

ANNAMALAI UNIVERSITY

ANNAMALAINAGAR



DEPARTMENT OF STATISTICS

**M. Sc. STATISTICS (CBCS)
(TWO YEAR ON-CAMPUS PROGRAMME)**

**HAND BOOK
REGULATIONS AND SYLLBI FROM 2014 -2015**

DEPARTMENT OF STATISTICS
M.Sc. STATISTICS
(Two Year Programme) (CBCS)
Revised REGULATIONS AND SYLLABI FROM 2014 - 2015
Revised REGULATIONS

Eligibility

Candidates for admission to the Two Year “**M.Sc. Statistics**” (CBCS) Degree Programme shall be required to have passed in B.Sc (Statistics) or B.Sc(Mathematics) or B.Sc (Computer Science) with at least two papers in Mathematics with a minimum of 50% marks.

Master Programme

A Master’s Programme consists of a set of Core courses and common course on soft skills and Optional papers.

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 Two year Master’s Programme shall be 90.

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 Two year Master’s Programme in any subject is **Four** semesters.

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

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

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. CGPA is similarly calculated considering the core, allied and optional courses taken from I semester to IV 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 IV 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 and Optional courses of study from I Semester to IV 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**.

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 (Two Year CBCS Course)

COURSE CODE	SUBJECT OF STUDY	L	T	P	C	SEMESTER CREDITS
I – Year: Semester – I						
STSC 101	Real Analysis and Measure Theory	4	1		4	20
STSC 102	Probability Theory	4	1		4	
STSC 103	Sampling Theory	4	1		4	
STSC 104	Programming with C++	4	1		4	
STSP 105	Practical – I		1	4	4	
I – Year: Semester – II						
STSC 201	Distribution Theory	4	1		4	20
STSC 202	Estimation Theory	4	1		4	

STSC 203	Statistical Quality Control and Reliability	4	1		4	
STSP 204	Practical – II		1	4	4	
MAMO 215	Optional – I – Numerical Methods	4			4	
II – Year: Semester – III						
STSC 301	Testing of Statistical Hypotheses	4	1		4	24
STSC 302	Multivariate Statistical Analysis	4	1		4	
STSC 303	Operations Research	4	1		4	
STSP 304	Practical – III		1	4	4	
MAMO 315	Optional – II – Discrete Mathematics	4			4	
ENGO 316	Soft Skills	4			4	
II – Year: Semester – IV						
STSC 401	Design and Analysis of Experiments	4	1		4	26
STSC 402	Stochastic Processes	4	1		4	
STSO 403	Optional – III – Applied Regression Analysis	4	1		4	
STSO 404	Optional – IV – Oracle and Java Programming	4	1		4	
STSP 405	Practical – IV		1	4	4	
STSP 406	Project / Dissertation		4	2	6	
OVERALL CREDITS						90

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

Total Core Courses and Practical Credits = 70

Total Optional & Soft Skill Credits = 20

Overall Credits = 90

Note: 1. Soft Skills is offered by English Department

2. Optional I, II, III, IV is Chosen either Internal Optional or from other Departments.

OPTIONAL COURSE OFFERED TO OTHER DEPARTMENTS IN ODD AND EVEN SEMESTERS

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

List of Internal Optional Course			
Course code	Subject Title	Course Code	Subject Title
STSO403	Applied Regression Analysis	STSO408	Actuarial Statistics
STSO404	Oracle and Java Programming	STSO409	Bayesian Inference
STSO405	Bio – Statistics	STSO410	Advance Econometrics
STSO406	Advance Stochastic Processes	STSO411	Time Series Analysis
STSO407	Statistical Decision Theory		

I YEAR – SEMESTER – I

STSC 101: 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 A; 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; A continuous, nowhere-differentiable function. 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 $L^2[a, b]$; 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; 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 (1981). "Measure Theory and Integration", Wiley Eastern Ltd, New Delhi
4. Walter Rudin (1986) Real and Complex Analysis (International series in Pure and Applied Mathematics).
5. Halsey Royden and Patrick Fitzpatrick (2010) Real Analysis (4th Edition).

