

ANNAMALAI UNIVERSITY

ANNAMALAINAGAR



DEPARTMENT OF STATISTICS

M. Sc. STATISTICS (Integrated)
(FIVE YEAR ON-CAMPUS PROGRAMME)

HAND BOOK
REGULATIONS AND SYLLBI FROM 2014 -2015

DEPARTMENT OF STATISTICS

**M.Sc. STATISTICS
(Five Year Integrated Programme) (CBCS)**

Revised REGULATIONS AND SYLLABI FROM 2014-15

Revised REGULATIONS

Eligibility

Candidates for admission to the First year of the Five 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 under academic stream.(Any Group with Mathematics or Statistics as one of the subject)

Master Programme

A Master’s Programme consists of a set of Core courses and common course on languages, Computer, Civics, etc.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the respective faculties.

Common courses, suggested by the respective departments, may be distributed in the first four semesters.

A course is divided into five units to enable the students to achieve modular and progressive learning.

Semesters

An academic year is divided into two semesters, Odd semester and Even semester. The normal semester periods are:

Odd semester: July to November (90 working days)

Even semester: December to April (90 working days)

Credit

The term credit is used to describe the quantum of syllabus for various programmes in terms of hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.

The minimum credit requirement for a Five year Integrated Master’s Programme shall be 225.

The core courses shall carry 155 credits, Common courses shall carry 50 credits and the optional courses shall carry 20 credits.

Courses

A course carrying one credit for lectures, will have instruction of one period per week during the semester, if four hours of lecture is necessary in each week for that course then 4 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lecture tutorials/laboratory work and other form of learning in a 15 week schedule:

- i) One credit for each lecture period per week.
- ii) One credit for every three periods of laboratory or practical work per week.

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.

Duration

The duration for completion of a Five year Integrated Master's Programme in any subject is Ten semesters.

Structure and Programme

The Five year Integrated Master's Programme will consist of:

- i) Core courses and Common course which are compulsory for all students.
- ii) Optional courses which students can choose from amongst the courses offered by the other Departments of Science faculty as well as by the Departments of other faculties. (Arts, Education and Indian Language)

Attendance

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

Each student should earn 80% attendance in the courses of the particular semester failing which he or she will not be permitted to sit for the end-semester examination.

However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of a condonation fee and such exemptions should not under any circumstance be granted for attendance below 70%.

Examinations

Each candidate admitted to the course will be examined in each paper under Continuous Internal Assessment by the course teacher and by "End semester University Examination". The proportion of marks of Continuous Internal Assessment and the end semester University examinations shall be 25:75 for theory courses and 40:60 for practical courses and the proportion of marks of pre-presentation and report of Project/ Dissertation shall be 20:80.

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

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

Theory	Marks	Practical	Marks	Project / Dissertation	Marks
Test-I	10	Test-I	15	Viva-Voce	40
Test-II	10	Test-II	15	Project Record	60
Assignment/Seminar	5	Record	10		

Total	25	Total	40	Total	100
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There will be one End Semester Examination (75% marks) of 3 hours duration for each theory course. The pattern of question paper will be decided by the respective faculty.

Evaluation

The performance of a student in each course is valued in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The sum total performance in each semester will be rated by GPA while the continuous performance in Core, Allied and optional courses will be marked by (CGPA).

Marks and Grading

The 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 student has to secure 50% minimum in the End Semester Examination.

The student who has not secured minimum of 50% of marks (sessional plus end semester examination) in a paper shall be deemed to have failed in that paper.

A candidate who has secured a minimum of 50% marks in all the papers prescribed in the programme and earned 225 credits will be considered to have passed the integrated Master's Programme.

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 Point	Letter Grade	Class
90 +	10	S	Exemplary
85-89	9.0	D ⁺	Distinction
80-84	8.5	D	„
75-79	8.0	D ⁻	„
70-74	7.5	A ⁺	First Class
65-69	7.0	A	„
60-64	6.5	A ⁻	„
55-59	6.0	B	Second Class
50-54	5.5	C	„
49 or Less		F	Fail

Grade cards will be issued to the students, after the declaration of results. The grade card will contain the list of programmes registered during the semester, the grades scored and the Grade point Average for the semester.

GPA is the sum of the products of the number of credits of a programme with the grade point scored in that programme, taken over all the courses for the semester

divided by the sum of the number of credits for all courses taken in that semester SS CGPA is similarly calculated considering the core, allied and optional courses taken from I semester to X semester.

The results of the final semester will be withheld until the student obtains passing grade in all the programmes of all earlier semester.

The Candidates who are eligible to get the M.Sc degree in First class with distinction will be ranked on the basis of CGPA scored in Part-III Core, Allied and Optional Courses of Study from I Semester to X Semesters.

The Candidates Passing with First Class will be ranked next to those with distinction on the basis of CGPA scored in Part-III Core, Allied and Optional courses of study from I Semester to X Semesters.

Candidates who obtain FIRST CLASS with Distinction shall be deemed to have passed the examinations provided he/she passes all the papers prescribed for the programme at the First Appearance.

R13. TRANSITORY REGULATIONS

Wherever there had been change of syllabi, examinations based on the existing syllabi will be conducted for three times consecutively after implementation of the new syllabi in order to enable the students to clear the arrears. Beyond that the students will have to take up their examinations in equivalent programmes, as per the new syllabi, on the recommendations of the Head of the Department concerned.

The University shall have powers to revise or change or amend the regulations, the scheme of examinations, the programmes of study and the syllabi from time to time.

M.Sc. (STATISTICS)
FIVE-YEAR INTEGRATED (CBCS) COURSE
SEMESTER WISE SCHEME OF COURSES AND CREDITS

COURSE CODE	COURSE	L	T	P	C	SEMESTER CREDITS
I YEAR – SEMESTER - I						
ITAC 11	Part – I Tamil – Cheyyulum Urainadaiyum	3			3	18
IENC 12	Part – II English – Through Literature I : Prose	3			3	
ICEC 13	Civics, Environmental and Health Sciences	3			3	
ISTT 14	Descriptive Statistics	5			5	
ISTA 15	Ancillary Mathematics – I	4			4	
I YEAR – SEMESTER - II						
ITAC 21	Part – I Tamil – Payanpattu Tamilum Semmozhi Varalarum	3			3	18
IENC 22	Part – II English – Through Literature II : Poetry	3			3	
ICAC 23	Computer Applications – I	3			3	
ISTT 24	Real Analysis and Matrices	5			5	
ISTA 25	Ancillary Mathematics – II	4			4	
II YEAR – SEMESTER – III						
ITAC 31	Part – I Tamil – Urainadaiyum Nadahamum	3			3	26
IENC 32	Part – II English – Through Literature III : Drama	3			3	
ISTT 33	Basic Probability Theory	5			5	
ISTT 34	Programming in Fortran & Foxpro	5			5	
ISTP 35	Practical – I		2	4	6	
ISTA 36	Ancillary Demography – I	4			4	
II YEAR – SEMESTER – IV						
ITAC 41	Part – I Tamil – Tamil Elakkiya Varalaru	3			3	21
IENC 42	Part – II English – Through Literature IV : Short Story	3			3	
ISTT 43	Probability Distributions	5			5	
ISTP 44	Practical – II		2	4	6	
ISTA 45	Ancillary Demography – II	4			4	
III YEAR – SEMESTER – V						
ISTT 51	Sampling Techniques	5			5	26
ISTT 52	Statistical Methods For Data Analysis	5			5	
ISTT 53	Statistical Inference	5			5	
ISTT 54	Statistical Process Control	5			5	
ISTP 55	Practical – III		2	4	6	

COURSE CODE	COURSE	L	T	P	C	SEMESTER CREDITS
III YEAR – SEMESTER – VI						
ISTT 61	Experimental Designs	5			5	26
ISTT 62	Applied Statistics	5			5	
ISTT 63	Econometrics	5			5	
ISTT 64	Optimization Methods	5			5	
ISTP 65	Practical – IV		2	4	6	
IV YEAR – SEMESTER – VII						
ISTT 71	Real Analysis and Measure Theory	4	1		4	20
ISTT 72	Probability Theory	4	1		4	
ISTT 73	Sampling Theory	4	1		4	
ISTT 74	Programming with C++	4	1		4	
ISTP 75	Practical – V			4	4	
IV YEAR – SEMESTER - VIII						
ISTT 81	Distribution Theory	4	1		4	20
ISTT 82	Estimation Theory	4	1		4	
ISTT 83	Statistical Quality Control and Reliability	4	1		4	
ISTP 84	Practical – VI			4	4	
ISTO 85	Optional – I – Numerical Methods	4			4	
V YEAR – SEMESTER - IX						
ISTT 91	Testing of Statistical Hypotheses	4	1		4	24
ISTT 92	Multivariate Statistical Analysis	4	1		4	
ISTT 93	Operations Research	4	1		4	
ISTP 94	Practical - VII			4	4	
ISTO 95	Optional – II – Discrete Mathematics	4			4	
ENGO316	Soft Skills	4			4	
V YEAR – SEMESTER - X						
ISTT 101	Design and Analysis of Experiments	4	1		4	26
ISTT 102	Stochastic Processes	4	1		4	
ISTO 103	Optional – III – Applied Regression Analysis	4			4	
ISTO 104	Optional – IV – Oracle and Java Programming	4			4	
ISTP 105	Practical – VIII			4	4	
ISTD 01	Project/Dissertation		2	4	6	
Semester I to Semester VI Total Credits(UG Level)						135
Semester VII to Semester X Total Credits(PG Level)						90
Overall Credits						225

