VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

M. A. / M.Sc. : STATISTICS

Effective From: 2010 – 2011

1. **Fee structure:-** As per Grant in Aid course

2. **Eligibility for Admission :**

   I A candidate must have passed the Bachelor's Degree examination in Science with English as compulsory subject.

   II A candidate who has obtained his/her B.Sc. degree with either (i) Statistics as principal subject or (ii) Mathematics as principal subject and Statistics as subsidiary subject or (iii) both Mathematics and Statistics as optional subjects will be eligible for admission to this course.

3. **Passing standard** in this course will be same as that of any other science subject.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road,
SURAT – 395 007.

SYLLABUS

M. A. / M.Sc. Statistics

Effective From: 2010– 2011

(Semester-I)

Paper No.	Title of the paper	Marks			Work load / week	
		Int.	Ext.	Total	L	T
101	Real Analysis	30	70	100	3	1
102	Univariate Distributions	30	70	100	3	1
103	Linear Algebra	30	70	100	3	1
104	Sample Survey	30	70	100	3	1
105	Introduction to MS office and Internet	30	70	100	3	1
106	Practical paper-I based on theory papers using MS office tools	30	70	100	12 hrs	
Project	At Department	50	-	50	3 hrs	
Viva – Voce		30	70	100		
Total		260	490	750	15	05
Total Work Load Per Week -					35 hrs	

(Semester-II)

201	Probability Theory	30	70	100	3	1
202	Estimation Theory	30	70	100	3	1
203	Multivariate Analysis	30	70	100	3	1
204	Stochastic Process	30	70	100	3	1
205	Statistical Quality Control & Reliability	30	70	100	3	1
206	Practical Paper- II based on theory papers using MS office tools	30	70	100	12 hrs	
Project	At Department	50	-	50	3 hrs	
Viva – Voce		30	70	100		
Total		260	490	750	15	05
Total Work Load Per Week -					35 hrs	

(Semester-III)

Paper No.	Title of the paper	Marks			Work load / week	
		Int.	Ext.	Total	L	T
301	Testing of Hypotheses	30	70	100	3	1
302	Linear Models	30	70	100	3	1
303	Operations Research -I	30	70	100	3	1
304	Mathematical Economics	30	70	100	3	1
305	Introduction to Statistical Software	30	70	100	3	1
306	Practical paper- III based on theory papers –using statistical software	30	70	100	12 hrs	
Project	At Department	50	-	50	3 hrs	
Viva – Voce		30	70	100		
Total		260	490	750	15	05
Total Work Load Per Week -					35 hrs	

(Semester-IV)

401	Decision Theory	30		70	100	3	1
402	Design of Experiments	30		70	100	3	1
403	Operations Research -II	30		70	100	3	1
404	Econometrics	30		70	100	3	1
405	Practical paper – IV based on theory papers – using statistical software	30		70	100	12 hrs	
Project	At Some industry / firm /organization	Report 100	Viva 50	-	150		
Viva – Voce		30		70	100		
Total		330		420	750	12	04
Total Work Load Per Week -						28 hrs	

GRAND TOTAL: 3000 MARKS

SEMESTER - I

PAPER – 101

REAL ANALYSIS

Recap of elements of set theory and Real number system. Limits of sequences of sets. Classes of sets: Semirings, rings, fields, σ-rings, σ-fields. Monotone classes. Generated classes, Borel σ-field of R and 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 : "Real Analysis and Probability"; Academic Press.
2. Halmos P.R. : "Measure Theory"; McGraw Hill.
3. Kingman JFC and Taylor S.J. : "Introduction to Measure and Probability"; Cambridge Uni. Press.
4. Burrill C.W. : "Measure, Integration and Probability".

PAPER – 102

UNIVARIATE DISTRIBUTIONS

Laplace, Lognormal and Cauchy distributions. Idea of truncated distributions, 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 distributions: Non-central chi-square, t and F distribution.

