VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

SYLLABUS

AS PER NEP-2020

M.Sc. STATISTICS

Effective From: 2023-24

1. **Fee Structure:** As per Grant in Aid course

2. **Eligibility for Admission:**
   I. A candidate must have passed the B.Sc. Degree examination in Science with English as compulsory subject and Statistics at least as a subsidiary subject with Mathematics.
   II. A candidate shall have cleared B. Sc. Degree Examination, provided, a candidate who has obtained his / her B. Sc. Degree with either (i) Statistics as principal/core subject or (ii) Mathematics as principal/core subject and statistics as subsidiary/optional/ elective subject or (iii) Both Mathematics and Statistics as subsidiary/optional/elective subject, shall be considered eligible for admission to M.Sc. Degree course in Statistics.

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. (Statistics)
Proposed Syllabus as per NEP-2020
Effective from the Academic year 2023-2024

SEMESTER – I

Courses	No.	Title	Hrs/Week	Exam Schedule			Total Marks	Credit
				Duration (Hrs)	Internal (Hrs)	External Marks		
Core I	101	Probability Theory	4	3	30	70	100	4
Core II	102	Univariate Distributions	4	3	30	70	100	4
Core III	103	Linear Algebra	4	3	30	70	100	4
Select Any ONE Elective Paper:								
Elective I	1041	Real Analysis	4	3	30	70	100	4
Elective II	1042	Sampling Theory I						
Elective III	1043	Official Statistics						
Practical base on 101 to 104 using Excel and JAMOVI	105	Practical Paper I	12	10-15	50	100	150	6
Skill based Elective Course	106	Statistical Computing with Excel and JAMOVI	2	2	20	30	50	2
		Total	**30**		**190**	**410**	**600**	**24**

SEMESTER – II

Courses	No.	Title	Hrs/ Week	Exam Schedule			Total Marks	Credit
				Duration (Hrs)	Internal (Hrs)	External Marks		
Core-I	201	Estimation Theory	4	3	30	70	100	4
Core-II	202	Testing of Hypotheses	4	3	30	70	100	4
Core-III	203	Multivariate Analysis	4	3	30	70	100	4
Select any one elective course from 2041 to 2044								
Elective-I	2041	Industrial Statistics	4	3	30	70	100	4
Elective-II	2042	Decision Theory						
Elective-III	2043	Actuarial Statistics						
Elective-IV	2044	Database Management System						
Practical based on 201 to 2044 using excel and jamovi	205	Practical Paper-II	12	10-15	50	100	150	6
Skill based elective course	206	Computer programming language-C	2	2	20	30	50	2
		TOTAL	**30**		190	410	600	24

Core I
Course 101: Probability Theory

Unit I

- **Probability measure, random variable and inequalities:**
- Probability spaces, Random variables and random vectors. Expectations. Moments.
- Holder's inequality, Minkowski's inequality, Cauchy–Schwartz inequality, Markov's inequality, Jenson's inequality, Chebychev's inequality

Unit II

- **Distribution of a random variable and Characteristic functions:**
- Distribution function, joint distribution function. Decomposition of a d.f. in its discrete, absolutely continuous and 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) and their properties.

Unit III

- **Stochastic Independence and Conditional Expectations:**
- Independence of events, classes and random variables.
- The multiplication theorem, Borel - Cantelli lemma, Borel zero-one law
- Sequence of independent random variables, Tail σ -field and Kolmogorov zero-one law.
- Conditional Expectations and its properties

Unit IV

- **Convergence of sequences of random variables:**
- Convergence almost everywhere of sequences of random variables in probability
- Convergence of sequences of random variables in rth mean and
- Convergence of sequences of random variables in probability
- Convergence of sequences of random variables in distribution
- Inter – relationships amongst these modes of convergence.

Unit V

- **Laws of Large Numbers and Central limit theorems:**
- Weak law of Large numbers,
- Kolmogorov's inequality, Kolmogorov's strong law of large numbers.
- Central limit theorems- Liapunov's theorem. Statement of Lindbergh- Feller theorem.

REFERENCES:

1. LoeveM. : "Probability Theory". ISBN: 978-1-4684-9466-2
2. Athreya, K. B., Lahiri, S. N. (2006). Measure Theory and Probability Theory. Ukraine: Springer. ISBN: 9780387329031
3. BASU, A. K. (2012). MEASURE THEORY AND PROBABILITY. India: PHI Learning. ISBN: 9788120343856
4. Burrill, C. W. (1972). Measure, integration, and probability. Germany: McGraw-Hill." ISBN: 9780070092235
5. Ash, R. B. (2014). Real Analysis and Probability: Probability and Mathematical Statistics. ISBN: 9781483191423
6. Chung, K. L. (2001). A course in probability theory. San Diego: Elsevier Science." ISBN: 9780121741518
7. Linde, W. (2016). Probability Theory: A First Course in Probability Theory and Statistics. Germany: De Gruyter. ISBN:9783110466195
8. Rohatgi, V. K., Saleh, A. K. M. E. (2015). An Introduction to Probability and Statistics. United States: Wiley. ISBN: 9781118799680