STSC 102: 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} monotone convergence theorem 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 Reyni (2007), Probability Theory, Dover Books on Mathematics.
7. Willam Feller (1968), An Introduction to Probability Theory and Its Applications, Vol.1, 3rd Edition, Wiley Eastern.
8. Willam 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.

STSC 103: 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 Organisation (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. Murthy, M.N., (1977), Sampling Theory and Methods, Statistical Publishing Society, Kolkatta.
4. Sampath, S. (2005), Sampling theory and methods, Narosa Publishing house.
5. Agarwal Np, Sonia Agarwal (2006), Sampling methods and Hypothesis testing. Rbsa Publishers.
6. Desraj, Promod Chandhok (1998), Sample survey theory, Narosa Publishing house.
7. Parimal Mukhopadhyay(1998)Theory and methods of survey sampling.Prentice Hall of India Pvt. Ltd.
8. Sukhatme & Sukhatme, P.V. (1958), Sampling Theory of Surveys with Applications. The Indian Society of Ag. Statistics, New Delhi.
9. Desraj (1976) Sampling Theory, Tata McGraw Hill, New Delhi.

STSC 104: PROGRAMMING WITH C++

OBJECTIVES:-

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

UNIT-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.

STSP 105: PRACTICAL – I (COMPUTER BASED PRACTICAL)

PRACTICAL SCHEDULE:-

SPSS

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

MATLAB

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

SYSTAT

Descriptive Statistics.
Correlation and Regression.
Chi-Square Test.
ANOVA One-way Classification.
ANOVA Two-way Classification.

SIGMAPLOT

Descriptive Statistics.
Correlation and Regression.

STATGRAPH

Diagrams and Graphs related to Statistical Data.
Statistical Applications.

I YEAR - SEMESTER – II **STSC 201: 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 distribution.

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, χ^2 and Beta distribution - Properties 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 statistics, p.d.f of a single order statistics, Joint p.d.f of a order statistics, Joint p.d.f of k^{th} order statistics, Joint p.d.f of n 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 and S. Kotz & Kemp, A.W. (1993), Univariate Discrete Distribution Vol. I, New York:Jhon Wiley & Sons 1st Edition.
3. Johnson, N. L and S. Kotz & Balakrishnan, N. (1997), Discrete Multivariate Distribution, New York:Jhon Wiley & Sons 1st Edition.
4. Johnson, N. L and S. Kotz & Balakrishnan, N. (1994), Continuous Univariate Distribution, Vol 1, New York:Jhon Wiley & Sons 2nd Edition.
5. Johnson, N. L and S. Kotz & Balakrishnan, N. (1995), Continuous Univariate Distribution, Vol 2, New York:Jhon 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. Gibbons , J.D and Subhabrata Chakraborti (2010), Non-parametric Statistical Inference, McGraw Hill
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, Vol. 1, 2nd Edition.
11. William Mendenhall, Robert J. Barbara M. Beaver (2012), Introduction to Probability and Statistics.

STSC 202: 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. Dhanavanthan., Statistical inference, PHI Learning Private Limited, New Delhi, 2012).
2. Gibbons, J.D. and S. Chakraborti, Nonparametric Statistical Inference, 3rd ed., Marcel Dekker, 2010.
3. Lehman, E.L. and G. Casella, Theory of Point Estimation, 2nd ed., Springer – Verlag, 1998.
4. Rao, C.R., Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York, 1973.
5. Zacks, S., Parametric Statistical Inference: Basic Theory and Modern Approach, Pergamon Press 1981.
6. Zacks, S., The Theory of Statistical inference, John Wiley, New York, 1971.
7. Santhakumaran, A (2004), Probability Models and Their Parametric Estimation, K.P. Jam Publication, Chennai.

