

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Part-I) Statistics

Effective From: 2002-03 – 2003-04

Paper No.	Title of the paper	Marks			Work load / week
		Int.	Ext.	Total	
Paper- I	Real Analysis and Probability	18	42	60	3L + 1T
Paper II	Univariate Distributions & Estimation Theory	18	42	60	3L + 1T
Paper III	Linear Algebra & Multivariate Analysis	18	42	60	3L + 1T
Paper IV	Sample Survey & Stochastic Processes	18	42	60	3L + 1T
Paper V	Computer Programming & Quality Control	18	42	60	3L + 1T
Practical : Paper 1	Practicals based on Numerical Analysis, Papers II, III & IV	15	35	50	6 hours
Practical : Paper 2	Computer Programming & Applications	15	35	50	6 hours
Viva – Voce		15	35	50	
Project		50		50	

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Part-I) Statistics

Paper I Real Analysis and Probability

Section A : REAL ANALYSIS

Recap of elements of set-theory and Real number system. Limits of sequences of sets. Classes of sets: Semirings, rings, fields, o-rings, o-fields. Monotone, classes. Generated classes, Borel σ -field of \mathbb{R} and \mathbb{R}^k .

Finitely additive and σ -additive set functions. Measures, properties of measures. Caratheodory extension theorem (statement only) . Application of Caratheodory extension theorem to the construction of Lebesgue and Lebesgue- Stieltjes measures through distribution functions.

Measurable space, simple functions, Measurable function. Borel measurable functions. Convergence in measure and almost everywhere convergence.

Integration of measurable function with respect to a given measure. Elementary properties of integral. Monotone convergence theorem. Absolute continuity and singularity of measures. Statements (without proof) of 'Lebesgue Decomposition theorem' and the Radon – 'Nikodym theorem'.

REFERENCES

1. Ash, Robert (1972) : Real Analysis and Probability, Academic Press.
2. Halmos, P.R. (19) : Measure Theory, McGraw Hill.
3. Kingman, JFC and Taylor, S.J. (1966) : Introduction to Measure and Probability, Cambridge Univ. Press.
4. Billingsley, C.W. (19) : Measure, Integration and Probability.

Section B : PROBABILITY THEORY

Probability spaces. Random variables and random vectors. Expectations. Moments. Holder's inequality, Minkowski's inequality, Sturztz inequality, Markov's inequality, Jensen's inequality.

Distribution of a random variable. Distribution function, joint distribution function. Decomposition of a d.f. in its discrete and continuous and continuous singular parts.

Weak convergence of sequences of distribution functions. The weak compactness theorem. Characteristic functions and their properties. Inversion theorem. Uniqueness theorem. Continuity theorem (statement only). Convolution of distribution functions. Characteristic function of convolution in terms of its components.

Independence of events. Independence of classes and independence of random variables. The multiplication theorem. Borel - Cantelli lemma, Borel zero-one law. Sequence of independent random variables. Tail σ -field. Kolmogorov zero-one law.

Convergence of sequences of random variables in distribution, in probability, in r th mean, and with probability one. Inter – relationships amongst these models of convergence.

Weak law of Large numbers, Kolmogorov's inequality, Kolmogorov's strong law of large numbers.

The Central limit theorem. Liapunov's theorem. Statement of Lindberg- Feller theorem. Conditional Expectations and their properties.

REFERENCES

1. Loeve, M. : Probability theory.
2. Burrill, C.W. (19) : Measure, Integration and Probability.
3. Ash, Robert (1972) : Real Analysis and Probability, Academic press.
4. Chang, K.L.: A Course in Probability Theory.
5. Dudley, R.M. (1989) : Real Analysis and Probability, wadsworth & Brooks.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Part-I) Statistics

Paper II

Univariate Distributions & Estimation Theory

Section A : UNIVERIARE DISTRIBUTIONS

Laplace, Lognormal and Cauchy distributions: Idea of truncated dioributions Truncated Poisson and Normal distributions.

Univariate compound distribution: Contagious distributions: Neyman type-A, Poisson-Binomial and Poisson –Negative Binomial distribution: Univariate Power series distributions.

Non-central distribution : Non-central chi square, t and f distribution.

Ordered statistics, their distributions and Properties, distribution of r

REFERENCES

1. N. L. johnson and S.Kotz: Distributions in Statistics, John wiley (1977).
2. M. Fioz: Probability Theory and Mathematical Statistics, John wiley (1963)
3. V.K.Rohatgi: An Introduction to Probability Theory and Mathematical statistics, John wiley (1973)
4. M.C.Jaiswal : Statistical Distributions (in Gujarati), University Book Publication Biard (1973)
5. J.K.Patel et al. : handbook of statistics Distributions, Marcet Dekker (1976).
6. A.M.Mood, F.Graybill and D.C.Boes: Introduction to the theory of statistics, McGraw Hill, Kogakusha Pub. Co. (1974)

Section B

STATISTICAL INFERENCE I (THEORY OF ESTIMATION)

Different measures of closeness of an estimator : Pitman's closeness. Some desirable Properties of estimators: Consistency, Unbiasedness and Efficiency: BAN estimators.

Sufficient statistics, factorization theorem for discrete case, Exponential families of distributions, Minimal sufficient statistics, complete suffcient statistics, Rao-Blackwell theorem.

Minimum variance unbiased estimation: Lower bound of variance of an unbiased estimator, Cramar–Rao inequality, Minimum variance bound unbiased estimators, Chapman-Robbins inequality, Bhattacharya bounds, Lehmann –Scheffe theorem, Estimation in Exponential families of distributions.

Maximum likelihood estimator and its properties. Method of maximum likelihood, other methods of estimation: Method of moments, Method of minimum chi-square, Method of modified minimum chi squares, Location invariance and scale invariance, Pitman estimators for location and scale parameters.

Confidence intervals, Methods of finding confidence interval, Large sample confidence intervals, confidence intervals for parameters of elementary distributions, confidence bounds of fixed lehgh, Stein's two –stage procedure.