Core II
Course 102: Univariate Distributions

Unit I
• Laplace, Lognormal, Cauchy (Quick revision of these distributions), Weibull and Logistic distributions. Idea of truncated distributions, Truncated Binomial, Poisson and Normal distributions.
Unit II
• Univariate compound distribution: Contagious distributions: Neyman type-A, Poisson-Binomial and Poisson –Negative Binomial distribution, Univariate Power series distributions.
Unit III
• Central & Non-central distributions: Non-central t, F and χ^2
Unit IV
• Ordered statistics, their distributions and properties, distribution of Range.

REFERENCES:

1. Johnson N.L. and Kotz S.(1970): "Distributions in Statistics"; John Wiley. ISBN-13-978-0471715812
2. Rohatgi V. K. (1984): Statistical Inference, John Wiley and Sons. ISBN-13-978-0471360914
3. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics"; John Wiley. ISBN- ISBN-13-978-0471272144
4. Patel J.K. et al. (1996): "Handbook of Statistics Distributions"; Marcel Dekker. ISBN-13-978-0824790469
5. Mood A.M., Graybill F. and Boes D.C. (1974): "Introduction to the Theory of Statistics"; McGraw Hill ISBN-13-978-0070380452
6. C. R. Rao (1965): Linear Statistical Inference and Its Applications, Wiley ISBN-13-978-0471754989
7. David, H. A., and Nagaraja, H. N. (2003)Arnold, B. C., Balakrishnan, N., and Nagaraja, H. N. (1992): A First Course in Order Statistics, John Wiley & Sons ISBN-13-978-0470284439
8. Johnson, N. L., S. And Balakrishnan, N. (2000): Discrete Univariate Distributions, John Wiley ISBN-13-978-0471584953
9. Johnson, N. L., S. And Balakrishnan, N. (2000): Continuous Univariate Distributions, John Wiley ISBN-13-978-0471584946

Core III
Course 103: Linear Algebra

Unit I
• 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.
Unit II
• Symmetric, skew-symmetric, Hermitian, skew-hermitian, orthogonal, unitary and normal matrices. Laplace expansion method, Matrix polynomial, Rank of a matrix, Properties of rank of a matrix, Idempotent matrices, generalized inverses, Moore-Penrose generalized inverse.
Unit III
• Real quadratic forms, reduction and classification of quadratic forms, index and signature, properties of quadratic forms.
Unit IV
• 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.

REFERENCE:

1. Johnson N.L. and Kotz S.(1970): "Distributions in Statistics"; John Wiley. ISBN-13-978-0471715812
2. Rohatgi V. K. (1984): Statistical Inference, John Wiley and Sons. ISBN-13-978-0471360914
3. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics"; John Wiley. ISBN- ISBN-13-978-0471272144
4. Patel J.K. et al. (1996): "Handbook of Statistics Distributions"; Marcel Dekker. ISBN-13-978-0824790469
5. Mood A.M., Graybill F. and Boes D.C. (1974): "Introduction to the Theory of Statistics"; McGraw Hill ISBN-13-978-0070380452
6. C. R. Rao (1965): Linear Statistical Inference and Its Applications, Wiley ISBN-13-978-0471754989
7. David, H. A., and Nagaraja, H. N. (2003)Arnold, B. C., Balakrishnan, N., and Nagaraja, H. N. (1992): A First Course in Order Statistics, John Wiley & Sons ISBN-13-978-0470284439
8. Johnson, N. L., S. And Balakrishnan, N. (2000): Discrete Univariate Distributions, John Wiley ISBN-13-978-0471584953
9. Johnson, N. L., S. And Balakrishnan, N. (2000): Continuous Univariate Distributions, John Wiley ISBN-13-978-0471584946

Elective I
Course 1041: Real Analysis

Unit I

- **Set, Indicator factions and classes of sets**:
- Recap of elements of set theory and Real number system.
- Limits of sequences of sets,
- Classes of sets like Semi-rings, rings, fields, σ -rings, σ -fields, Monotone classes.
- Generated classes, Borel σ -field of R and Rk and related results.

Unit II

- **Measurable Space:**
- Measurable space, simple function, Measurable function, Borel measurable function and related results.
- Almost everywhere convergence of sequence of measurable functions and related results.

Unit III

- **Set function and Measures:**
- Finitely additive and σ -additive set functions,
- Measures & its properties
- Monotone convergence theorem,
- Absolute continuity and singularity of measures.
- Statements of 'Lebesgue Decomposition theorem' and the Radon – Nikodym theorem.

