POST GRADUATE PROGRAMME

1. At each of the Previous and Final Year Examination in a subject, a candidate must obtain for a pass (i) at least 36 % marks of the aggregate marks in all the papers prescribed at the examination, and (ii) atleast 36% marks in practical, wherever prescribed, at the examination; provided that if a candidate fails to secure 25% marks in each individual paper of theory at any of the examination and also in the Dissertation; wherever prescribed, he/she shall be deemed to have failed at the examination, notwithstanding his/her having obtained the minimum percentage of marks required in the aggregate for the examination. Division will be awarded at the end of the Final Examination of the combined marks obtained at the Previous and the Final Examinations taken together as noted below. No Division will be awarded at the Previous Examination.

First Division : 60 Percent ⎤ of the total aggregate

Second Division : 48 Percent ⎟ marks of Previous and

Third Division : 36 Percent ⎟ Final year taken
                together ⎦

Note : The candidate is required to pass separately in theory and practicals.

2. Dissertation may be offered by regular students only in lieu of one paper of Final Year Examination as prescribed in the syllabus of the subject concerned. Only such candidates will be permitted to offer dissertation who have secured atleast 50% marks in the aggregate at the previous examination.

Note: Dissertation shall be type-written and shall be submitted in triplicate, so as to reach the Controller of Examinations atleast two weeks before the commence-ment of Examination.

3. There shall be atleast eight theory in Post-Graduate Examination, 4 in Previous and 4 in Final year examinations of 100 marks each unless and otherwise prescribed. The non-credit papers wherever prescribed will remain as such. The marks of these non-credit papers will not be counted for division but passing in the same is compulsory.

4. Each theory paper will be of three hours duration.

5. Wherever practicals are prescribed the scheme will be included in the syllabus.

6. A candidate who has completed a regular course of study for one academic year and Passed M.A. / M.Sc./ M.Com. Previous Examination of the university shall be admitted to the Final Year Examination for the degree of Master of Arts / Master Of Science / Master of Commerce provided that he / she has passed in atleast 50% of the papers at the previous examination by obtaining atleast 36% marks in each such paper.

(a) For reckoning 50% of the papers at the previous examination, practical will be included and one practical will be counted as one paper.

(b) Where the number of papers prescribed at the previous examination is an odd number it shall be increased by one for the purpose of reckoning 50% of the paper.

(c) Where a candidate fails for want of securing minimum aggregate marks but secured 36% marks in atleast 50% of the papers, he/she will be exempted from re-appearing in those papers in which he/she has secured 36% marks.

(d) Where the candidate secures requisite minimum percentage in the aggregate of all the papers but fails for want of the requisite minimum percentage of marks prescribed for each individuals paper he/she shall be exempted from re-appearing in such paper (s) in which he / she has secured atleast 25% marks.

7. A candidate who has declared fail at the Final Year Examination for the degree of Master of Science / Arts, Commerce shall be exempted from re-appearing in a subsequent year in the following papers :

(a) Where a candidate fails for want of securing the minimum percentage in the aggregate marks, he/she shall be exempted from re-appearing in such paper (s) Practical (s). Dissertation in which he/she has secured atleast 36% marks; provided he/she is passing in atleast 55% of the papers. (Here passing in each paper requires 36% marks).

(b) Where a candidate secures the minimum requisite including dissertation wherever prescribed but fails for want of minimum percentage of marks prescribed for in each individual paper / dissertation, he / she shall be exempted from reappearing in such paper (s) dissertation in which he/she has secured atleast 25% marks provided he/she is passing in atleast 50% of the paper (here passing in each paper requires 25% marks)

M.A./M.Sc. STATISTICS PREVIOUS, 2004-2005

Paper-I	Advanced Mathematics for Statistics	100 Marks	3 hours
Paper-II	Probability & Theoretical Distributions	100 Marks	3 hours
Paper-III	Sampling Distributions and Statistical Inference	100 Marks	3 hours
Paper-IV	Design of Experiments and Theory of Sample Surveys-I	100 Marks	3 hours
Paper-V	Practicals based on C programmIng in Computational Statistics	100 Marks	4 hours
Paper-VI	Practicals based on Papers II, III and IV	100 Marks	4 hours

FINAL, 2005-2006

Compulsory Papers:

Paper-VII	Multivarlate Analysis and Statistical Inference	100 Marks	3 hours
Paper-VIII	Design of Experiments and Theory of Sample Surveys-II	100 Marks	3 hours
Paper-IX	Operations Research and Statistical Quality Control	100 Marks	3 hours
Paper-X	Practicals based Paper-VIII	100 Marks	4 hours
Paper-XI	Practical based on Papers - VII and IX	100 Marks	4 hours

Optional Papers

Any one of the following papers with the permission of the Department concerned.

Paper-XII	Non Parametric Inference and Sequential Analysis	100 Marks	3 hours
Paper-XIII	Advanced Statistical Inference & Reliability	100 Marks	3 hours
Paper-XIV	Mathematical Economics and Econometrics	100 Marks	3 hours
Paper-XV	Economic Statistics and Demography	100 Marks	3 hours
Paper-XVI	Stochastic Processes and Information Theory	100 Marks	3 hours
Paper-XVII	Advanced Sampling Theory and Advanced Design of Experiments	100 Marks	3 hours
Paper-XVIII	Computer Intensive Statistical Methods 1, Knowledge Discovery and Data Mining	100 Marks	3 hours
Paper-XIX	Computer Intensive Statistical Methods II & Statistical Pattern Recognition	100 Marks	3 hours
Paper-XX	Survival Analysis and Statistical Ecology	100 Marks	3 hours
Paper-XXI	Dissertation/Project work and Viva voce	100 Marks	3 hours

Note :

1. The dissertation shall contain review material giving a review of some recent papers in an area of study.

2. The project work shall be based on either primary data involving field work or secondary data The candidate will be required to prepare Comprehensive and Critical reports on the same.

3. The faculty supervising the Dissertation/ Project Work of a candidate shall be provided one hour per week towards his/her supervision.

4. In all theory papers of M.A./M.Sc. (Previous and Final) Statistics except paper XXI the question paper will be divided into three Section A, B & C as follows:

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this Section, ten questions will be set taking two questions from each unit each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit. The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks)

Section C : In this section, four questions will. be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may

have subparts in it and will carry 20 marks. The candidate will be required to, attempt any two questions (aggregating 40 marks).

5. Visits to Government Departments/Organizations Semi Government Departments/Organizations, Government Undertaking Organizations, Statistical Institutes of repute, Private Sector Statistical Organizations and Research stations of the country may be organized to familiarize students with the practical work done at these centres.