REFERENCES

1. V.K.Rohatagi : An Introduction to Probability theory and Mathematical Statistics
2. C.R.Rao: Linear Statistical Inference and its Applications, John Wiley (1973)
3. A.M.Mood, F.Graybill and D.C.Boes: Introduction to the Theory of Statistics, McGraw Hill, Kogakusha Pub. Co. (1974).
4. E.L.Lehmann: Theory of Point Estimation, John wiley (1983)
5. T.S.Ferguson : Mathematical Statistics : A Decision Theoretic Approach, Academic Press (1967).
6. S. Zacks: Theory of Statistical Inference. John wiley (1971)

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Part-I) Statistics

Paper III

Linear Algebra & Multivariate Analysis

Section A : LINEAR ALGEBRA

Fields, Vector Spaces, subspaces, linear dependence and independence, basis and dimension of a vector space, finite dimensional vector space, completion theorem, examples of vector spaces over real and complex fields, linear equations.

Vector spaces with an inner product, Gram-Schmidt orthogonalization process, orthogonal basis and orthonormal basis and orthogonal projection of a vector.

Linear transformations, algebra of matrices, symmetric, skew-symmetric, Hermitian, skew-hermitian, orthogonal, unitary and normal matrices, row and column spaces of a matrix, elementary matrices, Kronecker products.

Hermite canonical form generalized inverses, Moore-penrose generalized inverse, idempotent matrices, solutions of matrix equations.

Real quadratic forms, reduction and classification of quadratic forms, index and signature, triangular reduction of a positive definite matrix.

Characteristic roots and vectors, properties of characteristic roots and vectors of a real symmetric, hermitian, skew-hermitian orthogonal, unitary and normal matrices, Cayley-Hamilton theorem, minimal polynomial, similar matrices, orthogonal and unitary similarity, Jacobi's theorem, algebraic and geometric multiplicity of a characteristic root, spectral decomposition of a real symmetric matrix, simultaneous reduction of a pair of real symmetric matrices, Hermitian forms.

Singular values and singular value decomposition, jordan decomposition, extrema of quadratic forms, vector and matrix differentiation,

REFERENCES

1. Gralbill, F. A. (1983) : Matrices with applications in Statistics; 2nd . Ed., wadsworth.
2. Rao, C.R. (1973) : Linear Statistical Inference and its application; 2nd Ed., John wiley and Sons, Inc.
3. Sear lc, S.R. (1932) : Matrix algebra useful for statistics, John wiley and Sons, Inc.
4. Rao, A.R. and Bhimasankaram, P. (1992) : Linear algebra; Tata McGraw Hill Pub.Co. Ltd.

Additional Books:

1. Bellman, R. (1970) : Introduction to matrix analysis; 2nd . Ed., McGraw Hill.
2. Biswas, S. (1984) : Topics in algebra of matrices ; Academic pub.
3. Hadley, G. (1987) : Linear algebra; Narosa Pub. House.
4. Halmos, P.R. (1958): Finite dimensional vector spaces; 2nd Ed., D. Van Nostrard Co. Inc.
5. Hoffman, K. and Kunze, R. (1971) : Linear algebra, 2nd Ed., Prentice Hall, Inc.
6. Rao, C.R. and Mitra, S.K. (1971) : Generalized inverse of matrices and its application; John wiley and Sons, Inc.

Section B : MULTIVERIATE ANALYSIS

Multivariate distributions: Multinomial distribution, Marginal and Conditional distributions, Characteristic function. Multivariate Normal distribution, Characteristic function, Marginal and conditional distributions, Distribution of linear function. Distribution of sample mean vector.

Wishart Distribution : pdf of wishart distribution, properties of Wishart distribution : Additive property, marginal distribution,

Distribution of $\mathbf{H}^{-1}\mathbf{w}/\mathbf{h}'\Sigma\mathbf{h}$, $\mathbf{h}'\Sigma^{-1}\mathbf{h}/\mathbf{h}'\mathbf{w}^{-1}\mathbf{h}$, Characteristic function. Distribution of sample generalised variance. Null and Non – null distribution of sample correlation coefficient r . Definition of Multiple and partial correlation coefficients. Null distributions of sample multiple and partial correlation coefficients. Application in testing and Interval estimation.

Hotelling T^2 statistic. Null distribution of T^2 Application in tests on mean vector for one and more multivariate normal populations and in testing equality of the components of mean vector (Problem of symmetry).

Multivariate Analysis of variance: (MANOVA) : One way classification problem and use of wilk's Λ criterion.

Classification Problem and Fisher's linear discriminant function, Probabilities of misclassification, Classification with more than Two multivariate normal populations.

Definition, use and computational method of principal components and canonical variables and canonical correlations,

REFERENCES

1. Anderson, T. W. (1983) : An Introduction to Multivariate Statistical Analysis; John Wiley.
2. Johnson and Wichern (1992): Applied Multivariate Statistical Analysis.
3. Khirsagar, A. M. (1972) : Multivariate Analysis; Marcel Dekker.
4. Morrison, D.F. (1976) : Multivariate Statistical Methods, McGraw Hill.
5. Muirhead, R.J. (1982) : Abstracts of Multivariate Statistical theory ; John wiley.
6. Seber, G.A.F. (1984) : Multivariate Observations : John wiley.
7. Srivastava and Khatri (1979) : An Introduction to Multivariate Statistics : North Holland.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Part-I) Statistics

Paper IV

Samle Surveys & Stochastic Processes

Section A : Sample Survey

Concept of population, samples, sampling frame and sampling design, sampling strategy, Simple random sampling Probability Proportional to size sampling (with and without replacement) , Stratified sampling, systematic sampling and cluster sampling (with equal and unequal cluster sizes), Two – stage sampling and its generalisation.

Use of auxiliary information at estimation stage: ratio, product, difference and regression estimators, Sen-Midzuno sampling scheme and unbiased ratio estimators, Hortlay –Ross unbiased ratio type estimators : Two phase sampling for ratio and regression estimators.

Books for Referenc:

1. Cochral, W.G.: Sampling Techniques; Ed. III, Johne Wiley & Sons, New york, 1977.
2. Des Raj and P.Chandroak: (19998) Sampling Theory; Narosa Publication.
3. Murthy, M.N. (1977s) : Sampling theory, Stat. Pub. House, Kolkata.
4. Sukhatme at al. (1984) : Sampling Theory with Application ; Ed. III, Iowa State Univ. Press, Iowa and Indian Society of Agricultural Statistics, New Delhi.
5. Chaudhary, A. and JWE Vos (1988) : Unified theory and strategies of survey sampling, North Holland, Amsterdam.

