into two semesters, the odd semesters being from July to November and the even semesters from December to April. The University examinations (end semester examinations) in the odd semesters shall be conducted in November and the even semesters examinations shall be conducted in May. A candidate who does not pass the examination in any course(s) of the current semester will be permitted to reappear in such course(s) that will be held in May or November in the subsequent semesters/years.

**4. Course Features:**

The programme consists of languages, ancillary courses, core courses (CC) and elective courses (EC) distributed among the ten semester periods. The core courses include theory, practical and project work, seminar, project report and viva voce examination.

**5. Grading System:**

The term grading system indicates a 10-point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

**6. Structure of the Programme:**

The Masters Programme will consist of:

- i. Languages in the first four semesters.
- ii. Two ancillary courses on Mathematics in first and second semesters and two ancillary courses on Demography in third and fourth semesters.
- iii. Core courses which are compulsory for all students.
- iv. Elective courses which students can choose from amongst the courses offered by the other departments of the same faculty as well as by the departments of other faculties of the University or within the Department.
- v. Dissertation / Project Work / Practical training / Field work, which can be done in an organization (Government, Industry, Firm, Public Enterprise etc.) approved by the concerned department.

## 7. Attendance:

Every teaching faculty handling a course shall be responsible for the maintenance of attendance Register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students.

Each student should earn 75% attendance in the courses of the particular semester failing which he or she will not be permitted to sit for the End-Semester Examination. The student has to repeat the semester in the next year.

## 8. Examinations:

The internal assessment for each course theory papers carries 25% marks and is based on two sessional tests and a variety of assessment tools such as seminar and assignment and that for practical examination carries 40% marks. The pattern of question paper will be decided by the respective department. The tests are compulsory.

For internal assessment, the break-up shall be as follows:

Theory	Internal Marks	Practical	Internal Marks
Test-I	15	Test-I	15
Test-II		Test-II	15
Seminar and Assignment	10	Viva and Record	10
Total	25	Total	40

There will be one End Semester Examination with 75% marks for theory and 60% for practical. The pattern of question paper for theory examination is common for the entire faculty and will be decided by the respective faculty.

## 9. Evaluation of dissertation:

The dissertation shall be evaluated as follows

Internal assessment by the Research supervisor	25	Marks
Valuation of Dissertation	50	Marks
Viva-Voce Examination	25	Marks

## 10. Marks and Grading:

A student cannot repeat the assessment of Sessional Test-I and Sessional Test-II. However, if for any compulsive reason the student could not attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the head of the Department.

A minimum of 50 % marks in each course is prescribed for a pass. A student has to secure 50% minimum in the end semester examination.

If a candidate who has not secured a minimum of 50% marks in a course shall be asked to reappear for the exam for that specific course.

The student can repeat the End Semester Examination when it is offered next in the subsequent Odd / Even Semesters.

### 11. Grading:

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme.

Marks	Grade Points	Letter Grade	Class
90 and above	10	S	Exemplary
85-89	9.0	D+++	Distinction
80-84	8.5	D++	Distinction
75-79	8.0	D+	Distinction
70-74	7.5	A+++	First Class
65-69	7.0	A++	First Class
60-64	6.5	A+	First Class
55-59	6.0	B	Second Class
50-54	5.5	C	Second Class
49 or Less		RA	Reappear

The successful candidates are classified as follows.

I – Class 60% marks and above in overall percentage of marks (OPM).

II – Class 50-59% marks in overall percentage of marks.

Candidates who obtain 75% and above but below 89% of marks (OPM) and above 90% (OPM) shall be deemed to have passed the examination in FIRST CLASS with Distinction and exemplary respectively provided he/she passes all the courses prescribed for the programme at the first appearance.

### 12. Course-Wise Letter Grades:

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade. A student is considered to have completed a course successfully and earned the credits if he/she secures an overall letter grade other than RA. A course successfully completed cannot be repeated for the purpose of improving the Grade Point.

A letter grade RA in any course implies a failure in that course. The RA Grade once awarded stays in the grade card of the student and will not be deleted even when he/she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the Odd/Even semester in which the candidate has appeared for clearance of the arrears.

If a student secures RA grade in the Project Work / Field Work / Practical Work / Dissertation, he/she shall improve it and resubmit if it involves only rewriting by incorporating the clarifications as per the suggestions of the evaluators or he/she can re-register and carry out the same in the subsequent semesters for evaluation.

Course Code	Course Title	Hours/Week		C	Marks		
		L	P		CIA	ESE	Total
<b>Semester-I</b>							
19ITAC11	Language-I: Course 1	3		3	25	75	100
19IENC12	Language-II: Course 1	3		3	25	75	100
19ICEC13	Civics, Environmental and Health Sciences	3		3	25	75	100
19ISTC14	Core 1: Descriptive Statistics	5		5	25	75	100
19ISTA15	Ancillary-I : Mathematics – I	4		4	25	75	100
Total Credits					<b>18</b>		
<b>Semester-II</b>							
19ITAC21	Language-I: Course 2	3		3	25	75	100
19IENC22	Language- II: Course 2	3		3	25	75	100
19ICAC23	Computer Applications – I	3		3	25	75	100
19ISTC24	Core 2: Real Analysis and Matrices	5		5	25	75	100
19ISTA25	Ancillary-I : Mathematics – II	4		4	25	75	100
Total Credits					<b>18</b>		
<b>Semester-III</b>							
19ITAC31	Language-I: Course 3	3		3	25	75	100
19IENC32	Language-II: Course 3	3		3	25	75	100
19ISTC33	Core 4: Basic Probability Theory	5		5	25	75	100
19ISTC34	Core 5: Introduction to C++	5		5	25	75	100
19ISTP35	Core 6: Statistics Practical – I		6	6	40	60	100
19ISTA36	Ancillary-II : Demography – I	4		4	25	75	100
Total Credits					<b>26</b>		
<b>Semester-IV</b>							
19ITAC41	Language-I: Course 4	3		3	25	75	100
19IENC42	Language-II: Course 4	3		3	25	75	100
19ISTC43	Core 7: Probability Distributions	5		5	25	75	100
19ISTP44	Core 8: Statistics Practical – II		6	6	40	60	100
19ISTA45	Ancillary-II : Demography – II	4		4	25	75	100
Total Credits					<b>21</b>		
<b>Semester-V</b>							
19ISTC51	Core 9: Sampling Techniques	5		5	25	75	100
19ISTC52	Core 10: Statistical Methods For Data Analysis	5		5	25	75	100
19ISTC53	Core 11: Statistical Inference	5		5	25	75	100
19ISTC54	Core 12: Elements of Quality Control	5		5	25	75	100
19ISTP55	Core 13: Statistics Practical – III		6	6	40	60	100
Total Credits					<b>26</b>		

<b>Semester-VI</b>							
19ISTC61	Core 14: Experimental Designs	5		5	25	75	100
19ISTC62	Core 15: Official and Applied Statistics	5		5	25	75	100
19ISTC63	Core 16: Econometrics	5		5	25	75	100
19ISTC64	Core 17: Optimization Techniques	5		5	25	75	100
19ISTP65	Core 18: Statistics Practical – IV		6	6	40	60	100
	Total Credits			<b>26</b>			
<b>Semester-VII</b>							
19ISTC71	Core 19: Linear Algebra and Matrix Theory	4		4	25	75	100
19ISTC72	Core 20: Measure and Probability Theory	4		4	25	75	100
19ISTC73	Core 21: Sampling Theory	4		4	25	75	100
19ISTP74	Core 22: Statistics Practical- V		6	3	40	60	100
19ISTP75	Core 23: Statistics Practical- VI		6	3	40	60	100
	Elective 1: Interdepartmental Elective	3		3	25	75	100
	Total Credits			<b>21</b>			
<b>Semester-VIII</b>							
19ISTC81	Core 24: Distribution Theory	4		4	25	75	100
19ISTC82	Core 25: Estimation Theory	4		4	25	75	100
19ISTC83	Core 26: Statistical Quality Control and Reliability	4		4	25	75	100
19ISTP84	Core 27: Statistics Practical–VII		6	3	40	60	100
19ISTP85	Core 28: Statistics Practical–VIII		6	3	40	60	100
	Elective 2: Interdepartmental Elective	3		3	25	75	100
	Elective 3: Department Elective	3		3	25	75	100
	Total Credits			<b>24</b>			
<b>Semester-IX</b>							
19ISTC91	Core 29: Testing of Statistical Hypotheses	4		4	25	75	100
19ISTC92	Core 30: Multivariate Statistical Analysis	4		4	25	75	100
19ISTC93	Core 31: Operations Research	4		4	25	75	100
19ISTC94	Core 32: Programming in R	4		4	25	75	100
19ISTP95	Core 33: Statistics Practical-IX		6	3	40	60	100
19ISTP96	Core 34: Statistics Practical-X		6	3	40	60	100
	Elective 4: Interdepartmental Elective	3		3	25	75	100
	Elective 5: Department Elective	3		3	25	75	100
	Total Credits			<b>28</b>			
<b>Semester-X</b>							
19ISTC101	Core 35: Design and Analysis of Experiments	4		4	25	75	100
19ISTC102	Core 36: Stochastic Processes	4		4	25	75	100
19ISTP103	Core 37: Statistics Practical – XI		6	3	40	60	100
19ISTP104	Core 38: Statistics Practical – XII		6	3	40	60	100
19ISTD05	Project (Dissertation and Viva-Voce/in plant training)		12	6	25	75	100
	Total Credits			<b>20</b>			

	<b>Semesters I-X Total Credits</b>			<b>228</b>			
	Value added Course						
	On-line courses (SWAYAM MOOC and NPTEL)						

L- Lectures; P- Practical; C- Credits; CIA- Continuous Internal Assessment; ESE- End-Semester Examination

**Note:**

1. Students shall take both Department Electives (DEs) and Interdepartmental Electives (IDEs) from a range of choices available.
2. Students may opt for any Value-added Course listed in the University website.

**Elective Courses**

**Department Electives (DE)**

Course Code	Course Title	Hours/ week		C	Marks		
		L	P		CIA	ESE	Total
19STAE806-1	Programming with C++	3	-	3	25	75	100
19STAE806-2	Applied Regression Analysis	3	-	3	25	75	100
19STAE907-1	Java and Oracle Programming	3	-	3	25	75	100
19STAE907-2	Advanced Econometrics	3	-	3	25	75	100

**Interdepartmental Electives (IDE)**

Course Code	Course Title	Hours/ week		C	Marks		
		L	P		CIA	ESE	Total
19 STSE 815.1	Statistical Methods	3	-	3	25	75	100
19 STSE 815.2	Mathematical Statistics	3	-	3	25	75	100
19 STSE 915.1	Bio Statistics	3	-	3	25	75	100

**VALUE ADDED COURSE FOR INTERDISCIPLINARY STUDENTS**

Course Code	Course Title	Hours/ week		C	Marks		
		L	P		CIA	ESE	Total
VAC	Statistical Methods for Data Analysis	3	-	0	25	75	100

## **Programme Objectives**

This Master Degree programme in Statistics (M.Sc., (Integrated) (Statistics)) has been designed according to the latest requirements of statistical data analysis. Initially, it provides courses on languages for four semesters, two courses on basic mathematics for first two semesters as ancillary courses and two courses on demography in third and fourth semesters as ancillary courses. Subsequently the various statistical theory and methods such as probability models, distributions, sampling techniques, estimation methods, hypothesis testing, multivariate techniques of data analyses, statistical quality control, stochastic modeling and optimization techniques are included with latest updation. Further the latest computer languages such as C++, R, Java programming are included and practical sessions are allotted to have training on various statistical softwares that includes SPSS, SAS, SYSTAT, STATGRAPH. The students are well equipped to enable to analyse the data statistically and interpret them with their self confidence.

### **Programme Outcomes**

- PO1: The students will gain knowledge in the concepts of statistical methods and models
- PO2: The students will be trained for data collection on various fields of survey enabling them to classify and analyze them statistically.
- PO3: Students will be familiarized in C++ and R programming languages and various statistical softwares.
- PO4: The students will be able to solve any problems in data relating to industrial applications to maintain the quality and improvement of the manufactured product.
- PO5: The students will be able to formulate any kind of design problems for application in the field of laboratory and agricultural field experiments.

### **Programme Specific Outcomes**

At the end of the programme, the student will be able to

- PSO1: Understand mathematical statistical and computer software concepts.
- PSO2: Prepare programs using the C++ and R languages.
- PSO3: Utilize the appropriate distributions on their problems, applying probability in real life problems and able to estimate the parameters based on the knowledge gained.
- PSO4: Apply various multivariate data analyses using statistical softwares.
- PSO5: Apply SQC techniques which will be faced in industrial applications.
- PSO6: Analyze the data on agriculture field experiments using various types of designs they learned.

## Outcome Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✓	✓		✓			✓			✓		✓	✓			✓		✓	
CO2	✓	✓			✓			✓	✓		✓			✓					✓
CO3	✓	✓		✓	✓					✓		✓	✓	✓		✓		✓	
CO4	✓	✓				✓		✓		✓		✓		✓				✓	✓
CO5	✓	✓	✓				✓			✓		✓			✓	✓	✓		✓
CO6	✓	✓	✓	✓		✓		✓		✓	✓		✓		✓	✓	✓		



**நோக்கீதி** தமிழில் தோன்றிய நவீன இலக்கியல்கல் ல்றில் அறில் கல் செல்தல். நவீன இலக்கியல்கல் ல்றில் வரையறை - தோன்ற பில் னணி - நவீன இலக்கிய வகைகல் - உரைநடை - ல்ல்கவிதை - செல்தில்்தால் - நாடகல் போல் றவல்றில் வரலால்றை விளல்்தல். இலக்கியல்களைல் அவை தொடல்பான இலக்கிய வரலால்றைல் இணைல்ல் பல்்தல்.

**அலவீ - 1 சிவீகதை**

- |                           |   |                       |
|---------------------------|---|-----------------------|
| 1. ல்லமைல்பில்்தல்        | - | பால்வல் னல் பில்ளை    |
| 2. கி.ராஜநாராயணல்         | - | கதல்                  |
| 3. ல்.அழகிரிசாமி          | - | ராஜா வல்்தில்ல்கிறால் |
| 4. கல் மணி ல்ணசேகரல்      | - | உயில்்தல் னீல்        |
| 5. மேலால் மை பொல் ல் ஷாமி | - | தேசிய மயில்           |

**அலவீ - 2 வீவீகவிதை**

- |                        |   |                                   |
|------------------------|---|-----------------------------------|
| 1. பாரதியால்           | - | ல்லமைல்பெல்                       |
| 2. பாரதிதாசல்          | - | தமில் உணல்                        |
| 3. உவமைல் கவிஞல்ல்ர்தா | - | தமிழில் பெயரில்ல்கல்              |
| 4. தேவதேவல்            | - | ல்கல்டல்                          |
| 5. அறில்மதி            | - | நல்ல்காலல் (ல் தல் 20 மல்ல்ல்)    |
| 6. மில்ரா              | - | ஹைல் எல் தோழி (ல் தல் 20 மல்ல்ல்) |

**அலவீ - 3 வீதினவீ**

- |                 |   |                   |
|-----------------|---|-------------------|
| 1. ல்.செல்வரால் | - | பொல்ல்கால் ல்திரை |
|-----------------|---|-------------------|

**அலவீ - 4 நாடகவீ**

- |               |   |      |
|---------------|---|------|
| 1. இல் ல்லால் | - | ஒளவை |
|---------------|---|------|

**அலவீ - 5 இவீகால இலக்கிய வரலாவீ**

ஐரோல்பியல் வல்கை - நவீன இலக்கியல்கல் அறில் கல் - ல்ல்கவிதை - சில் கதை - ல்தினல் ஆகியவல்றில் தோன்றல் வளல்்சில் - இலக்கிய ல் ல் னோல்கல் - செல்தில்்தால் வல்கை - நாடகல் - தோன்றல் வளல்்சில்.

**பாட வீவீ :**

- |                       |   |  |
|-----------------------|---|--|
| 1. பாரதியால்          | - | பாரதியால் கவிதைகல், நில் செல் சரி ல்லஹல்ல் , செல் னை |
| 2. பாரதிதாசல்         | - | பாரதிதாசல் கவிதைகல், மணிவாசகர் பதில்பகல், செல் னை.   |
| 3. ச.வே.ல்ல்பிரமணியல் | - | தமில் இலக்கிய வரலால் , மணிவாசகர் பதில்பகல், செல் னை. |
| 4. சோ.நா.கல்்தசாமி    | - | தமில் இலக்கிய வரலால் மணிவாசகர் பதில்பகல், செல் னை.   |
| 5. ல்ர்தா             | - | ல்றைல்கல் ல்வாதி பதில்பகல், அல்பல்ல் ல் செல் னை      |

6. ல். செல்வரால்	-	பொல்ல்கால் ல்திரை நில் செல் சரி ல்ஹல் , செல் னை.
7. அறில்மதி	-	நல்ல்காலல் கவிதா பதில்பகல், செல் னை.
8. இல் ல்லால்	-	ஒளவை அகரல் பதில்பகல், தல் சால் ல்
9. உ.கல்பல்தேவல்	-	ல்ல்மைல்பில்தல் ல்ல்மைல்கதைகல் நிய செல் சரி ல்ஹல் , செல் னை.
10. மில்ரா	-	ஹைல்
11. தேவதேவல்	-	அல் தல் மால்திரமே வெளில்பல்டல்

**Semester-I**

**19IENC12 - English Through Literature – I (Prose)**

**Credits:3**

**Hours:3**

**Learning Objectives:** By introducing the course, it is intended to:

- LO1: Develop the Language ability of the students
- LO2: Enable students to understand the passage, to read fluently, to enrich their vocabulary, and to enjoy reading and writing
- LO3: Make the students proficient in the four language skills
- LO4: Make the students read with correct pronunciation, stress, intonation, pause, and articulation of voice
- LO5: Develop their inquiry skill

**Unit-1**

Stephen Leacock  
Winston S. Churchill  
Grammar:

“With the Photographer”  
“Examinations”  
Introduce the Parts of speech Nouns, Verbs, Adjectives, and Adverbs

**Unit-2**

G.B. Shaw  
M.K. Gandhi  
Grammar:

“Spoken English and Broken English”  
“Voluntary Poverty”  
Articles

**Unit-3**

Robert Lynd  
Virginia Woolf  
Grammar:

“On Forgetting”  
“Professions for Woman”  
Pronouns

**Unit-4**

A. G. Gardiner  
R.K. Narayan  
Grammar:

“On Umbrella Morals”  
“A Snake in the Grass”  
Prepositions

**Unit-5**

Martin Luther King (Jr.)  
George Orwell  
Grammar:

“I Have a Dream”  
“The Sporting Spirit”  
Conjunctions & Interjections



Population explosion and Family Planning – Importance, Common Methods of family planning for Men & Women.

Mothers and Children – Immunisation of children (importance, schedule) care of mothers during pregnancy and after delivery.

Communicable Diseases – Symptoms and prevention.

#### **Unit–2**

(i) Mental Health – Factors for maintenance of good mental health. (ii) Adolescent problems. (iii) First Aid (iv) Environment – Ventilation, Lighting, Simple methods of purification of water, Sanitary latrine, Prevention of Worm infestation (round worm, hook worm).

#### **Book for Study and Reference:-**

- 1) Murray Grant, *Hand Book of Community Health*, Philadelphia: Lea & Febiger Publications, 1987.
- 2) Lawrence B.Chenoweth, et al. *Community Hygiene*, New York: F.S.Croft's & Co. 1934.
- 3) Charles Frederic Boldman, et.al. *Public Health and Hygiene*, Philadelphia: W.B. Saunders Company, 1936.
- 4) Harold S.Diehl, *Text Book of Healthful Living*, New York: McGraw Hill, 1945.