L – Lecture Hours T- Tutorial Hours P – Practical Hours C – Credits

OPTIONAL COURSE OFFERED TO OTHER DEPARTMENTS IN ODD AND EVEN SEMESTERS

SUBJECT CODE	SUBJECT TITLE	L	P	C	IA	EE	TOTAL MARKS
Optional – I ISTO 01	STATISTICAL METHODS	4	0	4	25	75	100

OPTIONAL COURSE OFFERED TO MATHEMATICS DEPARTMENT IN ODD AND EVEN SEMESTERS

SUBJECT CODE	SUBJECT TITLE	L	P	C	IA	EE	TOTAL MARKS
Optional – II ISTO 02	MATHEMATICAL STATISTICS	4	0	4	25	75	100

LIST OF INTERNAL OPTIONAL PAPERS

COURSE CODE	COURSE	COURSE CODE	COURSE
ISTO 103	Applied Regression Analysis	ISTO 108	Actuarial Statistics
ISTO 104	ORACLE and JAVA Programming	ISTO 109	Bayesian Inference
ISTO 105	Bio-Statistics	ISTO 110	Advanced Econometrics
ISTO 106	Advanced Stochastic Processes	ISTO 111	Time Series Analysis
ISTO 107	Statistical Decision Theory		

Note : 1. The paper Soft Skills is offered by Department of English.

- 2. The Optional I, II, III, IV is Chosen as either Internal Optional or offered by Other Departments.**
- 3. The Ancillary Mathematics –I and Ancillary Mathematics –II is offered by the Department of Mathematics.**
- 4. The Ancillary Demography –I and Ancillary Demography –II is offered by the Department of Population Studies.**
- 5. The Ancillary Statistics–I and Ancillary Statistics –II is offered to other Departments by the Department of Statistics (Syllabus is Provided).**

I YEAR - SEMESTER - I
ISTT 14 : DESCRIPTIVE STATISTICS

OBJECTIVE:-

- For learning the basic concepts which aims to resolve the real life problems.

UNIT-I

Introduction; Origin and Scope of Statistics; Definition of Statistics; Functions of Statistics; Applications of Statistics; Limitations of Statistics; Primary and Secondary Data; Methods of Collecting Primary Data; Drafting the questionnaire.

UNIT-II

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-III

Univariate measures - Measures of Central Tendency; Objectives 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-IV

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-V

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.

I YEAR - SEMESTER - II
ISTT 24 - REAL ANALYSIS AND MATRICES

OBJECTIVE:-

- To build the basis for promoting the aspects of Statistics.

UNIT-I

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-II

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-III

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

UNIT-IV

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-V

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.

II YEAR - SEMESTER - III
ISTT 33 : BASIC PROBABILITY THEORY

OBJECTIVE:-

- To study the basic concepts for promoting theoretical as well as applications of statistics.

UNIT-I

Probability: Definition; Mathematical Probability; Statistical probability; Axiomatic approach to probability; Some theorems on probability: Addition theorem of probability; Extension of Addition theorem of probability; Boole's inequality; Multiplication theorem on probability; Extension of Multiplication theorem on probability; Conditional

probability; Bayes theorem. Independence of events – Pair wise and mutual independence of events.

UNIT-II

Random Variable- Definition; Distribution function and its properties; Discrete random variable; Continuous random variable; properties; simple problems; Two dimensional random variable; joint and marginal distribution function; joint and marginal density function; Conditional distribution function and conditional probability density function; Transformation of random variables.

UNIT-III

Mathematical Expectation; Expected value of a Random variable; Expected value of a function of a Random variable; Properties of expectation; Properties of variance; Co-variance; Correlation; Variance of a linear combination of a random variable; Simple problems.

UNIT-IV

Moment Generating Function- Properties of moment generating function; Cumulents and their properties; uniqueness theorem on moment generating function; Characteristic function and its properties; Inversion theorem; Uniqueness theorem on characteristic function; Simple Problems.

UNIT-V

Chebyshev inequality- Weak law of large numbers; Bernoulli's law of large numbers; convergence in probability; Probability generating function; Probability generating function for independent variables; Simple problems.

Books for Study Reference:-

- 1) Gupta S.C and Kapoor V.K (2007): Fundamentals of Mathematical Statistics, Sultan chand & sons, New Delhi.
- 2) Hogg R.V Craig A.T (1978): Introduction to Mathematical Statistics, McGraw Hill Publishing Co.Inc, New York.
- 3) Hill Publishing Co.Inc, New York.
- 4) Mood A.M Graybill, F.A and Bose, D.C (1974) Introduction to the theory of Statistics, McGraw Hill Publishing Co.nc, New York.
- 5) K. SenthamaraiKannan and D. Venkatesan (2006). Introduction to Statistical Methods, Scitech Publishers, Chennai.
- 6) Bharat Jhunjhunwala (2008): Business Statistics, S. Chand & company Ltd. New Delhi.
- 7) Arora. P. N and Amit Arora and S. Arora (2008): Business Statistics, S. Chand & company Ltd. New Delhi.
- 8) A.M. Goon, Gupta and Das Gupta (1982) Vol.I: Fundamentals of Statistics.

ISTT 34 : PROGRAMMING IN FORTRAN AND FOXPRO

OBJECTIVE:-

- To get in depth knowledge in FORTRAN77 & FOXPRO and to write programs effectively for solving any statistical problems.

UNIT-I

FORTRAN 77 - character set; constants; variables; Type declaration; Different types of operators; Expressions-Arithmetic; Relational; Logical; Assignment statement; Input; Output statements ;STOP; END statements ;Format statement ; Subscripted variables.

UNIT-II

Control Statements- Logical IF Statement; Statement labels ; GOTO Statement; Nested Logical IF Statement ; Nested arithmetic IF Statement ; DO statement ;REPEAT; UNTIL structure.

UNIT- III

Arrays- Subscripted variable; expression; DIMENSION statement; do type notations for I/O statements; Programs for statistical measurements using one dimension & two dimensions; Statement function; function subprograms; subroutines; The common declarations; Array elements in common; File handling; Creating ; Searching and updating files.

UNIT-IV

DATABASE & FOXPRO - creating data files; making changes in the structure of a file; use of commands; BROWSE; LIST; DISPLAY; DELETE; PACK; Appending records; Sorting and indexing data files statistical function like SUM; AVG; STD; VAR; MIN; MAX; simple programs to produce statistical reports; Handling of multiple data files.

UNIT-V

EXCEL WORKSHEET – cell; rows & columns limitations; Data handling in Excel; Ready FoxPro file in Excel; simple calculation and graphs in Excel; Statistical functions like: AVG; MEAD MED; STD etc., Data Analysis Pack-Descriptive statistical analysis; correlation analysis; ANOVA-one way and two way tools.

Book for Study and Reference :-

- 1) C.Xavier(2007) Fortran 77 and Numerical Methods, New age International Publishers.
- 2) Ram Kumar: Programming with FORTRAN 77- TMH Publishing Co. Ltd, New Delhi.
- 3) Rajaram V: Computer Programming in FORTRAN 77.
- 4) Salaria R.S: Programming in Microsoft FORTRAN 77, BPB Publications, New Delhi.
- 5) Sarma, K.V.S. (2003). Statistics made simple Do it yourself on PC, Prentice Hall of India
- 6) Clifford E. Lunneborg (2000). Data analysis by resampling: Concepts and applications. Dusbury Thompson learning .Australia.
- 7) Everrit , B.S and Dunn, G(2001).Applied multivariate data analysis . Amol London.
- 8) Jeremy J.foster(2001).Data analysis using spss for windows. New edition. Versions 8_10.sage publications .London.
- 9) Michael S Louis-Beck (1995).Data analysis an introduction, series: quantities applications in the social sciences .Sage publications. London.

ISTP 35 : PRACTICAL - I (CALCULATOR BASED PRACTICAL)

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

II YEAR - SEMESTER - IV

ISTT 43 : PROBABILITY DISTRIBUTIONS

OBJECTIVE:-

- 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-I

Discrete uniform distribution; Bernoulli distribution; Binomial distribution; Moments; recurrence relation; Mean deviation about mean; Mode; Moment Generating Function; Additive property; Characteristic function Cumulants; Probability generating function; Poisson distribution; moment generating function; Mode; recurrence; relation; Characteristic function; Cumulants; Additive property; probability generating function of Poisson distribution; Negative Binomial distribution; Moment generating function; Cumulants; Probability generating function; Simple problems.

UNIT-II

Geometric distribution; Lack of memory property; Hyper- Geometric distribution; Multinomial distribution; Mean; Variance; Moments; Factorial Moments; Simple problems.

UNIT-III

Normal distribution; Properties of normal distribution; Median; Mode; Moment Generating Function; Cumulants and additive property of Normal distribution; Rectangular distribution; Moments; Moment generating function; Characteristic function; Mean deviation about mean of rectangular distribution; Simple problems.

UNIT-IV

Exponential distribution; Moment Generating Function; Important theorems; Exponential distribution; Gamma distribution; Moment Generating Function; Cumulants and Additive Properties; Beta distribution of first and second kind; Cauchy

distribution; Characteristic and Moment Generating Function of Cauchy distribution; Simple problems.

