VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

M.Sc.: APPLIED STATISTICS

Effective From: 2019 – 2020

1. **Fee structure** **:-** Higher Payment Course
   Rs. 12000/- per semester + university fees

2. Eligibility for Admission:

- A student having statistics / mathematics / quantitative techniques / econometrics / research methodology at under graduate or post graduate level as principal / subsidiary subjects and has secured 40% marks will be eligible for admission to this course
- Any graduate with three subjects with one of them should be statistics / mathematics and has secured at least II class will be eligible for admission to this course.

2. **Passing standard** in this course; as per prevailing rules sanctioned by the University.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhana-Magdalla Road,
Surat - 395 007.

M.Sc.: APPLIED STATISTICS

Effective from: 2019 – 2020

SEMESTER – I

Paper No.	Title of the Paper	Marks			Work Load (hrs /week)	Credit Point
		Int.	Ext.	Total	L	
MAS-101	Basic Mathematics and Elements of Probability Theory	30	70	100	4	4
MAS-102	Probability Distributions	30	70	100	4	4
MAS-103	Sample Survey	30	70	100	4	4
MAS-104	Industrial Statistics	30	70	100	4	4
MAS-105	Introduction to Ms-Office and Internet	30	70	100	4	4
MAS-106	Practical paper-I (Practical +viva-voce) based on Paper - 101, 102,103	20+ 10 =30	50+ 20 =70	100	4	2
MAS-107	Practical paper-II (Practical +viva-voce)based on Paper - 104, 105	20+ 10 =30	50+ 20 =70	100	4	2
Total		210	490	700	28	24
Total workload per week					28	

SEMESTER – II

Paper No.	Title of the Paper	Marks			Work Load (hrs /week)	Credit Point
		Int.	Ext.	Total	L	
MAS-201	Statistical Inference -I	30	70	100	4	4
MAS-202	Statistical Inference -II	30	70	100	4	4
MAS-203	Multivariate Analysis	30	70	100	4	4
MAS-204	Actuarial Statistics	30	70	100	4	4
MAS-205	Computer Programming Language - "C"	30	70	100	4	4
MAS-206	Practical paper-III (Practical +viva-voce) based on Paper - 201, 202, 203	20+ 10 =30	50+ 20 =70	100	4	2
MAS-207	Practical paper IV (Practical +viva-voce) based on Paper - 204, 205	20+ 10 =30	50+ 20 =70	100	4	2
Total		210	490	700	28	24
Total workload per week					28	

M.Sc.: APPLIED STATISTICS
Effective from: 2020 – 2021
SEMESTER - III

Paper No.	Title of the Paper	Marks			Work Load (hrs /week)	Credit Point
		Int.	Ext.	Total	L	
MAS-301	Statistics for Economics	30	70	100	4	4
MAS-302	Operations Research - I	30	70	100	4	4
MAS-303	Econometrics	30	70	100	4	4
MAS-304	Introduction to Statistical Softwares	30	70	100	4	4
MAS-3051 MAS-3052 MAS-3053	Elective* (Any one) Database Management Systems Official Statistics Population Studies	30	70	100	4	4
MAS-306	Practical paper V (Practical +viva-voce) based on Paper - 301,302,303	20+ 10 =30	50+ 20 =70	100	4	2
MAS-307	Practical paper VI (Practical +viva-voce) based on Paper - 304, 305	20+ 10 =30	50+ 20 =70	100	4	2
Total		210	490	700	28	24
Total workload per week					28	

* Elective Paper is to be selected from the above list of papers from papers 3051 to 3053.

SEMESTER – IV

Paper No.	Title of the Paper	Marks			Work Load (hrs /week)	Credit Point
		Int.	Ext.	Total	L	
MAS-401	Design of Experiments	30	70	100	4	4
MAS-402	Operations Research - II	30	70	100	4	4
MAS-4031 MAS-4032 MAS-4033	Elective* (Any one) Data Mining Bio-statistics & Clinical Research Statistical Simulation	30	70	100	4	4
MAS-404	Practical paper VII (Practical +viva-voce) based on Paper - 401, 402,403	20+ 10 =30	50+ 20 =70	100	4	4
**	Project and Seminar	60	140	200	4 hour per week per group	8
Project Viva		30	70	100		4
Total		420	280	700	16 + project workload	
Total workload per week					16 +project workload	

* Elective Paper is to be selected from the above list of papers from paper 4031 to 4033.

** To be done at some industry / firm / organization.

Grand Total: 2800 Marks

SEMESTER- I

PAPER: MAS-101

BASIC MATHEMATICS AND ELEMENTS OF PROBABILITY THEORY

UNIT I:

- Concepts of Function, Algebra of functions, Algebra of functions Polynomial and Exponential functions &Logarithmic functions.
- Concept of Derivative of a function. Derivatives of x^n, e^X, logx. Algebra of differentiation. Interpretation of derivative as rate of change & Applications.
- Integration as an inverse operation of differentiation. Definite Integral. Integral as the area under a curve. Properties of Integral. Integrals of some standard functions & its Applications.

UNIT II:

- Sums of some standard series of positive terms.
- **Numerical Methods:** Solution of algebraic and transcendental equations, Numerical integration, Concept of interpolation, Simpson 1/3 rule & 3/8 rule & its Applications.

UNIT III:

- Determinants, Matrices, Algebra of matrices: Determinants & its properties. Scalar multiplication, addition and multiplication of matrices. Inverse of a square matrix. Concept of rank of a matrix. Rank determination. Linear equations, Systems of linear equations as matrix equations. Characteristic roots and vectors.

UNIT IV:

- Permutations and Combinations.
- **Probability:** Sample space of a chance experiment, Elementary outcomes, Events, Representation of events as sets, Combination of events (Complements, Intersections, Unions). Probability functions over a sample space (Discrete case). Case of Equally likely, elementary outcomes: Laplace definition of probability of an event, Axioms of probability. Combinatorial problems of Probability calculation. Conditional Probability. Bayes Theorem. Independent events.

REFERENCES

1. John Scheick(1997):Linear Algebra With Applications, Mcgraw-hill, ISBN: 10:0071155309, ISBN-13: 9780071155304,
2. Strang(2008):Linear Algebra And Its Applications, Cengage Learning (Thompson), ISBN: 10:8131501728,ISBN-13: 9788131501726
3. Dutta K. B.(2003) : "Matrix and Linear Algebra"; Prentice Hall India, ISBN: 10:8120306368, ISBN-13: 9788120306363
4. Thomas S. Shores(2007): Applied Linear Algebra And Matrix Analysis, Springer Verlag Publication, ISBN:10: 0387331956, ISBN-13:9780387331959,
5. S. Lang, Serge A. Lang (1997): Introduction To Linear Algebra, Springer Publication, ISBN-10: 0387962050, ISBN-13: 9780387962054
6. K.M. Abadir & J.R. Magnus (2005): Matrix Algebra. Cambridge University Press: ISBN-10: 0521822890; ISBN-13: 978-0521822893. [MR2408356]
7. Fuzhen Zhang (1999):Matrix theory: basic results and techniques:, Springer Verlag new York, ISBN: 0387986960