Unit IV

- Integration of Simple functions and measurable function
- Integration of Simple functions with respect to a given measure & its properties
- Integration of measurable function with respect to a given measure.
- Elementary properties of integral of measurable function and related results.

Unit V

- **Caratheodory extension theorem & its Applications:**
- Caratheodory extension theorem (statement only)
- Construction of Lebesgue measures
- Lebesgue- Stieltjes measures through distribution functions.

REFERENCES:

1. Ash, R. B. (1972). Real analysis and probability. United Kingdom: Academic Press. ISBN: 9780120652013, 0120652013
2. Halmos, P. R. (2014). Measure Theory. United States: Springer New York, ISBN: 9781468494426, 1468494422
3. Athreya, K. B., Lahiri, S. N. (2006). Measure Theory and Probability Theory. Ukraine: Springer. ISBN-9780387329031, 038732903X
4. Taylor, S. J., Kingman, J. F. C. (2008). Introduction to Measure and Probability. United Kingdom: Cambridge University Press. ISBN: 9780521090322, 0521090326
5. Burrill , C.W. (1972) : ***Measure , Integration and Probability*** , McGraw - Hill , New York
6. Jay Cummings (2019): Real Analysis: A Long-form Mathematics Textbook, Pub.- LongFormMath.com, ISBN-1077254547, 9781077254541
7. Sherbert, D. R., Bartle, R. G. (2011). Introduction to Real Analysis. United Kingdom: Wiley, ISBN 10: 0471433314 / ISBN 13: 9780471433316
8. Folland, G. B. (2013). Real Analysis: Modern Techniques and Their Applications. Germany: Wiley. ISBN: 9781118626399, 1118626397
9. Stein, E. M., Shakarchi, R. (2005). Real Analysis: Measure Theory, Integration, and Hilbert Spaces. United Kingdom: Princeton University Press

Elective II

Course 1042: Sampling Theory I

Unit I

- **The place of sampling in census work:** the sampling process, sampling errors, Development of use of the use of sampling in censuses and surveys, methods of presentation.
- **Requirements of a good sample:** Bias, Methods of selection which give rise to bias, Avoidance of bias in selection, Examples of biased selection, Bias arising due to faulty demarcation of the sampling units, bias in estimation, Circumstances in which bias is permissible, Methods of reducing the random sampling error.
- **Practical Problems arising in the planning, execution and analysis of a survey:** Types of problems, Design of forms, Selection, training and supervision of field investigators, control of accuracy, Methods of handling the data, Questions requiring consideration, determination of the details of the information to be collected, Practicality of obtaining the required information, Methods of collecting the information and dealing with non-response, Frames for censuses, surveys, Agriculture census, undeveloped areas, economic institutions, frames from list of individuals, households, town plans, maps of rural areas, villages etc, Master samples, localized population surveys, market research and opinion surveys, crop estimation, pilot and exploratory surveys, Critical analysis of survey data.

Unit II

- **Non-probabilistic sampling**: Meaning, need, types: convenience, quota, snowball, purposive etc. Advantages and disadvantages.

Unit III

- **Simple random sampling:**
  Simple random sampling with and without replacement, selection of a simple random sample, definitions and notations, properties of the estimates, estimation of population mean, population totals and their standard errors, finite population correction, coefficient of variation of estimator. Confidence Intervals.
- **Sampling proportions and percentages:**
  Qualitative characteristics, Variances of sample estimators, Binomial distribution, Hypergeometric distribution, Confidence limits, classification into more than two classes, proportions and totals over subpopulations.
- **The Estimation of Sample size:**
  Analysis of the problem, The specification of the precision, The formula for n in sampling for proportions and with continuous data, Inverse sampling, sample size with more than one problem, sample size in decision problems, the design effect.

Unit IV

- **Stratified random sampling:** Stratified random sampling, proportional, optimum and Neyman allocation, comparison with simple random sampling for fixed sample size. Stratified sampling for proportions, Covariance and Variance Function. Gain in precision due of stratification. Estimation of sample size with proportions, Effects of deviations from the optimum allocation, effects of errors in the stratum sizes, the problem of allocation with more than one item and its various methods, two-way stratification with small samples, controlled selection, construction of strata, number of strata, post-stratification, estimation of variance with one unit per stratum, estimating totals and means over subpopulations. Sampling from two frames.

