VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.A. (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 & Multivariatc 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	

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Paper I Real Analysis and Probability

Scction 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 o-field of R and R^k .

Finitely additive and o-additive set functions. Measures, propreties 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 integial. 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, McG raw llill.
3. Kingman, JFC and Taylor, S.J. (1966) : Introduction to Measure and Probability, Cambnidge Univ. Press.
4. Buiill, C.W. (19) : Measure, Integrotion and Probability.

Section B : PROBABILITY THEORY

Probability spaces. Kandom variables and kandom vectors. Expectations. Moments. Holder's inequality, Minkowsky;s inequality stwartz inequality, Markov's inequality, jenson's inequality.

Diotribution of a random variable. Diotribution 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 s). Convolution of distribution functions. Characteristic function of convolution in terms of its conponents.

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 o-field. Kolmogorov zero-one law.

Convergence of sequences of random variables in distribution, in probability, in rth 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) : Meacure, Intrgration and Probability.
3. Ash, Robert (1972) : Real Analysis and Probability, Academic prass.
4. Chang, K.L.: A Course in Probability Theory.
5. Dudley, R.M. (1989) : Real Analysis and Probability, wadsworth & Broooks.

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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 Theoty 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 lehgth, Stein's two –stage procedure.

REFRENCES

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)

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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 basisand 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, sinilar 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

Multvariate 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,

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

Hotelling T^2 statistic. Mull 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 $\wedge$ 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, McGrow 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.

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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. Cochrall, 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 disfribution; 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 Procresses: 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.

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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' Odyssy 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

QUALUTY 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 Qualityvs Product Quality

Productivity and Quality
- The Leverage of Productivity and Quality
- management Systems vs Technology
- basic Measures of Productivity

TheCost of Quality
- Cost of Quality Defined
- Differentviews of Quality Costs
- Quality Costs and its Measur4ement

Criteria for Quality Programs
- ISO 9000 and onwards

Reliability:

Basic concepts and distributions for product life, failure rate. Hazard function, Reliability function for Expenenyial, Normal, Log-normal. Weibull and Gamma Distributions. Analysis of Complete Data. Linear analysis and Maximum Lielihood analysis of Censored data for exponential distribution only. Introduction of Bayes Mathods 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.