Ordered statistics, their distributions and properties, distribution of r.

REFERENCES

1. Johnson N.L. and Kotz S.: “Distributions in Statistics”; John Wiley.
2. Fioz M.: “Probability Theory and Mathematical Statistics”; John Wiley.
3. Rohatgi V.K. : “An Introduction to Probability Theory and Mathematical Statistics”; John Wiley.
4. Jaiswal M.C. : “Statistical Distributions”; (in Gujarati), University Book Publication Board.
5. Patel J.K. et al. : “Handbook of Statistics Distributions”; Marcel Dekker.
6. Mood A.M., Graybill F. and Boes D.C. : “Introduction to the Theory of Statistics”; McGraw Hill.

PAPER – 103

LINEAR ALGEBRA

Fields, Vector Spaces, subspaces, linear dependence and independence, basis and dimension of a vector space, finite dimensional vector space, completion theorem.

Vector spaces with an inner product, Gram-Schmidt orthogonalization process, orthogonal basis.

Symmetric, skew-symmetric, Hermitian, skew-hermitian, orthogonal, unitary and normal matrices.

Real quadratic forms, reduction and classification of quadratic forms, index and signature. Characteristic roots and vectors, properties of characteristic roots and vectors of a real symmetric, hermitian, skew-hermitian, orthogonal, unitary and normal matrices, Algebric and geometric multiplicity of a characteristic root.

Idempotent matrices, generalized inverses, Moore-Penrose generalized inverse.

REFERENCES

1. Gralbill F. A. : “Matrices with Applications in Statistics”; 2nd Ed., Wadsworth.
2. Rao C.R. : “Linear Statistical Inference and its Application”; 2nd Ed., John Wiley and Sons, Inc.
3. Searle S.R. : “Matrix Algebra useful for Statistics”; John Wiley and Sons, Inc.
4. Rao C.R. and Bhimasankaram P. : “Linear Algebra”; Tata McGraw Hill Pub.Co. Ltd.

Additional Books

1. Bellman R. : “Introduction to Matrix Analysis”; 2nd. Ed., McGraw Hill.
2. Biswas S. : “Topics in Algebra of Matrices”; Academic pub.
3. Hadley G. : “Linear Algebra”; Narosa Pub. House.
4. Halmos P.R. : “Finite Dimensional Vector Spaces”; 2nd Ed., D. Van Nostrard Co. Inc.
5. Hoffman K. and Kunze R. : “Linear Algebra”; 2nd Ed., Prentice Hall, Inc.
6. Rao C.R. and Mitra S.K. : “Generalized Inverse of Matrices and its Application”; John Wiley and Sons, Inc.

PAPER - 104

SAMPLE SURVEY

Concept of population, sample, 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 generalization.

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

REFERENCES

1. Cochran W. G. : “Sampling Techniques”; John Wiley & Sons, Inc., New York.
2. Hansen M. H., et al.: “Sample Survey Methods and Theory”; John Wiley & sons, Inc., New York.
3. Kish L. : “Survey Sampling”; John Wiley & Sons, Inc., New York.
4. Murthy M. N. : “Sampling Theory and Methods”; Statistical Publishing Society, Calcutta.
5. Raj D. : “Sampling Theory”; McGraw-Hill Book co., New York.
6. Raj D. : “The Design of Sample Surveys”; McGraw-Hill Book Co., New York.
7. Sukhatme P.V., et al.: “Sampling Theory of Surveys with Applications"; The Iowa State Univ. Press, Ames, Iowa, USA and Indian Society of Agricultural Statistics, New Delhi.
8. Yates F. : "Sampling Methods in Censuses and Surveys"; Charles Griffin & Co. Ltd., London.
9. Goulden C. H. : "Methods of Statistical Analysis", Asia Publishing House, Bombay.
10. Snedecor G.W. and Cochran W.G. : "Statistical Methods"; The Iowa State Univ. Press, Ames, Iowa, USA.