STSC 203: STATISTICAL QUALITY CONTROL AND RELIABILITY

OBJECTIVES:-

- 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. Gupta S.C and V.K. Kapoor (2007): Applied Statistics, Sultan Chand Sons, New Delhi.
3. Duncan A.J (1959). Quality control and Industrial Management by Duncan A.J. (Richard D. Irwin Inc. USA)
4. Leaven worth, R.S. (1964). Statistical Quality Control, (Mc Graw Hill).
5. Schilling, E.G. (1982). Advances in acceptance sampling. ASQC Publications, New York.

6. Burr, I.W. (1953) Engineering Statistics and Quality Control, McGraw Hill, New Delhi and Sons.
7. Mahajan, M (1998): Statistical Quality Control, Dhanpat Rao & Co, New Delhi.
8. Biswas S (1996). Statistics of Quality control, Sampling Inspection and Reliability, New Age Intl.
9. Bain, L.J and Englehard, M. (1991). Statistical Analysis of Reliability and Life Testing Models, Marcel Dekker.
10. Sinha, S.K. (1979), Reliability and Life-Testing, Wiley Eastern, New Delhi.

STSP 204: PRACTICAL – II
(CALCULATOR BASED PRACTICAL)

Practical Schedule:-
Sampling

- Estimation of sample mean and sample variance under simple random sampling without replacement.
- Estimation of sample mean and sample variance under SRSWR.
- Estimation of Proportion under SRSWOR.
- Estimation of Population total, mean and variances under systematic sampling.
- Estimation of mean, variances under stratified random sampling.

Statistical Quality Control

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

Multivariate Analysis

- Estimation of Mean vector and Covariance Matrix.
- Test for the Mean vector when Covariance Matrix is known.
- Test for Equality of Mean vector.
- Test for the Mean vector when Covariance Matrix is unknown.
- Test for Covariance Matrix.
- Test for Equality Covariance Matrices.

OPTIONAL – I – MAMO 215: 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.

II YEAR - SEMESTER - III**STSC 301: 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, Testing Statistical Hypotheses, 3rd ed., Springer 2005.
4. Lehman, E.L. and G.Casella, Theory of Point Estimation, (Springer Texts in Statistics), 2014.
5. Rao, C.R., Linear Statistical Inference and Its Applications, 2nd ed., Wiley, New York, 1973.
6. J.K. Lindsey (1996), Parametric Statistical Inference (Oxford Science Publications).
7. Igor Vajda (1989), Theory of Statistical Inference and Information (Theory and Decision Library B).
8. George Casella and Roger L. Berger (2001), Statistical Inference (Springer Texts in Statistics).
9. Paul Garthwaite, Ian Jolliffe and Byron Jones (2002). Statistical Inference (Oxford science Publications).

STSC 302: 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 (1982) – An Introduction to Multivariate Statistical Analysis, (2nd Edition) Wiley, NewDelhi.
2. Morison. D. F (1983), Multivariate Statistical methods, Mc Graw Hill 2nd Edition.
3. W. R. Dillon and M. Goldstein (1984), Multivariate Analysis methods and Applications, Wiley, New York.
4. Johanson. R. A and D. W. Wichern, (1996). Applied Multivariate Statistical Analysis, Wiley, New York.
5. Sam Kash Kanchigan (1991). Multiariate Statistical Analysis: A Conceptual Introduction, 2nd Edition.
6. Alvin C. Renher (1997). Multivariate Statistical Inference and Applications.
7. Wolfgang Karl Hardle and Leopold Simar (2012). Applied Multivariate Statistical Analysis.
8. Bryan F.J. Manly (2004). Multivariate Statistical Methods: A Primer, Third Edition.
9. Richard A. Johnson and Dean W.Wichen Applied Multivariate Statistical Analysis (5th Edition).
10. Alvin C. Rencher and William F. Christensen (2012). Methods of Multivariate Analysis.