**Semester-I**

**19ISTC14 - Descriptive Statistics**

**Credits:5**

**Hours:5**

**Learning Objectives:** To emphasis and enchance the basic statistical knowledge of the fresh students.

#### **Unit–1**

Introduction; Origin and Scope of Statistics; Definition of Statistics; Functions of Statistics; Applications of Statistics; Limitations of Statistics; Various types of Data; Nominal, Ordinal, Ratio Scale and Interval; Primary and Secondary Data; Methods of Collecting Primary Data; Drafting the questionnaire.

#### **Unit–2**

Classification of Statistical Data - Object of classification; Types of Classification; Formation of a Discrete Frequency Distribution; Formation of Continuous Frequency Distribution; Tabulation of data; Diagrammatic presentation of data; Graphs of Frequency Distribution; Histogram; Frequency Polygon; Ogives.

#### **Unit–3**

Univariate measures - Measures of Central Tendency; OBJECTIVESs of Averaging; Requisites of a Good Average; Mean; Median; Mode; Geometric Mean; Harmonic Mean; Computation of Quartiles; Percentiles; Measures of Dispersion –Range; Mean Deviation; Standard Deviation; Co-efficient of Variation – Lorenz curve.

#### **Unit–4**

Moments – non-central moments; Central moments; Relationship between non-central and central moments; Measures of skewness; Karl Pearson's coefficient of skewness ; Bowley's co-efficient of skewness ; Measures of Kurtosis ; Types of Kurtosis.

#### **Unit–5**

Bi-variate measures – Scatter diagram Correlation; Types of Correlation; Methods of studying correlation; Karl Pearson's coefficient of correlation; Properties of coefficient of correlation; Rank correlation coefficient; Regression; regression equations; types of regression; uses of regression.

#### **Book for Study and Reference:-**

- 1) Gupta, S. C and Kapoor V. K. *Fundamentals of Mathematical Statistics*, (2007). Sultan chand & Sons, New Delhi.
- 2) S. P. Gupta, *Statistical methods* (2007). Sultan chand & Sons, New Delhi.
- 3) A. M. Goon, Gupta and Das Gupta, (1994) *Fundamentals of Statistics (Vol - I)* Central Publisher, Calcutta.

- 4) K. Senthamaraikannan and D. Venkatesan (2006). Introduction to Statistical Methods, Scitech Publishers, Chennai.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Study the basic concepts of statistics and data.  
CO2: Have knowledge on various diagrams and graphs.  
CO3: Calculate various measures of averages and dispersion.  
CO4: Study the various measures of skewness and kurtosis.  
CO5: Study the measures of bivariate data.

Semester-I

19ISTA15 - Ancillary-I : Mathematics-I

Credits:4

Hours:4

**Learning Objectives:** To build the basis knowledge on series, matrices and differentiation.

#### Unit – 1

Series, Comparison test, Integral test, Comparison of ratios, D'Alembert's ratio test, Cauchy's root test, Alternating series, Convergence of exponential series, Uniform convergence.

#### Unit – 2

Matrix operations, Rank of a matrix, Normal form of a matrix, Inverse of a matrix, Eigen values and Eigen vectors, Caley-Hamilton theorem, Reduction to a diagonal form.

#### Unit - 3

Expansion of  $\sin n\theta$ ,  $\cos n\theta$ ,  $\tan n\theta$  in powers of  $\sin \theta$ ,  $\cos \theta$  and  $\tan \theta$ , Exponential function of a complex variable, circular function of a complex variable, Hyperbolic functions, Inverse hyperbolic functions.

#### Unit - 4

Differentiation, Successive differentiation, Meaning of derivative.

#### Unit – 5

Maxima and minima, Rolle's theorem and Mean value theorem, Expansions of functions, Partial differentiation.

#### Text Book:

- 1) Content and treatment as in the book "Higher Engineering Mathematics" by B.S. Grewal, Khanna Publishers, 2008.
  - Unit I Chapter 9 Sections 9.3 to 9.17 except 9.14
  - Unit II Chapter 2 Sections 2.5 to 2.9 and 2.14 to 2.17
  - Unit III Chapter 19 Section 19.6 to 19.11
- 2) Content and treatment as in the book "Calculus" Vol. I by S. Narayanan and T.K. Manicavachogam Pillay, S. Viswanathan Printers, 2009.
  - Unit IV Chapters 2, 3 and 4
  - Unit V Chapters 5, 6, 7 and 8 (Sections 1.1 to 1.7)

#### Book for Study and Reference:-

1. G.B.Thomas, R.L.Finney, Calculus and Analytic Geometry, Addison Wesley, 9<sup>th</sup> Edn., Mass. (Indian Print) 1998.
2. M.K.Venkataraman, Engineering Mathematics-Part B. National Publishing Company, Chennai, 1992.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Study the series of number system.  
CO2: Understand the various the matrix operations and types.

CO3: Study the trigonometric and hyperbolic functions.

CO4: Understand the differentiations methods.

CO5: Study the maximum and minimum.

Semester-II

19 ITAC 21 – பணி இலக்கியவீதி சிவ்றிலக்கியவீதி

Credits:3

Hours:3

**நோக்கி :** தமில்ல் பத்தி இலக்கியல்களைல்ல சிவ்றிலக்கியல்களை அறில்கல் செல்தல். பத்தி இலக்கியல்தில் செல்வால்ல் - தோல்தல் வளல்த்சி - பால்பால் - தமில்ழில் தனித்தல் மையை உணல்த்தி பால்ல் போல்தல் வல்தறை வரலால்ல் டல் விளல்த்தல். இலக்கியல்களைல்ல அவை தோடல்தான இலக்கிய வரலால்்தறைல்ல இணைல்தல் பல்த்தல்.

**அலவீ - 1 பணி இலக்கியவீதி**

1. தில்லூன சல்பத்தல் - தில்நல்தளால் - பல்தை பதிகல்  
(ல்தல் 5 பாடல்கல்)
2. தில்ல் லல் - தில்மல்திரல் (உடல்பிணை லல் னை,  
யாவல்தல்மால், ஒல் நே லல் லல்,  
உல்தல் பெல்ல்கோயில்,  
ஆல்தல் னைல் தோடல்ல்ல் பாடல்கல்)
3. சிவ்வால்கியல் - அறில்நிலை (5 பாடல்கல்)

**அலவீ - 2 பணி இலக்கியவீதி**

1. ஆல் டால் - தில்ல்பாவை (ல்தல் 5 பாடல்கல்)
2. வல்தலால் - தில்வல்ல்பா - பில்ளைல்தில் வில் னைல்பல்

**அலவீ - 3 பணி இலக்கியவீதி**

1. தேல்பாவணி - ல்தழவிகல் வதைல்படலல்
2. சீறால்லராணல் - மால் லல்ல் பிணை நில் து படலல்

**அலவீ - 4 சிவ்றிலக்கியவீதி**

1. ல்த்றாலல் ல்த்வல் சி - மலை வளல் (வானரல்கல்... பாடல் ல்தல்)
2. ல்தல் டல்பல் - நால்ல் வளல்

**அலவீ - 5 இலக்கிய வரலால்**

பத்தி சிவ்றிலக்கிய வரலால் - இடைல்காலல் தமில்ழகல் ல்தழல் - சைவ வைண சமயல்களில் செல்வால்ல் - சமண பெளல்த சமய இலக்கியல்கல் - கிறில்லவ இல்லால் இலக்கியல்கல் - நாயல்கல்காலல் சிவ்றிலக்கியல்கல் தோல்து பில் னணி - சிவ்றிலக்கிய வகை.

**பாட லீ லீ :**

1. ச.வே.ல்த்பிரமணியல் - தமில் இலக்கிய வரலால்  
மணிவாசகர் பதில்பகல், செல் னை.
2. சோ.நா.கல்தசாமி - தமில் இலக்கிய வரலால்  
மணிவாசகர் பதில்பகல், செல் னை.

3. ந.வ் .செயராமல்	-	சில்றிலல்கியல் செல்வல் மணிவாசகர் பதில்பகல், செல் னை.
4. ந.வ் . செயராமல்	-	பல் ல் இலல்கியல் மணிவாசகர் பதில்பகல், செல் னை.
5. க.ப.அறவாணல்	-	கல் ல்கல் ல்பரணி ஒல் மதில் ல் ஜைன இளைஞர் மல் றல், செல் னை
6. கோ.கேசவல்	-	பல் ல் இலல்கியல் ஒல் சல் கவியல் பாண்வை அல் னல் வெளில் ல், தல் சால் ல்
7. வேல்கடராமல்	-	பல் ல் இலல்கியல்களில் மல் ளர் மரல்கல் தேவேல்திர மல் றல், கோயல் ல் ல் ல்
8. ந.சேலர் ல் நாதல் , ப.ஆ.,	-	ல் ல் ல் டல் பல் ல் கழகல் வெளில் ல், செல் னை

Semester-II

19IENC22 – English Thorough Literature – II (Poetry)

Credits:3

Hours:3

**Learning Objectives:** By introducing the course, it is intended to:

LO1: Develop the ability of the learner to comprehend and appreciate poems in English

LO2: Enhance the competence of the learner in using the English language

LO3: Improve the interest of the learner in human values and perceptions

LO4: Enable students to study and analyze the use of language in poetry

LO5: Provide learners with the theoretical and practical understanding of grammar

#### Unit-1

William Shakespeare	“Sonnet 116”
William Blake	“Lamb”
Robert Burns	“A Red, Red Rose”
<b>Grammar</b>	Finite & Non-finite verbs

#### Unit-2

PB Shelley	“To Wordsworth”
John Keats	“Sonnet to Sleep”
Thomas Hardy	“Neutral Tones”
<b>Grammar</b>	Strong and Weak Verbs, Auxiliaries and Modals

#### Unit-3

Robert Frost	“Stopping By Woods on a Snowy Evening”
Wilfred Owen	“Anthem for Doomed Youth”
Emily Dickinson	“A Narrow Fellow in the Grass”
<b>Grammar</b>	Transitive, Intransitive Verbs, Active and Passive Voice

#### Unit-4

Sri Aurobindo	“The Tiger and the Deer”
AK Ramanujan	“Obituary”
Sarojini Naidu	“Queen’s Rival”
<b>Grammar</b>	Concord

## Unit-5

Roger Mc Gough	“My Bus Conductor”
Maya Angelou	“Still I Rise”
Langston Hughes	“The Negro Speaks of Rivers”
<b>Grammar</b>	Tenses and their forms

## Supplementary Reading

- Hydes, Jack. *Touched With Fire*. London: Cambridge UP, 1985.
- Narasimhaiah, C. D. *An Anthology of Common Wealth Literature*. New Delhi: Macmillan, 2006.
- Thomas, C. T. *Twentieth Century Verse: An Anglo-American Anthology*. New Delhi: Macmillan, 2006.
- Gates, Henry Louis, and Nellie Y. McKay. *The Norton Anthology of African American Literature*. New York: W.W. Norton & Co, 2004.
- Ramachandran. C. N. and Radha Achar. *Five Centuries of Poetry*. New Delhi: Laxmi, 1998.

## Course Outcomes

At the end of the course, the student will be able to

- CO1: Competency in communication, both in written and oral skills
- CO2: Fluency in English language
- CO3: Knowledge about construction of sentence structures
- CO4: Vocabulary to use the English language effectively
- CO5: Acquire the aesthetic sense for appreciating poetry

## Semester-II

### 19ICAC23 - Computer Applications-I

Credits:3

Hours:3

**Learning Objectives:** To Study the Fundamentals Concepts of Computers and Operating Systems.

#### Unit – 1

Introduction to computers, Applications of computers, Concepts of data and information, A typical computer system, Memory concepts, History of computers, Types of computers.

Input, output devices, data storage devices, software, the definition, the role of software, house keeping.

#### Unit – 2

The computer internals, typical PC configuration, booting, virus, antivirus, vaccine, versions of software.

Operating system, definition, classification, basics of MSDOS, introduction to windows operating system, features of windows OS, desktop and desktop icons, starting programs, browsing and managing windows explorer, setting, Taskbars and creating shortcuts.

#### Unit – 3

Introduction to internet, client sever basics, E-mail, Telnet and Archie, FTR – Gopher, Jughead and Veronica, WAIS and world wide web, fundamentals of HTML, TCP / IP and E – Commerce.

#### Unit – 4

Issues involved in web site management, addressing, designing web sites with front page.

#### Unit – 5

Multimedia, concept, requirements, applications and future, hardware and software requirements for Multimedia development and delivery platforms, multimedia methodologies fundamental and use of hypertext, hypermedia, sound, images, animation, video.

Using multimedia, multimedia interface, planning and development of multimedia projects.



**Book for Study and Reference:-**

1. Ron Mansfield, Osborne, Windows 95 for Busy People, McGraw Hill, 1997.
2. Ron White, How computers work, BPB, 2016.
3. Christian Crumlish – The ABCs of the Internet.
4. Alexies Leon and Mathews Leon “Internet in a nutshell” Leon Press, Chennai and Vikas Publishing House, New Delhi.
5. Tay Vaughan, Multimedia Making it work, Osborne, Tata McGraw Hill, 1996.
6. Computer fundamentals and Windows with Internet Technology by Krishnan, Scitech Publications Pvt Ltd, Chennai, India.
7. Windows and MS-Office 2000 with database concepts, by Krishnan, Scitech Publications Pvt Ltd, Chennai, India.

**Semester-II****19ISTC24 - Real Analysis And Matrices****Credits:5****Hours:5****Learning Objectives:** To build the basis for promoting the aspects of Statistics.**Unit-1**

Function; Real valued function; Equivalence; Countability; Real numbers; Least upper bounds; Sequence of Real numbers; Definition of sequence and subsequence; Limit of a sequence. Convergent sequence; Divergent sequence Bounded sequence; Monotone sequence; Operations on convergent sequences.

**Unit-2**

Series of real numbers; Convergence and divergence; series with non negative terms; Alternating series; Conditional convergence and absolute convergence; Rearrangements of series; Tests of absolute convergence; Series whose terms form a non increasing sequence.

**Unit-3**

Limits and uniform Continuity; Metric spaces; Limits in metric spaces; Function of metric spaces; Uniform continuity; differentiability and integrability.

**Unit-4**

Algebra of matrices: Transpose of a matrix; Determinant of a matrix; Adjoint of a matrix; Use of inverse of a matrix to solve system of linear equation; Rank of a matrix and its properties. Orthogonal and unitary matrices; Problems.

**Unit-5**

Characteristic equation; eigen values; eigen vectors; Simple properties; Cayley - Hamilton theorem; Verification of the theorem; Finding the inverse of matrix using Cayley - Hamilton theorem.

**Book for Study and Reference:-**

- 1) Richard R. Goldberg (1970). Methods of Real Analysis, OXFORD IBH Publishing Co. Pvt. Ltd. New Delhi.
- 2) Shanti Narayann (1991). A Text books of Matrices, S. Chand & Co. Delhi.
- 3) P. R. Vittal (1982) Allied Mathematics, Margham Publishing, Chennai – 17. ( for units III, IV and V)
- 4) Richard Bellman (1970). Introduction to Matrix Analysis, Tata Mc Graw Hill Publishing Co., New Delhi.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the sequence of real numbers and related results.  
CO2: Understand the series of real numbers and related results.  
CO3: Study the limits and continuity.  
CO4: Understand the operations of matrix algebra.  
CO5: Solve problems of linear homogeneous equations.

**Learning Objectives:** To build the basis knowledge on integration.

### Unit - 1 Integration

Introduction, Definite integral, Methods of integration, Integrals of the form

$$(i) \int \frac{f'(x)}{f(x)} dx \quad (ii) \int F\{f(x)\}f'(x) dx, \quad (iii) \int \frac{dx}{ax^2+bx+c}$$

$$(iv) \int \frac{lx+m}{ax^2+bx+c} dx \quad (v) \int \frac{1}{\sqrt{ax^2+bx+c}} \quad (vi) \int \frac{px+q}{\sqrt{ax^2+bx+c}} dx$$

### Unit - 2 Integration

Properties of definite integrals, Integration by parts, Reduction formula for the following types

$$(i) I_n = \int x^n e^{ax} \quad S \quad n \rightarrow +ve \text{ integer} \quad (ii) I_n = \int \cos^n x dx \quad n, \text{ positive integer}$$

$$(iii) I_n = \int \sin^n x dx \quad (iv) I_{mn} = \int \sin^m x \cos^n x dx \quad \text{Bernoulli's formula.}$$

### Unit - 3

Area under plane curves, Area of a closed curves, Area between two intersecting curves, Areas in polar coordinates, Volume of the solid of revolution, Length of a curve, Area of surface of revolution.

### Unit - 4

Vector differentiation, Scalar functions, Vector functions, Differentiation of a vector, Differentiations formulas, Differentiation of dot and cross products, The Vector differential operator Del, Gradient of a scalar function, Directional derivatives, Divergence of a vector, Curl of a vector, Expansion formulae, Second order differential operators, Solenoidal and irrotational fields.

### Unit - 5

Vector integration, The line integral, Green's theorem in two dimensions-verification, Gauss divergence theorem (without proof)-verification and evaluation of integrals, Stoke's theorem (without proof)-verification and evaluation of integrals.

### Text Book:

- Content and treatment as in the book "Calculus (Major)" Vol. II by S. Narayanan and T.K. Manicavachogam Pillay, S. Viswanathan Printers, 2003.
  - Unit I Chapter 1 Sections 1 to 8
  - Unit II Chapter 1 Sections 11 to 15.1
  - Unit III Chapter 2 Sections 1.1 to 1.4, Sections 3 to 5
- Content and treatment as in the book "Vector Calculus and Fourier Series" by M.K. Venkataraman and Manorama Sridhar, by The National Publishing Company, 2002.
  - Unit IV Chapter 2 Sections 2.2 to 2.4, 2.6, 2.7.
  - Chapter 3 Sections 3.2, 3.3, 3.4, 3.7, 3.9, 3.11, 3.12, 3.15.
  - Unit V Chapter 4 Sections 4.1, 4.3, 4.9 and 4.12

### Book for Study and Reference:-

- G.B.Thomas, R.L.Finney, Calculus and Analytic Geometry, Addison Wesley, 9<sup>th</sup> Edn, Mass, (Indian Print, 1998).
- M.K.Venkataraman, Engineering Mathematics-Part B. National Publishing Company, Chennai, 1992.
- P. R.Vittal, Vector Calculus, Fourier series and Fourier Transform, Margham Publications, Chennai, 2004.
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2008.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Solve exercise of integration of type I
- CO2: Solve exercise of integration of type II
- CO3: Understand the plane curves
- CO4: Solving problems of vector differentiations.
- CO5: Solving problems of vector integrations.

Semester-III

19ITAC31 - அற இலக்கியவீகாவீயவீ

Credits:3

Hours:3

**நோக்கவீ** தமழில் தோல்றி அற இலக்கியல்களால் கால்பிய இலக்கியல்களால் அறில்கல் செல்தல். அவற்றில் வகைகளை வரலால்லடல் விளல்தல். இலக்கியல்களால் அவை தொடல்பான இலக்கிய வரலால்றால் இணைல்ல் பல்்தல்.