PAPER - 105

INTRODUCTION TO MS OFFICE AND INTERNET

1. WINWORD
   - 1.1 Typing, Editing, Proofing & Reviewing
   - 1.2 Formatting Text & Paragraphs
   - 1.3 Automatic Formatting and Styles
   - 1.4 Working with Tables
   - 1.5 Graphics and Frames
   - 1.6 Mail Merge
   - 1.7 Automating Your Work & Printing Documents

2. EXCEL
   - 2.1 Working & Editing in Workbooks
   - 2.2 Creating Formats & Links
   - 2.3 Formatting a Worksheet & Creating Graphic Objects
   - 2.4 Creating Charts (Graphs), formatting and analyzing data
   - 2.5 Organizing Data in a List (Data Management)
   - 2.6 Sharing & Importing Data
   - 2.7 Printing

3. POWER POINT PRESENTATION
   - 3.1 Preparation of Slides,
   - 3.2 Inserting Elements into Slides,
   - 3.3 Inserting Animation
   - 3.4 Preparing Slideshows.

4. Introduction to Graphical Package
5. Introduction to Internet
   - 5.1 Internet Protocols
     http, ftp, TCP/IP, etc.
   - 5.2 Internet Utilities
     e-mail, chat, searching, etc.

6. Web Browsers
7. Web Server
8. HTML
   - 8.1 HTML Tags

9. Front Page (For static site only)

REFERENCES

1. Work 6 for windows quick & easy reference - Mansfield - BPB
2. Mastering Word 6 for windows - Mansfield - BPB
3. Mastering Excel 4 for windows - Townsend - BPB
4. Mastering Excel 4 for windows - Chester - BPB
5. Excel 5 for Windows Quick & Easy - Jones - Tech

SEMESTER - II

PAPER – 201

PROBABILITY THEORY

Probability spaces. Random variables and random vectors. Expectations. Moments. Holder's inequality, Minkowsky's inequality, Stwartz inequality, Markov's inequality, Jenson'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 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 Lindbergh-Feller theorem. Conditional Expectations and their properties.

REFERENCES

1. Loeve M. : "Probability Theory".
2. Burrill C.W. : "Measure, Integration and Probability".
3. Ash Robert : "Real Analysis and Probability"; Academic Press.
4. Chang K.L.: "A Course in Probability Theory".
5. Dudley R.M. : "Real Analysis and Probability"; Wadsworth & Brooks.

PAPER – 202

ESTIMATION THEORY

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 sufficient statistics, Rao-Blackwell theorem.

Minimum variance unbiased estimation: Lower bound of variance of an unbiased estimator, Cramer–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 length, Stein's two-stage procedure.

REFRENCES

1. Rohatagi V.K. : "An Introduction to Probability Theory and Mathematical Statistics".
2. Rao C.R. : "Linear Statistical Inference and its Applications"; John Wiley.
3. Mood A.M., Graybill F. and Boes D.C. : "Introduction to the Theory of Statistics"; McGraw Hill.
4. Lehmann E.L.: "Theory of Point Estimation"; John Wiley.
5. Ferguson T.S.: "Mathematical Statistics : A Decision Theoretic Approach"; Academic Press.
6. Zacks S. : "Theory of Statistical Inference"; John Wiley.

PAPER – 203

MULTIVARIATE 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: p.d.f of Wishart distribution, Properties of Wishart distribution, Additive property, Distribution of HWH', marginal distribution of W_{11}, distribution of h'wh/h'$\sum$h, h'$\sum^{-1}$h/h'w^{-1}h, Characteristic function.

Distribution of sample generalized 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 coefficeints. Testing of H_0 : (i) ρ=0, (ii) $\rho = \rho_0$, (iii) $\rho_{1(2..p)}$=0, (iv) $\rho_{12.3....p}$=0, (v) $\rho_{12.3....p}=\rho_0$.