6. Each theory paper of M.A. /M.Sc (Previous and Final will be allotted a minimum of 5 periods per week and each practical paper will be of three periods duration twice a week (each period= 1 hour duration). Also, there should be at least 80 periods teaching (each period of one hour duration) in each paper during an academic session where teaching is being assigned on Guest faculty basis.

7. Those candidates who have passed B.A. /B.Sc. degree with Statistics /Applied Statistics/ Mathematical Statistics as one of the optional subject will be considered eligible for admission to M.A./M.Sc Statistics course.

8. Those candidates who have passed B.A./B.Sc degree with Mathematics as one of the optional subject will also be considered eligible for admission to M.A./ M.Sc. Statistics course provided the seats remain vacant after accommodating all the eligible candidates of Statistics /Applied Statistics/ Mathematical Statistics.

M.A/M.Sc. (PREVIOUS) EXAMINATION, 2004-2005

PAPER-I
ADVANCED MATHEMATICS FOR STATISTICS

TIME : 3 hours   **Max. Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this Section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

MEASURE AND INTEGRATION. : Set operations, Limit of sequence of sets, Classes of sets (rings, σ-rings, σ-fields, fields), Monotone classes, Borel sets, Additive set functions, Measure, Properties of measure (monotonicity, countable, sub additivity and continuity), Extension of measure, Outer measures.

UNIT-II

Measurable sets, Probability measure, Lebesgue, stieltjes measure, Measurable and measure spaces, Measurable Functions and its properties. Simple functions, sequence of measurable functions.

UNIT-III

Integrability of simple and measurable functions, Properties of integrals, Lebesgue monotone and dominant convergence theorems, Fatou's lemma, Lebesgue stieltjes integrals.

MATRICES AND LINEAR ALGEBRA: Inverse and partitioning of matrices, Diagonal reduction, Normal form, Vector space, Linear dependence and independence, Basis, Dimension, Inner product spaces, Orthonormal basis, Gram Schmidt process.

UNIT-IV

Characteristic equation, Eigen values and Eigen vectors, Cayley Hamilton theorem, Bilinear and quadratic forms, Definiteness of quadratic forms, Reduction to canonical forms. Concept of Generalized Inverse.

UNIT-V

PROBABILITY: Random variables, Distribution functions, Convergence of random variables and distribution functions, Borel Cantelli lemmas Kolmogorov's zero one law, Expectation and conditional expectation Weak law of large numbers Kolmogorov's convergence and three series theorems.

Books Recommonded :

1. Kingman, J.F. & : Introduction to Measure and
   Taylor, S.J.   Probability.

2. Loeve, M.,   : Probability Theory

3. Halmos, P.R.   : Measure Theory

4. Ash R.B.   : Real Analysis and Probability

5. Bhatt, B.R.   : Modem Probability Theory

6. Rao, C.R.   : Linear statistical Inference and
                      Its Applications.

7. Goldberg R.   : Methods of Real Analysis.

8. Kolman, B.   : Elementary Linear Algebra

9. Dutta, K.B.   : Matrix and Linear Algebra.

PAPER-II
PROBABILITY AND THEORETICAL DISTRIBUTIONS

Duration 3 Hours   **Max. Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this Section, ten questions will be set taking two questions from each unit. Each question will be of short answer type not exceeding 20 words and will carry I mark. The candidates will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit. The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

Role of random experimentation in science Axiomatic approach to probability, sample space. Probability laws

for combination of two or more events, Independence of experiments, conditional probability and Statistical independence of events Baye's theorem and its applications.

UNIT-II

Random variables, Distribution functions and frequency functions, Mathematical expectation Moments and conditional expectation.

Chebyshev's inequality & its generalizations.

Kolmogorov's inequality, Weak and strong law of Large numbers, various definitions of probability and inter connections.

UNIT-III

Generating functions and their applications, Moments and cumulants, Moment generating and characteristic functions, their properties with proof.

UNIT-IV

Inversion theorem, derivation of distribution functions from characteristic functions. Central limit theorems for equal and unequal components.

UNIT-V

Binomial, Negative binomial, Poisson, Hyper geometric and Multinomial distributions, Normal, Rectangular, Cauchy, Laplace, Gamma and Beta distributions.

Recommended Books:

1. Feller, W. : Introduction to probability Theory and its applications, Vol -I.

2. Rohatgi, V.K. : Introduction to Probability Theory and Mathematical Statistics.

3. Goon and others : An outline of statistical Theory, Vol.-I.

4. Kendall M.G. & Stuart, A. : Advanced Theory of Statistics, Vol.-I.

5. Kolmogorov's A.N.: Foundations of Theory of Probability

6. Parzen, E : Modern Probability Theory and its Applications

7. Gnedenko B.V. : The Theory of Probability.

8. Elderton and Johnson : Systems of Frequency Curves

Reference Books

1. Cramer H : Mathematical Methods of Statistics

2. Rao, C.R. : Linear Statistical Inference and its Applications

3. Mukhopadhyay, P. : Mathematical Statistics

4. Cacoullos, T. : Exercises in Probability

PAPER-III
SAMPLING DISTRIBUTIONS AND STATISTICAL INFERENCE

Duration: 3 Hours   **Max. Marks: 100**

Note : The question paper will be divided into three sections A, B and C as follows:

Section A : I In this section, ten questions will be set taking two questions from each unit each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit. The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT - I

Univariate sampling distributions: Random sampling, Chi-square, t, F and Z distribtions (central and non-central) and their applications.

UNIT - II

Standard errors of functions of moments Order Statistics and their distributions from any continuous population sampling distributions of median and range from any univariate population. Regression and Correlation. Null and Non-null distributions of sample correlation coeffcient.

UNIT - III

Bivariate Distributions (discrete and continuous) : Bivariate normal distribution - distribution function and its properties, marginal and conditional distributions

Elements of Statistical Decision Function : Formulation of the problem, Loss functions, Risk Function, Admissibility.

UNIT - IV

Elements of Theory of Estimation : Point estimation, Criterion of good estimatiors for one parameter: consistency, unbiasedness, efficiency, sufficiency, minimum mean square, MVU and UMVU estimatiors, Cramer-Rao bounds for one parameter only Method of maximum likelihood estimation, Inteval estimation, Confidence interval and confidence coefficient, General method for obtaining confidence intervals.

UNIT - V

Elements of testing of hypothesis: Two kinds of errors in testing, Power of the test, Critical Region, Neyman Pearson Lemma and determination of Best Critical Region.

Elements of non parametric inference: Sign, Median and Run tests. Elements of sequential analysis: Constru-ction, of SPRT and its applications.