**அலவீ - 1 அற இலக்கியவீ**

1. தில்ல்தல் - உழல், ஒல்ல்கல் டைமை, காலமறிதல், நல்ல், பிரிவால்றாமை

**அலவீ - 2 அற இலக்கியவீ**

1. நாலல்யால் - பெரியாரைல் பிழையாமை  
2. பழமொழி நால் ல் - கல்வி

**அலவீ - 3 காவீயவீ**

1. சிலல்பதிகாரல் - இல்திர விழல் ஊரெல்்து காதை  
2. மணிமேகலை - ஆல்திரல் திறல் அறிவில்து காதை

**அலவீ - 4 காவீயவீ**

1. பெரிய ல்ராணல் - அல்்தி அல்கல் ல்ராணல்  
2. கல்பராமாயணல் - வால் வதைல்படல்

**அலவீ - 5 இலக்கிய வரலால்**

சல்க மல்விய கால அற இலக்கியல்கல் - தில்ல்தலில் பெல்மை - அற இலக்கியல்களில் வளல்சி - கால்பிய இலக்கணல் - பல்ல்கல் - காலல்தோறல் தோல்றிய கால்பியல்கல் - வரலால்.

**பாட லீகவீ**

1. ச.வே.ல்பிரமணியல் - தமில் இலக்கிய வரலால் மணிவாசகர் பதில்பகல், செல்லை.  
2. சோ.ந.கல்தசாமி - தமில் இலக்கிய வரலால் மணிவாசகர் பதில்பகல், செல்லை.  
3. ----- - பதினெல் கீல்கணல்ல் ல்கல் மணிவாசகல்பதில்பகல், செல்லை  
4. இளல்கோவல்கல் - சிலல்பதிகாரல்  
5. சீல்தலைல்சால்தனால் - மணிமேகலை  
6. செல்கிழால் - பெரியல்ராணல்  
7. கல்பல் - கல்பராமாயணல்

Semester-III

19IENC32 - English Through Literature – III (Drama)

Credits:3

Hours:3

**Learning Objectives:** By introducing the course, it is intended to:

LO1: Enhance the conversational competence of the learners by introducing drama in English.

LO2: Make the students the understand characteristics of the Elizabethan Age.

- LO3: Make the students appreciate Shakespearean drama.  
 LO4: Make the students learn the key elements of sentence structures  
 LO5: Make the students master the mechanics of writing

**Unit-1**

William Shakespeare *The Tempest* (Act I)  
 Grammar "Phrases and Clauses"

**Unit-2**

William Shakespeare *The Tempest* (Act II)  
 Grammar "Simple, Compound, and Complex Sentences"

**Unit-3**

William Shakespeare *The Tempest* (Act III)  
 Grammar "Transformation of Sentences"

**Unit-4**

William Shakespeare *The Tempest* (Act IV)  
 Grammar "Sequence of Tenses and Reported Speech"

**Unit-5**

William Shakespeare *The Tempest* (Act V)  
 Grammar "Punctuation and Capitals"

**Text Books:**

1. Shakespeare, William. *The Tempest*. Ed. W. Turner. New Delhi: S. Chand & Co., 2008.
2. Green, David. *Contemporary English Grammar, Structures, and Composition*. Chennai: MacMillan, 2010.

**Supplementary Reading:**

- Cahn, L Victor. *Shakespeare the Playwright: A Companion to the Complete Tragedies Histories, Comedies, and Romances*. London: Praeger, 1996.  
 Crystal, David. *Shakespeare's Words: A Glossary and Language Companion*. London: Penguin, 2009.  
 Greenbaum, Sidney. *Oxford English Grammar*. London: Oxford UP, 2005.  
 McCarthy. *Cambridge Grammar of English*. London: Cambridge UP, 2018.  
 Quirk, Randolph. *A Comprehensive Grammar of the English Language*. London: Pearson, 2010.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Obtain a literary acumen to answer MCQs of NET/SET Examinations and other competitive examination  
 CO2: Appreciate conversational English  
 CO3: Recognize the dramatic elements of Shakespearean dramas  
 CO4: Use punctuations and capitals effectively in their composition  
 CO5: Recognize the elements of the spoken discourses

**Semester-III**

**19ISTC33 - Basic Probability Theory**

**Credits:5**

**Hours:5**

**Learning Objectives:** To study the basic concepts for promoting theoretical as well as applications of statistics.

**Unit-1**

Probability: Sample space – Events - algebraic operations on events. Definitions - Classical Probability, Statistical Probability, Axiomatic approach to probability - Independent events – Conditional probability -- Addition and Multiplication theorems of probability –Bayes Theorem.

## Unit-2

Random variables: Discrete and continuous random variables –Distribution function-properties – Probability mass function and Probability density function –Discrete and continuous probability distributions.

## Unit-3

Multiple Random Variables: Joint, marginal and conditional distributions- independence of random variables –Transformation of random variables (one and two dimensional) and determination of their distributions.

## Unit-4

Mathematical Expectation: Expectation – Properties, Cauchy-Schwartz inequality, conditional expectation and conditional variance – theorems on expectation and conditional expectation. Moment generating function, cumulant generating function, characteristic function, probability generating function and their properties. Tchebychev's inequality.

## Unit-5

Limit Theorems: Convergence in probability, weak law of large numbers - Bernoulli's theorem, Khintchine's theorem (Statements only) – Simple form of Central limit theorem for i.i.d random variables.

### Book for Study and Reference:-

- 1) Gupta, S.C. and Kapoor, V. K. (1982) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
- 2) Hogg, R.V. and Craig, A. G. (1978) Introduction to Mathematical Statistics, MacMillan, London
- 3) Mood, A.M. Graybill, F. A. and Boes, D. C. (1974) Introduction to Theory of Statistics, Tata McGraw Hill, New Delhi.
- 4) Goon, A.M. Gupta, M.K. and Das Gupta, B. (1993) Fundamentals of Statistics Vol. I. World press, Kolkata.
- 5) Lipschutz, S. (2008) Probability Theory (Second Edition), Schaum's Outline Series, McGraw Hill, New York.
- 6) Spiegel, M.R. and Ray, M. (1980) Theory and Problems of Probability and Statistics, Schaum's Outline Series, McGraw Hill, New York.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Study the various concepts of probability
- CO2: Understand a random variables probability functions.
- CO3: Study the bivariate probability functions.
- CO4: Understand the mathematical expectations and related functions.
- CO5: Study the law of large numbers.

### Semester-III

### 19ISTC34 - Introduction To C++

Credits:5

Hours:5

**Learning Objectives:** To get in depth knowledge in C++ Programming and to write programs effectively for solving any statistical problems.

#### Unit-1

C++ character set, Constants, Variables and Expressions. Basic structure of a "C++" program. Operators - Pre-processor directives - Library functions - Input-output functions. Decision making statements - Loop statements.

#### Unit-2

Functions by Reference. Introduction to Pointers and Structures - File handling. Simple programs need to be written based on above concepts.

Arrays – User defined functions – Calling functions by Value – Calling

### Unit-3

Object Oriented Programming(OOP):Class – Objects – Member data – Member functions - Constructors – Destructors – Function overloading – Function overriding – Calling functions using objects as arguments.

### Unit-4

Inheritance – Simple, Multiple and Multi-Level inheritance with public, private and protected access modifiers. Polymorphism - Virtual functions – Friend functions. Introduction to I/O streams.

### Unit-5

C++ Programs for Statistical Data Analysis:

Formation of frequency distribution – Computation of mean, median, mode, minimum, maximum, range, quartiles, variance, standard deviation, co-efficient of variation, Fitting of Binomial and Poisson distributions.

#### Book for Study and Reference:-

- 1) Balagurusamy, E. (2000) Object Oriented Programming C++, Tata McGraw Hill, New Delhi.
- 2) Jesse Liberty. (1999) C++ Unleashed, Techmedia, New Delhi.
- 3) Robert Lafore. (1988) Object Oriented Programming in Turbo C++, Galgotia Publications, New Delhi.

#### Course Outcomes

At the end of the course, the student will be able to

- CO1: Study the variables and expressions of C++.
- CO2: Understand the concepts of pointers and structures.
- CO3: Study the objects and functions of C++
- CO4: Study the inheritance of C++
- CO5: Develop programs related to statistical problems.

Semester-III

**19ISTP 35 - Statistics Practical – I  
(Calculator Based Practical)**

**Credits:6**

**Hours:6**

**Learning Objectives:** To acquire the knowledge of basic statistics in the form computation.

#### Statistics Practical Schedule:-

##### Descriptive Statistics

- 1) Calculation of Mean, Median, Mode, Geometric Mean and Harmonic Mean for raw data.
- 2) Calculation of Mean, Median and Mode.
- 3) Calculation of Mean, Median and Mode for frequency distribution with Class Intervals.
- 4) Calculation of raw and central moments for raw data.
- 5) Calculation of raw and central moments for frequency distribution.
- 6) Calculation of range, Quartile Deviation, Standard Deviation, Mean Deviation, Coefficient of Variation and Variance for raw data.
- 7) Calculation of range, Quartile Deviation, Standard Deviation, Mean Deviation, Coefficient of Variation and their relative measures for frequency distribution.
- 8) Calculation of Pearson's and Bowley's Coefficient of Skewness.
- 9) Calculation of Simple Correlation and Regression coefficients.
- 10) Forming of Regression Lines and Predictions from Bivariate Data.

##### Matrices

- 1) Matrix operations.
- 2) Inverse of Matrix using adjoint Matrix.
- 3) Inverse of Matrix using Sweepout Process for a 4X4 Matrix.
- 4) Solving system of linear equations using matrix method.
- 5) Solving system of linear equations using Cramer rule.
- 6) Solving system of linear equations using Gauss Doolite's Method.
- 7) Finding the Rank of a Matrix.

### **Fitting Of Distributions**

- 1) Fitting of Binominal distribution.
- 2) Fitting of Poisson distribution.
- 3) Fitting of Normal distribution

### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Calculate variate statistical measures.  
CO2: Solve problems of matrices.  
CO3: Fit binomial, Poisson and normal distributions.

**Semester-III**

**19ISTA36 - Ancillary-II : Demography-I**

**Credits:4**

**Hours:4**

**Learning Objectives:** To acquire the knowledge of demographic methods applicable to statistical data analysis.

#### **Unit-1**

Population Change and Components of Population Change. Demographic Data and Sources of Demographic Data. Importance of the Quality of Demographic Data in the Formulation of Policies and Programmes. Types of Errors in Different Sources of Demographic Data. Techniques for Evaluation and Adjustment of Demographic Data in Different Sources. Importance of Balancing Equation and Age-Sex Pyramids. Computer Applications in the Evaluation and Adjustment of Demographic Data.

#### **Unit-2**

Fertility and Reproduction. Importance of the Quality of Fertility Data in the Demographic Analysis. Period Measures of Fertility and Reproduction. Cohort Measures of Fertility and Reproduction. Replacement Level of Fertility and Fertility Transition. Population Momentum. Mathematical relationships of different fertility indicators with other components of population change. Importance of Fertility Surveys in Demographic Analysis.

#### **Unit-3**

Mortality and Morbidity. Importance of the Quality of Mortality Data in the Demographic Analysis. Period Measures of Mortality and Morbidity. Cohort Measures of Mortality and Morbidity. Lexis Diagram and its importance in Mortality Analysis. Force of Mortality. Mathematical relationships of different mortality indicators with other components of population change.

#### **Unit-4**

Life Table. Different Types of Life Tables: Cohort Life Table and Period Life Table. Complete Life Table and Abridged Life Table. Different Methods of Construction of Complete Life Table and Abridged Life Table. Mathematical interrelationships of different life table functions and its utility in Mortality Analysis. Uses of Life Tables in Demographic Analysis.

#### **Unit-5**

Migration. Importance of the Quality of Migration Data in the Demographic Analysis. Different Types of Migration. Different Measures of Migration: Migration Rates and Ratios. Migration Streams and Counter Streams. Index of Redistribution. Indices of Migration differentials and selectivity. Index of Preference, Index of Velocity, Index of Net Velocity, Index of Effectiveness.

### **Book for Study and Reference:-**

- 1) R. Ramakumar (1986), Technical Demography
- 2) K.B. Pathak & F. Ram (2005), The Techniques of Demographic Analysis
- 3) B.D. Misra (1980)- The Study of Population
- 4) United Nations (1952)- Manual I- Methods of Estimating Total Population for Current Dates
- 5) United Nations (1955)- Manual II- Methods of Appraisal of Quality of Basic Data for Population Estimates
- 6) United Nations (1956)- Manual III- Methods for Population Projection by Sex and Age
- 7) United Nations (1967) - Manual IV- Methods of Estimating Basic Demographic Measures from Incomplete Data.

- 8) United Nations (1971)- Manual V- Methods of Projecting the Economically Active Population
- 9) United Nations (1970)- Manual VI- Methods of Measuring Internal Migration
- 10) United Nations (1973)- Manual VII- Methods of Projecting Households and Families

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the basic concepts of demography.  
 CO2: Study the area of fertility.  
 CO3: Have thorough knowledge mortality and morbidity.  
 CO4: Understand the use of life table.  
 CO5: Have idea on migration concepts.

**Semester-IV**

**19ITAC41 - சனிக இலக்கியவீனீ செவீமொழி வரலாவீனீ**

**Credits:3**

**Hours:3**

**நோக்கீனீ** உலகல்செல்மொழியில் வரலால்றைல் ல் ல் தல். தமில்ல்செல்மொழியில் தனில் சிறல்ல்சுகளைல் செல்மொழி இலக்கியல்சுகளைல் விவரில் தல் - சல்க இலக்கியல்சுகளில் தனில் தல் மைகளை வரலால் டல் விளல் தல்.

#### அலவீ - 1 அக இலக்கியவீனீ

- |                 |   |                         |              |
|-----------------|---|-------------------------|--------------|
| 1. ல் ல் தொகை   | - | 125, 129, 177, 302, 397 | (நெல் தல்)   |
| 2. நல் றிணை     | - | 206, 217, 304, 334, 382 | (ல் றில் சி) |
| 3. ஐல் ல் ல் ல் | - | 17, 18, 71, 75, 96,     | (மல் தல்)    |
| 4. அகநால் ல்    | - | 147, 303, 370           | (பாலை)       |
| 5. கல் தொகை     | - | 104, 105                | (ல் லலை)     |

#### அலவீ - 2 வீற இலக்கியவீனீ

- |                |   |  |
|----------------|---|--|
| 1. ல் றநால் ல் | - | பெல் பால் ல் லவர;கல்                           |
|                |   | 76, 83, 133, 146, 178, 188, 227, 261, 264, 278 |

#### அலவீ - 3 பனீவீபாவீனீ

1. நெல் நெல்வாடை

#### அலவீ - 4 சனிக இலக்கிய வரலாவீ

தொல்கால்பியல் - சல்க காலல் - ல் ல் சல்கல்சுகல் - பால் ல் தொகைல் - தொல் ல் ல் றை - தனில் தல் மைகல்.

#### அலவீ - 5 பயவீ பாவீவீதமில் வீ செவீமொழி வரலாவீ

மொழி விளல்சுகல் - மொழில் ல் ல் ல் ல் ல் ல் - உலகல் செல்மொழிகல் - இல் தியல் செல்மொழிகல் - செல்மொழில் தல் திகல் - வரையறைகல் - வால் ல் செல்மொழில் தமில் - தமில் ல் தொல் மை - தமில் ல் சிறல் ல் ல் சுகல் - தமில் ல் செல்மொழி ல் ல் சுகல் - தமில் செல்மொழி அறில் தேல் ல் - பரிதிமால்சுகளை ல் ல் தல் தல் கால அறில் ல் ல் வரை (அறில் ல் ல் - அமைல் ல் ல் - றில் வனல்சுகல் - இயல்சுகல் தொடல் ல் ல் ல் ல் - அறல் பேரால் ல் ல் - உலல் தமில் ல் செல்மொழி மாநால், கோவை-2010)

**பாட வீனீ:**



1. ச.வே.ல்பிரமணியல் - சல்க இலக்கியல்  
மணிவாசகல்பதில்பகல்.
- பாலீவ வீ வீகவீ :**
1. ல்.வரதராசல் - தமில் இலக்கிய வரலால் ,  
சாகில்திய அகாதெமி வெளில்ல் 1998.
2. ல்வல் ணல் - தமில் இலக்கிய வரலால் ,  
கழக வெளில்ல் செல் ணை.
3. தமிழல் ணல் - ல்திய நோல்கில் தமில் இலக்கிய வரலால்  
மீனால்சி ல்தக நிலையல், மல் ரை 1998.
4. சி.பாலல்பிரமணியல் - தமில் இலக்கிய வரலால் ,  
பாரிநிலையல், செல் ணை - 1987
5. எல்.ஆல்அடைல்கலசாமி - தமில் இலக்கிய வரலால்  
கழக வெளில்ல், செல் ணை - 1994.
6. மல்.ச.விமலானல்தல் - தமில் இலக்கிய வரலால்ல் களல் சியல், 1987.
7. கல் ணல் ப.ஆ. - ல்றல்பாடல்களில் பெல் பால்லவல்கல்  
பரதல் பதில்பகல். செல் ணை - 117

**Semester-IV**                      **19IENC42 – English Through Literature – IV (Short Story)**                      **Credits:3**  
**Hours:3**

**Learning Objectives:**By introducing the course, it is intended to:

- LO1: Develop the communicative competence of learners in the English Language through training them in the skills of listening, speaking, reading, and writing
- LO2: Enable the students to know about the origin and development of short story
- LO3: Write objectively, avoiding vague, prejudice, and exaggeration
- LO4: The broad aim of this course is to enable the learner to function through the written mode of English language in all situations including classroom, library, laboratory etc
- LO5: It also aims at different levels of a short story, such as discovering an author's purpose, drawing conclusions about certain events, evaluating cause and effect, and understanding point of view

**Unit-1**

- |             |                        |
|-------------|------------------------|
| 1. O' Henry | "The Gift of The Magi" |
| 2. Ken Liu  | "The Paper Menagerie"  |
| Grammar     | Synonyms and Antonyms  |

**Unit-2**

- |                      |                      |
|----------------------|----------------------|
| 1. Flora Annie Steel | "Valiant Vicky"      |
| 2. Oscar Wilde       | "Happy Prince"       |
| Grammar              | Words often confused |

**Unit-3**

- |                   |                       |
|-------------------|-----------------------|
| 1. R. K. Narayan  | "The Martyr's Corner" |
| 2. Mahasweta Devi | "Draupati"            |
| Grammar           | Paragraph-Writing     |

**Unit-4**

- |                     |                                  |
|---------------------|----------------------------------|
| 1. Leo Tolstoy      | "How much Land Does a Man Need?" |
| 2. Somerset Maugham | "The Verger"                     |
| Grammar             | Letter-Writing                   |

## Unit-5

- |                    |                |
|--------------------|----------------|
| 1. Langston Hughes | “On the Road”  |
| 2. Premchand       | “BakthiMarg”   |
| Grammar            | Precis-Writing |

### Supplementary Reading:

- Srinivasa Iyengar, K.R. Indian Writing in English. Sterling Publ., 1996.  
Swan, Michael. Practical English Usage: Oxford University Press, 2016.  
Palmer, Frank Robert. Grammar: (by) Frank Palmer. Penguin Books, 1975.  
Browns, Julie, ed., Ethnicity and the American Short Story. Garland, 1997.  
Patea, Viorica, ed., Short Story Theories: A Twenty-First-Century Perspective. Rodopi, 2012.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Use more vocabularies while writing
- CO2: Learner can ensure about the history and development
- CO3: The learner has a development in flow of writing
- CO4: Students can come up with new ideas while reading stories from different perspectives.
- CO5: Write in a style appropriate for communicative purposes

## Semester-IV

### 19ISTC43 - Probability Distributions

Credits:5

Hours:5

**Learning Objectives:** To build probability models for non mathematical forms of real life problems into mathematical forms and emphasize relevance statistical tools to make decision on the real life problems.