REFERENCES:

1. Cochran, W. G. (1977). Sampling Techniques. India: Wiley. ISBN: 9788126515240, 8126515244
2. Madow, W. G., Hansen, M. H., Hurwitz, W. N. (1953). Sample survey methods and theory. United Kingdom: Wiley. ISBN: 9780471006282, 0471006289.
3. Kish, L. (1965). Survey Sampling. United Kingdom: Wiley. ISBN: 9780471489009, 047148900X
4. Murthy M. N. : "Sampling Theory and Methods"; Statistical Publishing Society, Calcutta.
5. Chandhok, P., Raj, D. (2013). Sample Survey Theory. United States: Create Space Independent Publishing Platform. ISBN: 9781481027090, 1481027093
6. Raj, D. (1972). The design of sample surveys. United Kingdom: McGraw-Hill. ISBN: 9780070511552, 0070511551
7. Sukhatme, P. V., Sukhatme, B. V. (1970). Sampling Theory of Surveys: With Applications. India: Asia Publishing House. ISBN: 9780210225196, 021022519X.
8. Yates, F. (1960). Sampling Methods for Censuses and Surveys. United Kingdom: Hafner Publishing Company. ISBN: 9780852640067, 0852640064.
9. Goulden, C. H. (1952). Methods of Statistical Analysis. Japan: Wiley. ISBN: 9780598555977, 0598555978
10. Cochran, W. G., Snecdecor, G. W. (1989). Statistical Methods. India: Wiley. ISBN: 9780813815619, 0813815614
11. Rao, P. S. (2017). Sampling Methodologies with Applications. United Kingdom: CRC Press. ISBN: 9781138462557, 1138462551
12. Chaudhuri, A. (2018). Survey Sampling. United States: CRC Press. ISBN: 9781498774758, 149877475X
13. Som, R. K. (1996). Practical Sampling Techniques, Second Edition. Hong Kong: Taylor & Francis. ISBN: 9780824796761, 0824796764.
14. Foreman, E. (1991). Survey Sampling Principles. Hong Kong: Taylor & Francis. ISBN: 9780824784072, 0824784073.
15. Fowler, F. J. (2014). Survey Research Methods. United Kingdom: SAGE Publications. ISBN: 9781452259000, 1452259003
16. International Encyclopedia of Statistical Science. (2010). Germany: Springer. ISBN: 978-3-642-04897-5
17. Daniel, J. (2011). Sampling Essentials: Practical Guidelines for Making Sampling Choices. Italy: SAGE Publications. ISBN: 9781412952217, 1412952212.

Elective III
Course 1043: Official Statistics

Unit I
• Official statistics: Meaning, Need, Uses, Users, Reliability, Relevance, Limitations, Transparency, its visibility, Compilation, Collection, Processing, Analysis and Dissemination, Agencies Involved, Methods. • Introduction to National and International official statistical system. Role, function and activities of Central and State statistical organisations. Nodal Ministry of India: MOSPI. • National Statistical Organization: Vision and Mission, NSSO and CSO; roles and responsibilities; Important activities, Publications etc. • National Statistical Commission: Need, Constitution, its role, functions etc; Legal Acts/ Provisions/ Support for Official Statistics; Important Acts
Unit II
• Index Numbers: Different Types, Need, Data Collection Mechanism, Periodicity, Agencies Involved, Uses. • Sector Wise Statistics: Agriculture, Health, Education, and prices, Labour, Industry, Women and Child etc. Important Surveys related them, Indicators, principal publications, Agencies and Usages etc.
Unit III
• National Income – Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India. Measurement of income inequality: Lorenz curves, Application of Pareto and Lognormal as income distribution. • National Accounts of India: Definition, Basic Concepts; issues; the Strategy, Collection of Data and Release.
Unit IV
• Population Census: Need, Data Collected, Periodicity, Methods of data collection, dissemination, Agencies involved. • Socio Economic Indicators, Gender Awareness/Statistics, Other Important Surveys and census. Organization of large scale sample surveys. General and special data dissemination systems.

REFERENCES:

1. https://unstats.un.org : Historical Perspective of Official Statistics in India
2. https://www.mospi.gov.in : Official statistical System in India, Reports, publications and surveys, NSO and its divisions, NSC.
3. https://censusindia.gov.in : Population census in India
4. Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol. 2, World Press, India.
5. Mukhopadhyay P. (2011). Applied Statistics, Second Edition, Books & Allied Ltd, India
6. United Nations. "Economic and development statistics" http://www.un.org/esa/progareas/stats
7. Fundamental Principles of Official Statistics http://www.unece.org

Skill based Elective Course

Course 106: Statistical Computing with Excel and JAMOVI

Unit I

1.1 WINDOWS

- 1.1.1. Typing, Editing, Proofing & Reviewing
- 1.1.2. Formatting Text & Paragraphs, Automatic Formatting and Styles
- 1.1.3. Working with Tables, Graphics and Frames
- 1.1.4. Mail Merge

1.2 POWERPOINTPRESENTATION

- 1.2.1 Preparation of Slides, Inserting Elements into Slides
- 1.2.2 Inserting Animation
- 1.2.3 Preparing Slideshows