Recommended Books:

1 Goon and others : An outline of statistical Theory, Vol. I

2 Kale B.K : A first course on parametric Inference, Narosa Pub. House, New Delhi.

3 Kendall M.G. & Stuart, A : Advanced Theory of Statistics, Vol.-I & II

4 Mood, Graybill & Boes : Introduction to the Theory of Statistics

5 Rohatgi V.K. : An Introduction to Probability Theory and Mathematical Statistics.

6 Hogg and Craig : Introduction to Mathematical Statistics

Reference Books:

1 Cramer, H : Mathematical Methods of Statistics.

2 Sidney Siegal : Non parametric Statistics for the Behavioral Sciences

3 Weiss, : Statistical Decision Theory.

4 Wald, A : Sequential Analysis.

5 Mukhopadhyay, P. : Mathematical Statistics

PAPER-IV
DESIGN OF EXPERIMENTS AND THEORY OF SAMPLE SURVEYS-I

Duration : 3 Hours   **Max Marks: 100**

Note : The question paper will be divided into three sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and. will carry 1 mark. The candidate will be required to. attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

DESIGN OF EXPEREMENTS

Analysis of experimental model by method of least squares, Cochran's theorem, Orthogonal polynomials.

Analysis of variance and covariance Transformations. Principles of experimentation, Uniformity trials. Completely Randomised, Randomized Block, Latin Square Designs.

UNIT-II

Balanced Iincomplete Block Designs and their analysis. Factorial experiments: 2^n and 3^2 factorial experiments, Total and partial confounding in 2^n and 3^2 factorial experiments.

UNIT-III

Missing plot technique with reference to randomized block and latin square designs, split plot designs. Theory of sample surveys : Planning, execution and analysis of large scale sample surveys with illustrative examples. Detailed treatment of simple random sampling.

UNIT-IV

Stratified sampling, Cluster, two stage sampling with equal and un equal first stage units.

UNIT-V

Systematic sampling : Ratio and regression methods of estimation, Double sampling elements of unistage sampling with varying probabilities with replacement.

Recommended Books :

1. Anderson R.L and : Statistical Theory in Research
   Bancroft, T.A.

2. Kempthorne, O : Design and Analysis of Experiments

3. Cochran W.G. & : Experimental Designs
   Cox G.M.

4. Sukhatme P.V & : Sampling Theory of surveys with
   Sukhatme B.V. Applications

5. Cochran W.G. : Sampling Techniques

Reference Books :

1. Das, M.N.and : Design and Analysis of
   Giri N.C. Experiments

2. Chakraborti, M : Mathematics of Design & Analysis of Experiments

3. Joshi, D.D : Linear estimation & Design of Experiments

4. Montegomery, : Design & Analysis of
   D.C. Experiments, Second Ed

5. Deming W.E. : Some Theory of sampling

6. Des Raj : Sampling Theory

7. Hansen Hurwitz : Sampling surveys Methods I
   and Madow and Theory. Vol. II & I

8. Murthy M.N. : Sampling Theory and Methods

9. Mukhopadhyay, : Theory & Methods of Survey
   P sampling

PAPER-V
PRACTICALS BASED ON C - PROGRAMMING IN COMPUTATIONAL STATISTICS

Duration : 4 Hours　　　　　**Max. Marks: 100**

Theory & Practical　: 70 Marks

Practical Record　　: 15 Marks

Viva voce　　　　　: 15 Marks

Introduction to Computer and its uses. Hardware and Software, I/O Devices: Knowledge of Computer Terminology: Memory, Main Memory, Secondary Storage Memory and their devices, Random Access Memory (RAM), Read Only Memory (ROM, Device Drivers, Central Processing Unit (CPU), Binary System, Bits and Bytes: Kilobytes, Megabytes, Giabytes, Floppy Disk and Hard Disk; Type of languages: Machine Level, High Level, Low Level, Middle Level, General Purpose, Special Purpose and Assembly Languages; Translators: Assembler, Compiler, Interpreter, Application Software and System Software.

Computer Programming in C-Language; Introduction to C-Language and its uses & advantages, C-Fundamentals: Character Set in C, Structure of C-Program; Data Types: constants, Variables and C-Keywords or Reserved words and defining defined Variable Names (user's defined variables indicating appropriate data types), and Characters type data, Types of Constants: Integer, Real and Character Constants and their print format specifications (Formatted and Un-Formatted Both); Declaration of Type of Variables used, operators: Arithmetic, Relational, Logical, Conditional, Assignment Operators, Making Expressions using Operators and converting mathematical expressions into C-Expressions, Commonly used C-Library functions, C-Statements: Input and Output Control Statements, Conditional Statements (simple and nested), Loop Control Statements (simple and nested), Creating Functions in C, Use of Automatic, External, Global and Static variables; Strings as Arrays.

The Characteristic Powerful Features of C: data structures; Structures: Array of structures, Introduction to multifile programs Macro, Recursion Functions passing arrays and structures as arguments to functions, functions returning pointer etc.; Pointers: Array of Pointers, Passing Pointers to Functions, Pointers and one dimensional Arrays, Pointer arithmetic, application of Pointers in processing strings, passing function to other functions.

Working with Data Flies: Defining File Name, Types of File (Sequential, Random File), Modes of Files, Opening and Closing a File, Creating a File, Creating and Processing/Updating formatting and unformatting a File containing data records, File input and Output Functions, Detecting end of a File, Removing a File.

Application of C Programming in Various Areas of Computational Statistics: Techniques related to generating random number, developing Algorithm and

Programs for some useful Statistical Data Analysis problems related to: (i) Statistical Methods-Univariate, Bivariate, Multivariate cases; (ii) Theoretical and Sampling Distributions, (iii) Statistical Inference, (iv) Theory of Sample Surveys and (v) Theory of Design of Experiments; Uses of Statistical Package - SPSS.

Books Recommended

1 Programming with C Byron Gottfried, schaum. Series.

2 C Programming Balaguruswami.

3 Let us C by Kanitkar.

Reference Books:

1 Snedecor G.W and Cochran, W.G.: Statistical Methods.

2 Computer Organizations and C- Programming, William Gear, McGraw Hill Co.

3 Data structures and Program Design Robert L.Kruse, Prentice Hall of India.

PAPER-VI
PRACTICALS BASED ON PAPERS II, III AND IV

Duration: 4 Hours   Max Marks: 100

Practicals   : 70 Marks

Practical Record   : 15 Marks

Viva voce   : 15 Marks

List of Practicals

1 Calculation of central Moments, coefficient of variation, β_1, & β_2 and γ_1 & γ_2 coefficients, sheppard's correction to moments.