Section B 2: Stochastic Processes

Markov chain with finite and countable state space, Classification of stated, limiting behaviour of n-step transition probabilities, stationary disribution; Random walks, Gambler's ruin. Markov Processes in continuous time (Poisson Process, Birth and death processes).

Queueing Theory: Definition, Characteristics of a queueing system, Poisson Process and Exponential distribution, Classification of queues, Detailed study of M/M./1 and M/M/C queueing models.

REFERENCES

1. Karlin, S. (1975) : A First Course in Stochastic Processes; 2 nd., Academic Press.
2. Parzen,E.(1960): Stochastic Processes: Holden-Day.
3. Feller, W. (1968): An Introduction to Probability Theory and its Application: Vol.I, 3rd Ed., John wiley.
4. Hoel, P.G., Port, S. C. and Stone, C. J. (1972): Introduction to Stochastic Processes; Horeghton Miffin.
5. K. Swarup, P.K.Gupta and Man Mohan : Operations Research, S. Chand & Co., New Delhi.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. (Part-I) Statistics

Paper -V

Computer Programming & Quality Control

Section A :Programming Language – “C”

1. Introduction
 - 1.1 Algorithms and Flowchart
 - 1.2 Types of Languages
 - 1.3 Introduction to C Language
2. C Fundamentals
 - 2.1 Identifiers
 - 2.2 Data Types
 - 2.3 Constants and Variables
 - 2.4 Arrays
3. Operators and Expressions
 - 3.1 Arithmetic Operators
 - 3.2 Unary Operators
 - 3.3 Relations Operators
 - 3.4 Logical Operators
 - 3.5 Assignment Operators
 - 3.6 Conditional Operators
 - 3.7 Library Functions
 - 3.8 Expressions
 - 3.9 Evaluation of Expression
4. Data Input and Output
 - 4.1 Single Character input and output
 - 4.2 The scanf function
 - 4.3 The printf function
 - 4.4 Gets and Puts functions
5. Control statements
 - 5.1 The While Statement
 - 5.2 do-while statement
 - 5.3 for statement
 - 5.4 if – else statement
 - 5.5 switch statement
 - 5.6 break statement
 - 5.7 continue statement
 - 5.8 goto statement
6. Functions
 - 6.1 Introduction to functions
 - 6.2 Function definition
 - 6.3 Accessing function
 - 6.4 Passing arguments to function
 - 6.5 Recursive function

7. Arrays
 - 7.1 Defining an array
 - 7.2 Processing an array
 - 7.3 Multi dimensional arrays
 - 7.4 Passing array to a function
 - 7.5 Arrays and Strings
8. Structures and Unions
 - 8.1 Defining a structure
 - 8.2 Processing a structure
 - 8.3 Unions

Reference Books

1. C programming Language – karnighan & Ritchie – TMH
2. ‘C’ Odyssey 6th Volume – Vijay Mukhi – PHI
3. Programming in ‘C’ – Stephan Kochan – CBS
4. Mastering turbo C- Kelly and Bootle – BPB
5. C language Programming Byron Gottfried – TMH

Section B QUALITY CONTROL

Quality Control : Review of :

Quality and Statistical Quality control concept
 Control Charts for Measurements
 Control Charts for Attributes
 Acceptance sampling Plans for Attributes

 Cusum Charts
 Standard Plans for Attributes
 Plan for Acceptance Sampling by Measurement
 Concept of Total Quality Management (TQM)
 Accelerating use of TQM
 Service Quality vs Product Quality
 Productivity and Quality
 The Leverage of Productivity and Quality
 management Systems vs Technology
 basic Measures of Productivity
 The Cost of Quality
 Cost of Quality Defined
 Different views of Quality Costs
 Quality Costs and its Measurement
 Criteria for Quality Programs
 ISO 9000 and onwards

Reliability:

Basic concepts and distributions for product life, failure rate. Hazard function, Reliability function for Exponential, Normal, Log-normal. Weibull and Gamma Distributions. Analysis of Complete Data. Linear analysis and Maximum Likelihood analysis of Censored data for exponential distribution only. Introduction of Bayes Methods in Reliability. Accelerated life testing and System reliability.

REFERENCE BOOKS

1. A. G. Hopper : Basic Statistical Quality Control; McGraw Hill, London.
2. R. C. Gupta: Statistical Quality Control; Khanna Publishers, New Delhi.
3. T.P.Ryan : Statistical methods for Quality Improvement ; John wiley & Sons.
4. V. K. Omachonu and J.E.Ross: Principles of Total Quality: S. Chand & Co., New Delhi.
5. S. K. Sinha : Reliability and Life Testing ; Wiley Estern Ltd, New Delhi.
6. I. Bazovksy : Reliability Theory and Practice; Prentice hall International Series in Enginnering.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Paper VI

Testing of Hypotheses & Decision Theory

Section A:(TESTING OF HYPOTHESIS)

Stating the problem of testing of hypotheses as a special case of general decision problem. Simple and composite hypotheses, Critical function and critical region, randomised test, non –randomised test, size of the test, Power function of a test. Generalised Neyman –Pearson’s Lemma, Most Powerful test and Uniformly most Powerful test. UMP tests for families of distributions admitting monotone likelihood ratio, two sided hypothesis, use of least favourable distribution. Likelihood ratio test for simple and composite hypotheses.

Unbiasedness for testing of hypotheses. Similar test, relationship with UMP unbiased test, UMP similar test and its application to one parameter exponential family, Similarity and completeness, tests with Neyman structure, UMP unbiased tests for multiparameter exponential families, Locally most Powerful unbiased tests.

Invariance in testing of hypotheses, maximal invariant test, most powerful invariant test, unbiasedness and invariance.

Sequential testing of hypotheses, Wald’s sequential probability ratio test (SPRT), Properties of SPRT, approximate bounds, OC and ASN functions Efficiency of SPRT, Fundamental identity of sequential analysis and its use to obtain OC and ASN functions of SPRT.