Hotelling T^2 statistic. Null distribution of T^2, application in tests on mean vector for one and two 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. : "An Introduction to Multivariate Statistical Analysis"; John Wiley.
2. Johnson and Wichern : "Applied Multivariate Statistical Analysis".
3. Khirsagar A. M. : "Multivariate Analysis"; Marcel Dekker.
4. Morrison D.F.: "Multivariate Statistical Methods"; McGraw Hill.
5. Muirhead R.J. : "Abstracts of Multivariate Statistical Theory"; John Wiley.
6. Seber G.A.F. : "Multivariate Observations"; John Wiley.
7. Srivastava and Khatri C.G.: "An Introduction to Multivariate Statistics"; North Holland.

PAPER – 204

STOCHASTIC PROCESSES

Markov chain with finite and countable state space, Classification of states, limiting behavior of n-step transition probabilities, stationary process; 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. : "A First Course in Stochastic Processes"; Academic Press.
2. Parzen E.: "Stochastic Processes"; Holden-Day.
3. Feller W. : "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. : "Introduction to Stochastic Processes"; Houghton Mifflin Co., Bosten.
5. K. Swarup, Gupta P.K. and Man Mohan : "Operations Research"; S. Chand & Co., New Delhi.
6. Sharma S.D. : "Operations Research"; Kedar Nath Ram Nath & Co. Publishers, Meerut.

PAPER – 205
STATISTICAL QUALITY CONTROL AND RELIABILITY

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.

Strategic Quality Planning.
- Strategy and Strategic Planning Process
- Strategic Quality Management

Organizing for TQM
Productivity and Quality
- The Leverage of Productivity
- 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, Lognormal, 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. System reliability.

REFERENCES

1. Hopper A.G. : “Basic Statistical Quality Control”; McGraw Hill, London.
2. Gupta R.C. : “Statistical Quality Control”; Khanna Publishers, New Delhi.
3. Ryan T.P. : “Statistical Methods for Quality Improvement”; John Wiley & Sons.
4. Omachonu V.K. and Ross J.E. : “Principles of Total Quality”; S.Chand & Co., New Delhi.
5. Sinha S.K. : “Reliability and Life Testing”; Wiley Eastern Ltd., New Delhi.
6. Bazovksy I.: “Reliability Theory and Practice”; Prentice Hall International Series in Engineering.
7. Grant E. L. and Leavenworth R. : “Statistical Quality Control” ; Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
8. Irving W.B. : “Elementary Statistical Quality Control”; Marcel Dekker, Inc., New York.

SEMESTER - III

PAPER – 301

TESTING OF HYPOTHESES

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. Generalized Neyman–Pearson's Lemma, Most Powerful test and Uniformly Most Powerful test. UMP tests for families of distributions admitting monotone likelihood ratio, two sided hypotheses, use of least favourable distribution.

Unbiasedness for testing of hypotheses. Similar test, relationship with UMP unbiased test, UMP similar test and its application to one parameter exponential family, Similarilty 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.

Wilks - Likelihood ratio test for simple and composite hypotheses.

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. Ferguson T.S. : "Mathematical Statistics"; Academic Press.
2. Kendall M.G. and Stuart A.: "The Advanced Theory of Statistics"; Vol. 2., Ed. IV, Charles and Griffin.
3. Lehman E.L. : "Testing Statistical Hypotheses"; Wiley Eastern.
4. Mood A.M., Grabill F. and Boes D.C. : "Introduction to the Theory of Statistics"; McGraw Hills, International Student Ed. III.
5. Rao C.R. : "Linear Statistical Inference and its Applications"; Wiley Eastern, EdII.
6. S. Wilks : "Mathematical Statistics", Wiley New York.
7. S. Zacks : "The Theory of Statistical Inference"; Wiley New York.
8. Goon A. M., Gupta M. K. and Dasgupta B. : "An Outline of Statistical Theory" Vol.1, 2; World press.
9. Rohatgi V.K.: "Introduction to Probability Theory and Mathematical Statistics"; Wiley Eastern.