2 Fitting of Binomial distribution when p is known and when p is unknown.

3 Fitting of Poisson distribution when parameter is known and unknown.

4. Fitting of Normal and Negative binomial distributions.

5 Calculation of area under normal curves.

6 Correlation and regression coefficients for Bivariate frequency distributions.

7 Large sample tests.

8 Small sample tests viz Chi square, t, F and Z tests.

9 Bartlett's test for homogeneity of Variances.

10 Power curves for testing a simple hypothesis against a composite hypothesis (one sided and two sided),

11 Test of significance of sample correlation coefficient.

12 Sign, Median and Run tests for small and large samples.

13 Sequential probability Ratio Test and calculation of constants.

14 Analysis of CR Design.

15 Analysis of RB Design.

16 Analysis of L S Design.

17 Analysis of BIB Design.

18 Analysis of RBD, LSD with missing observations.

19 Yate's method for analysis of a factorial experiment.

20 Analysis of a confounded factorial experiment.

21 Analysis of split Plot Design.

22 Drawing of random samples from finite populations.

23 Drawing of random samples from Binomial and Normal populations.

24 Estimation of population mean and estimation of variance in SRS with and without replacement.

25 Estimation of mean and variance in stratified sampling under proportional and optimum allocations.

26 Gain in precision due to stratification.

27 Estimation of mean and variance in systematic sampling and comparison with SRS.

28 Estimation of mean and variance in cluster sampling and comparison with SRS.

29 Estimation of mean and variance by (i) ratio and (ii) regression methods of estimation.

30 Estimation of mean & variance in two stage sampling

31 Estimation in double sampling.

32 PPSWR selection of the sample and estimation.

Books for reference

1 Goulden C.H.   : Methods of statistical Analysis.

2 Snedecor G.W & : Statistical Methods.
   Cochran,W.G.

3 Laha and others : Hand Book of Methods of
                     Applied Statistics.

4. Singh, D and   : Theory and Analysis of sample
   Choudhary F.S   Survey Designs, Wiley
                     Eastern Ltd

M.A./M.Sc. FINAL EXAMINATION, 2005-2006

STATISTICS

PAPER-VII
MULTIVARIATE ANALYIS AND STATISTICAL INFERENCE

Time: 3 hours   **Max. Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set of covering all the five units and whose answers shall not exceed 500 words or five pages each question may have subparts in it and will carry 20 marks The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

Multivariate Analysis: Multivariate normal distribution and its properties, density function, marginal and Conditional distribution. Distribution of Quadratic forms.

Maximum likelihood estimators of the mean vector and covariance matrix, and related distributions.

UNIT-II

Hotelling's T_2 its properties and uses, Mahalanobis D_2, Wishart Distribution and its properties Classification of observations.

UNIT-III

Null and Non null distributions of partial and multiple correlation coefficients Multivariate central limit theorem and asymptotic distribution of $Z= \tanh^{-1} r$.

STATIST1CAL INFERENCE: Likelihood ratio test and its applications asymptotic distribution of the L. R. statistic.

UNIT-IV

Properties of Maximum Likelihood Estimators: Generalization of Cramer Rao Inequality for multi-parametric case.

UNIT-V

Complete family of probability distributions complete Statistics and minimal sufficiency, Lehmann scheffe theorem on minimum variance estimation.

Uniformly most powerful tests with one and more than one parameter, Unbiased ness, consistency and efficiency of tests, similar regions.

Relationship between notions of completeness and similarly unbiased tests.

Books Recommended

1   Anderson T.W.   : An Introduction to Multivariate statistical Analysis first seven Chapters.

2   Rao, C.R.   : Linear statistical Inference and its applications.

3   Kshirsagar, A.M : Multivartate Stat. Analysis.

4   Morrison   : Multivariate Stat. Methods

5   Kendall M.G.and : Advanced Theory of Statistics,
    Stuart, A.   Vol.II

6   Hogg, R.V.and   : Introduction to Mathematical
    Craig A.T.   Statistics

7   Kale B.K   : A first course in parametric inference, Narosa Publishing House, N. Delhi.

PAPER-VIII
DESIGN OF EXPERIMENTS AND THEORY OF SAMPLE SURVEYS-II

Duration: 3 Hours   **Max. Marks: 100**

Note : The question. Paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit. The answer of each Will not exceed 250 words or two and a half page. Each, question will be of 10 marks. The candidate will be Required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions win be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

DESIGN OF EXPERIEMNTS: Linear estimation Gauss Markoff theorem ,Testing of hypothesis (involving several linear functions, test of sub hypothesis and test involving equality of some of the parameters).

General theory of analysis of experimental designs, Designs for two way elimination of heterogeneity Desirable properties of a good Design: Orthoganality, Connectedness and Balanced ness Relation between blocks of incomplete block designs Resolvability and affine resolvability Theorem on bounds.

UNIT-II

Concept of association scheme with two associate classes, Definitions of partially balanced incomplete block design with two associate classes and relation among the parameters of PBIBD.

Group divisible design and its classification, Lattice and linked block designs intra block analysis Construction of complete set of mutually orthogonal Latin square for prime and prime powers. Construction and analysis of Youden square design.

UNIT-III

Simple methods of construction of BIB designs, Methods of obtaining residual and derived designs from SBIBD. Complementary design of a given design. Theory of sample surveys: Partition of sample space and definition of T classes of linear estimators. The wideness of set of seven classes of linear estimators. A unified approach to T_2 class of linear estimators Non sampling Errors, their sources and elimination.

UNIT-IV

Quenouille's Techniques of bias reduction and its application to Ratio type estimators, Hartley and Ross

Unbiased Ratio type estimator Ratio method of estimation in PPSWR sampling.

Ratio method of estimation under Midzuno's scheme of sampling when X is known.

Bivariate extension of the Ratio and Regression Methods of estimation when population means of auxiliary variables are known.

UNIT-V

Varying Probabilities without replacement: Horvitz-Thompson estimator and its variance, Yates and Grundy form of variance unbiased estimators of variance of Horvitz Thompson's estimators.

Rao Hartley Cochran sampling schemes and their estimation procedures. The theory of multi stage sampling with varying probabilities with and without replacement, Des Raj ordered estimators, Murthy's unordered estimators.

Books recommended :

1. Chakraborti M.C : Mathematics of Design and analysis.

2. Raghavarao D : Construction and Combinatorial Problems in Design of Experiments.

3. Cochran W.G.& : Experimental Designs. Cox G.M.

4   Sukhatme P.V &: Sampling Theory of surveys
    Sukhatme B.V   with Applications.

5   Tikkiwal B.D.   : Lecture notes on Advanced
                      Theory of sample surveys.

Reference Books :

1   Das M.N and   : Design and Analysis of
    Giri N.C.   Experiments.

2   Kempthorne, O. : The Design and Analysis of
                      Experiments.

3. Cochran W.G.   : Sampling Techniques.

4   Murthy M.N.   : Sampling theory and methods.

5   Des Raj   : Sampling Theory.

6   Mukhopadhyay,   : Theory and methods of survey
    P.   sampling.

PAPER-IX
OPERATIONS RESEARCH AND
STATISTICAL QUALITY CONTROL

Duration: 3 Hours,   **Max Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit. Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

Operations Research: Definition, scope and general nature of O.R. Different types of models - their construction and general method of solutions.