#### Unit-1

Discrete Distributions: One-point distribution, Bernoulli Distribution, Binomial distribution, Poisson distribution, Recurrence relations for probabilities, Geometric distribution. Moments, Moment generating function, Characteristic function, Cumulant Generating Function. Fitting of Binomial and Poisson Distributions.

#### Unit-2

Negative binomial distribution Hypergeometric distribution, Multinomial distribution and Discrete Uniform Distribution - Moments, Moment generating function, Characteristic function, Cumulant Generating Function.

#### Unit-3

Continuous Distributions: Continuous Uniform, Normal Distribution, Exponential distribution, Moments, Moment generating function, Characteristic function, Cumulant Generating Function. Fitting of Normal Distribution.

#### Unit-4

Gamma distribution, Beta distribution of First kind and second kind – Moments, Moment generating function, Characteristic function, Cumulant Generating Function.

#### Unit-5

Distributions of Functions of Random variables: Functions of Normal random variables leading to  $t$ , Chi-square and F-distributions (derivations, properties and interrelationships).

### Book for Study and Reference:-

- 1) Hogg, R.V. and Craig, A. G. (1978) Introduction to Mathematical Statistics, MacMillan, London.
- 2) Mood, A.M Graybill, F.A. and Boes, D.C. (1974) Introduction to Theory of Statistics, Tata McGraw Hill, New Delhi
- 3) Goon, A.M. Gupta M.K. and Das Gupta, B. (1993) Fundamentals of Statistics Vol. I. World press, Kolkata.
- 4) Rohatgi, V.K and Saleh A. K MD.E. (2001) An Introduction to Probability and Statistics, Wiley, India.

- 5) Hoel, P G. (1971) Introduction to Mathematical Statistics, Wiley, New York.
- 6) Spiegel, M.R. (1982) Theory and problems of Probability and Statistics, Schaum's outline series, McGraw Hill, New York.
- 7) Spiegel, M.R. and Ray, M(1980) Theory and Problems of Probability and Statistics, Schaum's Outline Series, McGraw Hill, New York.
- 8) Gupta, S.C and Kapoor, V. K. (1982) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the binomial Poisson distributions.
- CO2: Study the various discrete distributions.
- CO3: Study the various continuous distributions.
- CO4: Study the beta and gama distributions.
- CO5: Study the t,F and chi-square distributions.

**Semester-IV**

**19ISTP44 - Statistics Practical – II  
(Computer Based Practical)**

**Credits:6  
Hours:6**

**Learning Objectives:** To acquire the knowledge in the creation of documentation and write a programme in C++.

**Statistics Practical Schedule:-**

**M.S. Word**

1. Creation of Documents.
2. Creation of Documents with Special functions.
3. Creation of Documents with Maths Equation Editor.
4. Creation of Documents with Maths Equation Editor
5. Creation of PDF from Word Documents.

**Programs Using C++**

1. Finding the mean, median, mode and standard deviation for raw data.
2. Finding the mean, median, mode and standard deviation for discrete case.
3. Finding the mean, median, mode and standard deviation for continuous case.
4. Finding the Skwness and kurtosis.
5. Finding the correlation co-efficient.
6. Finding the regression equations.
7. Testing for difference of means
8. Analysis of variance one-way classification.
9. Addition and subtraction of matrices.
10. Multiplication of matrices.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the various documentation commands of MS-WORD
- CO2: Prepare programs using C++ for statistical problems
- CO3: Prepare programs using C++ for matrix operations.

**Semester-IV**

**19ISTA45 - Ancillary-II : Demography-II**

**Credits:4  
Hours:4**

**Learning Objectives:** To acquire the knowledge of advanced concepts of demographic techniques and applications.

**Unit-1**

Model Life Tables: United Nations Model Life Tables, Coale and Demeny Regional Model Life Tables, Ledermann's System of Model Life Tables, Brass-Logit Life Table System, United

Nations Model Life Tables of Developing Countries. Stable Population, Stationary Population and Quasi-Stable Population. Model Stable Populations. Derivation of Stable Population Theory and its Application in Demographic Analysis. Estimation of Birth Rate, Death Rate, Growth Rate and Age Distribution from Stable Population Model. Models for Stationary and Quasi-Stable Populations.

#### **Unit-2**

Fertility Models: Coale and Trussel Model, Brass Relational Gompertz Fertility Model. Nuptiality Models. Indirect Estimation of Fertility and its need in Demographic Analysis. Brass Type P/F Ratio Method of Estimating Fertility, Estimation of Age-Specific Fertility from the increment of Cohort Parities between Two Surveys, Estimation of Fertility based on the information on Children Ever Born Classified by Duration of Marriage. Estimation of Fertility using Model Stable Age Distributions. Estimation of Fertility by Reverse Survival Methods.

#### **Unit-3**

Indirect Estimation of Mortality and its need in Demographic Analysis. Estimation of Child Mortality from the data on Children Born and Children Surviving. Estimation of Child Mortality from the data classified by duration of marriage. Estimation of Adult Survivorship Probabilities from data on Orphanhood and Widowhood. Estimation of Adult Mortality from the data on the distribution of deaths by age. Estimation of Mortality using Model Stable Age Distributions. Estimation of Adult Mortality using Census Age Distributions.

#### **Unit-4**

Migration Models. Indirect Estimation of Migration and its need in Demographic Analysis. Estimations of Inter-Censal Migration using Data on Place of Birth, Duration of Residence, Place of Last Previous Residence and Place of Residence at a Fixed Prior Date. Indirect Estimations of Inter-Censal Migration using Vital Statistics Method, Life Table Survival Ratios Method, Census Survival Ratios Method and National Growth Rate Method. Direct and Indirect Methods for Estimating of Rural-Urban Migration.

#### **Unit-5**

Population Projections and its need in Demographic Analysis. Mathematical Methods of Population Projections. Economic Methods of Population Projections. Component Method of Population Projection. Different Methods of Projecting Base Population by Age and Sex. Projections of Urban and Rural Population Totals using Urban Growth Rates, Rural Growth Rates and Ratio Methods. United Nations Method of Urban and Rural Population Projections. Different Methods of Projecting Households and Families. Methods of Projecting School Going and Labour Force Populations.

#### **Book for Study and Reference:-**

- 1) R.Ramakumar (1986), Technical Demography
- 2) K.B.Pathak & F.Ram (2005), The Techniques of Demographic Analysis
- 3) B.D.Misra (1980)- The Study of Population
- 4) United Nations (1952)- Manual I- Methods of Estimating Total Population for Current Dates
- 5) United Nations (1955)- Manual II- Methods of Appraisal of Quality of Basic Data for Population Estimates
- 6) United Nations (1956)- Manual III- Methods for Population Projection by Sex and Age
- 7) United Nations (1967) - Manual IV- Methods of Estimating Basic Demographic Measures from Incomplete Data.
- 8) United Nations (1971)- Manual V- Methods of Projecting the Economically Active Population
- 9) United Nations (1970)- Manual VI- Methods of Measuring Internal Migration
- 10) United Nations (1973)- Manual VII- Methods of Projecting Households and Families

#### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: To study the use and applications of life table.
- CO2: Estimate and fitting of fertility models.
- CO3: Estimate the adult mortality and child mortality.
- CO4: Fit migration models using vital statistics method.
- CO5: Study the population projections in demographic analysis.

**Semester-V**

**19ISTC51 - Sampling Techniques**

**Credits:5**

**Hours:5**

**Learning Objectives:** To learn the basic concepts and Applications of Sampling techniques for real life situations.

**Unit-1**

Basic concepts of sample surveys – Principles of samples theory; sampling Unit; sampling frame; complete enumeration versus sampling; Merits and demerits; Basic concepts of sampling distribution; Unbiasedness; Mean square error and relative standard error.

**Unit-2**

Simple random sampling with and without replacement; Lottery method - Use of random number tables; Estimation of population parameters; Mean; Variance and proportion; simple random sampling for proportion.

**Unit-3**

Stratified random sampling - Principle of stratification; Estimation of population mean and variance; Allocation techniques; equal allocation; proportional allocation; Neyman's allocation and optimum allocation.

**Unit-4**

Systematic sampling Estimation of mean and its sampling variance – Comparison of simple; stratified and systematic sampling.

**Unit-5**

Functions of NSS and CSO; Sampling errors; Non – sampling errors; Sources of non – sampling errors.

**Book for Study and Reference :-**

- 1) Daroga Singh and Choudary F.S. (1996), Theory and analysis of sample survey designs, New Age International Publishers, New Delhi.
- 2) Sampath.S. (2001), Narasa Publishing house, New Delhi.
- 3) Gupta S.C and Kapoor V.K. (2007), Fundamentals of Applied Statistics, Sultan Chand and Company, 4<sup>th</sup> Edition, New Delhi.
- 4) Desraj. (1997), Sampling Theory, New Age International Pvt. Ltd. New Delhi.
- 5) William G. Cochran, (2008), Sampling Techniques, John wiley sons, New York.
- 6) Sukhatame P.V and Sukhatame B.V. (1957), Sampling theory of surveys with applications. ISAS Publishers 3<sup>rd</sup> Edition.
- 7) MN Murthy ( ) Sampling: Theory and Methods, ISI Publications, Calcutta.

**Course Outcomes**

At the end of the course, the student will be able to

CO1: Understand the concepts of census and sample surveys.

CO2: Study the concepts of simple random sampling.

CO3: Study the concepts of stratified random sampling.

CO4: Study the concepts of systematic sampling

CO5: Study the functions of national sample survey.

**Semester-V**

**19ISTC52 - Statistical Methods For Data Analysis**

**Credits:5**

**Hours:5**

**Learning Objectives :** To enlight the students to acquire skills for adopting statistical tools and techniques of data analysis.

**Unit-1**

Tests of significance- population and sample; parameter and statistic standard error and sampling distribution of a statistic; Utility of Standard error; Steps involved in any test of significance; Basic concepts; Large sample tests- Tests for mean and difference of means; single proportion and equality of proportions; difference of standard deviations ; testing the correlation coefficient; equality of two correlation coefficients.

## Unit-2

Exact tests- Test for mean; equality of means and for paired samples; observed partial and multiple correlation and regression coefficients; test for one population variance and test for equality of two population variances; test for observed sample correlation ratio.

## Unit-3

Chi-square test for goodness of fit- contingency tables; test for independence of attributes; Yate's correction for contingency table; Bartlett's test for homogeneity of several population variances; test for homogeneity of several population proportions.

## Unit-4

Multiple regressions- interpretation of  $R^2$ ; interpretation of partial regression coefficients; test for linearity of regression; test for intercept in a regression. Application of Multivariate tests- Test for population mean vector (for covariance matrix known and unknown). Test for equality of two population mean vectors when the covariance matrices are equal; (known and unknown) Mahalanobis  $D^2$  test.

## Unit-5

Non parametric methods; Advantages and disadvantages over parametric methods. Sign test for medians, Median test for two populations, Wald-Wolfowitz run test, Kruskal-Wallis Rank sum Test (H-Test), Mann-Whitney- Wilcoxon rank sum test, U-test, Kolmogorov – Smirnov, Test for goodness of fit, Test for comparing two populations, Test for randomness, Friedman's test.

### Book for Study and Reference :-

- 1) Ostle. B and Mensing R. W (1975), Statistics in Research, Third Edition, Oxford & IBH Publishes Co.,
- 2) Gupta S. C. and V. K. Kapoor (2007), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- 3) Norma Gilbert (1981), Statistics, Saunders College publishing.
- 4) Rajagopalan V. (2006). Selected Statistical Tests, New Age International Publishers (P) Ltd., NewDelhi.
- 5) Croxton, E. F and Cowden, D. J (1985), Statistics Practical Business Statistics, Prentice – Hall Inc.
- 6) Catelcult. R (1982), Statistics in Research and Development, Chapman and Hall.
- 7) Medhi. J (1992), Statistical methods, Wiley Eastern Ltd.

## Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the various concepts of statistical tests and to apply large sample tests.
- CO2: Apply the exact tests for research problems.
- CO3: Apply the various chi-square tests .
- CO4: Apply the multiple regression analysis and multivariate tests for real life problems
- CO5: Apply the non-parametric tests for sample data.

Semester-V

19ISTC53 - Statistical Inference

Credits:5

Hours:5

**Learning Objectives:** To enhance the knowledge of making inference using different types of estimation.

## Unit-1

Point estimation - Estimator and Estimate; Criteria of point estimation; Consistency; sufficient condition for consistency; Invariance property of consistency; unbiasedness; sufficiency; Neyman's Factorization Theorem; sufficient statistic; Efficient estimator; relative efficiency; Simple problems.

## Unit-2

Minimum variance unbiased estimator; Rao Blockwell Theorem; Cramer-Rao Inequality; Methods of estimation; Maximum likelihood method; Properties of Maximum likelihood method (without proof); Deriving the Maximum likelihood Estimators of standard distributions; Method of Moments; Simple problems.

### Unit-3

Interval Estimation- Confidence Intervals and confidence coefficient; Interpretation; Pivotal quantity method; Confidence Interval for parameters of standard distributions; Confidence interval for large samples ; Simple problems.

### Unit-4

Tests of Statistical Hypotheses - Null and Alternative; Simple and Composite hypothesis ; Critical region; Two types of errors; Level of significance and power of the test; simple problems to obtain the size of the test and power of the test; Simple problems.

### Unit-5

Neyman-Pearson fundamental lemma; Most powerful test and Best Critical Region (BCR); Deriving the BCR; Power of the tests . Unbiased test, UMP critical region; Simple problems.

### Book for Study and Reference :-

- 1) S.C. Gupta and V.K Kapoor (2007) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
- 2) Hogg and Craig (1985) Introduction to Mathematical Statistics, Amerind.
- 3) A. M. Mood, F.A. Graybill and D.C. Boes (2001), Introduction to the Theory of Statistics, Third Edition Tata McGraw Hill Publishing Company Limited, New Delhi.
- 4) V.K. Rohatgi (1988) An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern
- 5) Rao. C.R. (1983) Linear Statistical Inference and its Applications, 2<sup>nd</sup> edition, Wiley Eastern.
- 6) Saxena H.C and Surendran, P.U (1985) Statistical Inference, S. Chand & Company Ltd.
- 7) Santhakumaran. A (2004), Probability Models and their Parametric Estimation, K.P. J publications.
- 8) Santhakumaran. A (2001), Fundamentals of Testing Statistical Hypothesis, Atlantic Publishers.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the basic concepts and criteria of point estimators.  
CO2: Study the various types and methods of estimation.  
CO3: Understand the concepts of interval estimation.  
CO4: Study the basic concepts of statistical hypotheses testing.  
CO5: Understand the Neyman-Pearson Lemma and solving problems

### Semester-V

### 19ISTC54 - Elements Of Quality Control

Credits:5

Hours:5

**Learning Objectives:** On successful completion of the course the students should have understood the need of quality improvement, total quality management and statistical plots and tools such as SPC, CUSUM and ISO.

### Unit-1

Control charts for variables: Need for Statistical Quality Control techniques in Industry – Causes of Quality variation – Uses of Shewart Control charts – specifications, tolerance limits –  $3\sigma$  limits – warning limits —  $\bar{X}, R$  and  $\sigma$ - charts – Basis of sub grouping – Interpretation of  $\bar{X}$  and R charts.

### Unit-2

Control charts for attributes: p, np, c and u charts. Construction of charts – choice between p and np charts.

### Unit-3

Acceptance Sampling: Sampling inspection – inspection by attributes and variables - concepts of Producer's risk, Consumer's risk. AQL, LTPD, AOQ, AOQL, ATI and ASN. Rectifying inspection plans.

### Unit-4

Acceptance sampling for attributes: Single and Double sampling plans. OC, AOQ, ATI and ASN curves for Single and Double sampling plans.

## Unit-5

Acceptance sampling for variables: Known and unknown sampling plans (one sided specification only). Determination of n and k for one sided specification of OC curve.

### Book for Study and Reference :-

- 1) Kapoor, V.K. and Gupta, S.P. (2007) Fundamentals of Applied Statistics, Sultan Chand & Sons.
- 2) Gupta, R.C.(1974) Statistical Quality Control, Khanna Publishing Co, New Delhi
- 3) Montgomery, D.C. (1983) Introduction to Statistical Quality Control, Wiley, New York.
- 4) Grant, E.L. and Leavenworth, R.S (1996) Statistical Quality Control, McGraw Hill, New York.
- 5) Mahajan.(1997) Statistical Quality Control, Dhanpatrai & Sons, New Delhi.
- 6) Juran J. M. (1999) Juran's Quality Hand Book, McGraw Hill, New York.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the concepts of control charts for variables.
- CO2: Understand the concepts of control charts for attributes.
- CO3: Study the concepts of acceptance sampling.
- CO4: Study the single and double sampling plans.
- CO5: Study the acceptance sampling for variables.

### Semester-V

### 19ISTP55 - Statistics Practical – III (Calculator Based Statistics Practical)

Credits:6  
Hours:6

**Learning Objectives:** To solve the problems in test of significance, sample selection, time series and index numbers.

### Statistics Practical Schedule

#### Tests Of Significance

- 1) Testing the significance of population mean when  $\sigma$  is known.
- 2) Testing the significance of population mean when  $\sigma$  is unknown.
- 3) Testing the significance of population variance when  $\mu$  is known.
- 4) Testing the significance of population variance when  $\mu$  is unknown.
- 5) Testing the significance of equality of population means when  $\sigma_1, \sigma_2$  are known.
- 6) Testing the significance of equality of population means when  $\sigma_1, \sigma_2$  are unknown.
- 7) Testing the significance of population proportion.
- 8) Testing the significance of equality of population proportions.
- 9) Paired t- Test.
- 10) Chi-Square test for goodness of Fit.
- 11) Chi-Square test for independence of attributes.
- 12) F- Test for equality of population variances.
- 13) Bartlett's Test for homogeneity of several variances.
- 14) Test for population correlation coefficient.
- 15) Test for population regression coefficient.

#### Sampling

- 1) Simple random sampling with replacement.
- 2) Simple random sampling without replacement.

#### Time Series

- 1) Measurement of Trend – Method of Moving average, Method of Least Square
- 2) Measurement of Seasonal Variation – Simple average method.

#### Index Numbers

- 1) Construction of Price Index number – Laspeyres, Paasche, Fisher, Bowley and Marshal Edgeworth methods.
- 2) Fisher index number – Time reversal test and Factor reversal test.
- 3) Construction of Cost of Index number – Simple aggregate method, Family budget method.



## Anova

- 1) Analysis of variance - One - way Classification.
- 2) Analysis of variance Two - way Classification.

## Course Outcomes

At the end of the course, the student will be able to

- CO1: Apply various statistical tests for sample data  
CO2: Observe data using simple random sampling.  
CO3: Calculate time series components.  
CO4: Calculate problems of index numbers.  
CO5: Carryout anova tests for given data.

**Semester-VI**

**19ISTC61 - Experimental Designs**

**Credits:5**

**Hours:5**

**Learning Objectives:** To enable the students to learn basic concepts of design and its applications.

### Unit-1

Fundamental Principles of Experiments – Replication, Randomization and Local Control techniques – Size of experimental unit – Methods of determination of experimental units – (Maximum curvature method – Fairfield Smith's variance law).

### Unit-2

Analysis of Variance and Basic Designs: Concept of Cochran's Theorem. One-way and Two-way analysis of variance. Completely Randomized Design and its analysis – Randomized block design (RBD) and its analysis – RBD – More than one but equal number of observations per cell – Latin Square Design (LSD) and its analysis.