8. H. Anton (2005). Elementary Linear Algebra, 9th edition. John Wiley, ISBN-10: 0471669601; ISBN-13: 978-0471669609.
9. H. Anton & C. Rorres (2006). Elementary Linear Algebra with Applications, Student Solutions Manual, 9th edition. John Wiley, ISBN-10: 0471433292; ISBN-13: 978-0471433293.
10. Kolman, Bernard & Hill, David (2008): Elementary Linear Algebra: 9th edition Pearson Prentice Hall, (ISBN: 0-13-229654-3).
11. Kolman, Bernard(2008) Elementary Linear Algebra Student's Solutions Manual: 9th edition Prentice Hall, (ISBN: 0-13-229656-X).
12. Sastry S. S.(2006): "Introductory Methods of Numerical Analysis" ; Prentice Hall India. 4th Ed., ISBN:10: 8120327616, ISBN:13: 9788120327610
13. Balaguruswamy (1999): "Numerical Methods" ; Tata McGraw Hill.ISBN: 0074633112, 9780074633113
14. Rohatgi V.K.,(976):An Introduction to Probability Theory and Mathematical Statistics, JohnWiley & SonsInc, SBN-10:0471731358, ISBN-13:9780471731351
15. Mood A. M., Graybill F. A. and Boes D. C.(2001) : "An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill. ISBN:100070445206, ISBN-13: 9780070445208
16. Goon A. M., Gupta M. K. and Dasgupta B. : "An Outline of Statistical Theory"; Vol. 1 & 2, World press. ISBN:10- 8187567260, ISBN-13: 9788187567264, 978-8187567264
17. Gentle J. E. :(1998):Numerical linear algebra for applications in statistics, Springer, ISBN: 0387985425, 9780387985428
18. Lay D. C. (2006): Linear Algebra and Its Applications, Addison-Wesley, ISBN-10: 0321287134, ISBN-13: 9780321287137,
19. Shores T. S.(2007): Applied Linear Algebra and Matrix Analysis, Springer Publication, ISBN: 0387331956, 9780387331959
20. Robinson D. J. S.(2006) :A Course In Linear Algebra With Applications ISBN: 9789810205676 & 9810205678

PAPER: MAS - 102

PROBABILITY DISTRIBUTIONS

UNIT I:

- **Random Variables & their Distributions :**
  Definition of random variable, Discrete and continuous random variable. Probability distribution of a random variable. Concept of Probability mass function and Probability density function, Distribution Function (d.f.) of a random variable.
- **Expectations & Moments of a Distribution :**
  Expectation of a random variable & a function of a random variable (Discrete and Continuous case). Moments, Different types of moment generating functions, Mean, Variance, Standard deviation, Skewness and Kurtosis of a random variable (distribution). Independence of variables. Linear transformation of variable, Moments under linear transformation, Problems on calculation of mean, variance, S.D. and other moments of a distribution.

UNIT II:

- **Frequency Distributions :**
  Frequency distribution of a discrete and continuous random variable (Grouping of data in terms of class intervals). Mean, variance and Moments of a frequency distribution. Bivariate frequency distribution, Conditional distributions and their properties.

UNIT III:

- **Some Common Discrete Distributions: (proofs for p.m.f., mean & variance only):** Bernoulli distribution, Binomial distribution, Poisson distribution, Hyper-geometric distribution, Negative Binomial distribution, Geometric distribution. General concept of m.g.f. & other important properties of distributions (without proof).

UNIT IV:

- **Some Common Continuous Distributions: (proofs for p.d.f., mean & variance only):** Uniform distribution, Normal distribution, Exponential distribution, Beta and Gamma distribution. General concept of m.g.f. & other important properties of distributions (without proof)
- **Sampling Distributions:** χ^2 - distribution, t – distribution, F – distribution, Distribution of $\bar{x}$ and S^2 for Normal distribution.

REFERENCES

1. Mood A. M., Graybill F. A. and Boes D. C. (2001): "An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill. ISBN: 100070445206, ISBN-13: 9780070445208
2. Goon A. M., Gupta M. K. and Dasgupta B. : "An Outline of Statistical Theory"; Vol. 1 & 2, World press. ISBN:10- 8187567260, ISBN-13: 9788187567264, 978-8187567264
3. Valery Nevzorov, Vicki B. Galloway, V. B. Nevzorov: A Primer On Statistical Distributions **ISBN: 10:** 0471427985, **ISBN-13:** 9780471427988
4. A.k. Md. Ehsanes Saleh Vijay K. Rohatgi(2008): An Introduction To Probability And

Statistics, 2nd Ed **ISBN: 10**- 8126519266, **ISBN-13:** 9788126519262

5. Norman L. Johnson, Adrienne W. Kemp, Samuel Kotz(2008):Univariate Discrete Distributions, Set: III-Ed., John Wiley & Sons, **ISBN:10:** 0470383372, **ISBN-13:** 9780470383377,
6. Norman L Johnson, Samuel Kotz (2004); Continuous Univariate Distributions,2e, John Wiley, **ISBN:10:**9812530762, **ISBN-13:** 9789812530769
7. Peter Dalgaard (2008): Introductory Statistics with R *Statistics and computing, II-Ed.,* Springer, ISBN: 0387790535, 9780387790534
8. Julian James Faraway(2006): Extending the linear model with R: generalized linear, mixed effects and nonparametric regression models, CRC Press, ISBN: 158488424X, **ISBN-13:**9781584884248

PAPER: MAS – 103

SAMPLE SURVEY

UNIT I:

- **Planning and Execution of Surveys :**
  Concept of population, sample, Advantages of sample survey, Principal steps in a sample survey and Determination of sample size, Pilot surveys, selection of enumerators, training of enumerators, supervision of enumerators, control of quality of field work, observation, reinterviews, field edit, follow-up of nonresponse, interpenetrating sub samples, time coding, tabulation, control of data processing, use of computers, report writing, general report, technical report.
- **Data Collection in Selected Fields :**
  Surveys of agricultural area, surveys of agricultural production, demographic surveys, employment and unemployment surveys, consumer expenditure surveys, surveys of health, industrial surveys, surveys of distributive trade, sampling as an census surveys of road traffic, public opinion surveys, marketing research, payroll surveys, postal traffic surveys, sociological research.

UNIT II:

- **Simple random sampling:**
  Selection of sample, Estimation of population total and means, standard error and coefficient of variation of estimator.
- **Stratified random sampling:**
  Estimation of mean, variance of the estimator, Estimation of the variance, Estimation of gain due to stratification from a stratified sample: finding sample sizes under proportional and optimum allocations and their comparisons for a given sample.

UNIT III:

- **Systematic Sampling :**
  Estimation of mean, variance of the estimator, Estimation of variance based on interpenetrating sub samples, Comparison of systematic and simple random sampling for a given population.
- **Two stage sampling :**
  Estimation of the population mean, variance of the estimator and Estimation of the variance for first stage units of equal sizes, finding optimum values of first and second stage sample sizes for a given simple cost function.

UNIT-IV:

- **Cluster sampling :**
  Meaning and need, Estimation of population mean per unit, variance of estimator. Estimation of this variance. Variance in terms of intra class correlation coefficient as its comparison with unistage mean per unit estimator, when clusters are of equal selection, nationwide surveys, Design of nationwide sample surveys.
- **Ratio, Product and Regression methods of Estimation :**
  Finding the estimates and their standard errors from given data, comparison of their performance.

REFERENCES

1. Cochran W. G.(1977): “Sampling Techniques”; Ed.-III, John Wiley & Sons, Inc., New York, ISBN: 047116240X
2. Hansen M. H., et al.(1993): “Sample Survey Methods and Theory”; Wiley Blackwell; Volume 1 edition, **ISBN-10:** 0471309672, **ISBN-13:** 978-0471309673
3. Kish L. (1995) : “Survey Sampling”; John Wiley & Sons, Inc., New York. ISBN: 0471109495, 9780471109495
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. and Chandhok P. (1998): Sample Survey Theory, Sample Survey Theory, ISBN: 8173191379, 9788173191374
7. Raj D. : “The Design of Sample Surveys”; McGraw-Hill Book Co., New York.
8. Sukhatme P.V.,et al. (1997): “Sampling Theory of Surveys with Applications”;III-Ed., The Iowa State Univ. Press, Ames, Iowa, USA and Indian Society of Agricultural Statistics, New Delhi.
9. Yates F.(1960) : “Sampling Methods in Censuses and Surveys”; Ed.,-III, Charles Griffin & Co. Ltd., London.
10. Goulden C. H.(2007) : “Methods of Statistical Analysis”; READ BOOKS Publisher , ISBN: 1406737070, 9781406737073
11. Snedecor G.W. and Cochran W.G.(1989): “Statistical Methods”; Ed.:VIII, Wiley-Blackwell, ISBN: 0813815614, 9780813815619
12. Poduri S.R.S. Rao (2000):Sampling Methodologies with Applications, ISBN: 9781584882145, ISBN 10: 158488214X, Chapman & Hall/CRC Texts in Statistical Science
13. Arijit Chaudhuri (2005):Survey Sampling: Theory and Methods, Ed.,-II, Horst Stenger, University of Mannheim, Germany Series: ISBN:13: 9780824757540, ISBN 10: 0824757548
14. Ranjan K. Som (1995):Practical Sampling Techniques, Ed.,-II, Series: Statistics: A Series of Textbooks and Monographs, ISBN: 9780824796761,ISBN:10: 0824796764
15. Foreman E. K. (01991): Survey sampling principles, Marcel Dekker, ISBN: 0824784073, 9780824784072