UNIT-V

Sampling distribution; Concept of Sampling distribution; SE; Distribution of Statistics defines on random sample from Normal; t; Chi-square and F and their Properties; Important theorems; Sampling distribution of mean; variance; Correlation and regression co-efficient for large samples (results only).

Book for Study and Reference :-

- 1) Gupta, S.C. and Kapoor, V.K (2007) of Fundamentals of Mathematical Statistics, Sultan chand & sons, New Delhi.
- 2) Goon, A.M. Gupta, M.K and Das Gupta. B (1977), An outline of statistical theory (Vol -I), 6th edition, World Press, Calcutta.
- 3) Hogg R.V and Craig A.T (1978): Introduction to Mathematical Statistics, McGraw Hill Publishing Co.Inc, New York.
- 4) 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
- 5) Johnson and Kotz (1982). Discrete and continuous probability distributions vol.1, vol.2 and vol.3, Wiley Eastern, New York.
- 6) Parimal Mukhopadhyay (1996). Mathematical Statistics, New Central Book Agency, Pvt. Ltd., Calcutta.

ISTP 44 : PRACTICAL – II (COMPUTER BASED PRACTICAL)

PRACTICAL SCHEDULE:-

PROGRAMS USING FORTON 77

- 1) Finding the mean and standard deviation for raw data.
- 2) Finding the mean and standard deviation for discrete case.
- 3) Finding the mean and standard deviation for continuous case.
- 4) Finding the median for raw data.
- 5) Finding the Skewness and kurtosis based on moments.
- 6) Finding the correlation – coefficient.
- 7) Finding the regression equations.
- 8) Testing for population mean.
- 9) Testing for difference of means.
- 10) Paired t- Test.
- 11) Testing the independence of attribute chi-square test.
- 12) F- test for equality of Variances.
- 13) Fitting of Binomial Distribution and goodness of Fit.
- 14) Fitting of Poisson Distribution and goodness of Fit.
- 15) Fitting of Normal Distribution and goodness of Fit.
- 16) Analysis of variance One-way Classification.
- 17) Addition and Subtraction of Matrices.
- 18) Multiplication of Matrices.

III YEAR - SEMESTER - V
ISTT 51 : SAMPLING TECHNIQUES

OBJECTIVE:-

- To learn the basic concepts and Applications of Sampling techniques for real life situations.

UNIT-I

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-II

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-III

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-IV

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

UNIT-V

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, 4th 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 3rd Edition.

ISTT 52 : STATISTICAL METHODS FOR DATA ANALYSIS

OBJECTIVE :-

- The main objective of this paper is to enable the students how to make use of statistical tools and techniques to be adopted for statistical data analysis and to apply these tools for real life problems using SPSS. This paper will be helpful for application point of view. Derivations and proofs are not stressed.

UNIT-I

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-II

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-III

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-IV

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-V

Applications and analysis using SPSS – Analysis of variance one way and two way classifications; Multiple regression analysis; Logistic regression analysis; Factor analysis; Cluster analysis; Discriminant function analysis.

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) V. Rajagopalan (2006). **Selected Statistical Tests, New Age International Publishers (P) Ltd., NewDelhi.**
- 5) Croxton, E. F and Cowden, D. J (1985), **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.**

ISTT 53 : STATISTICAL INFERENCE

OBJECTIVE:-

- **The objective is to diagnose statistical distributions of real life problems and thereby represent reasonable approximations of statistical patterns of recognition by inductive logic.**

UNIT-I

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

UNIT-II

Optimal Estimation - 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-III

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-IV

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; Probability of Type - I and Type - II errors related to Bernoulli; Binomial; Poisson and Normal.

UNIT-V

Neyman-Pearson fundamental lemma; Most powerful test and Best Critical Region (BCR); Deriving the BCR; Power of the tests based on random sample from exponential and Normal Populations; Likelihood Ratio (LR) test; Testing the mean of a normal population; Properties of LR tests (without proof).

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, 2nd 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.

ISTT 54 : STATISTICAL PROCESS CONTROL

OBJECTIVE:-

- 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-I

Quality improvement in modern business environment; Philosophy and basic concepts of quality improvement-Statistical methods for quality improvement; Total quality management (TQM).

UNIT-II

Modelling process quality- Describing variation; Histogram; Stem and leaf plot; Box-Plot; Frequency distribution; Quantile Plot (QQ-plot).

UNIT-III

Statistical Process Control (SPC)- Methods and philosophy of SPC-Control charts for attributes data; p-chart; np-chart; c and u charts; control charts for variables; \bar{X} and R charts & \bar{X} and S charts.

UNIT-IV

Basic concepts of CUSUM; Exponential Weighted Moving Average Control Charts and Sopping Control Charts-process capability analysis-applications.

UNIT-V

Quality system standards – ISO 9000; Elements of ISO – 9000; Benefits of ISO 9000; Elements of a quality system; Documentation of ISO 9000 accreditation; Introduction to Six-sigma.

Book 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 Statistics Richard D.Irwin Inc.USA.
- 4) Grant. E. L. and Leaven worth, R.S. (1964). Statistical Quality Control, McGraw Hill.
- 5) Mahajan, M (1998) : Statistical Quality Control, Dhanpat Rao & Co, New Delhi.

ISTP 55 : PRACTICAL – III (CALCULATER BASED PRACTICAL)

PRACTICAL SCHEDULE:-

TESTS OF SIGNIFICANCE

- 1) Testing the significance of population mean when σ is known.
- 2) Testing the significance of population mean when σ is unknown.
- 3) Testing the significance of population variance when μ is known.
- 4) Testing the significance of population variance when μ is unknown.
- 5) Testing the significance of equality of population means when σ_1 , σ_2 are known.
- 6) Testing the significance of equality of population means when σ_1 , σ_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.

III YEAR - SEMESTER - VI ISTT 61 : EXPERIMENTAL DESIGNS

OBJECTIVE:-

- The contents will provide an insight into the basic concepts of simple designs and applications.

UNIT-I

Linear models – Least square estimates of parameters and variance of estimates; One way and Two way classified data concepts and applications.

UNIT-II

Fundamentals of experimentation - plot and pen techniques; Determination of shape and size of plots; Uniformity trials; Principles of Experimental Designs; Replication, Randomization and Local control techniques.

UNIT-III

Analysis of Completely Randomized Design (CRD); Randomized Block Design (RBD) and Latin Square Design (LSD) and their efficiencies; missing plot techniques (One missing Observation in RBD, LSD).

UNIT-IV

Analysis of Factorial design- 2^2 ; 2^3 factorial designs; Concepts of Confounding; total and partial confounding in 2^3 experiment; Analysis of covariance (ANACOVA) with one concomitant variable to CRD and RBD.

UNIT-V

Analysis of Split plot design; Strip plot design and Balanced Incomplete Block Design (BIBD).

Book for Study and Reference :-

- 1) Das M.N and Giri N.C. (2007), Design and analysis of experiments, New Age International publication, 3rd Edition.
- 2) Gupta S.C and Kapoor V.K(2009) Fundamentals of Applied Statistics, Sultan Chand and Company 4th, Edition.

- 3) Doughlas .C. Montgomery(2007) Designs and analysis of Experiments, John wiley & Sons.
- 4) O.Kempthorne (1957), Design and Analysis of experiments, John wiley & Sons, New York.

ISTT 62 : APPLIED STATISTICS

OBJECTIVE:-

- To apply statistics in multi disciplinary sciences for making decisions.

UNIT-I

Introduction - Components of Time Series; Trend; Periodic Changes; Irregular components; Analysis of Time Series; Uses of Time Series; Measurement of Trend; Graphic method; Method of Semi Averages; Method of Curve; Method of Moving Average; Method of Least square.

UNIT-II

Measurement of Seasonal fluctuations; Method of Simple Averages; Ratio to Trend method; Ratio to Moving Average method.

UNIT-III

Index numbers- Basic Index numbers and their definition; Construction and uses; fixed and Chain base index numbers; optimum tests for index numbers; Laspeyre; Paasche; Fisher and Marshall – Edgeworth index numbers; Cost of living index numbers; Construction and uses.

UNIT-IV

Scaling Techniques- Scaling individual Test; Scaling of scores on a Test; Z – score and Z – scaling; Standard scores; Normalized scores; T – scores; Percentile scores; scaling of Rankings; scaling of Ratings.

UNIT-V

Introduction - Uses of Vital Statistics; Method of obtaining Vital statistics; Measurement of population; measurement of mortality; Crude Death Rate; Standardised death rate; Mortality table; Abridged Life table; Fertility; measurement of population growth.

Book for Study and Reference :-

- 1) Fundamentals of Applied Statistics by S. C. GUPTA and V. K. KAPOOR, (2009). Sultan Chand & Sons, New Delhi.
- 2) Statistical methods by S. P. GUPTA, (2009). Sultan Chand & Sons, New Delhi.
- 3) Applied Statistics by Lotharachs, (1984). 2nd Edition, Springer – Verlag, New York.
- 4) A. M. Goon Gupta and Das Gupta (1994). Fundamental of Statistics, Vol. 2.
- 5) Warner (2007). Applied Statistics, Sage Publication, NewYork.