### Unit-3

Post ANOVA Tests: Multiple range test; Newman-Keul's test – Duncan's multiple range test – Tukey's test – Transformation – Square root, angular and log transformations.

### Unit-4

Missing plot techniques – Meaning – Least Square method of estimating one missing observation – RBD and LSD – Two observations missing in RBD and LSD – Analysis of covariance technique in CRD and RBD (without derivation).

### Unit-5

Factorial experiments – Definition –  $2^2$ ,  $2^3$  and  $3^2$  factorial experiments and their analysis – Principles of confounding – Partial and complete confounding in  $2^3$  – Split plot design and its analysis.

### Book for Study and Reference :-

- 1) Das M.N. and Giri, N.C. (1986) Design and Analysis of Experiments, Wiley Eastern, New Delhi.
- 2) Montgomery, D. (1972) Design of Experiments, Wiley, New York.
- 3) Kapoor, V.K. and Gupta, S.P. (1978) Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
- 4) Dean, A. and Voss.(2006). Design and Analysis of Experiments, Springer, New Delhi.
- 5) Dey, A. (1986) Theory of Block Designs, Wiley, New York.

## Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the basic concepts of experimental designs.  
CO2: Study the various basic designs.  
CO3: Understand the use of various multiple comparison tests.  
CO4: Study the missing plot techniques of basic designs.

CO5: Study the factorial experiments and confounding.

Semester-VI

19ISTC62 - Official And Applied Statistics

Credits:5

Hours:5

**Learning Objectives:** To apply statistics in multi disciplinary sciences for making decisions.

#### **Unit-1**

##### **Official Statistics**

Present official statistical system in India –Ministry of Statistics -NSSO, CSO and their functions - Registration of vital events – National Income Statistics – Agricultural Statistics – Industrial Statistics in India – Trade Statistics in India – Labour Statistics in India – Financial Statistics in India.

#### **Unit-2**

##### **Vital Statistics**

Introduction - Uses of vital statistics; Methods of obtain vital statistics; Measurement of Population; Measurement of mortality; Crude death rate; Standardized death rate; Mortality Table; Abridged life table; Fertility; Measurement of population growth.

#### **Unit-3**

##### **Index Numbers**

Index numbers and their definitions - construction and uses of fixed and chain based index numbers-simple and weighted index numbers - Laspeyre's, Paasche's, Fisher's, and Marshall-Edgeworth index numbers – optimum tests for index numbers-Cost of living index numbers.

#### **Unit-4**

##### **Time Series**

Seasonal variation- measuring seasonal variation: method of simple averages, ratio-to-trend method, ratio-to-moving average method and link relative method- Cyclical and Random fluctuations- variant difference method.

#### **Unit-5**

##### **Time series**

Concept –Components of Time series – Additive and Multiplicative models-Resolving components of a time series-measuring trend: Graphic, semi-averages, moving average and principle of least squares methods.

#### **Book for Study and Reference :-**

- 1) Goon, A.M. Gupta, M. K. and Das Gupta, B. (1991) Fundamentals of Statistics Vol.II, World Press, Kolkata.
- 2) Gupta, S.C. and Kapoor, V. K. (2000) Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
- 3) Fundamentals of Applied Statistics by S. C. GUPTA and V. K. KAPOOR, (2009). Sultan Chand & Sons, New Delhi.
- 4) Statistical methods by S. P. GUPTA, (2009). Sultan Chand & Sons, New Delhi.
- 5) Applied Statistics by Lotharachs, (1984). 2<sup>nd</sup> Edition, Springer – Verlag, New York.
- 6) Warner (2007). Applied Statistics, Sage Publication, NewYork.

#### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the present official statistical system.  
CO2: Study the various concepts of vital statistics.  
CO3: Study the various types of index numbers.  
CO4: Study the various components of time series models.

CO5: Apply the tools of time series concepts for given data.

**Semester-VI**

**19ISTC63 - Econometrics**

**Credits:5**

**Hours:5**

**Learning Objectives:** To enrich the skills of students to understand the nature and functioning of economic systems.

**Unit-1**

Model with one explanatory variable: Definition, scope and OBJECTIVESs of Econometrics. Linear model with one independent variable - Least squares estimators of regression coefficients, properties of least squares estimators - analysis of variance to regression model.

**Unit-2**

Model with more variables: Linear model with more than one explanatory variables – assumptions – estimation of model parameter - Least squares estimators and their properties. Hypothesis testing – test the overall significance of the regression – Testing the individual regression coefficients.

**Unit-3**

Adequacy of Model: Model adequacy checking – residual analysis – residuals – standardized residuals – residual plot – normal probability plot – plot of residuals against estimated response. A formal test for lack of fit of the model.

**Unit-4**

Autocorrelation: Meaning of serial independence – sources of autocorrelation – first order autoregressive scheme – consequences of autocorrelation – Durbin – Watson test – analysing the model in the presence of autocorrelation.

**Unit-5**

Multicollinearity: Meaning and sources – consequences of multicollinearity. Test for detecting multicollinearity – Examining the correlation matrix – Variance Inflation factor – Eigen values of  $X'X$ .

**Book for Study and Reference :-**

1. Montgomery, D.C. Peck, E.C. and Vining, G.G. (2003) Introduction to Linear Regression Analysis(3/e), Wiley Eastern, New Delhi.
2. Koutsoyiannis, A. (2006) Theory of Econometrics. (2/e) Palgrave, New York.
3. Singh, S. P., Parashar, K. and Singh, H. P. (1980) Econometrics. Sultan Chand &Co., New Delhi.
4. Klein, L. R. (1975) A Text Book of Econometrics (2/e). Prentice Hall, New Delhi.
5. Johnston, J (1984) Econometric Methods, McGraw Hill Pvt. Ltd., New Delhi,
6. Gujarati, D N & Sangeetha, (2008), Basic Econometrics, McGraw Hill, New York.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the basic concepts of econometric models.  
CO2: Study the linear model  
CO3: Study the adequacy and checking of models.  
CO4: Study the concept of autocorrelation and their tests.  
CO5: Study the concept of multicollinearity

**Learning Objectives:** To impart basic knowledge of various optimization techniques.

**Unit-1**

Linear Programming Problem: Formulation of Linear programming problem – Graphical solution of LPP in two variables – LPP in standard form – Principles of Simplex method – Algorithm – Need for artificial variables – Charne's M-Technique – Concept of degeneracy.

**Unit-2**

Transportation problem: Transportation problem formulation- North-West Corner, Least cost, Vogel's Approximation method – UV-method – Assignment problem and algorithm.

**Unit-3**

Theory of Games: Basic definition – Maximin and Minimax criterion – Solution of Games with saddle points – Two-by-Two (2x2) Games without saddle point – principle of dominance – problems based on dominance rule – Graphical method for (2xn) and (mx2) games.

**Unit-4**

Replacement problems: Replacement policy for items whose maintenance cost increases with time and the value of money remains constant – Replacement policy for items whose maintenance cost increases with time and the value of money also changes with time – Replacement of items that fail completely – Group replacement policy.

**Unit-5**

Network analysis by CPM/PERT: Basic Concept – Constraints in Network – Construction of the Network – Time calculations – Concept of slack and float in Network Analysis – Network crashing – Finding optimum project duration and minimum project cost.

**Books for Study and Reference :**

- 1) Kanti Swarup, P.K. Gupta and Manmohan (2007) Operations Research, Sultan Chand & Sons, New Delhi.
- 2) S.D. Sharma (2002): Operations Research: Kedarnath and Ramnath, Meerut.
- 3) Cheema, Col.D.S. (2005) Operation Research, Laxmi Publications (P) Lts., New Delhi.
- 4) Taha (2005).Operations Research, 8<sup>th</sup> editioni PHI, New Delhi.
- 5) F.S. Hiller and Liberman (1994): Operations Research, CBS Publishers and Distributions, New Delhi.
- 6) Gass Saul.I (1975).Linear programming methods and applications, 4<sup>th</sup> edition McGraw Hill, New Delhi.
- 7) Panneerselvam, 2010 – Operations Research – Prentice Hall of India, New Delhi.
- 8) Gupta, R.K.(1985) Operations Research, Krishna Prakashan, Mandir, Meerut.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand to solve the problems of LPP.
- CO2: Study the concepts of transportation and assignment problems.
- CO3: Study the different types of problems of game theory.
- CO4: Study the concepts of replacement problems.
- CO5: Understand the concepts of network analysis.

**Semester-VI**

**19ISTP65 - Statistics Practical – IV  
(Computer Based Practical)**

**Credits:6  
Hours:6**

**Learning Objectives:** To acquire knowledge of computation of statistics through statistical packages.

**Statistics Practical Schedule**

**Excel:**

1. Descriptive Statistics
2. Correlation and regression.
3. Chi-Square Test.
4. ANOVA – One way and Two way Classification.
5. Analysis of Multiple Regression.
6. Test for Single mean.
7. Test for difference of mean.
8. Paired t- Test.

**SX and SPSS**

9. Descriptive Statistics
10. Correlation and regression.
11. Chi-Square Test.
12. ANOVA – One way and Two way Classification.
13. Analysis of Multiple Regression.
14. Test for Single mean.
15. Test for difference of mean.
16. Paired t- Test.
17. CRD
18. RBD
19. LSD
20. Hotteling- $T^2$

**Power Point**

1. Preparation of power point for a word document.
2. Preparation of power point with special features.

**Course Outcomes**

At the end of the course, the student will be able to

CO1: Solve statistical problems using excel

CO2: Solve statistical problems and carryout analysis using SX and SPSS.

CO3: Prepare power point presentations

**Semester-VII**

**19ISTC71 - Linear Algebra And Matrix Theory**

**Credits:4  
Hours:4**

**Learning Objectives:** To enrich the skills of students for learning the concepts and methods of matrices, Linear Algebra.

**Unit-1**

Matrices – Rank and inverse of matrices – properties – Eigen values and Eigenvectors – Idempotent and partitioned matrices- Generalized inverse and its determination – Reduction of matrices into diagonal, echelon, canonical and triangular forms – Quadratic forms – Reduction and classification of quadratic forms – Cochran’s theorem.

#### **Unit-2**

Vector Space, Sub-spaces, Basis of a vector space – Vector spaces with inner products – Gram-Schmidt orthogonalization.

#### **Unit-3**

Linear transformation (LT) – Properties – Matrix of a linear transformation – Matrix of composite transformation – Matrix of an inverse transformation – Change of basis – Orthogonal transformation – Dual space.

#### **Unit-4**

Linear equations – Solution space and null space – Sylvester’s law of nullity – Generalized inverse of a matrix – Moore – Penrose inverse.

#### **Unit-5**

Eigen values and eigen vectors of an LT – left eigen vectors, right eigen vectors, Diagonalizable, LT – Lambda matrix, Composition of lambda matrices, Operator polynomial, Cayley-Hamilton theorem and minimal polynomial for an LT – Eigen values of matrix polynomials.

#### **Book for Study and Reference:-**

- 1) Shanti Narayan (1976). “A Text Book of Matrices”, S. Chand & Co, New Delhi.
- 2) Richard R. Goldberg (1970). “Methods of Real Analysis”, Oxford & IBH Pub. Co. Pvt. Ltd, New Delhi.
- 3) G. De Barra (1981). “Measure Theory and Integration”, Wiley Eastern Ltd, New Delhi
- 4) Walter Rudin (1986) Real and Complex Analysis (International series in Pure and Applied Mathematics).
- 5) Halsey Royden and Patrick Fitzpatrick (2010) Real Analysis (4<sup>th</sup> Edition).

#### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Solve problems in matrices and quadratic forms
- CO2: Understand the concepts of vector space
- CO3: Understanding various matrix transformations
- CO4: Solving problems in linear equations
- CO5: Obtain the eigen values and eigen vectors

**Semester-VII**

**19ISTC72 - Measure And Probability Theory**

**Credits:4  
Hours:4**

**Learning Objectives:** To build a foundation for the measure and applications of Probability Concepts.

#### **Unit-1**

Limit Superior, Limit inferior and limit of a sequence of sets – Field and Sigma field - Monotone class – Functions and inverse functions – Borel field – Countable and finitely additive set function – Measurable space – Measure space – Measure, Properties of Measure. Lebesgue – Steiltjes measure – Lebesgue measure. Measurable function, Simple function. Concept of almost everywhere. Approximation theorem (statement only).

#### **Unit-2**

Measure Integral – Properties – Monotone convergence theorem – Fatou’s lemma – Dominated convergence theorem (statement only) – Absolute continuity of two measures – Radon-Nykodym theorem (statement only). Product sets and Fubini’s theorem (statement only).

#### **Unit-3**

Probability measure – Random variable —distribution function – Expectation – inequalities – Jensen, Basic, Cauchy-Schwartz. Conditional probability - Conditional expectation – Independence of random variables – Borel-Cantelli Lemma – Kolmogorov Zero – one law.

#### **Unit-4**

Convergence of random variables – almost sure, in law, in probability, in  $r$ th mean and their interrelations – Characteristic function – Inversion formula, Convergence of distribution functions and characteristic functions –Helly-Bray theorem – Continuity theorem.

#### **Unit-5**

Law of large numbers – Weak law of large numbers – Kolmogorov's strong law of large numbers –Glivenko – Cantelli Theorem – Central limit theorems – Lindeberg–Cramer - Levy theorem, Liapounov's theorem.

#### **Books for Reference:**

- 1) Bhat, B.R. (1981) Modern Probability Theory, Wiley Eastern, New Delhi.
- 2) De Barra, G. (1987) Measure Theory and Integration, Wiley Eastern, New Delhi.
- 3) Burill, C.W (1972) Measure, Integration and Probability, McGraw Hill, New York.
- 4) Tucker, H.G. (1967) A Graduate Course in Probability, Academic Press, New York.
- 5) Loe'Ve, M. (1955) Probability Theory, D. Van Nostrand, London.
- 6) Munroe, M.E. (1965) Measure and Integration, Addison & Wesley, New York.
- 7) Ash, R.B. (1972) Real Analysis and Probability, Academic Press, New York.
- 8) Billingsley, P. (2012) Probability and Measure, 3/e, Wiley, New York.
- 9) Feller, W. (2008) An Introduction to Probability Theory and Its Applications, Vol.I, 3/e, Wiley, New York.
- 10) Feller, W. (1971) An Introduction to Probability Theory and Its Applications, Vol.II, Wiley, New York.

#### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the various types of measures
- CO2: Study the theorems relating to measures
- CO3: Apply the use of zero one laws
- CO4: Application of theorems on random variables
- CO5: Utilize the law of large numbers in research studies

**Semester-VII**

**19ISTC73 - Sampling Theory**

**Credits:4**

**Hours:4**

**Learning Objectives:** To enrich the skills of students to get more specialization in various sampling procedures and for adopting the appropriate sampling technique in real life application and survey.

#### **Unit-1**

Population and Sample; Notions of sampling and non-sampling errors; Sampling Unit—and sampling frame. Simple random sampling (SRS); from finite populations with and without replacement; Estimates of Mean, total and proportion and their standard errors; confidence intervals; Pooling of estimates; determination of sample size.

#### **Unit-2**

Systematic Sampling (SYS); Method of estimation of population total and mean; Estimation of their sampling variances; Case of linear trends; comparison of SRS and SYS; circular systematic sampling; Stratified random sampling (STRS): Need for stratification; detailed study of Allocation problems; Stratified random sampling with and without replacement; Estimates of population total, mean and proportion and their standard errors, Gain due to stratification and its estimate from a sample. Comparison of Simple Random Sample, Systematic sample and Stratified sampling in the presence of linear trend.

#### **Unit-3**

Varying probability sampling; PPS sampling with and without replacement; stratified PPS sampling; Gain due to PPS sampling; Selection procedures; ordered and unordered estimators; Desraj, Horvitz Thompson and Murthy's Estimators.

#### **Unit-4**

Use of auxiliary information to estimating parameters; Two phase sampling. Ratio estimators; Notion of Ratio estimation: Bias in ratio estimator; Mean square error; Ratio estimators under the cases of simple random sampling and stratified random sampling. Regression estimators; Bias and variance; Regression estimators in the cases of simple random sampling and stratified random sampling.

#### **Unit-5**

Cluster sampling: Need for cluster sampling; Sampling with equal clusters, simple random sampling with varying probabilities under varying cluster sizes; their relative efficiency compared to SRS; optimum cluster size. Multistage sampling; Estimates of population mean and its sampling variance in two stage sampling with SRS.

#### **Books for Study and Reference:-**

1. Daroga singh, and F.S.Chaudhary (1977), Theory and Analysis of sample survey design, New Age International Publishers, New Delhi.
2. Cochran,W.(1984) Sampling Techniques. Wiley Eastern.3<sup>rd</sup> Edition, New York.
3. Murthy, M.N., (1977), Sampling Theory and Methods, Statistical Publishing Society, Kolkatta.
4. Sampath, S. (2005), Sampling theory and methods, Narosa Publishing house.
5. Agarwal Np, Sonia Agarwal (2006), Sampling methods and Hypothesis testing. Rbsa Publishers.
6. Desraj, Promod Chandhok (1998), Sample survey theory, Narosa Publishing house.
7. Parimal Mukhopadhyay(1998)Theory and methods of survey sampling.Prentice Hall of India Pvt. Ltd.
8. Sukhatme & Sukhatme, P.V. (1958), Sampling Theory of Surveys with Applications. The Indian Society of Ag. Statistics, New Delhi.
9. Desraj (1976) Sampling Theory, Tata McGraw Hill, New Delhi.

#### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Study the various criteria of estimators
- CO2: Understand the concepts of sufficiency and completeness
- CO3: Derive different inequalities
- CO4: Understand the various methods of estimation and interval estimation
- CO5: Study the Bayes estimation

**Semester-VII**

**19ISTP74 – Statistics Practical – V  
(Calculator Based Practical)**

**Credits:3**

**Hours:6**

**Learning Objectives:** To have practical knowledge on solving problems in matrices, sampling techniques.

#### **Practical Schedule**

##### **Matrix Theory**

- Arithmetic operations on matrices
- Determinant of matrices
- Solution of simultaneous equations
- Cramer's rule
- Sweep-out methods
- Inverse of a matrix
- Rank of matrices



- Eigen values and eigen vectors

### Sampling

Estimation of sample mean and sample variance under simple random sampling without replacement.

- Estimation of sample mean and sample variance under SRSWR.
- Estimation of Proportion under SRSWOR.
- Estimation of Population total, mean and variances under systematic sampling.
- Estimation of mean, variances under stratified random sampling.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Operations of matrices using practical applications
- CO2: Problems solving for simultaneous equations
- CO3: Estimation of parameters using sampling techniques

**Semester-VII**

**19ISTP75 – Statistics Practical – VI  
(Computer Based Practical)**

**Credits:3  
Hours:6**

**Learning Objectives:** To Gain The Knowledge of Basic Statistical Computation through using SPSS and SIGMAPLOT.

### Practical Schedule

#### SPSS

Descriptive Statistics.  
Test for Single mean.  
Test for difference of mean.  
Paired t-Test.  
ANOVA One-way Classification.  
Two way ANOVA.  
Chi-Square Test.  
Principal Component Analysis.  
Correlation and Regression (Simple and Multiple).  
Factor Analysis.  
Discriminant Function.  
Cluster Analysis.

#### SIGMAPLOT

Descriptive Statistics: mean, Median, Mode.  
Skewness and Kurtosis  
Correlation and Regression.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Familiarize in SPSS and SIGMAPLOT to
- CO2: Calculate the various statistical measures
- CO3: Test the significance of the parameters
- CO4: Apply ANOVA test for appropriate data
- CO5: Analyze the data using various multivariate analyses
- CO6: Draw diagrams and graphs

**Learning Objectives:** Soft skills evolve the personality of a person and prepare for competition in the changing employment market elsewhere.