PAPER : MAS – 104

INDUSTRIAL STATISTICS

UNIT-I:

- The meaning of Quality & Quality improvement
- Introduction of statistical quality control
- Statistical process control
  - Introduction
  - Measure of location and variability
  - Process of control charts for variables & attribute
  - Process of control limits
  - Out of control criteria
- Process and measurement system capability analysis

UNIT-II:

- Cumulative sum chart
- Statistical product control
  - Introduction
  - Standard plans for attributes
  - Plan for acceptance sampling by measurement

UNIT-III:

- Total Quality Management
  - Meaning and important concepts
  - Importance of quality management
  - Total quality management models
  - Six sigma and Quality management
  - Kaizen process
  - Strategic quality planning and total quality management
  - The cost of quality
  - Productivity
  - ISO 9001

UNIT-IV:

- 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.
  - 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.
9. Douglas C. Montgomery: Introduction to statistical quality control

PAPER: MAS - 105

INTRODUCTION TO MS-OFFICE AND INTERNET

UNIT-I:

- WINWORD
  - Typing, Editing, Proofing & Reviewing
  - Formatting Text & Paragraphs
  - Automatic Formatting and Styles
  - Working with Tables
  - Graphics and Frames
  - Mail Merge
  - Automating Your Work & Printing Documents

UNIT-II:

- EXCEL
  - Working & Editing in Worksheets
  - Creating Formats & Links
  - Formatting a Worksheet & Creating Graphic Objects
  - Creating Charts (Graphs), formatting and analyzing data
  - Organizing Data in a List (Data Management)
  - Sharing & Importing Data
  - Printing

UNIT-III:

- POWER POINT PRESENTATION
  - Preparation of Slides,
  - Inserting Elements into Slides,
  - Inserting Animation
  - Preparing Slideshows.

UNIT-IV:

- Introduction to Internet
  - Internet Protocols: http, ftp, TCP/IP, etc.
  - Internet Utilities: e-mail, chat, searching, etc.
- Web Browsers
- Web Server
- HTML
  - HTML Tags
- Dreamweaver

REFERENCES

1. Dienes: Work 6 for windows quick & easy reference - Mansfield - BPB ISBN: 8170292972, ISBN-13: 9788170292975
2. Layman Hart (1995):WordPerfect 6.0 For Windows/book And Quick Reference, ISBN: 0130346535, ISBN-13: 9780130346537
3. Ron Mansfield(1994):Mastering Word 6 for windows- Mansfield – BPB, ISBN: 8170292980, ISBN-13: 9788170292982
4. Townsend :Mastering Excel - 4 For Windows, - Townsend – BPB, SBN:8170292301, ISBN-13: 9788170292302

5. Mansfield R. (1994): Mastering Word 6 for windows, BPB, **ISBN:** 8170292980, **ISBN- 13:** 9788170292982
6. Mastering Excel 4 for windows - Townsend - BPB, **ISBN:** 8170292301, **ISBN-13:** 9788170292302
7. Chester T.(1994): Mastering Excel 4 for windows - BPB, **ISBN:** 8170294762, **ISBN-13:** 9788170294764
8. Shelley O*hara Janice A. Snyder Christopher `Van Buren(1994):Excel Version 5 For Windows Quick Reference , **ISBN:** 1565294580, **ISBN-13:** 9781565294585

SEMESTER - II

PAPER: MAS – 201

STATISTICAL INFERENCE – I

UNIT I:

- **Estimation & Properties of Point estimator:**
  Theoretical finite and infinite population, parameter, parametric space, statistic, estimation of a parameter, Problem of Criterion of selecting a good estimator, Properties of closeness, Unbiasedness, Consistency, Efficiency and Sufficiency. Jointly sufficient statistics, Statement and application of factorization theorem. Minimal sufficient statistics, Complete sufficient statistics, BAN estimator.

UNIT II:

- Minimum variance unbiased estimator, Lower bound of variance of an estimator, Statements & application of Cramer- Rao inequality, condition of existence of uniformly minimum variance bound unbiased estimator, difference between MVUE and MVBUE. Uniformly minimum variance unbiased estimator, statement and applications of Rao-Blackwell theorem and Lehnam-scheffe theorem, Location and scale invariance estimator and parameter. Pitman's estimator for location and scale parameter.

UNIT III:

- **Methods of estimation**:
  (i) Method of maximum likelihood, Properties of maximum likelihood estimator, (ii) Method of moments, (iii) Method of scoring, (iv) Method of minimum chi-square, (v) Method of modified minimum chi-square, (vi) Method of least squares.
- **Interval Estimation:**
  Introduction to confidence interval, Definition of confidence interval, Pivotal quantity, Pivotal quantity method.
  (i) Confidence interval for mean and variance when sampling is done from normal population.
  (ii) Confidence interval for large samples.

UNIT IV:

- **Elementary Decision Theory:**
  Decision problem, basic components and spaces associated with the decision problem, Decision rules, Risk function, Minimax-decision rule, prior and posterior distribution, Bayes risk, Bayes Rule, Value of information.

REFERENCES

1. Mood A.M., Graybill F.A. and Boes D.C. (2001) : **"**An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill, **ISBN**: 0070445206, **ISBN-13**: 9780070445208, 978-0070445208
2. Goon A. M., Gupta M. K. and Dasgupta B. (2000) : "An Outline of Statistical Theory" Vol.1, 2; The World Press Private Limited, **ISBN**: 8187567260 **ISBN-13**: 9788187567264, 978-8187567264
3. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics";

John Wiley& Sons Incorporated, ISBN-10:0471731358,ISBN-13:9780471731351
4. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta.
5. Mukhopadhyay Parimal (2000): "Topics in Survey Sampling", Springer-verlag, **ISBN:** 0387951083, **ISBN-13:**9780387951089, 978-0387951089.
6. Rao C. R. (2001) : "Linear Statistical Inference and its Applications"; 2nd Edition, Wiley-Interscience,. **ISBN-10:** 0471218758, **ISBN-13:** 978-0471218753
7. Casella G. and Berger R. L. (2001): "Statistical Inference"; 2nd Revised edition Duxbury Press. **ISBN-10:** 0534243126 , **ISBN-13:** 978-0534243128
8. Zaven A. Karian and Edward J. Dudewicz (2010): "Handbook of Fitting Statistical Distributions with R"; Chapman and Hall/CRC, **ISBN:** 9781584887119, **ISBN10:** 1584887117
9. Zaven A. Karian and Edward J. Dudewicz (2000): "Fitting Statistical Distributions: The Generalized Lambda Distribution and Generalized Bootstrap Methods"; Chapman and Hall/CRC, **ISBN:** 9781584880691, **ISBN10:** 1584880694
10. Mukhopadhyay Nitis (2006) : "Introductory Statistical Inference"; Chapman and Hall/CRC, **ISBN:** 9781574446135, **ISBN10:** 1574446134

PAPER: MAS - 202

STATISTICAL INFERENCE - II

UNIT I:

- **Testing of Hypotheses:**
  Concepts of hypothesis, statistical hypothesis, simple and composite hypothesis, Null and Alternative hypothesis. One sided and two sided hypothesis. Test of hypothesis, critical region or region of rejection, acceptance region. Types of errors. Sizes of the errors, Level of significance, Size of the test, power function of the test, Two-tail and one tail tests, most powerful test, Likelihood Ratio Test & Test of significance as its particular case.

UNIT II:

- **Parametric tests:**
  i) Large sample test for mean, variance, proportion and correlation
  ii) Small sample tests: χ^2, t, F & Z-transformation
  iii) ANOVA

UNIT III:

- **Nonparametric tests:**
  Sign, Median, Run, Mann Whitney, Wilcoxen, K-S tests, K-W.Test,

UNIT IV:

- **SPRT:**
  Wald's sequential probability ratio test, its properties and applications.