Unit II

2.1 EXCEL

- 2.1.1. Working & Editing in Worksheets
- 2.1.2. Creating Formats & Links
- 2.1.3. Formatting a Worksheet & Creating Graphic Objects
- 2.1.4. Creating Charts(Graphs), formatting and analyzing data
- 2.1.5. Organizing Data in a List(Data Management)
- 2.1.6. Sharing & Importing Data
- 2.1.7. Printing

Unit III

3. JAMOVI
   - 3.1 Introduction to Jamovi
   - 3.2 Data management in Jamovi
   - 3.3 Functions in Jamovi
   - 3.4 One-way ANOVA
   - 3.5 Two-way ANOVA
   - 3.6 Correlation and linear regression

Unit IV

4.1.Introduction to Internet

- 4.1.1. Internet Protocols: HTTP, FTP,TCP/IP, etc.
- 4.1.2. Internet Utilities: e-mail, chat, searching, etc.

4.2.Web Browsers and Web Server

4.3.HTML

- 4.3.1. Introduction to
- 4.3.2. HTML Tags

References:

1. Dienes:Work6forwindowsquick&easyreference-Mansfield-BPBISBN:8170292972,ISBN-13:9788170292975
2. LaymanHart(1995):WordPerfect6.0ForWindows/bookAndQuickReference,ISBN:0130346535, ISBN-13: 9780130346537
3. Ron Mansfield(1994):Mastering Word 6 for windows- Mansfield – BPB, ISBN: 8170292980,ISBN-13:9788170292982
4. Townsend:MasteringExcel-4ForWindows,-Townsend–BPB,SBN:8170292301,ISBN-13: 9788170292302
5. Learning statistics with Jamovi (2018)-Danielle Navarro and David R. Foxcroft
6. The jamovi quickstart guide-Jonas Rafi

CORE-I

201: Estimation Theory

Course Content	**UNIT I:** • Concept of Estimator and Estimate, Different measures of closeness of an estimator: Pitman's closeness. Some desirable properties of estimators: Definition of Unbiasedness and Biasedness, Definition of Consistent estimator, Theorem of derivation of Consistent estimator, Efficiency: Best linear combination of unbiased estimator, BAN estimators. Sufficient statistics. **UNIT II:** • Neyman factorization theorem for discrete case, Minimal sufficient statistics, complete sufficient statistics, Minimum variance unbiased estimation: Lower bound of variance of an unbiased estimator, Cramer–Rao inequality, Minimum variance bound unbiased estimators, condition of existence of Minimum Variance Bound Unbiased Estimator. Chapman-Robbins inequality, Bhattacharya inequality, Rao-Blackwell theorem. Lehmann –Scheffe theorem, one parameter family of exponential distribution, Concept of finding uniformly minimum variance unbiased estimator (UMVUE) **UNIT III:** • 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, Method of scoring, MLE for grouped data, Method of scoring, Location invariance and scale invariance estimator and parameter, Pitman estimators for location and scale parameters. **UNIT IV:** • 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.
Reference Books	1. Mood A.M., Graybill F.A. and Bose 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. ***ISBN***-13: 978-8187134930 ***ISBN***-10: 8187134933. 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-Inter science. 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

Core-II

202: Testing of Hypotheses

Course Content	**UNIT I:** • **Basic concepts of testing of hypotheses** Statistical Hypotheses, types of hypotheses, Statistical tests, Critical region, randomized test, non–randomised test, Types of Errors, Size and Power of a test • **MP and UMP tests** Neyman–Pearson's Lemma & Generalized Neyman–Pearson's Lemma and its applications to get Most Powerful test and UMP tests respectively, for parameters of well-behaved distributions. **UNIT II:** • **Unbiasedness for testing of hypotheses:** α-Similar test, Similar test, UMP α-similar test, unbiased test, relationship with UMP unbiased test, and its applications for well-behaved distributions, Similarity and completeness, tests with Neyman structure, UMP unbiased tests for multi-parameter exponential families. **UNIT III:** • **Concept of Invariance in testing of hypotheses:** Maximal invariant test, most powerful invariant test. • **Concept of least favourable distribution and its use in testing of hypotheses** **UNIT IV:** • **Likelihood ratio tests:** Likelihood ratio test for simple and composite hypotheses. **UNIT V:** • **Sequential testing of hypotheses:** Basics of 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 SPRT and its use to obtain OC and ASN functions.
Reference Books	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. and Joseph P. Romano (2005): "Testing StatisticalHypotheses";3rdEdition, Springer,ISBN0-387-98864-5. 4. RohatgiV.K.(1976):"AnIntroductiontoProbabilityTheoryandMathematicalStatistics";John Wiley&SonsIncorporated,ISBN-10:0471731358,ISBN-13:9780471731351 5. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta. 6. RaoC.R.(2001):"LinearStatisticalInferenceanditsApplications";2ndEdition,Wiley-Inter-science,**ISBN-10:**0471218758,**ISBN-13:**978-0471218753 7. Sheskin, D.J. (2011). Handbook of Parametric and Nonparametric Statistical Procedures, Fifth Edition (5th ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9780429186196 8. Kale, B.K. and Muralidharan, K.(2015): "Parametric Inference: An Introduction"; Pub.: Alpha Science International Limited, ISBN: 9781842659397