#### **Unit-1 Personality Development**

Personal Effectiveness Skills- Managerial and Supervisory Skills – Leadership Skills- Creativity Skills- Problem Solving Skills – Team Spirit – Culture Building.

#### **Unit-2 Effective Listening**

Registration of ideas – Crystallization – Listening – What does Listening mean? – Why are people inherently listening? –Poor listening habits- Types of Listening – Effective and Ineffective Listening Skills – Pay – Offs of Effective Listening – Barriers to Listening- Active and Passive Listening.

#### **Unit-3 Interpersonal Communication**

Characteristics of Interpersonal Relationships – Intimacy in Interpersonal Relationship – Relationship Development and Maintenance – Self Disclosure in Interpersonal Relational Relationships.

#### **Unit-4 Public Speaking**

What is Public speaking – The art of Public Speaking –Language and Proficiency in Public Speaking – Spoken English – Fluency –Awareness of Different Accents – Interviews – Group Discussion – Seminars – Telephone Skills.

#### **Unit-5 Writing Skills**

Business writing of Sorts – Common Components of business Letters – strategies for Writing the Body of a Letter- Writing of Order sorts like Memos, Notes etc. – Business Report – Business Proposal.

#### **Books for study and Reference:-**

1. Namrata Palta, the Art of effective Communication, Lotus Press, New Delhi, 2007.
2. Ed gar Thorpe, Showick Thrope, Winnning at Intervies, doring Kindersley (India) Pvt.Ltd, 2006.
3. S.K.Mandal, Effective communication and Public Speaking, Jaico Publising H/ouse, Mumbai, 2005.
4. Lani Aredondo, Communicating Effectively, Tata McGraw- Hill Edition,2003.
5. Robert Bolton , People Skills, Simon & Schuster, 1986.
6. Ronald B. Adler, George Rooman, Understanding Human Communication , Oxford University Press, 2006.
7. Meenakshi Raman, Prakash Singh, Business Communication, Oxford University Press,2006 .
8. Sasikumar.V and Kiranmai Dutt.P, Geetha Rajeevan, Course in Listening and Speaking II , Cambridge University Press, 2007.
9. Date Carnegie, The Leader in You, Pocket Books , New York,1993.

#### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Develop skills of personality development.
- CO2: Understand the effective listening.
- CO3: Communicate interpersonal relationships.
- CO4: Shine in public speaking.
- CO5: Develop writing skills.

**Learning Objectives:** To know the basic ideas of continuous and truncated distributions and to study the concepts of Bivariate distribution, Non-central t, F and  $\chi^2$  and Beta distributions, Order statistics and quadratic forms.

#### Unit-1

A preamble of basic probability distributions – binomial, Poisson, negative binomial, hypergeometric, multinomial, normal, uniform, gamma, beta. Logarithmic and power series distributions – compound distribution – compound binomial and Poisson distributions – Lognormal distribution – Cauchy distribution.

#### Unit-2

Truncated distributions – left truncated binomial – left truncated Poisson – left and right truncated Normal distributions – Non central t,  $\chi^2$  and F distributions.

#### Unit-3

Bivariate Normal distributions – M.G.F. – Moments – Distribution of correlation coefficient when population correlation coefficient is equal to zero – Distribution of Regression coefficients.

#### Unit-4

Distributions of order statistics - median, range and mid-range. Distribution of Quantiles– Sample cumulative distribution function and its properties, Kolmogorov–Smirnov one sample statistic.

#### Unit-5

Distribution of quadratic forms in normal random variables, their mean and variance, independence of quadratic forms, independence of linear and quadratic forms, Fisher-Cochran's theorem.

#### Books for Study and Reference:-

- 1) Johnson, N.L. Kemp, A.W. and Kotz, S. (2005) Univariate Discrete Distributions.3/e, Wiley, New York.
- 2) Johnson, N.L.Kotz, S. and Balakrishnan, N. (2004) Continuous Univariate Distributions, Vol. I. Wiley , Singapore.
- 3) Johnson, N.L Kotz, S. and Balakrishnan, N. (2014) Continuous Univariate Distributions, Vol. II.Wiley , Singapore.
- 4) Karian, Z.A. and Dudewicz, E.J. (2011) Handbook of Fitting Statistical Distributions, Chapman & Hall,London.
- 5) Rao, C.R. (2009) Linear Statistical Inference and Its Applications,2/e,Wiley,New York.
- 6) Rohatgi, V.K. and Saleh, A.K.MD.E. (2011) An Introduction to Probability and Statistics, Wiley, New Delhi.
- 7) David, H.A. (1971): Order Statistics, Wiley ,New York.
- 8) Mood A.M Graybill, F.A and Boes, D.C (1974) Introduction to the theory of Statistics, 3rd edition, McGraw Hill Publishing Co. Inc., New York.
- 9) Gibbons , J.D and Subhabrata Chakraborti (2010), Non-parametric Statistical Inference, McGraw Hill
- 10) Parimal Mukhopadhyay (1996), Mathematical Statistics, New Central Book Agency, Pvt. Ltd., Calcutta.

#### Course Outcomes

At the end of the course, the student will be able to

- CO1: Study the various discrete and continuous distributions
- CO2: Study the various truncated distributions
- CO3: Understand the biivariate distributions
- CO4: Study the distributions of order statistics
- CO5: Understand the distributions of quadratic forms

**Learning Objectives:** To enhance the methods of diagnosis of statistical estimation of parameters.

**Unit-1**

Unbiasedness and Consistency – Point Estimation, Highest Concentration Criterion, Minimum MSE Criterion, Unbiased Estimators, Quenoulli's Method of Reducing the Bias in Stages, Consistent Estimator, BAN Estimator and Case of Several Parameters. Problems and Exercises. (Contents as in Chapter -2 of Book-1)

**Unit-2**

Sufficiency and Completeness : Sufficient Statistics, Fisher Information Measure, Neyman-Fisher Factorization Theorem, Minimal Sufficient Statistics, Complete Statistics, Exponential Family of Distributions, Pitman's Family of Distributions. Problems and Exercises. (Contents as in Chapter -3 of Book-1)

**Unit-3**

Minimum Variance Unbiased Estimators: Case of a single parameter, Lower Bounds for Variance of Unbiased Estimators (Cramar-Rao Inequality) UMVUE, Bhattacharya Inequality, Chapman-Robin's Inequality, Rao-Blackwell theorem, Lehman- Sheffee Theorem. Use of Sufficient and Complete Statistics, Case of Several Parameters. Problems and Exercises. (Contents as in Chapter -4 of Book-1)

**Unit-4**

Point Estimation: Method of moments, method of maximum likelihood, and its Properties Method of Minimum Chi-square, Method of Least Squares. Concept of Bayesian Estimation, Prior and Posterior Distributions. Problems and Exercises. (Contents as in Chapter -5 of Book-1)

Interval Estimation : Concept , A general Method of Constructing Confidence Intervals (CIs), and Shortest Confidence Intervals . Problems and Exercises. (Contents as in Chapter -6 of Book-1)

**Unit-5**

Bayesian Estimation: Concept of prior distribution – Classifications of prior: Informative, Non informative and Restricted classes of priors – Non-informative priors for location and scale problems Conjugate prior distributions: Posterior distribution and Estimation.

**Books for Study and Reference:-**

- 1) Rajagopalan, M and P.Dhanavanthan., Statistical inference, PHI Learning Private Limited, New Delhi, 2012).
- 2) Gibbons, J.D. and S.Chakraborti, Nonparametric Statistical Inference, 3rd ed., Marcel Dekker, 2010.
- 3) Lehman, E.L. and G.Casella, Theory of Point Estimation, 2nd ed., Springer – Verlag, 1998.
- 4) Rao, C.R., Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York, 1973.
- 5) Zack, S., Parametric Statistical Inference: Basic Theory and Modern Approach, Pergamon Press 1981.
- 6) Zacks, S., The Theory of Statistical inference, John Wiley, New York, 1971.
- 7) Santhakumaran, A (2004), Probability Models and Their Parametric Estimation, K.P.Jam Publication, Chennai.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Study the various criteria of estimators
- CO2: Understand the concepts of sufficiency and completeness
- CO3: Derive different inequalities
- CO4: Understand the various methods of estimation and interval estimation
- CO5: Study the Bayes estimation

**Learning Objectives:** To enhance the knowledge of statistical applications in industries.

**Unit-1**

Meaning and scope of statistical quality control; causes of quality variation, statistical basis for control charts, choice of control limits, sample size and sampling frequency, rational subgroups, specification, tolerance and warning limits. Construction and operations of  $\bar{X}$ , R and  $\sigma$  charts, np, p, c and u charts, Operating Characteristic curves for control charts.

**Unit-2**

Principles and construction of modified control charts, cumulative sum control chart, Basic principles and design of CUSUM charts, concept of V-mask, one and two sided decision procedures. Moving-average and geometric moving-average control chart, sloping control charts.

**Unit-3**

Acceptance sampling plans, Rectifying inspection, Sampling Inspection by Attributes, Concept of OC, ASN, ATI, AOQ functions of sampling plans, AQL, LTPD, producer's risk and consumer's risk on OC curve. Operation and use of single, double and multiple sampling plans. MIL STD-105D Standard, Dodge and Romig Sampling Plans.

**Unit-4**

Sampling inspection by variables - known and unknown sigma, Variable sampling plan, merits and demerits of variable sampling plan, derivation of OC curve. Determination of parameters of the plan. Continuous sampling plans by attributes, CSP-1, CSP -2 and CSP-3. Concept of AOQL in CSPs and Multi-level continuous sampling plans, Indian Standards ISO 2000 (concepts only).

**Unit-5**

Concept of reliability, components and systems, coherent systems, reliability of coherent systems. Life distributions, reliability function, hazard rate, Standard life time distribution, Exponential, Weibull, Gamma distributions. Estimation of parameters, IFR and DFR distributions. Reliability of system with independent components. Basic idea of maintainability.

**Books for Study and Reference:-**

- 1) Douglas C. Montgomery (2005): Introduction to Statistical Quality Control, Sixth edition, John Wiley & Sons, New York.
- 2) Gupta S.C and V.K.Kapoor (2007): Applied Statistics, Sultan Chand Sons, New Delhi.
- 3) Duncan A.J (1959). Quality control and Industrial Management by Duncan A.J. (Richard D.Irwin Inc.USA)
- 4) Leaven worth, R.S. (1964). Statistical Quality Control, (Mc Graw Hill).
- 5) Schilling, E.G. (1982). Advances in acceptance sampling. ASQC Publications, New York.
- 6) Burr, I.W. (1953) Engineering Statistics and Quality Control, McGraw Hill, New Delhi and Sons.
- 7) Mahajan, M (1998): Statistical Quality Control, Dhanpat Rao & Co, New Delhi.
- 8) Biswas S (1996). Statistics of Quality control, Sampling Inspection and Reliability, New Age Intl.
- 9) Bain, L.J and Englehard, M. (1991). Statistical Analysis of Reliability and Life Testing Models, Marcel Dekker.
- 10) Sinha, S.K. (1979), Reliability and Life-Testing, Wiley Eastern, New Delhi.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: To draw and obtaining results of various control charts.
- CO2: To study the Cusum, V-mask and moving average control charts.
- CO3: Understanding the concepts of acceptance sampling plans and their functions.
- CO4: Apply the various sampling inspections in real life situations.
- CO5: Understand the various concepts of reliability and their applications.

Semester-VIII

**19ISTP84 : Statistics Practical – VII  
(Calculator Based Practical)**

**Credits:3  
Hours:6**

**Learning Objectives:** To have practical knowledge on solving problems in matrices, sampling techniques and estimation of parameters.

**Practical Schedule**

**Estimation**

- Unbiased estimator
- Maximum Likelihood Estimation method
- Method of least squares
- Confidence intervals

**Statistical Quality Control**

- Control Chart for  $\bar{X}$  and R
- Control Chart for  $\bar{X}$  and  $\sigma$
- Np – Control Chart
- P – Chart
- C – Chart
- U – Chart
- Single sampling plan – OC, ASN, ATI and AOQ.

**Operation Research**

- Linear Programming Problem – Simplex Method.
- Two Person Zero Sum Games.
- Network – CPM.
- Network – PERT.

**Stochastic Processes**

- Estimation - TPM
- Stationary Probability
- M/M/1 queueing model

**Course Outcomes**

At the end of the course, the student will be able to

CO1: Calculate problems relating to estimation methods.

CO2: Construction of various charts in SQC

CO3: Solving problems in operation research by LPP, Game theory and network.

CO4: Solve problems of stochastic processes

Semester-VIII

**19ISTP85 : Statistics Practical – VIII  
(Computer Based Practical)**

**Credits:3  
Hours:6**

**Learning Objectives:** To have practical knowledge on solving problems using SYSTAT, STATGRAPH and DBMS.

**Practical Schedule**

**SYSTAT**

- Descriptive Statistics.
- Correlation and Regression.
- Chi-Square Test.
- Single mean, Two mean-Z- Test
- Student t-Test: single mean
- Independent two sample
- Pared t-Teat
- ANOVA One-way Classification.

ANOVA Two-way Classification.

### **STATGRAPH**

Diagrams: Bar, Multiple, Component, Pie diagrame  
Graphs: related to Statistical Data.  
Q-Q plot and P-P plot  
Statistical Applications.

### **DBMS**

Creation of data base file  
Use simple command

### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Familiarize in SYSTAT, STATGRAPH and DBMS to
- CO2: Calculate the various statistical measures
- CO3: Test the significance of the parameters
- CO4: Apply ANOVA test for appropriate data
- CO5: Analyze the data using various multivariate analyses
- CO6: Draw diagrams and graphs

**Semester-VIII**

**19 MATE 815.2 Elective-II - Numerical Methods**

**Credits:3**

**Hours:3**

**Learning Objectives:** The role of numerical analysis is to develop and analyze the numerical techniques.

#### **Unit-1**

##### **The solution of Numerical Algebraic and Transcendental Equations:**

Introduction, The Bolzano's bisection method, Method of successive Approximations or the iteration method, The method of false position (Regula Falsi Method), Newton's iteration Method (Newton - Raphson method).

#### **Unit-2**

##### **Simultaneous Linear Algebraic Equations:**

Gauss Elimination method, Computation of the inverse of a matrix using Gauss elimination method, Method of Triangularisation (Method of Factorization), Crout's method, Iterative methods, Jacobi method of iteration (Gauss-Jacobi Method), Gauss Seidal method of iteration.

#### **Unit-3**

##### **Interpolation:**

Introduction, Linear interpolation, Gregory Newton Forward and Backward interpolation Formula, Equidistant terms with one or more missing values.

Interpolation with unequal intervals:

Divided Differences, Properties of Divided differences, Newton's interpolation formula for unequal intervals, Lagrange's interpolation formula, Inverse interpolation.

#### **Unit-4**

##### **Numerical Differentiation and Integration:**

Introduction, Newton's forward difference formula to compute the derivatives, Newton's backward difference formula to compute the derivatives, Derivatives using Stirling's formula.

Trapezoidal rule, Simpson's rule, Statistics Practical applications of Simpson's rule, Trapezoidal rules.

#### **Unit-5**

##### **Numerical Solution of Ordinary Differential Equations:**

Euler's method, improved Euler method, modified Euler method, Runge-Kutta methods, Second order Runge-Kutta Method, Higher order Runge - Kutta method.

**Text Book**

Content and treatment as in the book “Numerical Methods in Science and Engineering” by M.K. Venkataraman, The National Publishing Company, Madras, 1991.

**Books for Study and Reference:-**

1. Introductory Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India (P) Ltd. 1994.
2. Numerical Methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar, and R.K. Jain, Wiley Eastern Ltd., Third Edition, 1993.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the problems of numerical algebraic equations.
- CO2: Solve problems in linear algebraic equations.
- CO3: Understand the various methods of interpolation.
- CO4: Understand the various methods of numerical differentiation and integration.
- CO5: Solve problems of ordinary differential equations

**ELECTIVE-III – DE-1 19STAE806-1 or 19STAE806-1**

**Semester-IX**

**19ISTC91 - Testing Of Statistical Hypotheses**

**Credits:4**

**Hours:4**

**Learning Objectives:** The object is to acquire knowledge on advancements for making decisions based on statistical hypotheses.

**Unit-1**

Tests of Hypotheses – Concepts, Test functions Non-randomized and randomized tests, Critical region, Two types of errors, level of significance, size and power of the test Neyman-Pearson Theory and Lemma, Test Functions or Critical Functions, MP tests when H and K are simple, Uniformly Most Powerful Tests, monotone Likelihood Ratio Property, Problems and Exercises. (Contents as in Chapter -7 of Book-1)

**Unit-2**

UMP Tests - Monotone likelihood ratio property, Generalized NP lemma, Tests for One Parameter Exponential Family of Distributions, Locally Most Powerful Tests, UMPU Tests for Multi-Parameter Exponential Family of Distributions, Tests with Neyman’s Structure, Problems and Exercises. (Contents as in Chapter -8 of Book-1)

**Unit-3**

Likelihood Ratio Method of Test Construction- Likelihood Ratio (LR) Test, Asymptotic Distribution of the LR test Criterion, LR test for testing the mean and variance of the Normal distribution based on K-samples( $K \geq 1$ ), Test Consistency, LR Test when Domain of RV Depends on Parameter, Problems and Exercises. (Contents as in Chapter -9 of Book-1)

**Unit-4**

Non-Parametric Methods –Nonparametric Estimation: Empirical Distribution Function, U-statistics. Nonparametric Tests: Single sample Problems, Kolmogorov –Smirnov Test, Sign test, Wilcoxon signed rank test. Two sample Problems: Wald – Wolfowitz run test, Mann- Whitney U-test, K-S two samples Test, Chi-square test, Median test, Kruskal Wallis Test, and Friedman’s Test, Problems and Exercises. (Contents as in Chapter -12 of Book-1)

**Unit-5**



Sequential Procedures: Sequential Estimation- Sequential Hypothesis Testing, SPRT, Determination of the Constants of B and A for the SPRT, OC and ASN function of the SPRT. Certain Basic Results for SPRT, SPRTs When the Hypotheses are Composite, Basic results of SPRT, Decision intervals under SPRT for Binomial, Poisson and Normal distribution, Problems and Exercises. (Contents as in Chapter -13 of Book-1)

**Books for Study and Reference:-**

- 1) M.Rajagopalan and P.Dhanavanthan., Statistical inference, PHI Learning Private Limited, New Delhi,2012).
- 2) Gibbons, J.D. and S.Chakraborty, Nonparametric Statistical Inference, 3rd ed., Marcel Dekker,2010.
- 3) Lehman, E.L. and J.P. Romano, Testing Statistical Hypotheses, 3rd ed., Springer 2005.
- 4) Lehman, E.L. and G.Casella, Theory of Point Estimation, (Springer Texts in Statistics), 2014.
- 5) Rao, C.R., Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York, 1973.
- 6) J.K. Lindsey (1996), Parametric Statistical Inference (Oxford Science Publications).
- 7) Igor Vajda (1989), Theory of Statistical Inference and Information (Theory and Decision Library B).
- 8) George Casella and Roger L. Berger (2001), Statistical Inference (Springer Texts in Statistics).
- 9) Paul Garthwaite, Ian Jolliffe and Byron Jones (2002). Statistical Inference (Oxford science Publications).