REFERENCES

1. T.S.Ferguson : Mathematical Statistics, Academic Press, (1967).
2. M.G. Kendall and A. Stuart: The Advanced Theory of Statistics, Vol. 2. Ed. IV, Charles and Griffin, (1960).
3. E.L.Lehman : Testing Statistical Hypotheses, Wiley eastern, (1976).
4. A. Mood, F. A.Frabil and D.C.Boes: Introduction to the Theory of Statistics, McGraw Hills, International Student Ed. III, (1974).
5. C.R.Rao: Linear Statistical Inference and its Applications, Wiley Eastern, EdII, (1973).
6. Sddney Segial: Nonparametric Methods for Behavioral Sciences, McGraw Hill (1956).
7. S. Wilks: Mathematical Statistics, Wiley New york Ed. II, (1962).
8. S. Zacks: The Theory of Statistical Inference, Wiley New york, (1971)

Section B : (DECISION THEORY)

Review of basic elements of statistical decision problem. Various inference problems viewed as decision problems. Randomization, Optimal decision rules. Bayes and minimax decision rules. Geometric interpretation for finite parameter space. Generalized Bayes and extended Bayes rules.

Natural ordering of decision rules. Complete and essentially complete classes of decision rules. Admissibility of Bayes rules. Existence of Bayes decision rules and of Minimax complete class when parameter space is finite and the risk set is closed and bounded from below.

Invariant decision problems, Invariant decision rules. Admissible minimax invariant rules.

Introduction, to non-parametric test Sign test, Run test, Median – test, rank test, Wilcoxon & Mann-Whitney test, Kolmogorov – Smirnov test of goodness of fit. Chi-square test of goodness of fit. Fisher's exact probability test for independent samples, Extension of Median test, Kruskal Wallis's test; One way analysis of variance for K-independent samples. Cochran Q test for related samples. Friedman two way analysis of variance. Kendall's rank correlation, Kendall's partial rank correlation, Kendall's coefficient of concordance.

REFERENCES

1. J.O.Berger: Statistical Decision Theory, Springer –Verlag pub. Co., New York, (1980).
2. T.S.Ferguson : Mathematical Statistics, Academic Press, (1967).
3. J.D.Gibbons: Nonparametric Statistical Inference, McGraw Hills, (1971)
4. Sedney Segal : Nonparametric Methods for Behavioral Sciences, McGraw Hill (1956).

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M. Sc. (Part – II) Statistics

Paper VII

Linear Models & Design of Experiments

Section A : LINEAR MODELS

The general linear model : Gauss-Markoff set –up, estimation of its parameters, least squares, and generalised least squares, Normal equations and least squares estimates. Estimation of linear parametric function, variance and covariances of least squares estimates, estimation of error variance, estimation with correlated observations, least square, estimates with restrictions on parameters, simultaneous estimates of linear parametric functions, Canonical form of the linear hypothesis model and Error and Estimation spaces.

Estimation of scale parameter in the general linear model by quadratic functions, necessary and sufficient conditions for (i) a quadratic form to be distributed as chi-square (ii) two quadratic forms to be independently distributed, Cochran's theorem and its generalization.

Tests of hypotheses regarding parameters of a general linear model, tests involving linear functions of parameters, tests of subhypotheses.

REFERENCES

1. Rao, C.R. (1973) : Linear statistical inference and its applications; 2nd . Ed., John Wiley and Sons, Inc.
2. Searle, S.R. (1971) : Linear Models.
3. Seber, G.A. F. (1977) : Linear Regression Analysis.
4. Graybill, F. A. (1961) : An Introduction to linear statistical models.
5. Kshirsagar A.M. (1983) : A Course in linear models.

Section B : DESIGN AND ANALYSIS OF EXPERIMENTS

General theory of analysis of experimental designs with one way elimination of heterogeneity (intrablock analysis only)

General properties of incomplete block design; Concepts of connectedness, balance and orthogonality. Balanced incomplete block design and related designs, resolvable and affine resolvable BIB designs, Partially balanced incomplete block designs with two associated classes.

General theory of analysis of experimental designs with two way elimination of heterogeneity (intrablock analysis only); youden square and Cross over design.

Missing plot technique; its application to randomized block, latin square and balanced incomplete block designs.

General theory of symmetric factorial experiments; concepts of total and partial confounding and 2^n and 3^n confounded experiments.

Construction of (i) orthogonal latin squares, (ii) Balanced incomplete block designs using finite geometries and (iii) total and partially confounded symmetric factorial experiments.

REFERENCES

1. Chakraborti., M.C. (1962): Mathematics of Design of Experiments.
2. Dey, Aloke (1986) : Theory of Block Designs.
3. Raghva Rao, D. (1971) : Construction and Combinatorial Problems in Design of Experiments.
4. Kempthorne, O. (1952) : The Design and Analysis of Experiments.
5. Federer, W.T. (1955) : Experimental Designs.
6. Das, M. N. and Giri, N. (1979) : Design and Analysis of Experiments.
7. Ogawa, J. (1974) : Statistical Theory of the Analysis of Experimental Designs.
8. John , P.W.M. (1971) : Statistical Design and Analysis of Experiments.
9. Joshi, D. D. (1987) : Linear Estimation and Design of Experiments.

The three optional papers in M.Sc. (Part-II) are to be selected from out of the following list:

List of Optional Papers:

1. **Mathematical Economics & Econometrics**
2. **Operations Research**
3. **Advanced Computer Programming and FoxPro**
4. **Computer Intensive Statistical Methods**
5. **Data Mining and Pattern Recognition**
6. **Advanced Sample Surveys and Official Statistics**
7. **Advanced Probability Theory**
8. **Advanced Stochastic Processes**
9. **Advanced Regression Analysis**
10. **Bio-Statistics**

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Mathematical Economics and Econometrics

SECTION – A

MATHEMATICAL ECONOMICS

1. Input – Output Analysis: Leontief's static models for inter –industry relations. The Walras-Leontief's closed system.
2. Growth Models: Classical and Keynesian simple income determination models. Concepts of multipliers and accelerator. Hicks-Samuelson model, Harrod-Domar and Solow's Growth models. Mahalanobis two and four sector models.
3. Time Series Analysis: Definition, Importance of time series analysis, Components of a time series, Trend, seasonal fluctuations, Determination of trend, moving average method, variate difference method, fitting of polynomial curve, Stationary time series, Box-Jenkin's models, Introduction to AR, MA, ARMA and ARIMA models, Detailed study of AR (1) MA (1) and ARMA (1,1) Models.