ISTT 63 : ECONOMETRICS

OBJECTIVE:-

- **To enrich the skills of students to understand the nature and functioning of economic systems.**

UNIT-I

Econometrics – Introduction; Methodology of econometrics; Interpretation on regression; statistical versus deterministic; nature and sources of data; Accuracy of data; Measurement of Scales of variables; The role of computers.

UNIT-II

Two variable regressions model- Concept of population regression function (PRF); the meaning of the term linear; stochastic specification of PRF; significance of the stochastic disturbance term; sample regression function. The Method of Least Squares; classical linear regression model; properties of LS estimates; Gauss – Markov theorem (without proof); Coefficient of determination.

UNIT-III

Normal Linear Regression Model- probability distribution of disturbance term; Normality assumption; Properties of Ordinary Least Square estimators under the normality assumption; Method of Maximum likelihood; MLE of two-variable regression model; Interval estimation; Confidence Intervals for regression coefficients; Hypothesis testing; Confidence Intervals for future observation.

UNIT-IV

Regression analysis and analysis of variance; using application of regression analysis; prediction; reporting the results of regression analysis; evaluating the results of regression analysis.

UNIT-V

Regression through origin; Regression on Standard variables; functional forms; log-linear model; semi - log models; reciprocal models; choice of functional form.

Book for Study and Reference :-

- 1) Gujarati, D.N and Sangeetha (2008), Basic Econometrics, the McGraw Hill Co, New York.
- 2) J. Johnston (1984), Econometric methods, McGraw Hill Pvt. Ltd., New Delhi.
- 3) G.M.K. Madhani(2009) – Introduction to Econometrics, Principles and applications, Oxford & IBH Publication company Pvt. Ltd, New Delhi.
- 4) James H. Stock and Mark W. Watson (2010) Introduction to Econometrics (3rd Edition) (Addison-Wesley Series in Economics)
- 5) James H. Stock and Mark W. Watson (2006) Introduction to Econometrics, 2nd Edition (Addison-Wesley Series in Economics).
- 6) Ronald J. Wonnacott and Thomas H. Wonnacott (1979) Econometrics (Wiley Series in Probability and Statistics - Applied Probability and Statistics Section).
- 7) Simon P. Washington, Matthew G. Karlaftis and Fred L. Mannering (2010) Statistical and Econometric Methods for Transportation Data Analysis, Second Edition.

ISTT 64 : OPTIMIZATION METHODS

OBJECTIVE:-

- **To impart basic knowledge of various optimization techniques. To find the optimal solution for real life situation with help of Operations Research Techniques.**

UNIT-I

Introduction; Definition; Salient features of OR; Types of OR; Models in OR; Slack and Surplus variables – objective functions; Tools of OR; Limitations of OR; Some applications of OR; Linear Programming-Requirement for a LPP; Formulation of LPP-Optimization - Graphical method of solving of LPP.

UNIT-II

Simplex method – Development of simplex method; Examples on the applications of simplex technique; Solution of problem by Simplex method; Artificial variable technique for finding the basic feasible solution; Big-M method; Concept of Primal and Dual.

UNIT-III

Transportation problem - Finding an Initial basic feasible solution by Northwest corner rule; Least cost method and Vogel's Approximation Method – Optimality (MODI Method); Assignment problem-solving an assignment problem by Hungarian method - Traveling Salesman problem.

UNIT-IV

Sequencing problem-processing n jobs through two machines; Processing n jobs through three machines; Processing n jobs through m-Machines; Processing two jobs through m-Machines; GANT – Chart; Method of finding Idle time.

UNIT-V

Game Theory – Decision making in competitions; two-person zero-sum games; pure and mixed strategies; existence of solution and uniqueness value in zero-sum games; finding solutions in 2×2 ; $2 \times m$ and $m \times n$ games.

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, 8th edition 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, 4th edition McGraw Hill, New Delhi.**

ISTP 65 : PRACTICAL – IV
(COMPUTER BASED PRACTICAL)

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.

DBMS

1. Creation of data file for Practical of student.
2. Creation of data file for employees in campus
3. Creation of data file for marks of SSLC and +2 students.
4. Creation of data file stock commodity of a department stage.
5. Retrieving data from the above file by using simple command of foxpro.

POWER POINT

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

MATLAB

1. Arithmetic operations on matrix.
2. Finding of Determinant and Rank of a Matrix.
3. Solution of Simultaneous equations
4. Finding of Mean vector, Variance – Covariance and Correlation matrix.

SX and SPSS

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.

IV YEAR – SEMESTER – VII
ISTT 71 : REAL ANALYSIS AND MEASURE THEORY

OBJECTIVE:-

- To enrich the skills of students for learning the concepts and methods of matrices,
Real analysis and Measure theory.

UNIT I:

Matrix - Rank of a matrix; Elementary transformation of a matrix; Invariance of rank through elementary transformation Theorem; Elementary transformation of a matrix do not alter its rank; Multiplication of the elements of a row by a non-zero number does not alter rank; Reduction to normal form; Elementary matrices; Elementary transformation and elementary matrices; Theorem; Employment of only row (column) transformations; The rank of a product; A convenient method for computing the inverse of a non-singular matrix; Equivalence of matrices.

Characteristic root and Characteristic vectors of a square matrix; Nature of the characteristic roots; special types of matrices; Mutual relations between characteristic

vectors corresponding to different characteristic roots; The construction of orthogonal matrices and Construction of unitary matrices.

UNIT II:

Sequences and series of functions -Point wise convergence of sequences of functions; Uniform convergence of sequences of functions; Consequences of uniform convergence; Convergence and uniform convergence of series of functions; Integration and differentiation of series of functions; Abel summability; Three famous theorems; The metric space $C[a, b]$; The Weierstrass approximation theorem; Picard existence theorem for differential equations; The Arzela theorem on equicontinuous families.

UNIT III:

The Lebesgue integral - Length of open sets and closed sets; Inner and outer measure; Measurable sets; Properties of measurable sets; Measurable functions; Definition and existence of the Lebesgue integral for bounded functions; Properties of the Lebesgue integral for bounded measurable functions; The Lebesgue integral for unbounded functions; Some fundamental theorems; The metric space $\mathcal{L}^2[a, b]$; The integral on $(-\infty, \infty)$ and in the plane.

UNIT IV:

Measure-Lebesgue outer measure; Integration of Functions of a real Variable; Integration of Non-negative Functions; The general integral; integration of series; Riemann and Lebesgue integrals. Differentiation; The four derivatives; Continuous Non-differentiable functions; Functions of Bounded variation; Differentiation and Integration; The Lebesgue set.

UNIT V:

Signed Measure and their Derivatives - Signed measure and the Hahn Decomposition; The Jordan Decomposition theorem; The Radon - Nikodym theorem and its applications. Lebesgue- Stieltjes measure; absolutely continuous functions; Integration by parts; Measure and Integration in a product space; Measurability in a Product space; The product measure and Fubini's Theorem.

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(1991)"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 (4th Edition).
- 6) Walter Rudin(1986) Real and Complex Analysis (International series in Pure and Applied Mathematics).

ISTT 72 : PROBABILITY THEORY

OBJECTIVE:-

- To build a foundation for the applications of Probability Concepts.

UNIT-I

General probability space; sigma algebra of events; Axiomatic Definition of probability; Random variable; Limit of a sequence of random variables; induced probability space; Distribution function of a random variable; Decomposition of distribution function; Distribution functions of vector of random variables; Correspondence theorem.

UNIT-II

Expectation of a random variable; Properties of Expectation; Moment; Inequalities involving moments; Convergence in probability; Convergence almost surely; Convergence in distribution; Convergence in r^{th} Mean; Convergence theorems for expectation.

UNIT-III

Characteristic function and its properties; Inversion theorem; Characteristic function and moments; Khintchine - Bochner's theorem; Weak and complete convergence sequence of distribution functions; Convergence of a sequence of characteristic functions.

UNIT-IV

Independence of events; rule and properties; Zero - one laws; Convergence of a series of independent random variables; Kolmogorov inequalities; Stability of Series of RV's.

UNIT-V

Central limit theorem; Bernoulli Case; Linderberg-Levy form; Liapounov's form; Linderberg-Feller form; p-variate central limit theorem (Statement only); Conditional probability; Conditional expectation and its properties.

Book for Study and Reference:-

- 1) Bhat, B.R (2007). Modern Probability Theory, New Age Int. Pvt. Ltd., New Delhi.
- 2) Kishore K.Das and Dibyojyoti Bhattacharjee (2010), An Introduction to Probability Theory, Asian Books Private Ltd., New Delhi.
- 3) Burill, C.W (1972) Measure, Integration and Probability, McGraw Hill, New York.
- 4) Chow and Tiecher (1994). Probability theory, Narosa Publications, New Delhi.
- 5) Olav Kallenberg (2002), Foundations of Modern Probability (Probability and Its Applications).
- 6) Alfred Renyi (2007), Probability Theory, Dover Books on Mathematics.
- 7) William Feller(1968)An Introduction to Probability Theory and Its Applications, Vol. 1, 3rd Edition, Wiley Eastern.
- 8) William Feller(1971) An Introduction to Probability Theory and Its Applications, Vol.2. Wiley Eastern.
- 9) Sheldon M. Ross (2009) Introduction to Probability Models, 10th Edition.
- 10) Dimitri P. Bertsekas and John N. Tsitsiklis (2002) Introduction to Probability.
- 11) Charles M.Grinstead and J.Laurie Snell(2012) Introduction to Probability: 2nd Edition.
- 12) Charles M. Grinstead and J. Laurie Snell (1997) Introduction to Probability.
- 13) Parimal Mukhopadhyay(2011)An Introduction to the Theory of Probability, New Central Book Agency, Calcutta.