REFERENCES

1. Mood A.M., Graybill F.A. and Boes D.C. (2001) : "An Introduction to Theory of Statistics"; McGraw Hill and Tata McGraw Hill, **ISBN:** 0070445206, **ISBN-13:** 9780070445208, 978-0070445208
2. Goon A. M., Gupta M. K. and Dasgupta B. (2000) : "An Outline of Statistical Theory" Vol.1, 2; The World Press Private Limited, **ISBN:** 8187567260 **ISBN-13:** 9788187567264, 978-8187567264
3. Lehmann, E.L.(1986): "Testing Statistical Hypothesis"; John Wiley & Sons, New York.
4. Lehmann. E.L. and Joseph P. Romano (2005): "Testing Statistical Hypothesis"; 3rd Edition, Springer, ISBN 0-387-98864-5.
5. Gibbons, J. D. (1985): "Nonparametric Statistical Inference", 2nd Edition, Marcel Dekker, New York.
6. Gibbons J.D. and Pratt J.W. (1981): "Concepts of Nonparametric Theory"; Springer-Verlag, **ISBN:** 0387905820, **ISBN-13:** 9780387905822, 978-0387905822.
7. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics"; John Wiley& Sons Incorporated, ISBN-10:0471731358,ISBN-13:9780471731351
8. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta.
9. Mukhopadhyay Parimal (2000): "Topics in Survey Sampling", Springer-verlag, **ISBN:** 0387951083, **ISBN-13:**9780387951089, 978-0387951089
10. Rao C. R. (2001) : "Linear Statistical Inference and its Applications"; 2nd Edition, Wiley-Interscience,. **ISBN-10:** 0471218758, **ISBN-13:** 978-0471218753
11. Daniel W.W. (1990):"Applied Nonparametric Statistics"; PWS-KENT publishing Co., Boston.

12. Daniel W.W. (1989): "Applied Nonparametric Statistics"; 2nd Edition, Wadsworth Publishing Company, Belmont, California**,** U.S.A**.,** ISBN-10: 0534919766, ISBN-13: 978-0534919764
13. Wald A. (2004):"Sequential Analysis"; Dover Pubns, **ISBN:** 0486439127, **ISBN-13:** 9780486439129, 978-0486439129
14. Wald A. (1947): "Sequential Analysis"; John Wiley and Sons, New York.
15. Conover, W. J. (1980): "Practical Nonparametrics Statistics", John Wiley & Sons, Inc., New York.
16. Peter Sprent, Nigel C. Smeeton (2007): "Applied Nonparametric Statistical Methods"; 4th Edition, Taylor & Francis Ltd, **ISBN:** 9781584887010, **ISBN 10:** 158488701X
17. Gibbons J. D., Subhabrata Chakraborti (2003): "Nonparametric Statistical Inference"; 4th Revised Edition, CRC Press (Taylor & Francis Ltd), **ISBN:** 9780824740528, **ISBN 10:** 0824740521.
18. David J. Sheskin (2007) : "Handbook of Parametric and Nonparametric Statistical Procedures";
19. David J. Sheskin (2007) : "Handbook of Parametric and Nonparametric Statistical Procedures"; Chapman & Hall; 4th Edition, **ISBN:** 9781584888147, **ISBN 10:** 1584888148

PAPER: MAS - 203

MULTIVARIATE ANALYSIS

UNIT I:

- Concept and need of multivariate analysis, Concept of multinomial distribution and multivariate Normal distribution – its properties (without proof).

UNIT II:

- Concept of Hotelling T^2 distribution (without derivation) & its applications.
- Comparisons of several multivariate means: multivariable analysis of variances.

UNIT III:

- Partial correlation and multiple correlations.
- Multiple linear regression model, least square estimation, inference.

UNIT IV:

- Concept and application of (i) Factor analysis (ii) Principal Component analysis and (iii) Canonical Correlation analysis.
- Discrimination and classification: Separation and classification of populations, classification of multivariate populations. Fisher's discriminant function, Classification of several populations. Fisher's method of discriminating among several populations.

REFERENCES

1. Anderson T. W. (2003): "An Introduction to Multivariate Statistical Analysis"; 3rd Edition, Wiley-interscience, **ISBN:** 0471360910, **ISBN-13:** 9780471360919
2. Johnson R.A. and Wichern D.W. (2008) : "Applied Multivariate Statistical Analysis"; Pearson Education(singapore) Pte. Ltd., **ISBN:** 8131722228, **ISBN-13:** 9788131722220
3. Stephen E. Fienberg, Jobson J. D., Ingram Olkin (1994): "Applied Multivariate Data Analysis: Volume Ii: Categorical and Multivariate Methods"; Springer, ISBN: 0387978046, **ISBN-13:** 9780387978048, 978-0387978048
4. Khirsagar A.M. (1972): Multivariate Analysis. Marcel Dekker, New York.
5. Kent J. T. , J. M. Bibby, K. V. Mardia (1980) : "Multivariate Analysis (probability And Mathematical Statistics)"; Academic Press, **ISBN:** 0124712525**, ISBN-13:** 9780124712522
6. Morrison D.F. (1990): "Multivariate Statistical Methods"; Mcgraw-hill Professional, **ISBN:** 0071008152,**ISBN-13:** 9780071008150, 978-0071008150
7. Morrison D.F. (2004): "Multivariate Statistical Methods"; Thomson Brooks/cole, ISBN**:** 0534387780**, ISBN-13:** 9780534387785
8. George A. Marcoulides, Scott L. Hershberger and Marcoulide (1997) : "Multivariate Statistical Methods: A First Course"; Lawrence Erlbaum Associates, **ISBN:** 080582572X**, ISBN-13:** 9780805825725
9. Muirhead R.J. (2005): "Aspects of Multivariate Statistical Theory"; Wiley-interscience, ISBN: 0471769851, ISBN-13: 9780471769859
10. Seber G.A.F. **(**1984**): "**Multivariate Observations"; John Wiley & Sons Inc., ISBN 10: 047188104X , ISBN 13: 9780471881049

11. Gnanadesikan R. (1997): “Methods For Statistical Data Analysis Of Multivariate Observations”; Wiley-interscience, **ISBN:** 0471161195,ISBN-13: 9780471161196
12. Srivastava and Khatri (1979): “An Introduction to Multivariate Statistics”; North Holland, New York.
13. Srivastava M.S. (2002): "Methods of Multivariate Statistics"; John Wiley and Sons Inc., New York.
14. Dillon W.R. and Goldstein M. (1984): "Multivariate Analysis: Methods and Applications"; John Wiley and Sons Inc., New York. **ISBN:** 0471083178, **ISBN-13:** 9780471083177
15. Rohatgi V. K., A. K. Md. Ehsanes Saleh (2008): “An Introduction To Probability And Statistics”; 2nd Ed, Wiley, **ISBN:** 8126519266, **ISBN-13:** 9788126519262
16. Wolfgang Hardle, Zdenek Hlavka (2007): “Multivariate Statistics: Exercises And Solutions”; Springer Verlag, **ISBN:** 0387707840, **ISBN-13:** 9780387707846

PAPER: MAS – 204

ACTUARIAL STATISTICS

UNIT I:

- Basics of Probability & Interest: Theory of Interest, Variable interest rates, continuous time payment streams.
- Interest & Mortality: Annuities, Loan Amortization and Mortgage Refinancing, Mortality and Analytical models.

UNIT II:

- Life Tables: Concepts of Life Tables, Assumptions related to life tables, columns of life tables, Complete and Abridged life tables, Construction of life tables, Estimation from life table data.

UNIT III:

- Expected present values of payments, Continuous contracts & residual life, Premium calculations, m-payment net single premiums
- Population functions and indicator notations, Stationary population concepts

UNIT IV:

- Risk models: Proportional Hazard models, excess risk models, Multiple decrement models, death rate estimators, causes specific life insurance premiums.