BOOKS:

1. Kendall, M. (1976) : Time Series; Charles Griffin and Company.
2. Box and Jenkins (1970) : Time Series Analysis: Forecasting and Control, Holden Day Pub.
3. Chatfield, C. (1975) : The Analysis of Time Series: Theory and Practice; Chapman and Hall.
4. Waller Vancuels (1983) : Applied Time Series and Box Jenkins Models.

Section B: ECONOMETRICS

The nature and role of econometrics, Introduction to econometric models.

Single Equation method: Revision of the study of Gauss-Markoff theorem, general linear model and its extensions, OLS estimation and Prediction.

Problem of multicollinearity: Detection and consequences, Ridge estimator

Generalized least square method, Heteroscedastic disturbances, Grouping of observations.

Autocorrelation, its consequences and tests. The BLUS procedure. Linear Regression with stochastic regressors, Instrumental variable method Problem of errors, Distributed Lag Models.

Simultaneous Equation method : The Identification problem, Rank and Order conditions.

Estimation methods: Recursive systems, 2SLS Estimators, Limited Information estimators, K-class estimators, Introduction to 3SLS estimators, and Full Information ML method.

REFERENCES

1. Apte, P.G. (1990): Text Book of Econometrics, Tata McGraw Hill.
2. Chatterjee and Price, B. : Regression Analysis by Example, John Wiley & Sons, (1977) .
3. Cramer (1971): Empirical Econometrics, North Holland.
4. D.Gujarati (1979) : Basic Econometrics, McGraw Hill.

5. H. D. Intriligator (1980) : Econometric Methods, Techniques and Applications, Prentice Hall Pub. Co..
6. J. Jonston (1982) : Econometric Methods, McGraw Hill, Kogakusha Ltd.
7. L.R. Klein: An Introduction to Econometrics, Prentice Hall of India, (1969).
8. Kontsoyiannis, A. (1979): Theory of Econometrics ; Mac Millan press.
9. Malinvald, E. (1966) : Statistical Methods in Econometrics: North Holland.
10. Theil, H. C. (1982) : Introduction to the Theory and Practice of Econometrics, John Wiley.
11. C. F. Charist (1966) : Econometric Models and Methods, John Wiley.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

OPERATIONS RESEARCH

Section A

1. Linear Programming:
 - 1.1 Definition of linear programming problem (LPP)
 - 1.2 Formulation of LPP
 - 1.3 Solution of LPP by Graphical and Simplex Method (including Big-M and two –phase methods)
2. Duality:
 - 2.1 Definition of Dual Problem
 - 2.2 Rules for converting any Primal into its Dual
 - 2.3 Properties of Duality
 - 2.4 Dual – Simplex Method
3. Transportation and Assignment Problems:
 - 3.1 Definition of Transportation problem (TP)
 - 3.2 Special structure of TP
 - 3.3 Methods for Getting Basic feasible solution to TP
 - 3.4 Methods for getting Optimum solution to TP
 - 3.5 Unbalanced TP
 - 3.6 Definition of Assignment Problem (AP)
 - 3.7 Algorithm for solving an AP
 - 3.8 Unbalanced AP
 - 3.9 Routing Problem
4. Inventory Management Systems:
 - 4.1 Definition
 - 4.2 Costs involved in Inventory Problems
 - 4.3 Classical EOQ Models without and with shortages
 - 4.4 Multi-item Deterministic Models
 - 4.5 Probabilistic Inventory Models
 - 4.6 Inventory Models with Price Breaks
5. Game Theory:
 - 5.1 Two Person zero sum game
 - 5.2 Game with and without saddle Points
 - 5.3 Mixed Strategies
 - 5.4 Two person zero sum game and its transformation into a linear Programming problem.
 - 5.5 Minimax theorem (without proof).

REFERENCE BOOKS

1. K. Swarup, P.K.Gupta and Man Mohan : Operations Research, S. Chand & Co., New Delhi.
2. G. Hadley : Linear Programming, Oxford & IBH Pub. Co., 1969.
3. K.G. Murthy: Linear and Nonlinear Programming.

Section B

1. Sensitivity Analysis:
 - 1.1 Basic concepts
 - 1.2 Changes in the coefficient of objective function
 - 1.3 Changes in the components of vector b and of Matrix A
 - 1.4 Addition / Deletion of variable in the problem
 - 1.5 Addition / Deletion of constraint in the problem

2. Integer Programming :
 - 2.1 Introduction
 - 2.2 All and mixed integer programming (IPP) Problems
 - 2.3 Gomory 's all –IPP algorithm
 - 2.4 The branch and bound technique
 - 2.5 Zero – one programming

3. Replacement Theory
 - 3.1 Types of Replacement Problem
 - 3.2 Replacement of Items that Deteriorate
 - 3.3 Replacement of Items that fails completely and that of Staff

4. PERT / CPM:
 - 4.1 Basic concepts
 - 4.2 Construction and Time Calculation of the Network
 - 4.3 Determination of Float and of the Critical Path
 - 4.4 Crashing a Project
 - 4.5 Scheduling a Project
 - 4.6 Resource Analysis and Allocation
 - 4.7 Application of PERT/ CPM

5. Sequencing :
 - 5.1 Definition, Notations and Assumptions
 - 5.2 Solution of Sequencing problem
 - 5.3 Problems with n -jobs and 2-machines
 - 5.4 Problems with n -jobs and 3-machines
 - 5.5 Problems with 2-jobs and m -machines

6. Goal Programming :
 - 6.1 Definations and Concepts.
 - 6.2 Formulation of Goal Programming Problem (GPP)
 - 6.3 Solution of GPP by Graphical and Extended Simplex Methods

REFERNCES BOOKS

1. K. Swarup, P.K.Gupta and Man Mohan: Operations Research, S. Chand & Co., New Delhi.
2. G.Hadley : Linear Programming, Oxford & IBH Pub. Co., 1969.
3. K.G.Murthy : Linear and Nonlinear Programming.