ISTT 73 : SAMPLING THEORY

OBJECTIVE:-

- 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-I

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-II

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-III

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; 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-IV

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.

UNIT-V

Planning and organization of sample surveys; Preparation of schedules; Analysis and Preparation of report; The nature and scope of samples surveys conducted in India by the National Sample Survey Organization (NSS).

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. Wily Eastern.3rd Edition, New York.
- 3) Parimal Mukhopadhyay(1998)Theory and methods of survey sampling.Prentice Hall of India Pvt. Ltd.
- 4) Murthy,M.N.,(1977),Sampling Theory and Methods, Statistical Publishing Society, Kolkatta.
- 5) Sampath, S. (2005), Sampling theory and methods, Narosa Publishing house.
- 6) Agarwal Np,Sonia Agarwal(2006),Sampling methods and Hypothesis testing. Rbsa Publishers.
- 7) Desraj, Promod Chandhok (1998), Sample survey theory, Narosa Publishing house.
- 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.

ISTT 74 : PROGRAMMING WITH C++

OBJECTIVE:-

- 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-I

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

UNIT-II

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 specifiers; Recursive function; Pre-processors; Header files and standard function.

UNIT-III

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-IV

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

UNIT-V

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.

ISTP 75 – PRACTICAL – V (COMPUTER BASED PRACTICAL)

PRACTICAL SCHEDULE:-

SPSS

- 1) Descriptive Statistics.
- 2) Test for Single mean.
- 3) Test for difference of mean.
- 4) Paired t- Test.
- 5) ANOVA One-way Classification.
- 6) Two way ANOVA.

- 7) Chi-Square Test.
- 8) Principal Component analysis.
- 9) Correlation and Regression(Simple and Multiple).
- 10) Factor Analysis.
- 11) Discriminant Function.
- 12) Cluster Analysis.

MATLAB

- 1) Arithmetic operations on matrices (Addition, Subtraction, Multiplication).
- 2) Inverse of a Matrix.
- 3) Solving of simultaneous equations.

SYSTAT

- 1) Descriptive Statistics.
- 2) Correlation and Regression.
- 3) Chi-Square test.
- 4) ANOVA One- Way Classification.
- 5) ANOVA Two- Way Classification.

SIGMAPLOT

- 1) Descriptive Statistics.
- 2) Correlation and Regression.

STAT GRAPH

- 1) Digrams and Graphs related to Statistical Data.
- 2) Statistical Applications.

IV YEAR – SEMESTER –VIII ISTT 81 : DISTRIBUTION THEORY

OBJECTIVE:-

- To know the basic ideas of continuous and truncated distributions and to study the concepts of Bivariate distribution, Non-central t, F and χ^2 and Beta distributions, Order statistics and quadratic forms.

UNIT-I

Detailed Study of Binomial; Poisson; Normal; exponential; Gamma; Beta; Weibull; Logistic; Cauchy distributions (derivations; properties; Moments; C.F and Applications); Concept of truncated distributions and Compound distributions.

UNIT-II

Bivariate distribution; Concept of joint; Marginal and conditional distribution; Functions of random variables and their distributions; Maximum and minimum; sum; difference; product and quotient of random variables; Various techniques of finding distributions of functions of random variables; Distribution of functions involving several random variables.

UNIT-III

Non-Central t; F and Chi-square distribution - Properties and derivations of these distributions; Sampling distributions of mean; correlation and regression coefficients for normal samples (null case).

UNIT-IV

Order statistics- cumulative distribution function of a single order statistic; p.d.f of a single order statistic; Joint p.d.f of k^{th} order and n^{th} order statistics; Distribution of range; mid range and Quantiles.

UNIT-V

Quadratic forms for normal variables; Distribution of Quadratic forms; Conditions for independence of quadratic forms and linear forms; Cochran's theorem (Without proof) and its application.

Books for Study and Reference:-

- 1) Vijay K. Rohatgi and A. K. Md. Ehsanes Saleh,(2000), An Introduction to Probability and Statistics, Wiley Eastern.
- 2) Johnson , N.L., Kotz, S. & Kemp, A.W. (1993)*Univariate Discrete Distributions, Vol 1*. New York:John Wiley & Sons 1st. Edition.
- 3) Johnson , N.L., Kotz, S. & Balakrishnan, N.(1997) *Discrete Multivariate Distributions* New York: John Wiley & Sons 1st. Edition.
- 4) Johnson , N.L., Kotz, S. & Balakrishnan, N. (1994)*Continuous Univariate Distributions, Vol 1*, New York: John Wiley & Sons 2nd edition.
- 5) Johnson , N.L., Kotz, S. & Balakrishnan, N. (1995)*Continuous Univariate Distributions, Vol 2*, New York: John Wiley & Sons 2nd edition.
- 6) 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.
- 7) Stuart. A and M.G. Kendall (1969) The Advanced Theory of Statistics Volume II (Griffin) 3rd edition.
- 8) Jean Dickinson Gibbons and Subhabrata Chakraborti (2010)Nonparametric Statistical Inference, Fifth Edition (Statistics: Textbooks & Monographs).
- 9) Parimal Mukhopadhyay (1996), Mathematical Statistics, New Central Book Agency, Pvt. Ltd., Calcutta.
- 10) Samuel Kotz, N. Balakrishnan and Normal L. Johnson *Continuous Univariate Distributions, Volume 1, 2nd Edition*.
- 11) William Mendenhall, Robert J. Beaver and Barbara M. Beaver (2012) Introduction to Probability and Statistics.

ISTT 82: ESTIMATION THEORY

OBJECTIVE:-

- To enhance the methods of diagnosis of statistical estimation of parameters.

UNIT-I

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-II

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-III

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-IV

Method of Estimation - Method of moments; method of maximum likelihood; Fisher's Iteration Technique of MLE; Properties of MLE; Method of Minimum Chi-square and Its Modification; Method of Least Squares; Problems and Exercises.
(Contents as in Chapter -5 of Book-1)

UNIT-V

Internal Estimation - A general Method of Constructing Confidence Intervals (CIs); Construction of Shortest Average Width CIs; Construction of CIs in Large Samples; Construction of Most Accurate CIs; Construction of Bayesian CIs; Problems and Exercises.
(Contents as in Chapter -6 of Book-1)

Books for Study and Reference:-

- 1) Rajagopalan, M and P. Dhanavathan., (2012). Statistical inference, PHI Learning Private Limited, New Delhi.
- 2) Jean Dickinson Gibbons and Subhabrata Chakraborti (2010). Nonparametric Statistical Inference, Fifth Edition (Statistics: Textbooks & Monographs).
- 3) Jean Dickinson Gibbons and Subhabrata Chakraborti and Gibbons Dickinson Gibbons (2003) Nonparametric Statistical Inference, Fourth Edition: Revised and Expanded (Statistics: A Series of Textbooks...).
- 4) Lehman, E.L. and G. Casella, (1998) Theory of Point Estimation, 2nd ed., Springer - Verlag.
- 5) Rao, C.R., (1973) Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York.
- 6) George Casella and Roger L. Berger (2001) Statistical Inference.
- 7) E.L. Lehmann and George Casella (2014) Theory of Point Estimation, Springer Texts.
- 8) J.K Lindsey (1996) Parametric Statistical Inference (Oxford Science publication).
- 9) Igor Vajda (1989) Theory of statistical Inference and information (theory and Decision Library B).
- 10) Santhakumaran, A (2004), Probability Models and Their Parametric Estimation, K.P. Jam Publication, Chennai.

ISTT 83 : STATISTICAL QUALITY CONTROL AND RELIABILITY

OBJECTIVE:-

- This paper gives an exposure to various concepts in statistical quality control and the notions of reliability theory are the components to be dealt with in this paper.

UNIT-I

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 σ charts; np; p; c and u charts; Operating Characteristic curves for control charts.

UNIT-II

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-III

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-IV

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-V

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

ISTP 84 : PRACTICAL - VI (CALCULATOR BASED PRACTICAL)

PRACTICAL SCHEDULE:-

SAMPLING

- 1) Estimation of sample mean and sample variance under simple random sampling without replacement.
- 2) Estimation of sample mean and sample variance under SRSWR.
- 3) Estimation of Proportion under SRS WOR .
- 4) Estimation of Population total, mean and variances under systematic sampling.
- 5) Estimation of mean, variances under stratified random sampling

STATISTICAL QUALITY CONTROL

- 1) Control Chart for \bar{X} and R
- 2) Control Chart for \bar{X} and σ
- 3) np - Control Chart
- 4) P - Chart
- 5) C- Chart
- 6) U-Chart
- 7) Single sampling plan - OC, ASN, ATI and AOQ

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.

OPTIONAL – I – ISTO 85 : NUMERICAL METHODS

Objectives: The roll of numerical analysis is to develop and analyze the numerical techniques. In this paper, different methods for finding the roots of algebraic and transcendental equations, solutions of simultaneous equations, solutions of differential equations are concentrated. Numerical differentiation and integration are also evaluated.

UNIT - I: 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 - II: 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 - III: 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 - IV: 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, Practical applications of Simpson's rule, Trapezoidal rules.