Core III

Course 203: Multivariate Analysis

Course Content	**UNIT I:** i. Multinomial distribution, Marginal and Conditional distributions, Characteristic function. ii. Multivariate Normal distribution, Marginal and conditional distributions, Distribution of linear function and Characteristic function, Distribution of sample mean vector. **UNIT II:** i. Distribution of sample generalized variance. ii. Wishart Distribution: p.d.f of Wishart distribution, Properties of Wishart distribution, Additive property, Distribution of HWH', marginal distribution of W11, distribution of h'wh/h'Σh, h'Σ-1h/h'w-1h, Characteristic function. iii. Definition of Multiple and partial correlation coefficients. Null and Non-null distribution of sample correlation coefficient r. Testing significance of multiple and partial correlation coefficients of H0: **(**i) $\rho = 0$, (ii) $\rho = \rho_0$ (iii) $\rho_{1(2.p)} = 0$ (iv) $\rho_{12.3....p} = 0$ (v) $\rho_{12.3....p} = \rho_0$ **UNIT III:** i. Hotelling T^2 statistic and Null distribution of T^2 ii. Applications of Hotelling T^2 statistics in significance of testing on single mean vector for one sample, two multivariate normal populations for independent (equal and unequal population variance) and dependent sample and in testing equality of the components of mean vector (Problem of symmetry). iii. Multivariate Analysis of variance (MANOVA): One-Way classification problem. **UNIT IV:** i. Classification Problem and Fisher's linear discriminant function, Probabilities of misclassification, Classification with more than two multivariate normal populations. ii. Concept and application of (i) Factor analysis (ii) Principal Component analysis and (iii) Canonical Correlation analysis.
Reference Books	1. Anderson T. W. (2003): "An Introduction to Multivariate Statistical Analysis"; 3rd Edition, Wiley-inter science, **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. Kshirsagar A. M. (1972): Multivariate Analysis. Marcel Dekker, New York, ISBN-10-0824713869, ISBN-13-978-0824713867. 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,ScottL. Hershberger and Marcoulide(1997)

: “Multivariate Statistical Methods A First Course”; Lawrence ErlbaumAssociates,**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 M. S. and Khatri C. G. (1979): “An Introduction to Multivariate Statistics”; North Holland, New York, ISBN: 9780444003027
13. Srivastava M.S. (2002): “Methods of Multivariate Statistics”; John Wiley and Sons Inc., New York, ISBN: 978-0-471-22381-8
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. RohatgiV.K.,A.K.Md.EhsanesSaleh(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

Elective Paper
Course-2041: Industrial Statistics

Course Content	**Unit – I** • **Introduction of Statistical Quality** • **Introduction, concept of quality and quality control, Process control and product control, variation in quality, theory of runs, specification limits, process limits and modify limits, advantages(uses) of S.Q.C.** **Unit – II** • **Statistical Quality Control techniques to control process** • **Theory of Control charts** i. **Control charts for variables: X-bar,R-chart and sigma chart** ii. **Control charts for attributes: p-chart, np-chart, c-chart and u-chart** iii. **Comparison between for variables and control charts for attributes.** iv. **Cumulative sum chart** • **Statistical Quality Control techniques to control product quality** i. **Principle of acceptance sampling plans.** ii. **Single and double sampling plan for attribute and their OC, AQL,AOQL,ASN,ATI Functions with graphical interpretation, Use and interpretation of Dodge and Romig's sampling inspection plan tables** iii. **Multiple Sampling plan and Sequential sampling plan** iv. **Plan for acceptance sampling by measurement.** **Unit - III** • **Introduction to six sigma** i. **overview of six sigma, lean manufacturing and Total Quality Management(TQM)** ii. **Organizational structure and six sigma training plans- Selection criteria for six -sigma roles and training plans** iii. **Voice of customers(VOC)** iv. **Importance and VOC data collection** v. **criteria to Quality** vi. **Introduction to DMAIC using one case study: Define Phase, Measure Phase, analyze phase, Improve Phase and control phase.** **Unit - IV** • **Reliability** i. **Basic concepts and distributions for product life, failure rate.** ii. **Reliability function for Exponential, Normal, Lognormal, Weibull Gamma Distributions.** iii. **Analysis of complete Data** iv. **Linear analysis and maximum likelihood analysis of censored data for exponential distribution only** v. **System reliability.**
Reference Books	1. Hopper A.G. (1969):"Basic Statistical Quality Control"; McGraw Hill, London. ISBN 100070941092, ISBN 13 9780070941090 2. Gupta R.C. (1998): "Statistical Quality Control"; 10th edition Khanna Publishers, New Delhi. ISBN-13 978-81-7409-111-6 3. Ryan T.P. (2011): "Statistical Methods for Quality Improvement"; John Wiley & Sons. ISBN:9780470590744, ISBN:9781118058114 4. Sinha S.K. (1986): "Reliability and Life Testing"; Wiley Eastern Ltd., New Delhi.