REFERENCES

1. Barcley G.W. (1970). Techniques of Population Analysis. John Wiley, New York.
2. Borowiak, D.S., and A. F. Shapiro. (2013). Financial and Actuarial Statistics: An Introduction, Second Edition. CRC Press.
3. Donald, D.W.A. (1970). Compound interest and annuities, Second Edition, The Institute of Actuaries and the Faculty of Actuaries at the University Press.
4. Spurgeon, E.T. (2011), Life Contingencies, Third Edition, Cambridge University Press.
5. Eric V. Slud (2001): Actuarial Mathematics and Life Table Statistics (Mathematics Department, University of Maryland)

PAPER: MAS - 205

COMPUTER PROGRAMMING LANGUAGE – 'C'

UNIT I:

- Introduction
  - Algorithms and Flowchart
  - Types of Language
  - Introduction to C Language
- C Fundamentals
  - Identifiers
  - Data Types
  - Constants and Variables
  - Arrays
- Operators and Expressions
  - Arithmetic Operators
  - Unary Operators
  - Relations Operators
  - Logical Operators
  - Assignment Operators
  - Conditional Operators
  - Library Functions
  - Expressions
  - Evaluation of Expression

UNIT II:

- Data Input and Output
  - Single Character input and output
  - The scanf function
  - The printf function
  - Gets and Puts functions
- Control Statements
  - The While Statement
  - do-while statement
  - for statement
  - if - else statement
  - switch statement
  - break statement
  - continue statement
  - goto statement

UNIT III:

- Functions
  - Introduction to functions
  - Function definition
  - Accessing function
  - Passing arguments to function
  - Recursive function
- Data Files

UNIT IV:

- Arrays
  - Defining an array
  - Processing an array
  - Multi dimensional arrays
  - Passing array to a function
  - Arrays and Strings
- Structures and Unions
  - Defining a structure
  - Processing a structure
  - Unions

REFERENCES

1. Karnighan B. W. and Ritchie D. M. (1978) : "C programming Language"; Prentice Hall-Gale, **ISBN:** 0131101633, **ISBN-13:** 9780131101630
2. VijayMukhi: "The C Odyssey -vol. 6: Windows"; Bpb, **ISBN:8170291682, ISBN-13:** 9788170291688
3. Stephan G. Kochan (2001) : "Programming In C" ; CBS Publishers & Distributors, ISBN PB : CBS0000031
4. Stephen G. Kochan (2004): **"**Programming in C"; 3rd Edition, Sams, **ISBN-10:**0672326663, **ISBN-13:** 978-0672326660
5. Kelly Stan and Bootle (1988): "Mastering turbo C"; BPB Publications
6. Stan Kelly Bootle (1988): "Mastering Turbo C"; Wiley John & Sons Incorporated, ISBN-13: 9780895884626 , ISBN: 0895884623
7. Kanetkar Yashwant (2006) : "Let us C" ; 9th Edition , BPB, **ISBN:** 8183331637, **ISBN-13:** 9788183331630,
8. E Balaguruswamy (2007) : "Programming In C#"; Tata Mgraw Hill, **ISBN:** 0070667578 **ISBN-13:** 9780070667570, 978-0070667570
9. Robert Lafor (2001) : "Object - Oriented Programming in C" ; Sams , 4th Edition, **ISBN:** 0672323087, **ISBN-13:** 9780672323089, 978-0672323089
10. Robert Lafore (1995) : "Object Oriented Programming in C++"; Galgotia Publications.

.

SEMESTER – III

PAPER: MAS - 301

STATISTICS FOR ECONOMICS

UNIT I:

- **Analysis of Time Series :**
  - Definition and importance of time series analysis, 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.
  - Stationary Time series, 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.

UNIT II:

- **Index Numbers :**

  Importance of Index Numbers, Various Formulae: Ratio of Simple Aggregate, Ratio of Weighted Aggregate, Unweighted average of price relatives, Choice of base period, Different tests of a good index number, Cost of Living Index Number and Various Official Index Numbers, HDI (Human Development Index).

UNIT III:

- **Demand Analysis :**

  Concept related to demand and supply, price elasticities of demand and supply, Methods of determining demand and supply curves for cross section data and time series data, Leontief's method, Pigou's Method, Engels Curves, Pareto's Law of Income Distribution.

UNIT IV:

- **Input-Output Analysis :**

  Leontief's Static Model for Inter-industry relations.

- **Growth Models**

  Concepts of multiplier and accelerator, Hicks-Smauelson's Model, Harrod-Domar and Solow's Growth Models.

REFERENCES

1. Croxton E.F., Cowden D.J.and Klein S. (1967): "Applied General Statistics"; III-Ed Prentice-Hall (Englewood Cliffs, N.J).
2. Karmel P.H. (1963): "Applied Statistics for Economics"; 2nd ed., Pitman (Melbourne)
3. Kendall M.(1976) : "Time Series", 2nd ed., Charles Giffin & Co.,
4. Chatfield C. (1975): "Analysis of Time Series: Theory and Practice"; Chapman & Hall, London
5. Chatfield Chris(2003) :"The Analysis Of Time Series: An Introduction"; Sixth Edition, Chapman & Hall/crc, **ISBN:** 1584883170, **ISBN-13:** 9781584883173
6. Sen A.K. (1970): "Growth Economics" : Penguin Modern Economic Reading Edition.
7. Pillai S.(1973) : "Economic & Business Statistics"; Progressive Corporation Pvt. Ltd.
8. Mukhopadhyay P. (2009) : "Applied Statistics"; Books & Allied (p) Ltd , **ISBN:** 8187134380, **ISBN-13:** 9788187134381
9. Gupta S.C. and Kapoor V.K.(2006) : " Fundamentals of Applied Statistics"; Sultan Chand & Sons, **ISBN:** 8170141516, **ISBN-13:** 9788170141518

PAPER: MAS – 302

OPERATIONS RESEARCH – I

UNIT I:

- **Linear Programming:**
  - Definition of linear programming problem (LPP)
  - Formulation of LPP .
  - Solution of LPP by Graphical and Simplex Method (including Big-M and Two-phase method)

UNIT II:

- **Transportation and Assignment Problems:**
  - Definition of Transportation Problem (TP)
  - Special structure of TP
  - Methods for getting basic feasible solution to TP
  - Methods for getting optimum solution to TP
  - Unbalanced TP
  - Definition of Assignment Problem (AP)
  - Algorithm for solving an AP
  - Unbalanced AP
  - Routing Problem

UNIT III:

- **Duality:**
  - Definition of Dual Problem.
  - Rules for converting any Primal into its Dual
  - Properties of Duality
  - Dual-Simplex Method
- **Simulation**
  - Introduction & definitions
  - Types of simulation
  - Uses & limitation
  - Phases of simulation Model
  - Even type simulation
  - Monte-Carlo Simulation & its applications
  - Advantages and Disadvantages
- **Dynamic Programming**
  - Introduction
  - The recursive Equation Approach
  - Characteristics of Dynamic Programming
  - Dynamic Programming Algorithm
  - Solution of Discrete D.P.P.
  - Some APPLICATION
  - Solution of L.P.P. By Dynamic Programming

UNIT IV:

- **Inventory Management Systems:**
  - Definition
  - Costs involved in Inventory Problems
  - Classical EOQ Models without and with shortages
  - Multi-item Deterministic Models
  - Probabilistic Inventory Models
  - Inventory Models with Price Breaks
- **Sequencing:**
  - Definition, Notations and Assumptions
  - Solution of sequencing problem.
  - Problems with n-jobs and 2-machincs
  - Problems with n-jobs and 3-machines
  - Problems with 2-jobs and m-machines

REFERENCES

1. K. Swarup, Gupta P.K. and Man Mohan(2008): "Operations Research"; S.Chand & Co., New Delhi, **ISBN:** 8180545350, **ISBN-13:** 9788180545351
2. G. Hadley (2002): "Linear Programming"; Narosa Book Distributors Pvt Ltd, **ISBN:** 8185015910, ISBN-**13:** 9788185015910
3. Murthy K.G.(1988): Linear complementarity, linear and nonlinear programming, Heldermann Verlag, ISBN: 3885384035, 9783885384038
4. Kasana H.S. and Kumar K.D.(2005) : "Introductory Operations Research: Theory & Applications"; Springer Verlag , ISBN: 8181282827, 9798181282827.
5. Kapoor V.K. (2006) : "Operations Research"; 7th Edition, Jain Book Depot, **ISBN :** 8170148286.
6. Sharma S.D.(2005):Operations Research"; 15th Ed., Kedar Nath Ram Nath & Co. Publishers, Meerut,
7. Hira,D.S., Gupta,P.K.(2007): OPERATIONS RESEARCH, S.Chand & Co., New Delh, ISBN: 81-219-0281-9

PAPER: MAS - 303

ECONOMETRICS

UNIT I:

- Introduction to Econometrics and Methodology of an Econometrics study.
- Multivariate Linear regression model : Three variable case :
  Introduction to OLS estimation, Coefficient of multiple correlations, Interpretation of regression coefficients, Partial correlation coefficients.
- Multivariate Linear regression model: The general Model.
  The General form of model, Gauss-Markoff Theorem, OLS estimators and their properties, Coefficient of determination, Normality assumptions about error term, Statistical inference under normality assumption.