UNIT - V: 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. Chapters - III, IV, VI, IX, XI.

REFERENCE BOOKS

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.**

V YEAR – SEMESTER – IX
ISTT 91 : TESTING OF STATISTICAL HYPOTHESES

OBJECTIVE:-

- The object is to acquire knowledge on advancements for making decisions based on statistical hypotheses.

UNIT-I

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-II

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-III

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-IV

Non-Parametric Methods –Nonparametric Estimation; Empirical Distribution Function; U-statistics; Nonparametric Tests -Single sample Problems; Kolmogorov – Smirnov Test; Sign test; Wilcoxon on 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-V

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,(2005)Testing Statistical Hypotheses, 3rd ed., Springer
- 4) Rao, C.R.,(1973) Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York.
- 5) E.L.Lehmann and George Casella(2014)Theory of Point Estimation (Springer Texts in Statistics).
- 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) David Olive (2014) Statistical Theory and Inference.
- 9) George Casella and Roger L. Berger (2001) Statistical Inference.
- 10) E.L. Lehmann and George Casella (2014) Theory of Point Estimation (Springer Texts in Statistics).
- 11) Paul Garthwaite, Ian Jolliffe and Byron Jones (2002). Statistical Inference (Oxford Science Publications).

ISTT 92 : MULTIVARIATE STATISTICAL ANALYSIS

OBJECTIVE:-

- To understand the basic concepts of Multivariate analysis for applying more than two dimension situation.

UNIT-I

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; tests and confidence regions for mean vectors and variance –covariance matrix are known; sufficient statistics for mean vectors and variance –covariance matrix.

UNIT-II

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-III

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-IV

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-V

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 (2003) An Introduction to Multivariate Statistical Analysis.
- 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) Johnson. R. A and D. W. Wichern, (1996). Applied Multivariate Statistical Analysis, Wiley, New York.
- 5) Sam Kash Kachigan(1991)Multivariate Statistical Analysis: A Conceptual Introduction, 2nd Edition.
- 6) Alvin C. Rencher (1997)Multivariate Statistical Inference and Applications.
- 7) Wolfgang Karl Härdle and Léopold 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.

ISTT 93 : OPERATIONS RESEARCH

OBJECTIVE:-

- To impart knowledge of various optimization techniques that makes use of statistical concepts abundantly. The Optimization techniques which do not involve Statistical concepts are included in OR-I. On the other hand, in this paper those optimization techniques involving the Statistical concepts, especially the probability principles are taught.

UNIT-I

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-II

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-III

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-IV

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-V

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, 8th 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, 4th 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.

ISTP 94 – PRACTICAL - VII

(COMPUTER BASED PRACTICAL)

PRACTICAL SCHEDULE:-

PROGRAMS USING C++

- 1) Finding the mean and standard deviation for raw data.
- 2) Finding the mean and standard deviation for discrete type frequency distribution.
- 3) Finding the mean and standard deviation for continuous type frequency distribution.
- 4) Finding the median for raw data.
- 5) Finding the Skewness and kurtosis based on moments.
- 6) Finding the correlation – coefficient.
- 7) Finding the regression equations.
- 8) Testing for population mean.
- 9) Testing for difference of means.
- 10) Paired t- Test.
- 11) Chi-square test for testing the independence of attributes.
- 12) F- Test for equality of Variances.
- 13) Fitting of Binomial Distribution and goodness of Fit.
- 14) Fitting of Poisson Distribution and goodness of Fit.
- 15) Fitting of Normal Distribution and goodness of Fit.
- 16) Analysis of variance One-way Classification.
- 17) Addition and Subtraction of Matrices.

Optional – II – ISTO 95 : DISCRETE MATHEMATICS

Objectives: Students must understand mathematical reasoning in order to read, comprehend and construct mathematical arguments. Mathematical logic, which serves as foundation for subsequent discussion is discussed. Discrete structures such as sets and permutations are studied. Discrete probability, recurrence relations, conquer relations and principles of inclusion and exclusion are studied.

UNIT I: Logic and Counting:

Propositions and logical operations, Conditional statements, Methods of Proof, Mathematical Induction. Permutations, Combinations, Pigeonhole Principle, Elements of Probability, Recurrence Relations.

UNIT II: Relations and Digraphs:

Product sets and partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of relations, Equivalence Relations, Computer Representation of

Relations and Digraphs, Operations on Relations, Transitive Closure and Warshall's Algorithm.

UNIT III: Functions:

Functions, Functions for Computer Science, Growth of Functions, Permutation Functions.

UNIT IV: Order Relations and Structures:

Partially Ordered Sets, Extremal Elements of Partially Ordered Sets, Lattice, Finite Boolean Algebras, Functions on Boolean Algebra, Circuit Designs.

UNIT V: Semigroups and Groups:

Semigroups, Product and Quotient of Semigroups, Groups, Product and Quotient of Groups.

TEXT BOOK

Content and treatment as in the book “Discrete Mathematical Structures” by Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, Prentice - Hall of India, Private Limited, New Delhi, 2002.

Unit I	Chapter 2 Sections 1 to 4, Chapter 3 Sections 1 to 5.
Unit II	Chapter 4 Sections 1 to 8.
Unit III	Chapter 5 Sections 1 to 4.
Unit IV	Chapter 6 Sections 1 to 6.
Unit V	Chapter 9 Sections 1 to 4.

REFERENCE BOOKS

- 1. Discrete Mathematics with Graph Theory by E.G. Goodaire and M.M. Paramenter, Prentice Hall International Editions, New Jersey (1998).**
- 2. Invitation to Discrete Mathematics by J. Matonsek and J. Nesetril, Clarendon Press, Oxford (1998).**
- 3. Discrete Mathematical Structures with Applications to Computer Science by J.P. Tremblay and R. Manohar, Tata McGraw Hill Publication Company, 1997.**

V YEAR – SEMESTER-X

ISTT 101 : DESIGN AND ANALYSIS OF EXPERIMENTS

OBJECTIVE:-

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

UNIT-I

Principles of Scientific experimentation; pen and plot techniques; Replication; Randomization and Local control; Notion of a design matrix; Inter and intra block analysis for general designs models; C matrix and its properties; Two way elimination of heterogeneity; Orthogonality; connectedness and resolvability.

UNIT-II

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 - one and more observations per cell for RBD; Analysis of Higher order orthogonal LSD; Analysis of covariance (one concomitant variable) in CRD; RBD and LSD.

UNIT-III

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; Analysis of incomplete LSD.

UNIT-IV

Factorial Experiments; their needs and advantages; definition of symmetric factorials; meaning of main effects and interactions in 2ⁿ and 3ⁿ experiments; method of splitting factorial effects into orthogonal components; Complete analysis of such Experiments laid out in CRD; RBD and LSD; Need and meaning of confounding; total; partial and mixed confounding; Construction and analysis of such designs; Split plot and strip plot designs (in RBD & LSD only).

UNIT-V

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. 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.

ISTT 102 : STOCHASTIC PROCESSES

OBJECTIVE:-

- To acquire the standard concepts and methods of Stochastic Modelling, Analysis the variability that are inherent in Natural, Engineering and Medical Sciences and to provide new perspective, models and intuition and aid in other mathematical and statistical studies.

UNIT-I

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-II

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-III

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-IV

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-V

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 and G/M/1 as particular cases; Erlangian Queues.

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 Verlages, New York, 2nd edition.
- 6) Srinivasan, S.K, Introduction to Stochastic processes and their applications.
- 7) Medhi. J (1991), Stochastic processes, New Age International Pvt. Ltd., New Delhi.

OPTIONAL – III – ISTO 103 : APPLIED REGRESSION ANALYSIS

OBJECTIVE:-

- To study the various regression models and their applications.

UNIT-I

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-II

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-III

Multiple regression analysis: Estimation of parameters, Three variable model, partial regression Coefficient, OLS and ML estimation, Coefficient of multiple R² and adjusted R². Cobb-Douglas production function, polynomial regression models, partial correlation coefficients.

UNIT-IV

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-V

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, (4th 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 Clavendon 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 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).

OPTIONAL – IV – ISTO 104 : ORACLE AND JAVA PROGRAMMING

OBJECTIVES:-

- This paper aims at introducing the language Oracle and Java in a systematic manner to make the students to have knowledge in program writing and developing the software. .

UNIT-I

Introduction to Database Management System – Purpose of database system – 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 database design: Pitfalls in relational database design – Normalization.

UNIT-II

PL/SQL: Variables – Variables in PL/SQL – Dynamic data types – Strings – Statements – Control Statements – Loops and Labels – Simple Statistics Programs- Oracle Forms:- SQL Forms –Generating a forms – Parent child coordination – Retrieving multiple data – Automatic generation of a types – Enforce keys – Triggers – procedures.

UNIT-III

Introduction to Java: Overviews of Java – Data types – Variables and arrays – operators – Control Statements – looping statements.

UNIT-IV

Classes – Methods – Data Structures – Inheritance –Package and Interfaces – Exception Handling – String Handling.

UNIT-V

Applet Classes – Abstract Windows Toolkit - Working with windows – Graphics and Text – AWT Controls – Layout Managers – Images – Animations – Swing Classes.