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M. Sc. (Part – II) Statistics

Advanced Computer Programming and FoxPro

Section A : Advanced Computer Programming

1. Pointers:
 - 1.1 Basis of Pointers
 - 1.2 Pointer Arithmetic
 - 1.3 Pointer Array
 - 1.4 Call by reference in user defined functions
 - 1.5 Pointer to function
2. Files:
 - 2.1 Reading and writing from a file
 - 2.2 Reading and writing Structures
 - 2.3 Random accessing a file
3. Principles of object oriented Programming :
 - 3.1 Procedure oriented Programming Vs object Oriented Programming
 - 3.2 Benefits of Object oriented Programming
4. Classes and Objects
5. Constructions and Destructions
6. Operators Overloading, Functional Overloading and Type Conversions.
7. Inheritance

REFERENCES

1. R. Decker and S.Hirshfield (1998) : The Object Concept: An Introduction to Computer Programming using C++ , PWS Publishing.
2. S.B.Lippmann and J.Lajoie (1998) : C++ Primer , Third Ed., Addison Wesley.
3. W.J. Savitch (2001): Problem Solving with C++ : The Object of Programming. Third Ed., Addison Wesley.

SECTION-B

FOXPRO

1. Database Package:
 - 1.1 OVERVIEW
 - 1.1.1 Database, Record, Field.
 - 1.1.2 Capabilities and Limitations.
 - 1.2 Operators.
 - 1.3 Database & Array Handling:
 - 1.3.1 Creation,
 - 1.3.2 Modification,
 - 1.3.3 Processing.
 - 1.4 Generating Menu:
 - 1.4.1 POPUP Mcnus,
 - 1.4.2 BAR Menus,
 - 1.4.3 Pull Down Menus.
 - 1.5 Screen Handling :
 - 1.5.1 Generating Screen & Windows.
 - 1.6 Inbuilt Functions, UDFs & Procedures.
 - 1.7 SET Commands.
 - 1.8 REPORT & LABEL Generation.
 - 1.9 Handling Memo Fields.
2. Introduction to Spreadsheet.

REFERENCE BOOKS

1. Illustrated FoxPro 2.0: Robert Granillo BPB Publications.
2. Illustrated FoxPro 1.0: Robert Granillo, BPB Publications.
3. Fox Pro 2.0 the art of Visual Programming : Mukhis
4. Clipper 5 & 5.01 Programming Guide : Spence Rick, BPB Publications.
5. Clipper 5 & 5.01 Developers Guide: BPB Publications.
6. Excel 5 for Windows, Quick & Easy : Jones TECH.
7. Mastering Excel 5 for Windows : Chester , BPB Publications.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Advanced Sample Surveys and Official Statistics

Section A : Advanced Sample Surveys

1. Determination of optimum stratification points when (i) stratification variable is same as character under study (ii) stratification variable is different than character under study under (i) Proportional, (ii) Neyman's allocation, and (iii) equal allocation . Stratification for multivariate character under study.
2. Rao-Hartley – Cochran Sampling scheme. Durbin's generalization of varying probability schemes to two – stage (multi-stage) design. IPPS schemes due to Sen –Midzeno, Brewer, Durbin and JNK Rao (for $n = 2$ only).
3. Introduction to unified theory of finite population: Class of linear homogeneous unbiased estimators. Non-existence of uniformly minimum variance estimator in the General class of linear homogeneous unbiased estimators.
4. Non-Sampling errors and biased responses, randomised response for variables, errors in surveys, modelling observation errors, estimation of variance components.
5. Introduction to super population models.

REFERENCES

1. Chaudhary, A. and JWE Vos (1988) : Unified theory and strategies of survey sapling, North Holland, Amsterdam.
2. Singh, R. and Singh, M. (1986) : Theory and Analysis of Sampling Design; New Age International Publications.
3. Cochran, W.G. (1984) : Sampling techniques, 3 rd Ed., Wiley, New york.
4. Caarsel, Sarandal & Writman.
5. Murthy , M.N. (1977) : Sampling theory, Stat. Pub. House, Kolkata.
6. Sukhatme et al. (1984) : Sampling Theory with Applications; Iowa State Univ. Press& ISAS. New Delhi.
7. Durbin' J. (1967) : Estimation of Sampling Error in Multistage Design; Appl. Stat., 16, 152 – 164.

Section B : Official Statistics

Introduction to Indian and International statistical systems. Role, function and activities of Central and State statistical organizations. Organization of large scale sample surveys. Role of national Sample Survey Organization. General and special data dissemination systems.

Population growth in developed and developing countries, evaluation of performance of family welfare programmes, projections of labour force and manpower. Scope and content of population census of india

System of collection of Agricultural Statistics. Crop forecasting and estimation, productivity, fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects.

Statistics related to industries, foreign trade, balance of payment, cost of living, inflation, educational and other social statistics.

REFERENCES

Basic Statistics Relating to the indian Economy (CSO) 1990.

Guide to Official Statistics (CSO) 1999.

Statistical System in India (CSO) 1995.

Principles and accommodation of National Population Censuses, UNESCO.

Panse, V. G., Estimation of Crop Yields (FAO).

Family Welfare Yearbook. Annual Publication of D/o Family Welfare.

Monthly Statistics of Foreign Trade in india. DGCIS. Calcutta and other govt. Publications.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Data Mining and Pattern Recognition

Section A : Data Mining

Review of classification Methods from multivariate analysis ; classification and decision trees.

Clustering methods form both statistical and data mining viewpoints ; vector quantization

Unsupervised learning form univariate and multivariate data ; dimensional reduction and feature selection.

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

Introduction to databases, including simple relational databases; data warehouses and introduction to online analytical data processing.

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

Note on practicals / tutorials : Each practical session should correspond to two teaching hours. Practical work should be done on statistical packages or using high level languages as taught in the core course on Statistical Computing Note on Prerequisites: This course assumes successful completion of Computer – intensive Statistical Methods I. It can be presented in conjunction with Computer – intensive Statistical Methods II.

REFERENCES

A. Berson and S.J. Smith (1997). Data Warehousing, Data Mining, and OLAP. McGraw–Hill.

L. Breiman, J.H. Friedman, R. A. Olshen, and C.J.Stone (1984) . Classification and Regression Trees. Wadsworth and Brooks/ Cole.

J. Han and M. Kambar (2000). Data mining; Concepts and Techniques. Morgan Kaufmann.

T.M. Nitchell (1997) Machine Learning. McGraw – Hill.

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Computer Intensive Statistical Methods

Section A

Exploratory data analysis: transforming data, graphical methods of clustering, outliers.