	5. Bazovksy I. (2004): "Reliability Theory and Practice"; Prentice Hall International Series in Engineering. ISBN-10 0486438678, ISBN-13 978-0486438672 6. Grant E. L. and Leavenworth R. (2017): "Statistical Quality Control"; 7th edition Tata Mc Graw Hill Publishing Co. Ltd., New Delhi. ISBN-10 0070435553, ISBN-13 978-0070435551 7. Irving W.B. (2020): "Elementary Statistical Quality Control"; 2ed edition Marcel Dekker, Inc., New York. ISBN-10 0367578123, ISBN-13 978-0367578121 8. Douglas C. Montgomery: (2020) "Introduction to statistical quality control"; 8th edition WileyISBN-10 1119723094, ISBN-13 978-1119723097

Elective paper
Course-2042: Decision Theory

Course Content	**UNIT I:** • **Review of basic elements of statistical decision problem:** Various inference problems viewed as a decision problem. **UNIT II:** • **Introduction to Decision Analysis:** Pay-off table for decisions and discussion of decision criteria (Maximax, Maximin, Minimax, Laplace, Hurwitz, EMV,EOL, EVPI), Decision making under uncertainty and risk, Decision trees. **UNIT III:** • **Main theorems of Decision Theory:** 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. **UNIT IV:** • **Invariant decision problems** Invariant decision rules, Admissible, minimax invariant rules.
Reference Books	1. Berger J.O. (1985): "Statistical Decision Theory"; Springer –Verlag Pub. Co., New York. ISBN: 978-1-4419-3074-3 2. Ferguson T.S. (1997): "Mathematical Statistics"; Academic Press. ISBN 0122537505, 9780122537509 3. Kendall M.G. and Stuart A. (1961): "The Advanced Theory of Statistics"; Vol. 2., Ed. IV, Charles and Griffin.ISBN 10: 0470233818ISBN 13: 9780470233818 4. Mood A.M., Grabill F. and Boes D.C. (2017): "Introduction to the Theory of Statistics"; 3rd edition McGraw Hills, International Student Ed. III. ISBN-10 9780070445208, ISBN-13 978-0070445208 5. Rohatgi, V.K. and Saleh, A.K. Md. E. (2005).: "An Introduction to Probability and Statistics", 2ed Edition, John Wiley & Sons. ISBN-109788126519262, ISBN-13 978-8126519262

Elective paper

Course-2043: Actuarial Statistics

Course Content	UNIT I: • **Basics of Probability & Interest**: Theory of Interest, Variable interest rates, continuous time payment streams, Interest rates or discount rates in terms of different time periods. • **Interest & Mortality**: Annuities, Loan Amortization and Mortgage Refinancing, Mortality and Analytical models, Generalized Cash- flow model, discounted cash flow techniques. 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. • **Finance & financial reporting**: Principal terms in investment and asset management, Key principles of finance, Structure of joint Stock Company and the different methods of financing by which it may be financed, Basic principle of personal and corporate taxation, The characteristics of principal forms of financial instrument used by companies, Factors to be considered by a company when deciding on its capital structure and divided policy UNIT III: • Expected present values of payments, Continuous contracts & residual life, Premium calculations, Repayment of loan by regular instalment of interest and capital, m-payment net single premiums • Population functions and indicator notations, Stationary population concepts UNIT IV: • The investment and risk characteristics of the following types of assets available for investment purposes. • **Risk models**: Proportional Hazard models, excess risk models, Multiple decrement models, death rate estimators, causes specific life insurance premiums.
Reference Books	1. Barcley G.W. (1970): "Techniques of Population Analysis"; John Wiley, New York.ISBN-10 0471048186, ISBN-13 978-0471048183 2. Borowiak, D.S., and A. F. Shapiro. (2013): "Financial and Actuarial Statistics": An Introduction, Second Edition. CRC Press. ISBN-13 978-0367576264 **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. ISBN-10 1316603873, ISBN-13 978-1316603871 4. Spurgeon, E.T. (2011):"Life Contingencies"; Third Edition, Cambridge University Press. ISBN-10 1107648092, ISBN-13 978-1107648098 5. Eric V. Slud (2001): "Actuarial Mathematics and Life Table Statistics" (Mathematics Department, University of Maryland)