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the various concepts of testing of hypotheses.
- CO2: Study the use of NP lemma and locally most powerful tests.
- CO3: Study the various likelyhood ratio tests.
- CO4: Apply the various non-parametric methods in practical problems.
- CO5: Understand the sequential methods of hypotheses testing

**Semester-IX**

**19ISTC92 - Multivariate Statistical Analysis**

**Credits:4  
Hours:4**

**Learning Objectives:** To understand the basic concepts of Multivariate analysis for applying more than two dimension situation.

**Unit-1**

Multivariate Normal Distribution, Properties, Singular and Non-singular matrices, Marginal and Conditional Distributions. Estimation of the Mean vector and the covariance matrix in Multivariate normal distribution: Maximum likelihood estimates of the Mean vector and the covariance matrix, distribution of the sample mean vector, inference concerning the mean when the covariance matrix is known.

**Unit-2**

Generalized  $T^2$  – Statistics: Introduction, derivation of the generalized  $T^2$  – Statistic and its distribution, uses of  $T^2$  – Statistic, confidence region for the mean vector, Two – Sample problem, problem of symmetry, distribution of  $T^2$  under alternative hypothesis optimum properties of the  $T^2$  – test.

Wishart distribution: Distribution (No derivation), characteristic function, properties, Marginal distributions, Linear transformation, sum of Wishart Matrices.

### **Unit-3**

Classification of observations: The problem of classification, standards of good classification, procedure of classification into one of two populations with known probability distributions, classification into one of two known multivariate normal populations, discriminant function, classification into one of several populations, classification into one of several multivariate normal populations.

### **Unit-4**

Principal components: Introduction, definition of principal components in the population, MLE of the principal components and their variances, computation of the MLE of the principal components. Canonical correlations and canonical variables: Introduction canonical correlations and variables in the population, estimation of canonical correlations and variables, computation.

### **Unit-5**

Factor Analysis: The Basic model common and special factor; communality; Estimation of factor loading principal factor method; maximum likelihood method; Factor Rotations; Cluster Analysis: Similarity and distance measures hierarchical clustering techniques.

### **Book for Study and Reference:-**

- 1) T. W. Anderson (1982) – An Introduction to Multivariate Statistical Analysis, (2nd Edition) Wiley, NewDelhi.
- 2) Morison. D. F (1983), Multivariate Statistical methods, Mc Graw Hill 2nd Edition.
- 3) W. R. Dillon and M. Goldstein (1984), Multivariate Analysis methods and Applications, Wiley, New York.
- 4) Johonson. R. A and D. W. Wichern, (1996). Applied Multivariate Statistical Analysis, Wiley, New York.
- 5) Sam Kash Kanchigan (1991). Multiariate Statistical Analysis: A Conceptual Introduction, 2nd Edition.
- 6) Alvin C. Renher (1997). Multivariate Statistical Inference and Applications.
- 7) Wolfgang Karl Hardle and Leopold Simar (2012). Applied Multivariate Statistical Analysis.
- 8) Bryan F.J. Manly (2004). Multivariate Statistical Methods: A Primer, Third Edition.
- 9) Richard A. Johnson and Dean W.Wichen Applied Multivariate Statistical Analysis (5th Edition).
- 10) Alvin C. Rencher and William F. Christensen (2012). Methods of Multivariate Analysis.

### **Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the use of multivariate normal tests.
- CO2: Apply the multivariate tests using  $T^2$  statistics.
- CO3: Understand the problems of classification of observations.
- CO4: Apply the multivariate analyses such as principal components, canonical correlations in real life problems.
- CO5: Apply the multivariate analyses such as factorial analysis and cluster analysis in real life problems.

**Semester-IX**

**19ISTC93 : Operations Research**

**Credits:4  
Hours:4**

**Learning Objectives:** To impart knowledge of various optimization techniques that makes use of statistical concepts abundantly.

### **Unit-1**

The General Linear Programming problem (GLPP)- properties and solutions of the LPP; generating development of optimal feasible solutions; theory and computational algorithms of simplex method; degeneracy procedures and perturbation technique; Primal and dual LPP and duality theorem; Methods using artificial variables.

**Unit-2**

Introduction; Limitation of integer LP; Methods of Integer programming; Cutting plane method; search methods-Branch and Bound techniques; Mixed Integer programming problem; Goal programming- formulation of problem and optimum solution.

**Unit-3**

Theory of games- zero sum two person games; pure and mixed strategies; saddle points; LPP and games; graphical solutions of  $2 \times n$  and  $m \times 2$  games; dominance property; minimax and maximin and saddle point theorems.

**Unit-4**

Network analysis by CPM/PERT-Basic Concept; Constraints in Network; Construction of the Network; Time calculations; Concept of slack and float in Network Analysis; Network crashing; Finding optimum project duration and minimum project cost.

**Unit-5**

Concept of scientific inventory management and analytical structure of inventory problems; The ABC inventory system-Costs associated with inventory-Deterministic inventory models-Economic lot size models-Stochastic inventory models with and without lead time.

**Books for Study and Reference:-**

- 1) Kanti Swarup, P.K. Gupta and Manmohan (2007) Operations Research, Sultan Chand Sons, New Delhi.
- 2) Cheema, Col.D.S.(2005) Operation Research, Laxmi Publications (P) Lts., New Delhi.
- 3) S.D. Sharma (2002): Operations Research: Kedarnath and Ramnath, Meerut.
- 4) Taha (2005).Operations Research, 8<sup>th</sup> editioni PHI, New Delhi.
- 5) F.S. Hiller and Liberman (1994): Operations Research, CBS Publishers and Distributions, New Delhi.
- 6) Gass Saul.I (1975).Linear programming methods and applications, 4<sup>th</sup> edition McGraw Hill, New Delhi.
- 7) Kanti Swarup, P.K. Gupta and Manmohan (2007) Operations Research, Sultan Chand Sons, New Delhi.
- 8) S.D. Sharma (2002): Operations Research: Kedarnath and Ramnath, Meerut.
- 9) J.K.Sharma(2002):Operations Research:Theory and application,Macmillan,India Ltd.
- 10) F.S.Hillier and Liberman (1994): Operations Research, CBS Publishers and Distributions, New Delhi.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the general LPP  
 CO2: Apply the integer programming problem.  
 CO3: Solve game problems in real life study.  
 CO4: Apply CPM/PERT techniques practically.  
 CO5: Apply the inventory system in economic problems.

**Semester-IX****19ISTC94 - Programming In R****Credits:4****Hours:4**

**Learning Objectives:** To understand the concepts and applications of R Programming in Statistics.

**Unit-1**

Introduction to R – Using the help facility. R data types and objects, reading and writing data import and export. Data structures: vectors, matrices, lists and data frames – Built-in data-Reading data from other sources – Merging data across data sources.

**Unit-2**

Control structures: functions, scoping rules, dates and times – Grouping, loops and conditional execution – Ordered and unordered factors – Arrays and matrices – Classes and methods – Graphical procedures.

### Unit-3

Dealing with Missing values – Data Cleaning and Transforming, Exploring and Visualizing – Writing your own functions – Statistical models in R.

### Unit-4

Descriptive statistics – Frequency and contingency tables – correlations – t-tests, Nonparametric tests of group differences: Comparing two groups – Comparing more than two groups.

### Unit-5

Distributions and Modeling – Regression – ANOVA – General linear models – Principal component analysis and factor analysis.

#### Books for study and Reference:-

1. An Introduction to R. Online manual at the R website at <http://cran.r-project.org/manuals.html>.
2. Peter Dalgaard. Introductory Statistics with R(Paperback) 1st Edition Springer-Verlag New York, Inc.
3. Brian Everitt and Torsten Hothorn. A Handbook of Statistical Analysis Using R, 2nd Edition Chapman and Hall/CRC, 2009.
4. Robert Kabacoff, R in Action Data Analysis and Graphic with R, Manning Publications, 2011.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the various basic concepts of R
- CO2: Study the various functions and rules of R.
- CO3: Understand the data cleaning and transformation.
- CO4: Solve problems in statistical methods using R.
- CO5: Obtaining inferences for statistical analysis using R.

Semester-IX

**19ISTP95 - Practical – IX  
(Calculator Based Practical)**

**Credits:3  
Hours:6**

**Learning Objectives:** To familiarise the students in solving problems in testing of hypotheses, non-parametric tests.

### Practical Schedule

#### Testing Of Hypotheses

1. Most powerful test Estimation of power and size.
2. Uniformly MP test – Estimation of power and size.
3. Sequential curve
4. SPRT- OC and ASN curve using binomial, poisson and normal distribution

#### Non-Parametric Tests

1. One sample Kolmogorov – Smirnov test.
2. Sign test
3. Wilcoxon signed rank test.
4. Mann – Whitney U – test
5. Kolmogorov – Smirnov two sample test.
6. Median test
7. Kruskal – Wallis test.
8. SPRT – OC and ASN curve for Binomial Distribution.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Solve problems in testing of hypotheses.  
 CO2: Solve problems in non-parametric tests

**Semester-IX**

**19ISTP96 – Statistics Practical – X  
 (Computer Based Practical)**

**Credits:3  
 Hours:6**

**Learning Objectives:** To acquire knowledge of computation of statistics through R software and C++ programming language.

### Practical Schedule

#### Programs Using R

- Finding the mean and standard deviation for raw data.
- Finding the mean and standard deviation for discrete type frequency distribution.
- Finding the mean and standard deviation for continuous type frequency distribution.
- Finding the median for raw data.
- Finding the Skewness and kurtosis based on moments.
- Finding the correlation – coefficient.
- Finding the regression equations.

#### Course Outcomes

At the end of the course, the student will be able to

- CO1: Able to develop programs using R for descriptive statistics.  
 CO2: Calculate various statistical measures using R  
 CO3: Analyse and interpret using sample data in R  
 CO4: Apply various statistical test and interpret using R.

**Semester-IX**

**19 MATE 915.1 Elective-IV Differential Equations**

**Credits:3  
 Hours:3**

**Learning Objectives:** This course aims to provide logical skills in the formation of differential equations, to expose to different techniques of finding solutions to these equations and in addition stress is laid on the application of these equations in geometrical and physical problems. It also aims to provide logical skills in the formation and solutions techniques of partial differential equations.

#### Unit-1 Ordinary Differential Equations

Bernoulli Equation – Exact Differential Equations – Equations Reducible to Exact Equations – Equations of First order and Higher degree: Equations solvable for p, Equation solvable for x and Equations Solvable for y – Clairaut's Equation.

#### Unit-2 Ordinary Differential Equations [Contd...]

Method of Variation of Parameters – 2nd order Differential Equations with Constant Coefficients for finding the P.I.'s of the form  $e^{ax} V$ , where V is  $\sin(mx)$  or  $\cos(mx)$  and  $x^n$ .

#### Unit-3 Laplace Transform

Laplace Transform, Inverse Laplace transform, Application to the first and second order linear differential equations.

#### Unit-4 Partial Differential Equations

Partial differential equations: Formation of P.D.E. by eliminating arbitrary constants and arbitrary functions, Complete, Singular and General integral. Solution of equations of standard types:  $f(p,q)=0$ ,  $f(x,p,q)=0$ ,  $f(y,p,q)=0$ ,  $f(z,p,q)=0$ ,  $f(x,p)=f(y,q)$ , and Clairaut's form. Lagrange's equation  $Pp+Qq=R$ , Simple problems.

#### Unit-5 Series Solution

Series solutions of first order equations, Second order linear equations, Ordinary points, Regular Singular Points

**Books for Study and Reference:-**

1. Differential Equations, Fourier and Laplace Transforms, by P.R. Vittal, Margham publications, Second Edition, 1999.
2. Differential equations with applications and historical notes by George F. Simmons, Tata McGraw Hill Pub. Co., New Delhi, Second Edition, 2003.
3. Ordinary and partial Differential equations by M.D. Raisinghania and R.S. Aggarwal, Sultan Chand and Company Ltd., 1983.
4. Ordinary and Partial Differential Equations by M.D. Raisinghania, S. Chand, 2006
5. B.S.Grewal [2002] Higher Engineering Mathematics, Khanna Publishers, New Delhi

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: The skill of the formation of differential equations and partial differential equations,  
CO2: The skill to expose different techniques of finding solution of differential equations and partial differential equations.

**ELECTIVE-V – DE-1 19STAE907-1 or 19STAE907-2****Semester-X****19ISTC101 - Design And Analysis Of Experiments****Credits:4****Hours:4**

**Learning Objectives:** To enrich the basic principles of design of experiments, general designs, multiple comparison tests, factorial and incomplete block designs and their applications.

**Unit-1**

Principles of Scientific experimentation; Replication, Randomization and Local control; Various concepts, definitions in experimental designs, Notion of a design matrix, Inter and intra block analysis for general designs models, Orthogonality; connectedness and resolvability.

**Unit-2**

Detailed analysis of CRD, RBD, LSD, GREACO LSD - Expected values of the various sum of squares to be obtained, comparison of CRD, RBD and LSD –Analysis of Higher order orthogonal LSD, Analysis of covariance (one concomitant variable) in CRD, RBD.

**Unit-3**

Multiple comparison tests; meaning and need; Detailed description of CD, SNK, DMR and Tukey tests. Missing plot analysis of RBD and LSD; Mixed plot analysis of RBD (with one observation per cell); Cross- over designs and their analysis.

**Unit-4**

Factorial Experiments; their needs and advantages, definition of symmetric factorials; meaning of main effects and interactions in  $2^n$  and  $3^n$  experiments; Complete analysis of such Experiments laid out in CRD and RBD. Need and meaning of confounding; total and partial confounding; Construction and analysis of such designs. Split plot design in RBD.

**Unit-5**

Balanced and partially balanced incomplete Block design (with two associate classes only); their meaning, definition, classifications and analysis. Youden square design, its description and analysis; Lattice design, its definition, construction and Analysis of simple and Balanced Lattices.

**Books for Study and Reference:-**

- 1) Montgomery, D.C. (2005). Design and Analysis of Experiments, Fifth Edition, John Wiley and Sons, New York.
- 2) Robert .O.Kuchi (2000) Design of experiments, statistical principles of research design and analysis 2nd edition, Brooks /wole Publishers.
- 3) Patric J. Wit comband Mark J. Anderson (2000) DOE simplified. Statistics Practical tools for effective experimentation, Productivity, Inc.
- 4) Antony, JV (2003) Design of experiments for engineers and scientists, Imprint, Butterworth, Heinemann.
- 5) Das, M.N and Giri. N.C (1986), Design and Analysis of experiments, 2nd Edition, New Age International, New Delhi.
- 6) Federer, W.T. (1967) Experimental Designs – Theory and Applications, Oxford, London.
- 7) Cochran.W.G. and Cox, G.M.(1995). Experimental design. 4th edn Wiley, Nework.
- 8) Kempthorne (1952). The Design and Analysis of Experiments, Wiley, New York.

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the various basic concepts of experimental designs.
- CO2: Analyse the basic designs and interpretation.
- CO3: Apply the various comparison tests and missing observations for experimental data.
- CO4: Apply the factorial designs in field experiments.
- CO5: Understand the incomplete block designs

**Semester-X**

**19ISTC102 - Stochastic Processes**

**Credits:4  
Hours:4**

**Learning Objectives:** To acquire the standard concepts and methods of Stochastic Modelling and applications.

#### Unit-1

Stochastic Processes: Definition and examples; Classification of stochastic processes with illustrations. Gambler's ruin problem Markov chains; Definition and examples; One and two dimensional random walk; Transition probabilities; Classification of states; Recurrent Markov Chains; Necessary and sufficient condition for a state to be recurrent; Basic limit theorems on recurrence. Statistical Inference for Markov chains.

#### Unit-2

Basic limit theorems of Markov chains. Theorem establishing the stationary probability distribution of a positive recurrent, a periodic class a states; Absorption probabilities; Criteria for recurrence, examples.

#### Unit-3

Continuous time Markov chains; Examples, General pure birth process; Poisson process. Definition; and properties; Birth and death process with absorbing states; Finite state continuous time Markov chains.

#### Unit-4

Branching Processes. Discrete time Branching Process. Generating function relation: Mean and Variance of generations – Extinction probabilities and theorems. Renewal processes – renewal function – renewal equation – renewal theorems.

#### Unit-5

Queuing processes; General Description M/M/1 models with finite and infinite capacities Waiting time and busy period for both steady state transient behavior; Birth and Death Processes in queuing theory; Multi-channel model M/M/S; Embedded techniques applied to M/G/1.

### Books for Study and Reference:

- 1) Karlin, S and H.W. Taylor (1975) A First course in Stochastic processes, Academic press, 2nd edition
- 2) Karlin, S and H.W. Taylor (1979) A Second course in Stochastic processes, Academic press.
- 3) Prabhu , N.U (1965) Stochastic processes, McMillan
- 4) Bharucha Reid, A.T (1960), Markov chain with applications. John Wiley, New York.
- 5) Chung, K.L (1967) Markov chains with stationary transition probabilities, Springer Verlagen, New York, 2nd edition.
- 6) Srinivasan, S.K, Introduction to Stochastic processes and their applicatons.
- 7) Medhi. J (1991), Stochastic processes, New Age International Pvt. Ltd., New Delhi.
- 8) Resnik, (1992) Adventures in Stochastic Processes, Brikauser, Boston

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the basic concepts and classifications of stochastic processes.  
CO2: Study the theorems of stationary probability distributions.  
CO3: Analyse the birth and death processes and their applications.  
CO4: Study the branching processes and their related concepts.  
CO5: Apply and analyse the various queueing systems in real life situations.

**Semester-X**

**19ISTP103 - Practical – XI  
(Calculator Based Practical)**

**Credits:3  
Hours:6**

**Learning Objectives:** To familiarise the students in solving problems in experimental designs and multivariate analysis.

### Practical Schedule

#### Design Of Experiments

- 1) Completely Randomized Design.
- 2) Randomized Block Design.
- 3) Latin Square Design.
- 4) Missing Plot Analysis in CRD, RBD and LSD.
- 5) Multiple Comparison Test – DMRT, LSD and CD.
- 6)  $2^2$ - Factorial Experiment .
- 7)  $2^3$  - Factorial experiment with complete confounding.
- 8)  $2^3$  - Factorial experiment with partial confounding.
- 9)  $3^2$  - Factorial Experiment.

#### Multivariate Analysis

- 1) Estimation of Mean vector and Covariance Matrix.
- 2) Test for the Mean vector when Covariance Matrix is known.
- 3) Test for Equality of Mean vector.
- 4) Test for the Mean vector when Covariance Matrix is unknown.
- 5) Test for Covariance Matrix.



6) Test for Equality Covariance Matrices.

### **Course Outcomes**

At the end of the course, the student will be able to

CO1: Carryout the analyses for various experimental designs and interpretation.

CO2: Apply the multivariate statistical tests.

**Semester-X**

**19ISTP104 - Practical – XII  
(Computer Based Practical)**

**Credits:3  
Hours:6**

**Learning Objectives:** To familiarise the students in solving problems in using C++.

### **Practical Schedule**

#### **Programs Using C++**

- Programs for mean and standard deviation
- Correlation coefficient
- Testing for population mean.
- Testing for difference of means.
- Paired t – Test.
- Chi-Square test for testing the independence of attributes.
- F – Test for equality of Variances.
- Fitting of Binomial Distribution and goodness of Fit.
- Fitting of Poisson Distribution and goodness of Fit.
- Fitting of Normal Distribution and goodness of Fit.
- Analysis of variance One-way Classification.
- Addition and Subtraction of Matrices.

### **Course Outcomes**

At the end of the course, the student will be able to

CO1: Prepare programs for various statistical measures .

CO2: Prepare programs for various statistical tests.