STSC 303: OPERATION 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 2xn and mx2 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 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.
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.

STSP 304: PRACTICAL – III (COMPUTER BASED PRACTICAL)

Practical Schedule:-

Programs Using C++

- Finding the mean and standard deviation for raw data.
- Finding the mean and standard deviation for discrete type frequency distribution.
- Finding the mean and standard deviation for continuous type frequency distribution.
- Finding the median for raw data.
- Finding the Skewness and kurtosis based on moments.
- Finding the correlation – coefficient.
- Finding the regression equations.
- Testing for population mean.
- Testing for difference of means.
- Paired t – Test.
- Chi-Square test for testing the independence of attributes.
- F – Test for equality of Variances.
- Fitting of Binomial Distribution and goodness of Fit.
- Fitting of Poisson Distribution and goodness of Fit.
- Fitting of Normal Distribution and goodness of Fit.

- Analysis of variance One-way Classification.
- Addition and Subtraction of Matrices.

Optional – II – MAMO 315: 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.

ENGO 316: SOFT SKILLS

OBJECTIVES:-

- Soft skills evolve the personality of a person and prepare him/her for competition in the changing employment market elsewhere. A degree from a university is a basic requisite for job but an acquirement of soft skills will boost the employment opportunities of a person. The skills, when acquired, will change the attitude of people and make them approach life with best.

UNIT-I Personality Development

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

UNIT-II Effective Listening

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

UNIT –III Interpersonal Communication

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

UNIT –IV Public Speaking

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

UNIT-V Writing Skills

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

Text Books and Reference:

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

II- YEAR - SEMESTER - IV

STSC 401: 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 2^n and 3^n 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.

STSC 402: 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 GI/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 – STSO 403: 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).

OPTIONAL – IV – STSO 404: 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.

STSP 405: PRACTICAL – IV (CALCULATOR BASED PRACTICAL)

Practical Schedule

Testing of Hypotheses

- Most powerful test Estimation of power and size.
- Uniformly MP test – Estimation of power and size.
- One sample kolmogorov – Smirnov test.
- Sign test.
- Wilcoxon signed rank test.
- Mann – Whitney U – test.
- Kolmogorov – Smirnov two sample test.
- Median test.
- Kruskal – Wallis test.
- SPRT – OC and ASN curve for Binomial Distribution.

Design of Experiments

- Completely Randomized Design.
- Randomized Block Design.
- RBD with more than one observation per cell.
- Latin Square Design.
- Graceco – Latin Square Design.
- Missing Plot Analysis in CRD, RBD and LSD.
- Multiple Comparison Test – DMRT, LSD and CD.
- Efficiency of RBD over CRD.
- Efficiency of LSD over RBD and CRD.
- 2^2 – Factorial Experiment.
- 2^3 - Factorial Experiment with complete confounding.
- 2^3 - Factorial Experiment with partial confounding.
- 3^2 - Factorial Experiment
- Split – Plot Design.

Operation Research

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

**STSO 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 Two year 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

STSO02: MATHEMATICAL STATISTICS
(EXTERNAL OPTIONAL)
(OPTIONAL PAPER OFFERED TO DEPARTMENT OF MATHEMATICS FROM
DEPARTMENT OF STATISTICS)

(This paper is offered to M.Sc (Mathematics) (Two year (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

STSO 403: 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).

STSO 404: 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 Referance 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.

STSO 405: 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, lognronal 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, Kuppor, 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 Biologica Assay, Charless 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. Colanhound 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. Kalbflaish J.D. and Prentice. R.L. (1989).The Statistical Analysis of Failure Time Data. Wiley. New York.

STSO 406: 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 behaviours, 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.

STSO 407: 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.

STSO 408: 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 Reference:-

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.

STSO 409: 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.

STSO 410: 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).

STSO 411: 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.