Linear Programming : Formulation of L.P problems, graphical method of solution, simplex method, Duality in Linear Programming.

Transportation and Assignment problems.

UNIT-II

Inventory Control: Deterministic Inventory models with at most one linear restriction and without restriction Probabilistic inventory models.

Queuing Theory: Examples of queuing processes, Models of queuing processes M/M/1 and M/M/S with Poisson arrivals; Exponential service time distribution, Length of queue and the queue discipline being F.I.F.O.

UNIT-III

Simulation: Definition, types, uses and limitations, phases of simulation model, Generation of random numbers, Monte Carlo simulation. Application to inventory control and queuing theory.

Statistical Quality Control: Meaning of specification limits, item quality, Process and Product Control, Objectives of S.Q.C., Control chart for measurable quality characteristic, Chance variation and assignable variation of a process.

Distribution of chance variates. Need for detection of assignable causes of Variation, $\overline{X}$ and R charts, Determination of control limits and central line in various situations.

UNIT-IV

Meaning of Statistical Control and its relation with specification limits, Modified control limits, warning limits and tolerance limits Rational sub grouping Control charts for Attributes: p, np and c charts.

Advantages of S.Q.C., comparison of X and R chart with p chart when both can be used for same situation.

Acceptance sampling by attributes, Need for sampling inspection, methods for acceptance. Lot quality and lot-by-lot acceptances A.Q.L., A.O.Q.L., producer's risk, consumer's risk, rectification, O.C function, A.S.N and average to inspection of an acceptance procedure.

UNIT-V

Single and double sampling plans and their mathematical analysis: Knowledge of standard sampling inspection tables Dodge and Romig table of Military standard 150. Sampling inspection plans for continuous production process where lots cannot be formed.

Sampling inspection plans by variables One-sided specification standard (known and unknown). Two sided specification (standard known).

Books Recommended :

1   Sharma S.D.   : Operating Research.

2   Gupta P.K.&   : Operations Research.
    Hira D.S.

3. Kanti Swarup : Operations Research.
   Gupta P.K.and
   Manmohan

4. Goel B.S & : Operations Research.
   Mittal, S.K.

5. Sasieni Yaspan : Operations Research
   & Friedman

6 Grant E.L.and : Statistical Quality Control
  Leavenworth, R.S.

7 Brooker and : Sampling Inspection by
  Goode   variables.

8 Burr.I.W. : Engineering Statistics and
            Quality Controls.

9 Montgomery : Statistical Quality Control
  D.C

10 M.Mahajan : Statistical Quality Control
              Dhanpat Rai & Co. Pvt. Ltd. Nai
              Sarak, Delhi.

PAPER-X
PRACTICALS BASED ON PAPER - VIII

Duration: 4 Hours   **Max. Marks: 100**

Practicals : 70 marks

Part I   Design of Experiments   : 3 Practicals

Part II   Theory of sample surveys   : 3 Practicals

   Practical Record   :   15 Marks

   Viva voce   :   15 Marks

Note : A candidate will have to attempt 3 Practicals in all taking at least one from each part.

List of Practicals

Design of Experiments

1 Testing of hypothesis regarding equality of some treatment effects in one and two way classifications.

2 Analysis of Incomplete Block Designs without specific form of C matrix

3 Group divisible designs.

4 Linked block designs.

5 Simple lattice designs with 2 or more replications.

6 Youden square designs.

Theory of sample surveys :

1   Horvitz and Thompson's procedure of estimating mean (total) of the population, variance of estimator and estimate of variance

2   Yate's and Grundy method.

3   Midzuno's sampling scheme.

4   Rao Hartley Cocharan schemes.

5   Two stage sampling method (a) f.s.u being select with pps with replacement (b) s.s.u with equal pro without replacement (c) Estimation of optimum number of f.s.u and s.s.u.

6. Hartley Ross unbiased Ratio method of estimation

7. Bivariate Extension of Ratio & regression method of estimation (Olkin's technique).

PAPER-XI
PRACTICALS BASED ON PAPER VII AND IX

Duration: 4 Hours   **Max Marks: 100**

Practicals   70 marks

Part I   Multivariate Analysis   25 Marks

Part Il   Statistical Quality Control   25 Marks

Part III   Operations Research   20 Marks

           Practical Record   15 Marks

           Viva voce   15 Marks

Note : A candidate will have to attempt 3 Practicals in all taking one from each part.

List of Practicals:

Multivariate Analysis:

1   Linear combination of correlated normal variates and evaluation of probabilities.

2   Estimation of mean vector and covariance matrix.

3   Testing of mean vector(s).

4   Estimation and testing of partial and multiple correlation coefficient.

5   Discriminant function.

Operations Research and Statistical Quality Control:

Practicals based on Paper IX

Note :

1. The dissertation shall contain review material giving a review of some recent papers in an area of study.

2. The project work shall be based on either primary data involving field work or secondary data. The candidate will be required to prepare Comprehensive and Critical reports on the same.

3 The faculty supervising the Dissertation / Project Work of a candidate shall be provided one hour per week towards his/her supervision.

OPTIONAL PAPERS

Any one of the following papers with the permission of the Department concerned.

PAPER-XII
NON-PARAMETRIC INFERENCE AND SEQUENTIAL ANALYSIS

Duration: 3 Hours   **Max. Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this Section, ten questions will be set taking two questions from each unit. Each question win be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit. The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and. whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

NON-PARAMETRIC INFERENCE

Order Statistics and their sampling distribution confidence interval estimates and hypothesis testing for population quantiles Tolerance limits for distribution and coverage's Kolymogrov smirnov and Chi square goodness of fit tests.Ordinary sign test and Wilcoxon signed rank test.

UNIT-II

Test for two sample problems, comparison of two distributions by Wald wolfowitz Runs test and Kolmogrov- smirnov test Median test for equality of locations and Mann whitney U test.

Linear ranks Statistics, its definition, probability distribution and usefulness in inference problems linear rank test for the location and scale problems.

UNIT-III

Ranks: Correlation between rank order Statistics and variates values, Treatment of ties ranks.

Tests for one sample problems: Run test for randomness. Tests based on the total number of runs and the length of the longest run.

Sequential estimation: Wald's equation, sequential estimation of mean of a normal population Wolfowitz Lower bounds to the variance of the sequential estimates, Robbins and stein's procedures, inverse binomial sampling.

UNIT-IV

Sequential Testing: Fundamental ideas about sequential procedures SPRT and its properties Fundamental identity of sequential analysis and its applications.

UNIT-V

Applications of SPRT ror testing simple hypothesis against simple alternative in case of exponential families.

Application of fundamental identity is finding O.C and A.S.N. functions.