Books for Study and Reference:-

- 1) **C.J. Date, An Introduction to Database Systems - Volume 1, 6th edition, Addison-Wesley, 1995.**
- 2) **Patrick Naughton and Herbert Schildf: The Complete Reference Java 2.0, TMH Publishing Company Limited, New Delhi, 1999.**
- 3) **C.Xavier, Projects on Java, Scitech Publications(India) Pvt.Ltd., Chennai.**
- 4) **S.S.Khandara, Programming in Java, S.Chand & Company Limited.**

ISTP 105 : PRACTICAL – VIII (CALCULATOR BASED PRACTICAL)

PRACTICAL SCHEDULE:-

TESTING OF HYPOTHESES

- 1) **Most powerful test Estimation of power and size.**
- 2) **Uniformly MP test – Estimation of power and size.**
- 3) **One sample Kolmogorov – Smirnov test.**
- 4) **Sign test**
- 5) **Wilcoxon signed rank test.**
- 6) **Mann – Whitney U – test**
- 7) **Kolmogorov – Smirnov two sample test.**
- 8) **Median test**
- 9) **Kruskal – Wallis test.**
- 10) **SPRT – OC and ASN curve for Binomial Distribution.**

DESIGN OF EXPERIMENTS

- 1) Completely Randomized Design.
- 2) Randomized Block Design.
- 3) RBD with more than one observation per cell.
- 4) Latin Square Design.
- 5) Graceco – Latin Square Design.
- 6) Missing Plot Analysis in CRD, RBD and LSD.
- 7) Multiple Comparison Test – DMRT, LSD and CD.
- 8) Efficiency of RBD over CRD.
- 9) Efficiency of LSD over RBD and CRD.
- 10) 2^2 - Factorial Experiment .
- 11) 2^3 - Factorial experiment with complete confounding.
- 12) 2^3 - Factorial experiment with partial confounding.
- 13) 3^2 - Factorial Experiment.
- 14) Split – Plot Design.

OPERATION RESEARCH

- 1) **Linear Programming Problem – Simplex Method.**
- 2) **Two Person Zero Sum Games.**
- 3) **Network – CPM.**
- 4) **Network – PERT.**

**ISTO 01 – STATISTICAL METHODS
(EXTERNAL OPTIONAL)**

**(OPTIONAL PAPER OFFERED TO OTHER DEPARTMENTS FROM DEPARTMENT OF
STATISTICS)**

(This is a Common optional paper offered to all other Branches of Faculty of Arts, Faculty of Science and Faculty of Marine Sciences. It can be chosen either in Odd Semester or Even Semester of their Five year Integrated(CBCS) P.G courses from the year 2014-15)

UNIT – I

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 – II

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.

UNIT – III

Measure of Bivariate data – Simple; Partial and Multiple Correlation; Scatter diagram and Pearson's method; Rank correlation; 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 – IV

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; Chi square test for goodness of fit and independence of attributes.

UNIT - V

Applications and analysis using SPSS – Analysis of variance one way and two way classifications; Multiple regression analysis; Logistic regression analysis; Factor analysis; Cluster analysis; Discriminant function analysis.

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

**ISTO 02 – MATHEMATICAL STATISTICS
(EXTERNAL OPTIONAL)**

**(OPTIONAL COURSE OFFERED TO DEPARTMENT MATHEMATICS FROM
DEPARTMENT OF STATISTICS)**

**(This paper is offered to M.Sc (Mathematics) (Five year Integrated(CBCS) course)
from the year 2014-15)**

UNIT-I

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-II

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-III

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 Theorems – Inversion Theorem; Uniqueness Theorem of Characteristic Functions; Necessary and Sufficient Condition for independence of Random Variables in Terms of Characteristic Functions; Hally –Bray Theorem; Continuity Theorem for characteristic Functions; Chebychev's Inequality; Problems and Exercises. (Content as in Chapter-7 of Book 1)

UNIT-IV

Discrete Probability Distributions – Binomial; Poisson; Negative Binomial; Geometric; Hyper geometric; Multinomial Distributions and theirs –Moments; Recurrence; MGF; Additive Properties; Characteristic Functions; Recurrence Relations; PGF; Problems and Exercises. (Content as in Chapter-8 of Book 1)

UNIT-V

Continuous Probability Distributions – Normal; Rectangular; Gamma; Beta; Exponential; Standard Laplace; Cauchy Distributions; Sampling Distributions of t; F; Chi-Square and their Derivations; Moments; Additive Properties; Characteristic Functions; MGF; PGF; Inter-relationships; Central limit Theorem (Statement Only). (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.

INTERNAL OPTIONAL PAPERS

ISTO 103 : APPLIED REGRESSION ANALYSIS

OBJECTIVE:-

- To study the various regression models and their applications.

UNIT-I

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-II

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-III

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-IV

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-V

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, (4th 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 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).
- 8) Iain Pardoe (2012)Applied Regression Modeling.

ISTO 104 : ORACLE AND JAVA PROGRAMMING

OBJECTIVE:-

- This paper aims at introducing the language Oracle and Java in a systematic manner to make the students to have knowledge in program writing and developing the software.

UNIT-I

Introduction to Database Management System; Purpose of database system ;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 database design; Pitfalls in relational database design; Normalization.

UNIT-II

PL/SQL- Variables; Variables in PL/SQL ; Dynamic data types; Strings; Statements; Control Statements; Loops and Labels; Simple Statistics Programs; Oracle Forms; SQL Forms; Generating a forms ;Parent child coordination; Retrieving multiple data; Automatic generation of a types; Enforce keys; Triggers; procedures.

UNIT-III

Introduction to Java - Overviews of Java; Data types; Variables and arrays; operators; Control Statements; looping statements.

UNIT-IV

Classes; Methods; Data Structures; Inheritance; Package and Interfaces; Exception Handling; String Handling.

UNIT-V

Applet Classes; Abstract Windows Toolkit; Working with windows; Graphics and Text; AWT Controls; Layout Managers; Images; Animations; Swing Classes.

Books for Study and Reference:-

- 1) C.J. Date,(1995) An Introduction to Database Systems - Volume 1, 6th edition, Addison-Wesley.
- 2) Patrick Naughton and Herbert Schildf (1999) The Complete Referance Java 2.0, TMH Publishing Company Limited, New Delhi.
- 3) C.Xavier, Projects on Java, Scitech Publications(India) Pvt.Ltd., Chennai.
- 4) S.S.Khandara, Programming in Java, S.Chand & Company Limited.

ISTO 105 : BIO STATISTICS

OBJECTIVE:-

- To enrich the skills of students to get more applied knowledge in Bio Statistics.

UNIT-I

Epidemiology – Measures of disease frequency; Mortality and morbidity rates; Incidence rates; Prevalence rates; Source of mortality and morbidity statistics – hospital record, s Vital; statistics; Measure of accuracy; Sensitivity index; specificity index; Types of studies; Cross sectional Prospective; case control and clinical trials.

UNIT-II

Epidemiology – Measures of association relative risks odds ratio and their confidence interval; Statistical techniques used in analysis Confounding and interaction (definition only); Adjustment for confounding – Mantelenzel procedure; Logistic regression approach.

UNIT-III

Bioassay; direct assays; quantitative dose; response relations; estimation of median effective dose; estimation of unknown concentration of potency; probit and logit transformation; structure for parallel line assays.

UNIT-IV

Bioassay- principles of planning an assay; slope ratio assays; efficiency in slope ationassays; quantal responses and the tolerance distributions; Assays; based on quantal responses; Symmetric and asymmetric assays.

UNIT-V

Survival analysis;purpose and scope; survival function; hazard function and their relationships; censoring Type I and II (definition only); Nonparametric methods estimating survival distributions; Analysis estimation procedures (exponential, Weibull, lognormal and gamma cases).

Books for Study and Reference:-

- 1) Hahan H. A (1983) **An Introduction to Epidemiologic Methods.** Oxford University Press, New York.
- 2) Kleinbaum, D.L, Kupper, L.L., and Hal Morgenstein (1982), **Epidemiologic Research and Quantitative Methods,** Life time learning Publications, New York.
- 3) Lilienfeld, A.M., and Lilienfeld. D.E (1980). **Foundations of Epidemiology,** Oxford University Press, New York.
- 4) Finney, D.J (1978), **Statistical Methods in Biological Assay,** Charles Griffin & Co. Ltd London 3rd Ed
- 5) Govindarajulu, Z (1988), **Statistical Techniques in Bioassay,** Karger Publications. New York
- 6) Lee, E.T (1980) **Statistical Methods for Survival Data Analysis,** Life time Learning Publication, California.
- 7) Colanhood Lectures in Bio 1971 Statistics, Clarendon Press.
- 8) Cox, D.R and Oakes. D (1984) **Analysis of Survival Data,** Chapman and Hall, New York.
- 9) Kalbfleish J.D. and Prentice. R.L. (1989). **The Statistical Analysis of Failure Time Data.** Wiley. New York.

ISTO 106 : ADVANCED STOCHASTIC PROCESSES

AIM: To motivate the Students for further study in advanced topics of Stochastic process.

UNIT-I

Renewal process- Definition; related concepts and examples; Renewal equation; Elementary Renewal equations; Basic Renewal theorem; Applications of the renewal theorem; superposition of renewal processes.

UNIT-II

Stationary processes and Time Series- Introduction; Models for time series; Purely random process; First order Markov Process; Moving average process; Autoregressive process; Auto regressive process of order Two; ARMA process; Time and frequency Domain; Power spectrum.