UNIT II:

- **Multicolinearity :**
  Introduction, Three variable cases, General case, Perfect and imperfect (near) multicolinearity, Tests for detecting the presence of multicolinearity, Methods for handling multicolinearity.
- **General Linear Model:**
  General form of the model with assumptions and their implication.
  Estimation of Parameters (Aitken estimator), Scalar Predictor (Goldberger Predictor)
  Particular Cases: (a) Heteroschedasticity (b) Autocorrelation.

UNIT III:

- **Hetroscedasticity:**
  The problem of hetroscedasticity, Consequence of hetroscedasticity, Tests for detecting the presence and nature of hetroscedasticity, Methods for handling hetroscedasticity.
- **Autocorrelation:**
  The problem of autocorrelation, Consequences of applying OLS method when here is autocorrelation, Tests for detecting presence of autocorrelation, Estimation of parameters when autocorrelation exists.

UNIT IV:

- **Simultaneous equations models**:
  Introduction and need for simultaneous equations models, General form and reduced form equations, Problem of identification, Conditions for identification, Methods of estimation, Indirect Least Square method and Two-stage Least Square (2-SLS) method.

REFERENCES

1. Samprit Chatterjee, Ali S. Hadi(2006): Regression analysis by example, IV-Ed., John Wiley and Sons, ISBN: 0471746967, 9780471746966
2. Apte P. G.(1990): " Text book of Econometrics"; Tata McGraw Hill, ISBN: 0074515217, 9780074515211
3. Chatterjee, Hadi S. A. & Price B.(2000): "Regression Analysis by Example"; III-Ed.,John Wiley & Sons. ISBN: 0471319465.

4. Cramer J. S. (1971): "Empirical Econometrics"; II-Ed.,North Holland.
5. Gujarati D. N.(2003): "Basic Econometrics"; IV_Ed.,McGraw Hill, ISBN: 0072335424, 9780072335422
6. Michael D. Intriligator(1981): “Econometric models, techniques, and applications”; II_Ed.,North-Holland Publishing Co.,ISBN: 0471029955, 9780471029953
7. John Johnston, John DiNardo(1997): "Econometrics Methods"; IV-Ed.,McGraw Hill,ISBN: 0079131212, 9780079131218
8. George G. Judge(1982): “Introduction to the theory and practice of econometrics”; ISBN: 0471082775, 9780471082774
9. Draper, N.R. and Smith, H (1981). Applied Regression Analysis, II-Ed.,John Wiley, New York.ISBN: 0521325706, 9780521325707
10. Montgomery, D. C.; Peck, E. A. and Vining G. G. (2006). Introduction to Linear Regression Analysis. Wiley India Pvt. Ltd., ISBN: 8126510471, 9788126510474
11. Seber, G. A. F and Lee Alan J. (2003). Introduction to Linear Regression Analysis, Wiley-interscience, and ISBN: 0471415405, ISBN-13: 9780471415404

PAPER: MAS - 304

INTRODUCTION TO STATISTICAL SOFTWARES

UNIT I:

- **SPSS:**
  - SPSS Introduction
  - Starting SPSS
  - Types of Data
  - Levels of Measurement
  - Missing Values
  - Important Files // database files
- **Data Management**
  - Selecting Cases
  - Standardizing Data
  - Transformation of Data
  - Split File
  - Variable and Value Labels
  - Recode Variables/Visual Binning
  - Random Sample of the Data
  - Creating a Population Variable
  - Multi Response
  - Time Saving Features / SPSS MACRO

UNIT II:

- **Basic Data Analysis**
  - Descriptive Statistics
  - Frequency Tables/Cross Tabs
  - Independent T test
  - Paired T Test
  - One-Way ANOVA
  - Correlation / Regression
- **Interpret the Results**

  Presentation with live data

UNIT III:

R:

- **Introduction to R**
  - Background and resources
  - Installing R.
  - R console.
  - R commander
  - Command and syntax
  - Packages and libraries
  - Help in R
  - Workspace in R

- **Data Structures**
  - Introduction to data structure
  - Vectors
  - Matrices
  - Arrays
  - Lists
  - Factors
  - Data frames
  - Importing and Exporting data
  - Data types
- **Frequencies & Descriptive Statistics**
  - Frequency
  - Measure of central tendency
  - Measure of Dispersion
  - Measure of skewness
  - Box and Whisker part
- **Data management**
  - Split
  - Find and replacement
  - Manipulations with alphabets
  - Evaluation of strings
  - Data frames.

UNIT IV:

- **Graphical Analysis**
  - Creating a simple graph
  - Modifying the points and line of graph
  - Modifying title and subtitle of a graph
  - Modifying axes of the graph
  - Adding additional elements to graph
  - Adding legend on a graph
  - Special graph
  - Multiple plots
- **Comparing Populations**
  - Cross tabulation
  - One sample t test
  - Independent sample t test
  - Paired sample t test
  - One way ANOVA
- **Bivariate Data Analysis**
  - Correlation
  - Simple linear regression
  - Multiple linear regression

- **Conditional executions and loops**
  - If loop
  - While loop
  - For loop

REFERENCES

1. Miller R. L., Ciaran Acton and Fullerton D. A., John Malthy (2009), "SPSS for Social Scientists"; 2nd Edition, Palgrave Macmilan. ISBN: 9780230209930.
2. Wagner W. E. III (2006): "Using SPSS for Social Statistics and Research Methods"; SAGE Publications, ISBN-13: 9781412940771.
3. Einsprucho E. L.: "An Introductory Guide to SPSS for Windows"; ISBN:1-412904153.
4. Pandya K. and Bulsari S.: "Enjoy Statistics with SPSS for Windows"; Popular.
5. Gaur A. S. and Gaur S. S(2009).: "Statistical Methods for Practice and Research- A guide to data analysis using SPSS"; 2nd Ed., Sage Publications, New Delhi.
6. George: "SPSS For Windows: Step By Step"; 8th Ed., Pearson, ISBN: 8131724298, 9788131724293.
7. Sudha G. Purohit, Sharad D. Gore, and Shailaja R. Deshmukh (2008), "Statistics using R, Second edition" , Narosa Publishing House, ISBN-978-81-8487-455-6
8. Dr. Mark Gardener (2015), "Beginning R: The statistical programming language", Wiley, ISBN-978-81-265-4120-1
9. Jared P. Lander (2014), "R for everyone advance analytics and graphics", Addison Wesley data & analytics series, Dorling Kindersley (India) Pvt. Ltd., ISBN-978-93-325-3924-2
10. Yanchang Zhao and Yonghua Cen (2014), "Data mining application with R",Elsevier, ISBN-978-93-5107-218-8
11. Nina Zumel and John Mount (2015), "Practical data science with R", Dreamtech Press, ISBN-978-93-5119-437-8
12. Paul D. Lewis (2010), "R for medicine and biology", Jones and Bartlett Publishers, ISBN-978-0-7637-5808-0.