Books Recommended :

1 Gibbons, J.D.   : Non-Parametric Statistical Inference.

2 Lehmann, E.L   : Testing Statistical Hypotheses.

3 Rohatgi, V.K   : An Introduction to Probability Theory and Mathematical Statistics (Chapter 4).

4 Rao, C.R.   : Linear statistical Inference and its Applications (Sec. 7c).

5 Wald, A   : Sequential Analysis (Chapters 4,6,7,8,9, 11).

PAPER-XIII
ADVANCED STATISTICS INFERENCE & RELIABILITY

Duration: 3 hours   **Max. Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit. Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

Advanced statistical Inference: Unified theory of linear estimation Estimation of variance components, variance components model MINQUE theory.

Admissibility of estimators: Basic theory of Admissibility and complete class, Admissibility of some commonly used estimators.

UNIT-II

Nature of Bayesian Inference, Baye's estimators for Quadratic and Convex Loss Functions Generalized Baye's Estimators, Asymptotic behavior of Baye's Estimators.

UNIT-III

Asymptotic relative Efficiency. Theoretical basis for calculating ARE, Examples of the calculation of efficiency and ARE.

Reliability: Reliability growth models probability plotting techniques for Basic ideas of accelerated life testing.

UNIT-IV

Reliability concepts and measures components and systems coherent systems reliability of coherent systems Life distributions reliability function hazard rate common life distributions exponential, Weibull, gamma etc Estimation of parameters and tests in these models.

UNIT-V

Notions of ageing IFR, IFRA, NBU DMRL and NBUE Classes and their duals. Uni-variate shock models and life distributions arising out of them.

Books Recommended :

1. Rao C.R. : Linear statistical Inference
   And   its Applications (2nd Edition,
             Chapter 4 pp.204 to 305)

2. Zacks, S. : The Theory of Statistical
             Inference (Wiley), Artoclcs 6. 1
             to 6.4 and 8. 1 to 8.5

Reference Books :

1. Barlow R.E. & : Statistical Theory of Reliability
   Proschan F.   and Life Testing; Rinehart and
   (1985)   Winston.

2. Lowless, J.F. : Statistical Models and Methods
   (1982)   of Life. Time Data; John Wiley

3. Bain L.J and : Statistical Analysis of Reliability
   Engelhardt (1991) and Life Testing Models; Marcel
                  Dekker

4. Nelson W (1982) : Applied Life Data analysis
                   John Wilev.

5. Zacks, S. : Reliability Theory; Springer.

PAPER-XIV
MATHEMATICAL ECONOMICS AND ECONOMETRICS

Duration: 3 Hours   **Max. Marks 100**

Note : The question paper will be divided 'into three Sections A, 8 and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit. The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT I

Mathematical Economics Use of Mathematics and Statistics in Economics Theory of consumer behavior, indifference curves, equilibrium, of exchange, family

budget enquiries, Angles curve, the derivation of slutsky's equation for 2 commodity, Elasticity relations in demand theory.

Nature of cost, Equalibrium of the firm: Pricing under' conditions of perfect competition and monopoly, Walrasion genral equilibrium of exchange, Leontiefs static input output analysis.

UNIT-II

Component of time' series Methods of their determination, variates difference method Yule slutsky effect Correlograrn analysis.

UNIT-III

Concept of structure and model: Theoretical models and decision models, Growth models of Harrod and D Mar, Mahalanobis model. The Pareto distribution, the lognormal distribution, Lorenz curve.

Econometrics : Meaning and scope of Economics, The classical least squares model, its assumptions and the properties of its estimators, Generalized least squares method.

UNIT-IV

Errors in variables. The treatment of Autocorrelation, disturbances in ordinary and distributed lag models. The problem of multicoilinearity, Identification problem in simultaneous equation models.

UNIT V

Simultaneous equation methods: Two stage least square estimators, limited information estimators, K-Class estimators, three stage least squares and full information maximum likelihood method.

Monte Carlo Studies: Empirical applications, of production function, consumption function, Engles curve.

Books Recommended

1	Klein, L.R.	: An Introduction to Econometrics
2	Allen R.G.D	: Mathematical Analysis for Economics.
3.	Chennery H B	: Inter Industrial Economics.
4	Gicks	: Value and Capital
5	Wold H	: Demand Analysis
6	Baumol W.J.	: Economic Dynamics.
7	Johnson J	: Econometric Methods 3rd Ed.
8	Goldberger A.S.	: Econometric Theory
9	Crist C.R.	: Econometric Models and Methods
10	Klein L.R.	: Text Book of Econometrics
11	Rao P. and Miller R.L.	: Applied Econometrics

PAPER-XV
ECONOMIC STATISTICS AND DEMOGRAPHY

Duration: 3 Hours　　　　**Max Marks: 100**

Note : The question paper will be divided into three Sections A. B and C as follows:

Section A : In this section ten questions will be set taking two questions from each unit. Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section ten questions will be set taking two questions from each unit. The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT I

Economic Statistics: Components of time series Methods of their determination, variates difference e method Yule slutsky effect Correlogram, Autoregressive models of first and second order Periodograrn analysis.

UNIT II

Income distribution Pareto and Engel curves, Concentration curve Methods of estimating national income Intersectoral flows, Inter Industry table

UNIT-III

Index numbers of prices and quantities and their relative Merits, Construction of index numbers of wholesale and consumer prices.

Demography: Census and Vital Statistics data, Vital Rates and ratios, standardization of rates, trends and differentials in mortality and fertility.

UNIT IV

Stationary population. construction of life table, gross and net reproduction rates: stable population theory, population estimation and projection.

Demographic trends in India. Labors force analysis, birth and death, stochastic processes.

UNIT - V

Stochastic population models, logistic models, bivariate growth models, migration models, fertility analysis models, mortaility analysis models.

Books Recommended:

1. Croxton Cowden and Klein : Applied General Statistics

2. Goon Gupta & Dasgupta : Fundamentals of Statistics VOL II

3. Kendall & Stuart : Advanced Theory of Statistics Vol. II

4. Ganguly and others : Studies in Consumer's Behavior.

5. Chennery H.B. : Inter Industrial Economics

6. Asthana & Srivastava : Applied Statistics of India

7. Cox : Demography

8. Barclay : Techniques of population Analysis

9. Kamitakar & Bhende : Principles of Populations studies.

PAPER-XVI
STOCHASTIC PROCESSES AND
INFORMATION THEORY

Duration: 3 Hours   **Max. Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and. a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions win be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT I

Stochastic Processes Markov chain with stationary transition probabilities properties of transition functions Classification of states stationary distribution of a

Markov chain existence and uniqueness convergence to the stationary distribution.

UNIT II

Markov pure jump processes Poisson process Birth and death process.