UNIT-III

Stochastic processes in queuing- queuing systems; General concepts, M/M/1 Queuing model; Steady state behavior; Transient behaviors; Birth and death processes in queuing theory, Multichannel model, Non-birth and death queuing processes; Bulk queues; Non-Markovian queuing; Model G1/M/1 model; queues with vacation; Discrete - time queues (Concept only).

UNIT-IV

Taboo probabilities; ratio theorems; and Existence of generalized stationary distribution; continuous time Markov chain; differentiability properties of transition probabilities; Forward and Backward differential equations; construction of a continuous time Markov chain from its infinitesimal parameters.

UNIT-V

Regular; inter regular and sub-regular sequences for Markov chain; sums of independent random variables as a Markov chain; recurrence properties; Local limit theorems.

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) Medhi. J (1999), Stochastic processes, New Age International Publishers.
- 4) Prabhu , N.U (1965) Stochastic processes, McMillan
- 5) Bharucha Reid, A.T (1960), Markov chain with applications (2nd Edition)
- 6) Feller, W (1968), An introduction to probability and its application, Wiley NewDelhi.
- 7) Chung, K.L (1968) Markov chain with stationary transition probabilities, Springer Vexlags, New York.
- 8) Srinivasan, S.K, Introduction to Stochastic processes and their applicatons.

ISTO 107 : STATISTICAL DECISION THEORY

OBJECTIVE:-

- This paper deals with the statistical decision theory.

UNIT-I

Game and Decision Theories- Basic elements of game and Decision; Comparison of the two theories; Decision function and Risk function; Randomization and optimal decision rules; Form of Bayes rules for estimation.

UNIT-II

Main Theorems of Decision Theory- Admissibility and completeness; Fundamental theorems of Game and Decision theories; Admissibility of Bayes rules; Existence of Bayes decision rules; Existence of minimal complete class; Essential completeness of the class of non randomized decision rules; Mini max theorem; The complete class theorem; Methods for finding minimax rules.

UNIT-III

Sufficient Statistics- Sufficient Statistics and essentially complete class of rules based on Sufficient Statistics; Complete Sufficient Statistics; Continuity of the risk function.

UNIT-IV

Invariant Statistical Decision Problems- Invariant decision problems and rules; Admissible and minimax invariant rules; Minimax estimates of location parameter; Minimax estimates for the parameters of normal distribution.

UNIT-V

Multiple Decision problems- Monotone Multiple decision problems; Bayes rules in multiple decision problems; Slippage problems.

Books for Study and Reference:-

- 1) T.S. Ferguson (1967), **Mathematical Statistics – A Decision Theoretic Approach**, Academic Press.
- 2) M.H. DeGroot (1976), **Optimal Statistical Decisions**, McGraw Hill.
- 3) J.O. Berger (1985), **Statistical Decision Theory and Bayesian Analysis**, 2nd Edition, Springer.
- 4) William M. Bolstad (2007) **Introduction to Bayesian Statistics**, 2nd Edition.
- 5) Robert Winkler (Jan 15, 2003) **An Introduction to Bayesian Inference and Decision**, Second Edition.

ISTO 108 : ACTUARIAL STATISTICS

OBJECTIVE:-

- This paper deals with full understanding of Actuarial Statistics.

UNIT-I

Accumulated value and present value of a sum under fixed and varying values of interest; Nominal and effective values of interest; Annuity; Classifications of annuities; Present and accumulated values of annuities; Immediate annuity due and deferred annuity.

UNIT-II

Redemption of loans – Redemption of loans by installments payable times in a year Interest being p.a. effective; Role of probability distribution in general insurance (Weibull, Exponential).

UNIT-III

Vital Statistics; meaning and uses of vital statistics; Measures of mortality; C.D.R, S.D.R., A.S.D.R.; Central mortality rate ; Force of mortality ; measures of fertility ;C.B.R., G.F.R.; A.S.F.R.; T.F.R; G.R.R. and N.R.R.

UNIT-IV

Mortality Table ; Columns of a mortality table; Completing an incomplete mortality table uses of mortality table; Expectation of life; Computing probabilities of survival and death using mortality tables; select mortality table; Ultimate mortality table; Aggregate mortality table.

UNIT-V

Principle of insurance; Assurance benefits; Types of assurance; Endowment assurance; pure endowment assurance; whole life insurance and temporary assurance ; Premiums; Natural premium; Level premium; Net premium; Office premium; Bonus loading with profit and without profit; Policy value; Retrospective policy value and prospective policy value.

Books for Study and Referene:-

- 1) **Mathematical basis of Life Assurance (IC-81):** Published by Insurance Institute of India, Bombay.
- 2) Gupta, S.C. and Kapoor, V.K. (2009). **Fundamentals of Applied Statistics (for Unit-III only)**, 11th Edition, Sultan Chand & Co.

ISTO 109 : BAYESIAN INFERENCE

OBJECTIVE:-

- This paper gives a clear in sight about Bayesian methodology inference and related problems.

UNIT-I

Statistical inference- Classification of inference; Fiducial inference; Likelihood inference; Plausibility inference; Structural inference; Pivotal inference; Nature of Bayesian inference ; Bayes' Theorem; applications.

UNIT-II

Concept of prior distribution – Classifications of prior; Informative; Non informative and Restricted classes of priors; Non-informative priors for location and scale problems; Non-informative priors in General settings; Various approach to prior selection.

UNIT-III

Conjugate prior distributions; Sufficient statistics; Construction of the conjugate family-Conjugate families for sample from a Normal distribution; Equivalent prior sample size.

UNIT-IV

Bayes estimation; Bayes estimates for Binomial and Poisson distribution using conjugate priors; Problems of testing hypothesis; Testing a simple hypothesis about the mean of a Normal distribution.

UNIT-V

Testing hypotheses about the mean of a Normal distribution when the precision is unknown; deciding whether a parameter is smaller or larger than a specified value; deciding whether a mean of a Normal distribution is smaller or larger than a specified value.

Books for Study and Reference:-

- 1) Ashok, K. Bansal (2007), Bayesian Parametric Inference, Narosa publishing house, New Delhi.
- 2) Barnett, V (1982), Comparative statistical inference (2nd Edition), John Wiley and sons, New York.
- 3) Berger, James. O (1985), Statistical Decision theory and Bayesian Analysis, Springer – Verlag, New York.
- 4) Box, G.E.P and G.C Tiao (1973), Bayesian inference in statistical analysis, Addition – Wesley.
- 5) Degroot, M.H. (1970), Optimal statistical Decision Mc Gram Hill, New York.
- 6) Lindley, D.V. (1970), Introduction to Probability and Statistics, Cambridge, London.
- 7) William A Link and Richard J. Barker (2009) Bayesian Inference: with ecological applications.

ISTO 110 : ADVANCED ECONOMETRICS

OBJECTIVE:-

- To enrich the skills of students to get more applied knowledge in Econometrics.

UNIT-I

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-II

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 heteroscedasticity.

UNIT-III

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-IV

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

UNIT-V

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:-

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

ISTO 111 : TIME SERIES ANALYSIS

AIM: To understand the concepts and applications of Time series analysis techniques.

UNIT-I

Forecasting Perspective- An overview of forecasting techniques; the basic steps in forecasting task; Basic forecasting tools; Time series and cross-sectional data; graphical summaries; numerical summaries; Measuring forecast accuracy; predictions intervals; transformations and adjustments; Time series decomposition; Classical decomposition; STL decomposition; Census Bureau methods; forecasting and decomposition.

UNIT-II

Exponential smoothing Methods- Averaging method; Single exponential smoothing, adaptive approach; Hot's linear method; Holt-Winter's trend and seasonality method; Pegels classification; Comparison of methods; General aspects of smoothing methods; Initialization; Optimization; Prediction intervals.

UNIT-III

Stationary Process -Stationary Process; non-Stationary Process; Auto Covariance and auto correlation functions; Properties; Examining correlations in time series data; White noise model; the sample distribution of auto correlations; portmanteau tests; partial auto correlation coefficient; Examining correlations in time series data; Removing non- Stationarity in time series; tests for Stationarity; seasonal

differencing; Examining of the auto covariance function; estimation of auto correlation function.

UNIT-IV

Discrete parameter models- Purely Random Process; First order auto regressive process; second order autoregressive process, Autoregressive process of general order; Moving average processes; ARMA processes; General linear process; relationship between MA and AR representations; Stationarity conditions; ARIMA Model.

UNIT-V

Box-Jenkins Methodology for ARIMA Models- ARIMA Models for time series data; Identification; Estimating the parameters; Identification revisited; Diagnostic checking; forecasting with ARIMA models.

Books for study and Reference:-

- 1) **Makridakis. S, Wheelright S.C and Hyndman. R.J (2003)“Forecasting: Methods and Applications”, 3rd Edition, John Wiley & Sons, Inc, New York.**
- 2) **M. B. Priestley (1981),”Spectral Analysis and Time Series”, Academic Press, London.**
- 3) **Gujarathi D. N and Sangeetha (2008), Basic Econometrics, 4th edition, The McGraw Hill & co.**
- 4) **Box.G. E and Jenkins (2005), Time Series Analysis: Theory, Practice and Control.**
- 5) **James Douglas Hamilton (Jan 11, 1994)Time Series Analysis.**
- 6) **Rob j Hyndman (2008) Forecasting methods and applications 3rd edition.**

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