PAPER – 302

LINEAR MODELS

The general linear model: Gauss-Markoff set up, least squares, and generalized least squares, Normal equations and least squares estimates, estimation of linear parametric functions, variances and covariances of least squares estimates, estimation with correlated observations, least squares 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) independence of a linear form and a quadratic form (iii) independence of two quadratic forms. Cochran's theorem and its generalizations.

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

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".

OPERATIONS RESEARCH - I

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 method)

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. Simulation :
- 5.1 Introduction
- 5.2 Types of Simulation
- 5.3 Generation of Random Numbers
- 5.4 Monte Carlo Simulation.
- 5.5 Application in different fields.

REFERENCES

1. K. Swarup, Gupta P.K. and Man Mohan : “Operations Research”; S.Chand & Co.,New Delhi.
2. G. Hadley : “Linear Programming”; Oxford & IBH Pub. Co.
3. Murthy K.G. : “Linear and Nonlinear Programming”.
4. Kasana H.S. and Kumar K.D. : “Introductory Operations Research”; Springer.
5. Kapoor V.K. : “Operations Research”; S.Chand & Co.,New Delhi.
6. Sharma S.D. : “Operations Research”; Kedar Nath Ram Nath & Co. Publishers, Meerut.

PAPER – 304

MATHEMATICAL ECONOMICS

1. Input – Output Analysis : Leontief's static models for inter industry relations. The Leontief's open and closed system.

2. Growth Models : Classical and Keynesian simple income determination models. Concepts of multipliers and accelerator. Harrod-Domar model, Hicks-Samuelson model, Solow's Growth model. Mahalanobis two and four sector models.

3. Time Series Analysis : Definition and importance of time series analysis. Stationary Time series. Components of a Time series. Different methods for determination of trend, their merits and demerits. Methods for elimination of seasonal components. Determination of cyclic components. Variate difference method. Box-Jenkins Models, Introduction to Autoregressive (AR) Models, Moving Average (MA) Models, Mixed Autoregressive Moving Average (ARMA) Models, Autoregressive Integrated Moving Average (ARIMA) Models. Properties of these models. Forecasting Techniques.

REFERENCES

1. Kendall M. : "Time Series"; Charles Griffin and Company.
2. Box and Jenkins : "Time Series Analysis : Forecasting and Control"; Holden Day Pub.
3. Chatfield C. : "The Analysis of Time Series : Theory and Practice"; Chapman and Hall.
4. Waller Vancuels : "Applied Time Series and Box Jenkins Models".
5. Karmel P.H. : "Applied Statistics for Economics".
6. Sen A.K. : "Growth Economics" : Penguin Modern Economic Reading Edition.
7. Pillai S. : "Economic & Business Statistics"; Progressive Corporation Pvt. Ltd.
8. Mukhopadhyay P. : "Applied Statistics"; New Central Book Agency (P) Ltd.
9. Gupta S.C. and Kapoor V.K. : " Fundamentals of Applied Statistics"; Sultan Chand & Sons.

PAPER – 305
INTRODUCTION TO STATISTICAL SOFTWARES

Introduction and use of Matlab, SYSTAT, SPSS and other such statistical packages for analysis of practical problems.

Matlab

Introduction :
Introduction to Matlab, variable and array, subarrays, displaying output data, data files operation on array, hierarchy of operation on array, built in function in Matlab

Plotting :
Introduction to plotting, graph window, two dimensional plot, multiple plot, components of graph(legend, title,),graphical image, commet, 3D graph, additional plotting features
Subplots, polar plots,

Branching statement and program design :
The if construct, switch construct, The try-catch construct , relational operators, logic operators, logical functions

Loops :
The while loop, The for loop, The break and continue statements, Nesting loops.

User defined function :
Introduction to Matlab functions, variable passing in Matlab(pass by value), preserving data between calls to functions, sub functions, private function, nested function.