(5L)

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

(11L)

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

(10L)

Section B : PATTERN RECOGNITION

Linear classification : linear discriminant function (LDF) for minimum squared error, LDF for binary outputs, perception learning algorithm.

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

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.

Note on practicals/ tutorials: Each practical session should correspond to two teaching hours. Practical work should be done on statistical packages or using high level languages as taught in the core course on Statistical Computing.

Note on prerequisites: This course assumes successful completion of Computer – intensive Statistical Methods I. It can be presented in conjunction with Computer- intensive Statistical Methods II.

REFERENBCES

R. O. Duda and P.E. Hart (1973). Pattern Recognition and Scene Analysis. Wiley.

K Fukunaga (1990) . introduction to Statistical Pattern Recognition, Second Edition. Academic Press.

G.J McLachlan (1992). Discriminant Analysis and Statistical Pattern recognition. Wiley.

B. D. Ripley (1996). Pattern Recognition and Neutal Networks. Cambribge University Press.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Computer Intensive Statistical Methods

Section A

Exploratory data analysis: transforming data, graphical methods of clustering, outliers.

Linear regression: Influential observation and diagnostics, robust method, collinearity, variable selection.

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.

Smoothing with kernels : density estimation, simple nonparametric regression.

Note on practicals: Each practical session should correspond to two teaching hours. Practical work should be done on statistical packages or using high level languages as taught in the core course on Statistical Computing.

REFERENCES

R. Gnanadesikan (1997) ; Methods for Statistical Data Analysis of Multivariate Observations, Second edition. Wiley.

D.A. Belsley E. Kuh, and R.E Welsch (1980) ; Regression Diagnostics. Wiley.

P. McCullagh and J.A. Nelder (1999) ; Generalized Linear Models, Third edition. Chapman and Hall.

G. E. F. Seber and C. J. Wild (1989); Nonlinear Regression Diagnostics. Wiley.

G. J. McLachlan and T. Krishnan (1997); The EM Algorithms and Extensions. Wiley

J.S. Simonoff (1996) ; Smoothing Methods in Statistics. Springer.

Section B

Stochastic simulation : Generating random variables, simulating multivariate distributions, simulating stochastic processes such as simple queues.

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

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.

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.

Note on practicals: Each practical session should correspond to two teaching hours. Practical work should be done on statistical packages or using high level languages as taught in the core course on Statistical Computing.

REFERENCES

G. S. Fishman (1996); Monte Carlo : Concepts, Algorithms, and Applications, Springer.

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

M.A. Tanner (1996); Tools for Statistical inference, Third Edition. Springer.

B. Efron and R. J. Tibshirani (1993) ; An introduction to the Bootstrap. Chapman and Hall.

J. Shao and D. Tu (1995) ; The Jackknife and the Bootstrap. Springer Verlag.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Advanced Probability Theory

SECTION- A

Metric Spaces, topological notions such as limit points, convergence, closed and open sets, continuity, compactness in metric spaces, isometries and homeomorphisms. Complete metric spaces, separable spaces, nowhere – dense sets, the metric spaces \mathbb{R} (infinity) and $C[0,1]$.

Normed linear spaces, metric defined by a norm, equivalent norms, Banach spaces and examples ($C[a, b]$ l_p , L_p (m) spaces).

Inner product spaces, Hilbert spaces, Bessel's inequality complete orthonormal sets, Parseval's identity, L_2 space. The. Projection theorem for Hilbert spaces.

Bounded linear transformations, Banach Steinhaus theorem (Principle of uniform boundedness), Open mapping theorem, the Hahn Banach theorem and applications.

The dual of a Banach space, (dual of $C[a,b]$, l_p , L_p spaces). Riesz representation theorem.

REFERENCES

Functional Analysis (1966) George Bachman and Lawrence Narici, Academic Press.

Real Analysis (1988) H. L. Royden, MacMillan, New York.

Real and complex analysis (1966) Walter Rudin, McGraw Hill

Real Analysis and Probability (1972) Robert Ash, Academic Press.

Principles of Functional Analysis (1971) Martin Schechter, Academic

Functional Analysis (1973) Walter Rudin McGraw Hill.

SECTION-B

Probability measures on metric spaces: Measures and integrals, tightness, (measure) determining class. Weak convergence of measures: properties of weak convergence and Prohorov's theorem. Convergence determining class.

Some special cases : Convergence of probability measures and convergence determining class in the Euclidean space, the circle, the space \mathbb{R} infinity, the product spaces etc.

Random element of a metric space and its distribution, convergence in distribution of sequence of random elements – various equivalent criteria for convergence; convergence in probability; weak convergence and mappings.

Relative compactness and Prohorov's theorem. Weak convergence and tightness in $C[0,1]$: wiener measure, Weak convergence and tightness in $D [0,1]$; Donsker's theorem.

REFERENCES

Billingsley, P. (1968) : Convergence of Probability Measures, Wiley.

Partasarathy, K.R. (1967) : Probability Measures on Metric Spaces, Academic Press.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Advanced Stochastic Processes

SECTION-A

Renewal theory : renewal function and its Properties, elementary and key renewal theorems, asymptotic normality of the number of renewals, cost/ rewards associated with renewals regenerative processes. Applications

A review of Markov chains analysis, computing stationary distribution of a large (finite) state –space, applications.

Poisson Process and Pure Jump Markov processes: a review of main results. Birth and Death processes, Applications to Queuing theory , inventory analysis, communication models, population biology and finance, ecology and epidemiology (depending upon the interests of students and the teacher). Computational issues.

Brownian motion applications to finance.

Semi-Markov processes and Markov decision processes: an introduction and applications to various areas.

REFERENCES

Tijms, H. C. (1986) Stochastic Modelling and analysis, Wiley.

Medhi. J. (1982) Stochastic Processes, Wiley Eastern.

Ross, S.M. (1983) Stochastic Processes, Wiley.

Bhat, B.R. (2000) Stochastic Models: Analysis and Applications, New Age international Publications.

Feller, W. (1971) An introduction to Probability theory and its applications, Vol II.

Ross, S.M. (1970) Applied Probability models with optimization applications. Holden- Day San Francisco.

Wolff. R. W. (1989) Stochastic Modelling and the Theory of Queues, Prentice Hall.