ELECTIVE PAPERS

PAPER: MAS - 3051

DATABASE MANAGEMENT SYSTEMS

UNIT I:

- Overview of Database Management System
  - Introduction to Database Languages
  - Advantages of DBMS over file processing systems.
- Relational Database Management System
  - Entity relationship model
  - Mapping constraints
  - Primary Keys
  - Foreign Keys
  - Structural Constraints
  - ER notations & ER model
  - Enhanced Entity Relationship Model

UNIT II:

- Database System
  - Database Structure
  - Levels of abstraction in DBMS
  - View of data
  - Role of Database users and administrators
  - Database Structure: DDL, DML, DCL,TCL

UNIT III:

- Types of Data Models
  - Hierarchical databases
  - Network databases
  - Relational databases
  - Object oriented databases

UNIT IV:

- PL/SQL
  - Stored Procedure
  - Concepts Procedure, Functions, Cursors ,Triggers

REFERENCE

1. An Introduction to Database System- C. J. Date-Narosa
2. Database System Concepts-Henry F. Korth & Abraham Silberschatz-McGraw-Hill
3. Principles of Database System-J. Ullman-Galgotia Pub.
4. Introduction to database system - Bipin C. Desai - Galgotia pub.
5. Fundamentals of Database System-Elmasri Navathe, Addison Wesley
6. Introduction to Databased Management- Navin Prakash - TMH
7. Oracle PL/SQL Programming-Feuerstein & Pribyl, O'Reilly, Shroff Publishers & Distributors Pvt. Ltd.
8. Manual of RDBMS

PAPER: MAS - 3052

OFFICIAL STATISTICS

UNIT I:

- Statistical System in India: Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO).

UNIT II:

- Official statistics: Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications - Banking and finance.

UNIT III:

- National Income – Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India.

UNIT IV:

- Measurement of income inequality: Lorenz curves, Application of Pareto and Lognormal as income distribution.
- Organization of large scale sample surveys. General and special data dissemination systems.

REFERENCES

1. Bhaduri, A. (1990). Macroeconomics: The Dynamics of Commodity Production, Macmillan India Limited, New Delhi.
2. Branson, W. H. (1992). Macroeconomic Theory and Policy, Third Edition, Harper Collins Publishers India (P) Ltd., New Delhi.
3. C. S. O. (1990). Basic Statistics Relating to the Indian Economy.
4. C.S.O. (1995). Statistical System in India.
5. C. S. O. (1999). Guide to Official Statistics.
6. C. S. O. (2016). Guide to Official Statistics.
7. Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol. 2, World Press, India.
8. Mukhopadhyay P. (2011). Applied Statistics, Second Edition, Books & Allied Ltd, India.
9. Asthana, B.N. and Srivastava, S.S.(1984): Applied Statistics of India, Chaitanya Publishing House, Allahabad.

PAPER: MAS - 3053

POPULATION STUDIES

UNIT I:

- **Introduction:**
  The nature of demography, demographic view of population, techniques of population studies.
  Basic demographic measures, sex-ratio, child-women ratio, crude rates, specific rates.
- **Life Tables :**
  Concepts of Life Tables, Assumptions related to life tables, The columns of life tables, Complete and Abridged life tables, Construction of life tables.

UNIT II:

- **Mortality :**
  Infant Mortality, Neonatal mortality, Perinatal mortality, Maternal mortality, death rates, standardized death rates.
- **Fertility and Reproduction :**
  Crude Birth Rate (CBR), General fertility rate (GFR), Age specific fertility rate, Total fertility rate (TFR), Gross reproduction rate (GRR), Net reproduction rate (NRR).
  Marriage rates, divorce rates, age pattern of marriage, types of migration, migration rates, migrant components, migrant streams, internal migration, international migration.

UNIT III:

- **Growth of Population and Models of Population :**
  Introduction, Simple Birth and Death Process, Stationary population models, Stable population models, intrinsic rate of growth, intrinsic age distribution, Quasi stability.
- **Population Estimates and Projections :**
  Inter - censal and Post - censal estimates, population projections, mathematical methods, component methods, mortality basis for projections, fertility basis for projections, migration basis for projections.

UNIT IV:

- **Census and Sample Surveys :**
  Definition of Census and its features, Organizing the Census, methods of enumeration, Census in India, Indian Census in 1991 and 2001.
  Defining the objectives and scope of sample surveys. Questionnaire design, sample design, organization of field work, collecting and processing the data, reporting.

REFERENCES

1. Barkley G.W. (1958): "Techniques of Population Analysis"; John Wiley & Sons Inc; First Edition, ISBN-10: 0471048186 ,ISBN-13: 978-0471048183
2. Pathak K. B. and F. Ram (1998) : "Techniques of Demographic Analysis"; 2nd Edition, Himalaya Publishing House, ISBN : 81-7493-472-3
3. R. Ramakumar (1986): "Technical Demography"; Wiley Eastern Ltd., ISBN: 0852267436
4. H. Raj (1986): "Fundamentals of Demography"; Surjeet Publication. **ISBN:** 8122903363, **ISBN-13:** 9788122903362
5. Cox. P.R. (1970): "Demography"; Cambridge University Press.
6. Keyfitz N. and Caswell H. (2005): "Applied Mathematical Demography"; 3rd Edition, Springer.
7. Keyfitz N. and Beekman J. A.(1984) : "Demography through Problems"; Springer-Verlag, New York, **ISBN10:** 0387908366, **ISBN13:** 9780387908366

SEMESTER - IV

PAPER: MAS – 401

DESIGN OF EXPERIMENTS

UNIT I:

- Concept and history of Design of experiments.
- The need for Designed experiments.
- Elementary ideas of blocking and randomized block design.
- Elementary idea of treatment structure and Basic principles of Design of experiments
- Concept of complete and incomplete block designs. Completely Randomized Design(CRD), Randomized Block Design(RBD), Latin square design(LSD), their analysis with applications. Missing plot technique for RBD, LSD with their applications.

UNIT II:

- Concept of BIBD and its properties. Intra block analysis of BIBD, construction of BIBD, Missing plot technique for BIBD

UNIT III:

- Analysis of Covariance: Analysis of covariance for CRD, RBD and LSD, Youden square design, Cross over design, split-plot designs.

UNIT VI:

- Factorial Experiments : Characterization of experiments, factorial experiments, factorial experiments with factors at two levels, grouping for interaction contrasts, confounding, confounding in more than two blocks, experiments with factors at three levels each, analysis of factorial experiments.

REFERENCES

1. Montgomery, D. C. (1997): "Design and Analysis of Experiments"; 4th edition, John Wiley & Sons, New York
2. Montgomery, D. C. (2006): "Design and Analysis of Experiments"; 5th Ed, Wiley (India), **ISBN:** 812651048X, **ISBN-13:** 9788126510481, 978-8126510481
3. R. Mead. (1990): "The Design of Experiments: Statistical Principles for Practical Application"; Cambridge Uni. Press. ISBN-10: 0521287626, ISBN-13: 978-0521287623
4. Cochran W.G. and Cox G.M. (2003): "Experimental Designs"; 2nd Edition, John Wiley (wie) **ISBN:** 9971513110, **ISBN-13:** 9789971513115, 978-9971513115.
5. Cochran W.G. and Cox G.M. (1957): "Experimental Designs"; 2nd Edition, John Wiley & Sons Inc., New York, **ISBN:** 0471162035, **ISBN-13:** 9780471162032
6. Das, M.N. and Giri, N.C. (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi.
7. Das M.N. and Giri N.C.(1999) : "Design and Analysis of Experiments"; 2nd Edition, New Age International Publishers Ltd, **ISBN:** 0852269145, **ISBN-13:** 9780852269145.
8. Federer W.T. (1993) : "Statistical Design And Analysis For Intercropping Experiments"; Springer-verlag, **ISBN:** 0387979239, **ISBN-13:** 9780387979236, 978-0387979236
9. Federer, W. T. (1955): "Experimental Design: Theory and Application"; The Macmillan Co., New York.
10. Klaus Hinkelmann, Kempthorne Oscar (2005): "Design and Analysis of Experiments"; Wiley-interscience, **ISBN:** 0471551775, **ISBN-13:** 9780471551775
11. Kempthorne, O. (1952), The Design and Analysis of Experiments, John Wiley & Sons, New York
12. Fisher R. A. (2005): "Statistical Methods for Research Workers"; Cosmo Publications, **ISBN:** 8130701332, **ISBN-13:** 9788130701332, 978-8130701332
13. Panse, V.G. and Sukhatme, P.V. (1978): "Statistical methods for agricultural workers"; ICAR, New Delhi.