SPSS

Introduction to SPSS
Preparing data for SPSS :
Invoking SPSS, Using Date Editor, Reading ASCII Files, Transforming Data, Selecting Subset of Cases, Other SPSS Windows.

Procedure Statistics for Data Analysis :
Frequency, Comparing Means, Crosstabs, ANOVA, Correlation, Linear Regression

SYSTAT

Introduction to SYSTAT

Preparing data for SYTAT:
Invoking SYSTAT Using Date Editor, Transforming Data, Selecting Subset of Cases, Other SYSTAT Windows.

Procedure Statistics for Data Analysis :
Frequency, Comparing Means, Crosstabs, ANOVA, Correlation, Linear Regression

REFERENCES

1. Chapman Stephen : "Matlab programming for engineers"; Thompson learning.
2. Rudra Pratap : "Getting started with Matlab"; Oxford university press.
3. Marques J.P. : “Applied Statistics using SPSS, Statistica and Matlab”; Springer-Verlag, London.
4. Miller R. L., Ciaran Acton and Fullerton D. A., John Malthy : "SPSS for Social Scientists" ; Palgrave Macmilan.
5. Wagner W. E. III : " Using SPSS for Social Statistics and Research Methods" ; Wagner.
6. Einspruch E. L. :"An Introductory Guide to SPSS for Windows" ; Einspruch .
7. Pandya K. and Bulsari S. : " Enjoy Statistics with SPSS for Windows" ; Popular.
8. Gaur A. S. and Gaur S. S. : "Statistical Methods for Practice and Research-A guide to data analysis using SPSS" ; Gaur and Gaur.

SEMESTER - IV

PAPER – 401

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, Krushkal wallis 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. Berger J.O. : "Statistical Decision Theory"; Springer –Verlag Pub. Co., New York.
2. Gibbons J.D. : "Nonparametric Statistical Inference"; McGraw Hills.
3. Ferguson T.S. : "Mathematical Statistics"; Academic Press.
4. Kendall M.G. and Stuart A.: "The Advanced Theory of Statistics"; Vol. 2., Ed. IV, Charles and Griffin.
5. Mood A.M., Grabill F. and Boes D.C. : "Introduction to the Theory of Statistics"; McGraw Hills, International Student Ed. III.
6. Sedney Seigal : "Nonparametric Methods for Behavioral Sciences"; McGraw Hill.
7. Gibbons J.D. and Pratt J.W. : "Concepts of Nonparametric Theory"; Springer-Verlag**.**
8. Daniel W.W. : "Applied Nonparametric Statistics"; PWS-KENT publishing Co., Boston.
9. Conover W.J. : "Practical Nonparametrics"; John Wiley.
10. Wald A. : "Sequential Analysis"; Wiley.

PAPER – 402

DESIGN 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 symmetric balanced incomplete block designs.

General theory of analysis of experimental designs with two way elimination of heterogeneity; Youden square and Crossover 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 confounded experiments.

Construction of (i) orthogonal Latin squares, (ii) Balanced incomplete block designs using finite geometries and (iii) total and partially confounded symmetric 2^n factorial experiments.

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OPERATIONS RESEARCH - II

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 al1-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-machincs
   - 5.4 Problems with n-jobs and 3-machines
   - 5.5 Problems with 2-jobs and m-machines

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

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ECONOMETRICS

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

1. **Single Equation method :**
OLS estimation : Estimation, Prediction, and tests of hypotheses.

Multicolinearity : Detection and consequences, Ridge estimator.

Generalized least square method: Estimation and prediction.

Heteroscedasticity: Problem of hetroscedasticity, Consequence of hetroscedasticity, Tests for detecting the presence and nature of hetroscedasticity, Methods for handling hetroscedasticity.
Grouping of observations.

Autocorrelation : Introduction, its consequences and tests. The BLUE procedure.

2. Dummy and Lagged variables.

3. 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.

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