Second order processes mean and covariance function Gaussian and Wiener process.

UNIT III

Stochastic differential equations estimation theory and spectral distribution.

Information Theory: A quantitative measure of information discrete memory less channel the entropy function conditional joint and marginal entropy and relation between them redundancy efficiency and channel capacity.

UNIT IV

B.S.C. and B.E.C. elements of encoding unique decipherability and noiseless coding theorem, minimum distance principle and parity check coding.

UNIT V

Shanon Fano encoding Shanon's binary encoding Huffman's code error correcting codes.

Books Recommended

1. Hoel P.G., Port S.C. and Stone, C.J. : Introduction to stochastic processes

2. Feller W. : An Introduction to Probability Theory and its Applications Vol.- 1, Chapters XI-XV.

3. Bailey N.T.J. : The Elements of stochastic Processes.

4. Takacs : Stochastic Processes Chapters I and II.

5. Ash, R. : Information Theory.

6. Reza, F.M. : An Introduction to Information Theory

7. Hancocd : Principles of communication Theory.

PAPER-XVII
ADVANCED SAMPLING THEORY AND ADVANCED DESIGN OF EXPERIMENTS

Duration: 3 Hours   **Max Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all, taking one question from each unit (aggregating 50 marks).

Section C : In this section, four questions will be se covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT I

Theory of Sample Surveys: Theory of uni-variate successive sampling on occasions and its applications. Stratification problems, sufficiency in sampling theory and its application to improve classical SRSWR estimator, sukhatme, Tukey and Robson's main results on symmetric Functions and Polykays.

UNIT -II

Variance estimation method of random groups, balanced half samples (IPNSS), Jack knife method, Introduction to super population models.

UNIT - III

Small area estimation: Issues in small area estimation, synthetic and generalized regression estimators. Design of Experiments: Galoi's field of order pm, Method of construction of minimum function for, generating the elements of GF (p^m).

Orthogonal Array Properties construction of orthogonal arrays of index unity.

UNIT IV

Pair wise balanced designs Applications of pair wise balanced designs in the construction of Mutually Orthogonal Latin square (MOLs), Falsity of Euler's conjecture.

Balanced incomplete block (BIB) designs Construction of BIB designs through the method of symmetrically repeated differences, Kronecker product designs, Duals of incomplete block designs. Duals of asymmetrical BIB designs with $\lambda=1$ or $\lambda=2$.

UNIT V

Partially balanced incomplete block (PBIB). Designs with two associate classes Group divisible, Triangular and Latin square type designs, Simple methods of their construction, Analysis with recovery of inter block of PBIB designs.

Construction of confounded factorial experiments balancing in factorial experiments fractional replications.

Books recommended:

1	Chakroborti, M.C.	:	Mathematics of Design and Analysis of Experiments.
2	Raghavarao, D.	:	Constructions and Combinatorial Problems in Design of Experiments
3	Kempthome,O.	:	Design and Analysis of Experiments
4	Sukhatma P.V. & Sukhatme B.V. et al	:	Sampling Theory of surveys with Applications
5	Pathak	:	Lecture Notes.
6	Choudheirl, Arijit & Stenger Horst	:	Survey sampling Theory & Methods
7	Mukhopadhyay, P.	:	Small area estimation in survey sampling

PAPER-XVIII
COMPUTER INTENSIVE STATISTICALMETHODS-I, KNOWLEDGE DISCOVERY AND DATA MINING.

Duration: 3 Hours   **Max Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section, ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all. the questions (aggregating 10 marks).

Section B : In this section, ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page.Each question will be of 10 marks. The candidate will. be required to attempt five questions in all taking one, question. From each unit (aggregating 50 marks).

Section C : In this section, four questions will be. set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT-I

Computer Intensive statistical Methods I : Exploratory data analysis : transforming data, graphical methods of clustering, outlers.

Linear regression : influential observations and diagnostics robust methods collinearity variable selection logistic regression.

Nonlinear regression : estimation hypothesis testing goodness of fit EM algorithm: application to missing and incomte data problems mixture models.

UNIT II

Generalized linear models :exponential families and ML estimation analysis of deviance and variable selection logistic regression.

Nonlinear regression : estimation hypothesis testing goodness of fit EM algorithm :applications to missing and incomplete data problems mixture models.

UNIT III

Smoothing with kernels : density estimation simple nonparametric regression. Knowledge discovery and Data Mining: Review of classification methods from multivariate analysis classification and decision trees.

Clustering methods from both statistical and data mining view point vector quantization.

UNIT IV

Unsupervised learning from univariate and multivariate data dimension reduction and feature selection.

Supervised learning from moderate to high dimensional input spaces artificial neural networks and extensions of regression models regression trees.

UNIT V

Introduction to databases: Including simple relational databases data warehouses and introduction to nonline analytical data processing.

Association rules and prediction data attributes applications to. electronic commerce.

Reference Books :

1   R. Gnanadesikan: Methods for statistical Data
    (1997)   Analysis of Multivariate
                         Observations second edition
                         Wiley

2   D.A. Belsley,   : Regression Diagnostics Wiley.
    E.Kuh and R.E.
    WeIsch (1980)

3   P.McCullagh and : Generalized Linear Models Third
    J.A. Nelder (1999)   edition. Champman and Hall.

4   G.E.F.seber and : Nonlinear Regression Wiley.
    C.J. Wild (1989)

5   G.J.McLachlan &: The EM Algorithms and
    Krishnan (1997)   Extensions. Wiley.

6   J.S.slmonoff   : Smoothing Methods in
    (1996)   Statistics. Springer.

7   A.Berson and   : Data Warehousing Data Mining
    S.J. Smith (1997) and OLAP. McGrawHill.

8   L.Breiman J.H.   : Classification and Regression
        Friedman, R.A.

Trees, Wadsworth and Brooks/

Olshen and C.J.   Cole.
    stone(1984)

9   J.Han and M.   : Concepts and Techniques
    Kamber Morgan   Mining : Gaufmann.
    Data (2000)

10 T.M.Mitchell   : Machine Learning McGrawHill.
    (1997)

11 B.D.Ripley   : Pattern Recognition and Neural
    (1996)   Networks Cambridge University
                       Press.

PAPER-XIX
COMPUTER INTENSIVE STATISTICAL PAIETHODS II & STATISTICAL PATTERN RECOGNITION

Duration: 3 Hours   **Max Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section ten questions will be set taking two questions from each unit. Each question will be of short answer type riot exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions,(aggregating 10 marks

Section B : In this section ten questions will be set taking two questions from each unit. The answer of each win not exceeds 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all taking one question from each unit (aggregating 50 marks).

Section C : In this, section four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will. carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks).

UNIT I

Computer Intensive statistical Methods II : stochastic simulation : generating random variables simulating multivariate distributions, simulating stochastic processes such as simple queues.