PAPER: MAS – 402

OPERATIONS RESERACH – II

UNIT I:

- Sensitivity Analysis:
  - Basic concepts
  - Changes in the coefficient of objective function
  - Changes in the components of vector b and of Matrix A
  - Addition / Deletion of variable in the problem
  - Addition / Deletion of constraint in the problem

UNIT II:

- Integer Programming:
  - Introduction
  - All and mixed integer programming (IPP) problems
  - Gomory's al1-IPP algorithm
  - The branch and bound technique
  - Zero - one programming

UNIT III:

- PERT / CPM:
  - Basic concepts .
  - Construction and Time Calculation of the Network
  - Determination of Float and of the Critical Path
  - Crashing a Project
  - Scheduling a Project
  - Resource Analysis and Allocation
  - Application of PERT/ CPM

UNIT IV:

- Replacement Theory:
  - Types of Replacement Problem
  - Replacement of Items that Deteriorate
  - Replacement of Items that fails completely and that of Staff
- Goal Programming:
  - Definitions and Concepts
  - Formulation of Goal Programming Problem (GPP)
  - Solution of GPP by Graphical and Extended Simplex Methods

REFERENCES

1. K. Swarup, Gupta P.K. and Man Mohan(2008): "Operations Research"; S.Chand & Co., New Delhi, **ISBN:** 8180545350, **ISBN-13:** 9788180545351
2. G. Hadley (2002): "Linear Programming"; Narosa Book Distributors Pvt Ltd, **ISBN:** 8185015910, ISBN-**13:** 9788185015910
3. Murthy K.G.(1988): Linear complementarity, linear and nonlinear programming, Heldermann Verlag, ISBN: 3885384035, 9783885384038
8. Kasana H.S. and Kumar K.D.(2005) : "Introductory Operations Research: Theory & Applications"; Springer Verlag , ISBN: 8181282827, 9798181282827.
9. Kapoor V.K. (2006) : "Operations Research"; 7th Edition, Jain Book Depot, **ISBN :** 8170148286.
10. Sharma S.D.(2005):Operations Research"; 15th Ed., Kedar Nath Ram Nath & Co. Publishers, Meerut,
11. Hira,D.S., Gupta,P.K.(2007): OPERATIONS RESEARCH, S.Chand & Co., New Delh, ISBN: 81-219-0281-9

ELECTIVE PAPERS

PAPER: MAS - 4031

DATA MINING

UNIT I:

- Introduction to Data Mining
  - Process of data mining
  - Types of data used for data mining
  - Application of data mining

UNIT II:

- Supervised Learning
  - Exploratory Data Analysis (EDA)
  - Multiple Regression/Stepwise Regression
  - Logistic Regression/Multi-Nomial regression
  - K-nearest neighbors (KNN)
  - Linear Discriminant Analysis (LDA)
  - Quadratic Discriminant Analysis (QDA)
  - Bayes classifier
  - Nearest neighbor classifier
  - Tree based methods like boosting or random forest

UNIT III:

- Unsupervised Learning
  - Clustering procedures- k-means hierarchical
  - Self-organizing map
  - EM algorithm
  - Feature selection: principal component analysis
  - Association rules

UNIT IV:

- Optimization
  - Neural Network
  - Genetic Algorithm
- Graphical evaluation of classification, Association rules
- Imputation of missing data

REFERENCES

1. Jiawei Han, Micheline Kamber(2006) : "Data Mining"; II-Ed., Morgan Kaufmann Publishers, ISBN: 1558609016, 9781558609013
2. Hillol Kargupta, Jiawei Han, Philip S. Yu(2008): Next Generation of Data Mining, CRC Press, ISBN: 1420085867, 9781420085860
3. Margaret H. Dunham: "Data Mining - Introductory and Advance Topics"; Pearson Edu., ISBN: 8177587854, 9788177587852

PAPER: MAS - 4032

BIO-STATISTICS AND CLINICAL RESEARCH

UNIT I:

- Introduction to Bio-statistics, Sources of medical uncertainties, Managing medical uncertainties. Applications and uses of Bio-statistics as a science.
- Clinical trials: the need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials, overview of Phase I-IV trials, multi-center trials. Data management: data definitions, data collection systems for good clinical practice, protocol definition.

UNIT II:

- Design of clinical trials : parallel vs. cross-over designs, cross-sectional vs. longitude designs, review of factorial designs, objectives and endpoints of clinical trials, design of Phase I trials, design of single-stage and multi-stage Phase II trials, design and monitoring of Phase III trials with sequential stopping, design of bioequivalence trials.

UNIT III:

- Reporting and analysis: analysis of categorical outcomes from Phase I - III trials, analysis of survival data from clinical trials. Interim analysis method, motivating intent- to-treat analysis.

UNIT IV:

- Determining sample size. Surrogate endpoints: selection and design of trials with surrogate endpoints, analysis of surrogate endpoint data.

REFERENCES

1. Prem Narayan, Bhatia & Malhotra (1979): Handbook of Statistical Genetics, IASRI, New Delhi.
2. Jain, J.R. (1982): Statistical techniques in quantitative genetics, Tata Mcgraw Hill.
3. Govindarajulu, Z. and Kargar, S. (2000): Statistical Techniques in Bioassay.
4. Finney, D.J (1971): Statistical Method In Bioassay, Griffin.
5. Finney, D.J (1971): Probit Analysis (3rd Edition), Griffin.
6. Weatherile, G.B. (1966): Sequential Methods in Statistics, Griffin.
7. Piantadosi, S. (1977): Clinical: A Methodologic Perspective. Wiley and Sons.
8. Jennison, C. and Turnbull, B.W (1999): Group Sequential Methods with Applications to Clinical Trials, CRC Press.
9. Flesis, J.L (1989): The Design and Analysis of Clinical Experiments. Wileyand Sons.
10. Marubeni, E. and Valsechhi, M.G (1994): Analyzing Survival Data From Clinical Trials and Observational Studies. Wiley and Sons.
11. Friendman,L.M., Furbery, C.D. and Demets, D.L.(1998): " Fundamental of clinical Trials " Springer Publication,3rd ed., Springer.
12. Duolaowang, A. B. (2006): Clinical Trials A Practical Guide to Design, Analysis, and Reporting, Published by Remedica, USA.
13. A. Indrayan and L. Satyanarayana : Biostatistics for medical, nursing and pharmacy students, Eastern Economy Edition, Prentice hall India, ISBN 81-203-3054.
14. B. K. Mahajan: Method in Biostatistics for medical students and research work, Sixth edition, Jaypee Brothers medical publisher LTD. ISBN 81-7179-520-X.

PAPER: MAS – 4033

STATISTICAL SIMULATION

UNIT I:

- Statistic simulations: generating random variables, simulating normal, gamma and beta random variables. Comparison of algorithms to generate random variables. Generating random variables from failure rates.

UNIT II:

- Simulating multivariate distributions, MCMC methods and Gibbs sampler, simulating random fields, simulating stochastic process. Variance reduction technique: importance sampling for integration, control variates and antithetic variables.

UNIT III:

- Simulating a non-homogeneous Poisson process, Optimization using Monte Carlo methods, simulated annealing for optimization. Solving differential equations by Monte Carlo methods.

UNIT IV:

- Jackknife and Bootstrap: Bootstrap methods, re-sampling paradigms, bias and standard errors, Bootstrapping for estimation of sampling distribution. Confidence intervals, variance stabilizing transformation, bootstrapping in regression and sampling from finite populations.

REFERENCES

1. Fishman, G.S. (1996) Mante Carlo: Concepts, Algorithms and Applications. (Springer).
2. Rubinstein, R.Y. (1981); Simulation and the Monte Carlo Method. (Wiley).
3. Ripley, B.D. (1987) Stochastic Simulations (Wiley).
4. Ross, S. M. (2002) Simulation (Third Edition) (Academic).
5. Efron,B. and Tibshirani. R.J. (1993); An introduction to the Bootstrap.
6. Davison, A.C. and Hinkley,D.V. (1997) Bootstrap methods and their applications (Chapman and Hall).
7. Sho.J and Tu,D (1995); The Jackknife and the Bootstrap. Springer Verlag.