CO3: Prepare programs for various matrix problems

### Department Elective Courses

#### 19STAE806-1 Programming With C++

Credits:3

Hours:3

**Learning Objectives:** This paper aims at introducing the language C++ in a systematic manner to make the students to have knowledge in program writing and developing the software.

##### Unit-1

C++: Introduction, Data types, Operators, Statements; Declaration of variables, Statements, simple C++ programs, Features of I/O stream, manipulation function, I/O stream flags.

##### Unit-2

Control Statements: Conditional expression, Switch statement, loop statements, Breaking control statements; Functions and Program structures; Introduction, definition, Types of functions, Actual and Formal arguments, Default arguments, Storage class specifier, Recursive function, Pre-processors, Header files and standard function.

##### Unit-3

Arrays: Notation, Declaration, Initialization, Processing, Arrays and Functions, Multidimensional arrays. Pointers; Declaration, Arithmetic; Pointers and Functions, Pointers and Arrays; Strings, Array of Pointers, Pointers to Pointers.

##### Unit-4

Structures: Declaration, Initialization, Functions, Array of structures, Arrays within a structure, Nested Structures, Pointers and Structures, Unions and Bit fields, Enumerations.

##### Unit-5

Classes and Objects: Introduction, Structures and classes, Declaration, Members Functions, Object a class, Array of class objects, Pointers and Classes, Unions and Classes, nested Class, Constructors and Destructors, Inline Members functions and Friend Functions. C++ programs for Descriptive Measures of Statistics, ANOVA- One way and Two way Classifications.

##### Books for Study and Reference:-

1. Ravichandran, D. (2003). Programming with C++: Tata Mc Graw Hill Publications, Company Limited, 2nd Edition.
2. Balagurusamy, E. (2006). Programming with C++: Tata Mc Graw Hill Publications, Company Limited, 3rd Edition.
3. Eric Nagler, (1999) Learning C++ Second Edition, PWS Publishing co., Ltd., 3rd Edition, 2003
4. Robert Lafore, (2002). Object oriented programming in C++, Galgotia Pub. Pvt. Ltd, NewDelhi, 4th Edition.

##### Course Outcomes

At the end of the course, the student will be able to

CO1: Understand the fundamental concepts of C++ programming

CO2: Understand the various statements of C++

CO3: Study the arrays and pointers in C++

CO4: Familiarize in structures, classes and objects of C++

CO5: Write programs using C++

#### 19STAE806-2 Applied Regression Analysis

Credits:3

Hours:3

**Learning Objectives :** To study the various regression models and their applications.

##### Unit-1

Linear regression: Fitting a straight line, Precision of the estimated regression Coefficient of regression equation, lack of fit and pure error, simple Correlation, inverse regression.

#### **Unit-2**

Fitting of straight line by matrix method (General Linear model), Analysis of variance, The general regression situation with and without distributional assumptions. General linear hypothesis testing in regression situation weighted least squares bias in regression estimates, restricted least squares.

#### **Unit-3**

Multiple regression analysis: Estimation of parameters, Three variable model, partial regression Coefficient, OLS and ML estimation, Coefficient of multiple  $R^2$  and adjusted  $R^2$ . Cobb-Douglas production function, polynomial regression models, partial correlation coefficients.

#### **Unit-4**

Multiple regression analysis: Hypothesis testing about individual regression coefficients, testing the overall significance of the sample regression, testing the equality of two regression coefficients, restricted least squares, Chow test, prediction with multiple regression, testing the functional form of regression.

#### **Unit-5**

Dummy variable regression models: ANOVA and ANACOVA models, The dummy variable alternative to the Chow test, interaction effects using dummy variables, use of dummy variables in seasonal analysis, piecewise linear regression, panel data regression models.

#### **Books for Study and Reference:-**

1. Draper N. R and Smith. H (1981), Applied Regression Analysis, John Wiley & Sons.
2. D.N. Gujarati and Sangeetha (2008) Basic Econometrics, (4<sup>th</sup> Edition). Tata Mc Graw Hill publishing Company, New Delhi.
3. Brook. R. J and Arnold. G. C (1985), Applied Regression Analysis and Experimental Design, Marcel Dekker, Inc.
4. Plackeff. R. L (1960), Principles of Regression Analysis, Oxford at the Clarendon press.
5. Huang. D. S (1970), Regression and Econometric Methods, John Wiley and Sons.
6. Norman R. Draper and Harry Smith (1998) Applied Regression Analysis (Wiley Series in 9) Probability and Statistics).
7. John O. Rawlings, Sastry G. Pantula and David A. Dickey (2001) Applied Regression Analysis: A Research Tool (Springer Texts in Statistics).

### **19STAE907-1 Elective – V Java and Oracle Programming Credits:3 Hours:3**

**Learning Objectives:** To understand the concepts and preparing programs using JAVA and also highlights the concept of ORACLE and its functions.

#### **Unit-1**

Introduction to JAVA, Data types, variables and arrays, control statements, looping statements. Classes, Methods, Data structures, Inheritance, packages and Inheritance. Exception handling, Multispread programming, I/O classes, String Handling, Utility classes and file stream.

#### **Unit-2**

Applet class – introduction to Abstract Windows Toolkit (AWT) – working with windows, Graphics and Test – AWT controls, Layout Managers, Images, Animations, Swing class library. Networking: Using connection less service connection oriented service utility package.

#### **Unit-3**

Introduction: Purpose of data base systems – Overall system structure. Entity Relationship model: Entity and Entity sets – Relationships – E.R. diagram. Basic concepts of database: recovery, concurrency control, database security and Integrity. Relational model: Structure of relational database – relational algebra. Relational data base design: Pitfalls in relational database design – Normalization using Functional dependencies.

#### Unit-4

Oracle's PL/SQL: Variables is PL/SQL – The other variables – dynamic data types – strings; Statements; Control Statements – If-Then-Endif-The Else – Elseif – For loop – The While loop – loops and labels – scoping. Oracle Forms: SQL forms – Generating a forms – Parent Child co-ordination – Retrieving multiple data – data entry – data types – Field characteristics – Automatic generation of a form – The enforce Key – Triggers – procedures.

#### Unit-5

Oracle menus: Securing the application Zoom in and out – Display no privilege – Sub menus – Oracle Report: Developing a report – The Reset group – The report setting – Parent Child queries.

#### Book for Study and Reference:

- 1) C. Xavier, (2002) Projects on JAVA, Scitech Publications (India) Pvt. Ltd., Chennai – 17.
- 2) Patrick Naughton and Herbert Schildf (2001). The complete Reference Java 2.0, TMH Publishing Company Ltd., 4<sup>th</sup> edn. New Delhi.
- 3) Margaret Levine Yound,(1999) "Internet: The Complete Reference", Tata McGraw Hill Publishing Company Limited, New Delhi, Millennium Edition.
- 4) Douglas E. Comer, (1999) "The Internet", 2<sup>nd</sup> Edition, PHI, New Delhi.
- 5) Khandara, S.S. (2002) programming in JAVA, S.CHAND & Company Limited 1<sup>st</sup> Edition, New Delhi.
- 6) Date C.J.(1995)(Volume I), 'An Introduction to Database Systems' Narosa Publishing House.

### 19STAE907-2 Advanced Econometrics

Credits:3

Hours:3

**Learning Objectives:** To enrich the skills of students to get more applied knowledge in Econometrics.

#### Unit-1

Nature and Scope of Econometrics. Normal linear Regression Model: Probability disturbances of error term, Normality Assumption, Properties of OLS estimator under Normality assumption, Method of Maximum likelihood, MLE of two variables regression model. Multicollinearity: The Nature, Estimation in the presence of Multicollinearity, Consequences of Multicollinearity, Detection of Multicollinearity, Remedial measures.

#### Unit-2

Heteroscedasticity: The nature of heteroscedasticity, OLS Estimation in the presence of heteroscedasticity, the method of generalized least squares (GLS), Consequences, Detection, remedial measures, caution about overreaching to heteroscedasity.

#### Unit-3

Autocorrelation: The nature, OLS estimation in the presence of autocorrelation, BLUE estimation in the presence of autocorrelation, consequence of auto correlation. Detecting autocorrelation, remedial measures. Correcting for autocorrelation, method of GLS, Newey-West method of correcting of OLS standard error. Other aspects of autocorrelation, ARCH, GARCH models.

#### Unit-4

Model selection criteria, Types of specification error, consequences of model specification errors, Test of specification of errors, errors of measurements, Model selection criteria.

#### Unit-5

Simultaneous-Equation Models: The nature, examples of simultaneous equation models. Identification problem, rules for identification, Estimation, *ILS*, *2SLS*, *Estimation using LIM*, instrumental variables, K-class estimators, FIML, 3SL.

**Books for Study and Reference:-**

- 10) Gujarati D.N and Sangeetha (2007) Basic Econometrics, McGraw- Hill co, New York.
- 11) Johnston (1984) – Econometric Methods, McGraw- Hill, 3rd Ed, New York.
- 12) James H. Stock and Mark W. Watson (2010) Introduction to Econometrics (3<sup>rd</sup> Edition) (Addison-Wesley Series in Economics).
- 13) James H. Stock and Mark W. Watson (2006) Introduction to Econometrics (2<sup>rd</sup> Edition) (Addison-Wesley Series in Economics).
- 14) Ronald J. Wonnacott and Thomas H. Wonnacott (1979) Econometrics (Wiley Series in Probability and Statistics – Applied Probability and Statistics Section).

**Inter Department Elective Courses****19 STSE 815.1– Statistical Methods****Credits:3****Hours:3**

**Learning Objectives:** To enable the students of other discipline to understand the basic concepts of statistical methods.

**Unit – 1**

Definition, scope, functions and limitations of Statistics – Collection, Classification, Tabulation of data, Diagrammatic representation of data – Simple, Multiple and Percentage Bar diagram, Pie diagram and Graphical representation of data – Histogram, frequency polygon, frequency curve and ogives. Primary and Secondary data – Questionnaire method.

**Unit – 2**

Measures of Central tendency – Mean, Median and Mode and their Statistics Practical usages. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance and Coefficient of Variation. Measures of Skewness – Pearson's, Bowley's method. Applications of Binomial and Normal distributions.

**Unit – 3**

Measure of Bivariate data – Simple, Partial and Multiple Correlation. Scatter diagram, Pearsons method and Rank correlation method. Regression and their equations – Prediction. Basic concept of Sampling – Parameter and Statistics – Sampling distribution and Standard Error – Simple random sampling and stratified random sampling.

**Unit – 4**

Tests of Significance with their important concepts. Tests for large samples - Test for mean, difference of means, proportion and equality of proportions. Small sample tests – Test for mean, difference of Means, paired samples, test for correlation and regression coefficients.

**Unit - 5**

Chi square test for goodness of fit and independence of attributes. F-test – Analysis of variance, Assumptions, Applications, one way anova and two way anova classifications.

Note: The emphasis is only on the application of the methods. The derivations of the formulae are not necessary.

**Books for Study and References :**

- 1) Gupta, S.P. (2011) Statistical Methods, Sultan Chand & Sons, Pvt. Ltd, New Delhi
- 2) Gupta, S.C and V.K. Kapoor, (2011) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Pvt. Ltd, New Delhi
- 3) Darren George, Paul Mallery (2011) SPSS for Windows, 10th Edition, PEARSON

**Course Outcomes**

At the end of the course, the student will be able to

CO1: Understand the various diagrams and graphs for statistical data.

CO2: Calculate the various statistical methods.

- CO3: Calculate the measures for bivariate data.  
CO4: Understand the use of tests of significance.  
CO5: Understand the use of chi square and anova tests.

**19 STSE 815.2- Mathematical Statistics**

**Credits:3**  
**Hours:3**

**Learning Objectives:** To impart basic knowledge about random variables and various distributions.

**Unit-1**

Random Variables and Distribution Functions- Introduction, Properties of Distribution Function, Discrete Random variable-Probability Mass Function, Discrete Distribution Function, Continuous Random variable - Probability density function, Various Measures of Central Tendency, Dispersion, Skewness and Kurtosis for Continuous Probability Distributions, Continuous Distribution Function, Two Dimensional Random Variables- Two dimensional or JPMF, Two dimensional Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence, Problems and Exercises. (Content as in Chapter-5 of Book 1)

**Unit-2**

Mathematical Expectation- Introduction, Mathematical Expectation or Expected Value of A Random Variable, Expected Value of Function of a Random Variable, Properties of Expectation - Addition Theorem of Expectation, Multiplication Theorem of Expectation, Properties of Variance, Covariance - Variance of Linear combination of Random Variables, Some Inequalities Involving Expectation, Moment of Bivariate Probability Distributions, Conditional Expectation and Conditional Variance, Problems and Exercises.  
(Content as in Chapter-6 of Book 1)

**Unit-3**

Generating Functions – Moment Generating Function- Limitations, Properties, Uniqueness Theorem, Cumulants - Properties, Characteristic Function- Properties of Characteristic Function, Necessary and Sufficient Conditions for a Function  $\phi(t)$  to be Characteristic Function, Some Important properties – Inversion Theorem, Uniqueness Theorem of Characteristic Functions, Problems and Exercises. (Content as in Chapter-7 of Book 1)

**Unit-4**

Discrete Probability Distributions - Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric, Multinomial Distributions and their Moments, Recurrence, MGF, Additive Properties, Characteristic Functions, PGF, Problems and Exercises. (Content as in Chapter-8 of Book 1)

**Unit-5**

Continuous Probability Distributions – Normal, Rectangular, Gamma, Beta, Exponential, Standard Laplace, Cauchy Distributions, Sampling Distributions of t, F, Chi-Square and their Derivations, Additive Properties, Characteristic Functions, MGF, PGF.  
(Content as in Chapter-9 of Book 1)

**Books for Study and Reference:-**

- 1) Gupta S.G and Kapoor.V.K 'Fundamentals of Mathematical Statistics' Sultan Chand & Sons.
- 2) Mood, A.M,F.A Graybill and D.C Boes (1974), Introduction to the Theory of Statistics, 3rd Edn.McGraw Hill.
- 3) Wilks, S.S.(1983) , Mathematical Statistics, Wiley.
- 4) Rao, c.R (1983), Linear Statistical Inference and its applications, 2nd Edn, Wiley Eastern.
- 5) Johnson and Kotz, (2002) Continuous Univariate Distributions-1, John Wiley and Sons.
- 6) Johnson and Kotz, (2002) Continuous Univariate Distributions-2, John Wiley and Sons.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understanding concepts random variables and probability distributions.  
CO2: Study the expectation and related results.

- CO3: Apply the use of various functions.  
CO4: Understand the various descriptive distributions.  
CO5: Understand the various continuous distributions

## 19 STSE 915.1– Bio Statistics

**Credits:3**  
**Hours:3**

**Learning Objectives:** To enable the students of other discipline to understand the basic concepts of Bio statistics in Biological applications.

### Unit – 1

Definition, scope, functions and limitations of Statistics – Collection, Classification, Tabulation of data, Diagrammatic representation of data – Simple, Multiple and Percentage Bar diagram, Pie diagram and Graphical representation of data – Histogram, frequency polygon, frequency curve and ogives. Primary and Secondary data – Questionnaire method.

### Unit – 2

Measures of Central tendency – Mean, Median and Mode and their practical usages. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance and Coefficient of Variation. Measures of Skewness – Pearson's, Bowley's method. Applications of Binomial and Normal distributions. Applications to Biological Studies.

### Unit – 3

Measure of Bivariate data – Simple, Partial and Multiple Correlation. Scatter diagram, Pearsons method and Rank correlation method. Regression and their equations – Prediction. Basic concept of Sampling – Parameter and Statistics – Sampling distribution and Standard Error – Simple random sampling and stratified random sampling. Applications to Biological studies.

### Unit – 4

Tests of Significance with their important concepts. Tests for large samples - Test for mean, difference of means, proportion and equality of proportions. Small sample tests – Test for mean, difference of Means, paired samples, test for correlation and regression coefficients. Applications to Biometric experiments.

### Unit – 5

Chi square test for goodness of fit and independence of attributes. F-test – Analysis of variance, Assumptions, Applications, one way anova and two way anova classifications. Applications to Clinical experiments.

Note: The emphasis is only on the application of the methods. The derivations of the formulae are not necessary.

### Books for Study and References:

- 1) Gupta, S.P. (2011) Statistical Methods, Sultan Chand & Sons, Pvt. Ltd, New Delhi
- 2) Gupta, S.C and V.K. Kapoor, (2011) Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Pvt. Ltd, New Delhi
- 3) Darren George, Paul Mallery (2011) SPSS for Windows, 10th Edition, PEARSON

### Course Outcomes

At the end of the course, the student will be able to

- CO1: Understand the various diagrams and graphs for statistical data.  
CO2: Calculate the various statistical methods.  
CO3: Calculate the measures for bivariate data.  
CO4: Understand the use of tests of significance.  
CO5: Understand the use of chi square and anova tests.

**Value Added Course For Inter Disciplinary Students**  
**VAC - Statistical Methods For Data Analysis**

**Learning Objectives** : To enlight the students to acquire skills for adopting statistical tools and techniques of data analysis.

**Unit-1**

Tests of significance- population and sample; parameter and statistic standard error and sampling distribution of a statistic; Utility of Standard error; Steps involved in any test of significance; Basic concepts; Large sample tests- Tests for mean and difference of means; single proportion and equality of proportions; difference of standard deviations ; testing the correlation coefficient; equality of two correlation coefficients.

**Unit-2**

Exact tests- Test for mean; equality of means and for paired samples; observed partial and multiple correlation and regression coefficients; test for one population variance and test for equality of two population variances; test for observed sample correlation ratio.

**Unit-3**

Chi-square test for goodness of fit- contingency tables; test for independence of attributes; Yate's correction for contingency table; Bartlett's test for homogeneity of several population variances; test for homogeneity of several population proportions.

**Unit-4**

Multiple regressions- interpretation of  $R^2$ ; interpretation of partial regression coefficients; test for linearity of regression; test for intercept in a regression. Application of Multivariate tests- Test for population mean vector (for covariance matrix known and unknown). Test for equality of two population mean vectors when the covariance matrices are equal; (known and unknown) Mahalanobis  $D^2$  test.

**Unit-5**

Non parametric methods; Advantages and disadvantages over parametric methods. Sign test for medians, Median test for two populations, Wald-Wolfwitz run test, Kruskal-Wallis Rank sum Test (H-Test), Mann-Whitney- Wilcoxon rank sum test, U-test, Kolmogorov – Smirnov, Test for goodness of fit, Test for comparing two populations, Test for randomness, Friedman's test.

**Book for Study and Reference :-**

1. Ostle. B and Mensing R. W (1975), Statistics in Research, Third Edition, Oxford & IBH Publishes Co.,
2. Gupta S. C. and V. K. Kapoor (2007), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
3. Norma Gilbert (1981), Statistics, Saunders College publishing.
4. Rajagopalan V. (2006). Selected Statistical Tests, New Age International Publishers (P) Ltd., NewDelhi.
5. Croxton, E. F and Cowden, D. J (1985), Statistics Practical Business Statistics, Prentice – Hall Inc.
6. Catelcult. R (1982), Statistics in Research and Development, Chapman and Hall.
7. Medhi. J (1992), Statistical methods, Wiley Eastern Ltd.

**Course Outcomes**

At the end of the course, the student will be able to

- CO1: Understand the various concepts of statistical tests and to apply large sample tests.
- CO2: Apply the exact tests for research problems.
- CO3: Apply the various chi-square tests .
- CO4: Apply the multiple regression analysis and multivariate tests for real life problems.
- CO5: Apply the non-parametric tests for sample data.