SECTION –B

Point Processes: Definition and examples. Product densities and characteristic functional. Stationary point processes- Khintchine's existence theorem, intensity of point processes. Poisson process, Renewal process, doubly stochastic process.

Stationary processes: wide sense and strict sense stationarity, covariance functions-properties. Bochner's theorem, Herglotz theorem, Karunen's representation theorem. Khintchine's and Cramer's representation of wide sense stationary process. Spectral decomposition for weakly stationary process. Ergodic theorems.

Markov processes- continuous time and continuous state space, time homogeneous Markov processes, Kolmogorov's equations. Diffusion processes with Wiener process and Ornstein – Uhlenbeck process as particular cases. First passage time and reflecting barriers for Wiener process, Relation between Wiener and Uhlenbeck processes.

REFERENCES

Cox, D.R. and Miller, H. D. (1965) : The theory of Stochastic Processes, Mathuen & Co, London.

Cramer, H. and Leadbetter, M.R. (1967) : Stationary and Related Stochastic Processes, Wiley.

Daley, D. J. and Vere- Jones (1988) : An introduction to the Theory of Point Processes. Springer- Verlag.

Karlin, S. and Taylor, H. M. (1981): A Second Course in Stochastic Processes Academic Press.

Ross, S. M. (1983): Stochastic Processes, Wiley.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

Advanced Regression Analysis

SECTION- A

Logistic and Poisson regression : logit model for dichotomous data with single and multiple explanatory variables, ML estimation, Large sample tests about parameter goodness of fit, analysis of deviance, variable selection, extension to polytomous data introduction to Poisson regression.

Log linear models for two and three dimensional contingency tables: interpretation of parameters, comparison with ANOVA and regression, ML estimation of parameters, likelihood ratio tests for various hypotheses including independence, marginal and conditional independence, partial association, models with quantitative levels.

Nonparametric regression and generalized linear models : interpolating and smoothing splines for simple regression , use of cross-validation, application to logistic and Poisson regression introduction to additive models and generalized additive models.

REFERENCES

D. W. Hosmer and S. Lemeshow (2000) . Applied Logistic Regression, Second edition. Wiley, New York.

A. Agresti (1990). Categorical Data Analysis. Wiley, New York.

R. Christensen (1997). Log- linear Models and Logistic Regression, Second edition. Springer, New York.

P. McCullagh and J.A. Nelder (1999) . Generalized Linear Models, Second edition Chapman and Hall, New York.

P.J. Green and B. W. Silverman (1994). Nonparametric Regression and Generalized Linear Models. Chapman and Hall, New York.

T.J. Hastie and R. J. Tibshirani (1999) . Generalized additive Models. Second edition Chapman and Hall, New York..

SECTION-B

Residuals and their analysis, influential observations, Power transformations for dependent and independent variables.

Robust and L-1 regression, Estimation of prediction error by cross-validation and boot strap.

Non-linear regression models, Different methods of estimation (Least squares, Maximum Likelihood). Asymptotic properties of estimators

Generalized linear models, Analysis of binary and grouped data by using logistic models, Log-linear models.

Random and mixed effect models, Maximum likelihood, MINQUE and restricted maximum likelihood estimators of variance components, Best linear unbiased predictors (BLUP). Growth curves.

REFERENCES

Bates, D.M. and Watts, D.G. (1988). Nonlinear Regression Analysis and its Application, Wiley, New York.

Cook, R.D. and Weisberg, S. (1982). Residuals and inference in Regression, Chapman and Hall, London.

Draper, N.R. and Smith, H. (1998); Applied Regression Analysis, 3rd Ed. Wiley, New York.

Efron, B. and Tibsirani, J. R. (1993). An introduction to the Bootstrap, Chapman and Hall, New York

Kshirsagar, A. M. (1995). Growth Curves, Marcel and Dekker, New York.

McCullagh, P. and Nelder, J.A. (1989). Generalized Linear Models, 2nd Ed., Chapman and Hall, London,

Searle, S. R. (1987) . Linear. Models for Unbalanced Data, Wiley, New Yirk .

Seber, G. A. and Wild, G. J. (1989). Nonlinear Regression, Wiley, New York.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M. Sc. (Part – II) Statistics

SECTION-A

Types of biological assays; Direct assays; Ratio estimators, asymptotic distributions; Fieller's theorem

Regression approaches to estimating dose-response relationships Logit and probit approaches when dose –response curve for standard preparation is unknown; Quantal responses; Methods of estimation of parameters ; Estimation of extreme quantiles; Dose allocation schemes; polychotomous quantal response

Estimation of points on the quantal response function

Sequential procedures

Estimation of safe doses

Bayesian approach to bioassay

REFERENCES

Z. Govidnarajulu (2000). Statistical Techniques in Bioassay. S. Kargar.

D. J. Finney (1971) . Statistical Method in Bioassay, Griffin.

D. J. Finney (1971). Probit Analysis (3rd Ed.) . Griffin.

G. B. Weatherile (1966). Sequential Methods in Statistics. Methuen.

SECTION – B

Basic biological concepts in genetics (relevant to this course).

Mendel's law. Hardy Weinberg equilibrium. Mating tables, estimation of allele frequency (dominant / co-dominant cases). Approach to equilibrium for X-linked gene, Natural selection. Mutation genetic drift, equilibrium when both natural selection and mutation are operative

Non-random mating, inbreeding phenotypic assortative mating.

Analysis of family data (a) Relative pair data. I. T . O matrices. Identity by descent (b) family data – estimation of segregation ratio under ascertainment bias (c) Pedigree data –Elston – Stewart algorithm for calculation of likelihoods Linkage. Estimation of recombination fraction, inheritance of quantitative traits Models and estimation 'o'

Sequence similarity, homology and alignment. Algorithms for (a) pairwise sequence alignment, (b) multiple sequence alignment, construction of phylogenetic trees, UPGMA, Neighbour joining, maximum parsimony and maximum likelihood algorithms.

REFERENCES

C, C. Li (1976). First course on population genetics. Boxwood Press, California.

W. J. Ewens (1979) . Mathematical population genetics. Springer Verlag.

T. Nagylaki (1992) . Introduction to theoretical population genetics Springer Verlag.

R. Durbin, S. R. Eddy, A. Krogh , G. Mitchison (1998) . Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids.

ADDITIONAL REFERENCES

R. C. Flandt