Variance reduction: importance sampling for integration control varieties and antithetic variables.

UNIT-II

Markov Chain Monte Carlo methods: Gibbs sampling for multivariate simulation simulated annealing for optimization.

Simulation based testing: simulating test Statistics and power functions permutation tests.

UNIT-III

Bootstrap methods: resampling paradigms, bias and standard errors confidence intervals bootstrapping in regression.

Jackknife and cross validation: Jackknife in sample surveys, cross validation for tuning parameters.

UNIT-IV

Statistical Pattern Recognition: Linear classifiers: Linear discriminant function (LDF. for minimum squared error LDF for binary outputs perception learning algorithms.

Nearest neighbor decision rules: description convergence, finite sample considerations use of branch and bound methods.

UNIT-V

Probability of errors: Two classes normal distributions equal covariance matrix assumptions chernoff bounds and Bhattacharya distance estimation of probability of error.

Feature selection and extraction: interclass distance measures discriminant analysis probabilistic distance measures principal components.

Reference Books :

1   G.S.Fishman   : Monte Carlo : Concepts, Algori-
    (1996)   thms and Applications Springer

2   R.Y.Rubinstein : Simulation and the Monte Carlo
    (1981)   Method Wiley.

3   M.A.Tanner   : Tools for statistical Inference,
    (1996)   Third edition, Springer.

4   B. Efron and   : An Introduction to k1the
    R.J. Tibshirani Bootstrap. Champman and Hall.
    (1993)

5   J. Shao and   : The Jackknife and the Bootstrap
    D.Tu (1995)   springer Verlag.

6   R.O. Duda and : Pattern Recognitlion and scene
    P.E. Hart (1973) Analysis Wiley.

7   K.Fukunaga   : Introduction to statistical
    (1990)   Pattern Recognitlion, Second
                     Edition Academic Press.

8   G.J.Mclachlan : Discriminant, Analysis and
    (1992)   Statistical Pattern Recognitlion
                     Wiley.

9   B.D.Ripley   : Pattern Recognitlion and Neural
    (1996)   Networks Cambridge University
                     Press.

PAPER-XX
SURVIVAL ANALYSIS AND STATISTICAL ECOLOGY

Duration: 3 Hours　　　　　　**Max Marks: 100**

Note : The question paper will be divided into three Sections A, B and C as follows:

Section A : In this section ten questions will be set taking two questions from each unit Each question will be of short answer type not exceeding 20 words and will carry 1 mark. The candidate will be required to attempt all the questions (aggregating 10 marks).

Section B : In this section ten questions will be set taking two questions from each unit The answer of each will not exceed 250 words or two and a half page. Each question will be of 10 marks. The candidate will be required to attempt five questions in all taking one question from each unit (aggregating 50 marks).

Section C : In, this section four questions will be set covering all the five units and whose answers shall not exceed 500 words or five pages. Each question may have subparts in it and will carry 20 marks. The candidate will be required to attempt any two questions (aggregating 40 marks)

UNIT-I

Survival Analysis: Concepts of time, Order and random Censoring likelihood in these cases Life distributions.

Exponential Gamma Weibull Lognormal Pareto Linear Failure rate parametric inference (Point estimation, Confidence intervals Scores, LR MLE tests, Rao WillksWaid for these distributions).

Life tables, failure rate mean residual life and their elementary properties Ageing classes and their properties Bathtub Failure rate.

UNIT-II

Estimation of survival function Acturial Estimator, Kaplan Meier Estimator, Estimation under the assumption of IFR/DFR.

Tests of exponentiality against non parametric classes Total time on test Deshpande test.

Two sample problem Gehan test Log rank test Mantel Haenszel test Tarone Ware tests.

UNIT III

Semi parametric regression for failure rate Cox's proportional hazards model with one and several convarliates Rank test for the regression coefficients.

Competing risk model, parametric and non parametric inference for this model.

Multiple decrement life table.

UNIT-IV

Statistical Ecology: Introduction to Ecology and evolution, Population dynamic : single species

Exponential logistic and Gompertz models, Leslie matrix model for age and stage structured population, Survivorship curves coexistence monotone and bath tub shaped rates.

Two species : Lotka Volterra equations isoclines competition and coexistence, predator pray oscillations.

Abundance estimation : Capture recapture Nearest neighbour line transect sampling, indirect methods.

UNIT-V

Ecological Diversity : species, abundance curve Indices of diversity, simpson's index shannon Wiener index, Diversity as average rarity.

Harvesting renewable biological resources Maximum sustainable yield trangedy of the commons.

Game theory in ecology Evolutionality stable strategy its properties simple games such as Hawk Dove game.

Foraging theory :Optimal foraging diet choice mean variance trade off.

Reference Books

1   Cox D.R. and Oakes D. (1984) : Analysis of survival Data Chapman and Hall New York.

2. Gross A.J and Clark, V.A.(1975) : Survival Distribution: Reliability applications in the Biomedical Sciences, John wiley and sons.

3. Wlandt Johnson R.E, Johnson R.L. : Survival Models and Data Analysis, John Wiley and Sons.

4. Miler R.G (1981) : Survival Analysis John Wiley.

5   Kalbfieisch J.D.& Prentice R.L (1980) : The statistical Analysis of Failure. Time Data, John Wiley.

6   Anil Gore and S.A. Paranjpe (2000) : A course on Mathematical and Statistical Ecology (Kluwer)

7   Clark C.W. (1976) : Mathematical Bioeconomics : Optimal Management of Renewable Resources.Wiley.

8   Maynard Smith, J. (1982) : Evolution and the Theory of Games (Cambridge Press).

9   Pielou E.C (1977) : An Introduction to Mathematical Ecology (Wiley).

10 Seber G.A.F. (1982) : Estimation of Animal udance and Related Parameters (Charles Griffiri).

11 Stephens D.W Krebs J.R (1986) : Foraging Theory Princeton (University Press)

PAPER - XXI
DESSERTATION/PROJECT WORK AND VIVA VOCE

Max Marks: 100

The distribution of marks wfll be as follows

Dissertation/Project Work   50 Marks

Viva voce   30 Marks

Regular Assessment   20 Marks

Note:

i)   The dissertation shall generally contain material giving a review of some recent papers in an area of study.

ii) The project work shall be based on either primary data involving field work or secondary data. The candidate will be required to prepare a critical report on the same.

Mohanlal Sukhadia University
Udaipur (Raj.)

Syllabus

Scheme of Examination and Courses of Study

(Common for the Faculties of Arts & Science)

M.A./M.Sc. STATISTICS

Previous Examination : 2004-2005

Final Examination   : 2005-2006

Edition : 2004   **Price : Rs.20/-**

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100

M.A./M.Sc. STATISTICS - 2004 - 100