Elective paper

Course:2044

DATA BASE MANAGEMENT SYSTEMS

Course Content	**UNITI:** • Overview of Data base Management System ➢ Introduction to Data base Languages ➢ Advantages of DBMS over file processing systems. • Relational Data base Management System ➢ Entity relationship model ➢ Mapping constraints ➢ Primary Keys ➢ Foreign Keys ➢ Structural Constraints ➢ ER notations & ER model ➢ Enhanced Entity Relationship Model **UNITII:** • Database System ➢ Database Structure ➢ Levels of abstraction in DBMS ➢ View of data ➢ Role of Data base users and administrators ➢ Database Structure: DDL,DML,DCL,TCL **UNITIII:** • Types of Data Models ➢ Hierarchical databases ➢ Network databases ➢ Relational databases ➢ Object oriented databases **UNITIV:** ➢ Stored Procedure ➢ PL/SQL ➢ Concepts Procedure ,Functions, Cursors, Triggers
Reference Books	1. C.J. Date-Narosa (1999): "An Introduction to Database System"; 7th Edition, Pearson. ISBN-10 0201385902 ISBN-13 978-0201385908 2. Henry F.Korth &Abraham Silberschatz & S. Sudarshan (2010): "Data base System Concepts"; 6th edition, McGraw-Hill education. ISBN-10 **0073523321** ISBN-13 **978-0073523323** 3. Jeffrey D. Ullman. (1994): "Principles of Database System"; 3rd edition, Galgotia Pub. ISBN-10 **8175155450**ISBN-13**978-8175155459** 4. Bipin C. Desai. (2010): "Introduction to database system"; revised edition,Galgotiapub.ISBN-10 **8175156171**ISBN-13**978-8175156173** 5. Fundamentals of Database System-Elmasri Nava the, Addison Wesley Elmasri Ramez &Navathe Shamkant. (2017): "Fundamentals of Data base System" 7th edition, **Pearson Education.** ISBN-10 **9789332582705** ISBN-13 **978-9332582705** 6. Navin Prakash. (1991): "Introduction to Databased Management"; **McGraw-Hill Education**ISBN-10 **0074602942**ISBN-13**978-0074602942**TMH 7. Feuerstein & Pribyl. (2005): "Oracle PL/SQL Programming"; O'Reilly, Shroff Publishers & Distributors Pvt. Ltd. ISBN-10 **0596009771**ISBN-13**978-0596009779** 8. Manual of RDBMS

Skill Based Course

Course-206: Computer Programming Language- "C"

Course Content	**Unit-I** **1. Introduction** **1. Algorithms and Flowchart** **2. Types of Languages** **3. Introduction to C Language** **2. C Fundamentals** **1. Identifiers** **2. Data Types** **3. Constants and Variables** **4. Arrays** **3. Operators and Expressions** **1. Arithmetic Operators** **2. Unary Operators** **3. Relations Operators** **4. Logical Operators** **5. Assignment Operators** **6. Conditional Operators** **7. Library Functions** **8. Expressions** **9. Evaluation of Expression** **Unit-II** **1. Data Input and Output** **1. Single Character input and output** **2. The scanf() function** **3. The printf() function** **4. gets() and puts() functions** **2. Control Statements** **1. The While Statement** **2. do-while statement** **3. for statement** **4. if - else statement** **5. switch statement** **6. break statement** **7. continue statement** **8. goto statement** **Unit-III** **1. Arrays** **1. Defining an array** **2. Processing an array element** **3. Multi-dimensional arrays** **4. Passing array to a function** **5. Arrays and Strings** **2. Structures and Unions** **1. Defining a structure** **2. Processing a structure** **3. Unions**

	Unit-IV **1. Functions** **1. Introduction to functions** **2. Function definition** **3. Accessing function** **4. Passing arguments to function** **5. Recursive function** **2. Data Files** **1. Opening a file** **2. Reading and writing operations in file** **3. Closing a file**
Reference Books	1. Karnighan B. W. and Ritchie D. M. (1978):"C programming Language"; Prentice Hall- Gale, ISBN: 0131101633, ISBN-13: 9780131101630 2. Vijay Mukhi: "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 (2011): "Programming in ANSI C" (fifth edition),Tata Mc-graw Hill, ISBN-10: 0-07-068182-1 ISBN-13: 978-0-07-068182-8, 978-0070681828.

Course-205: Practical paper-II

Course Content	Based on theory paper 201 to 2044
Reference Books	Reference book mention in theory paper 201 to 2044

Syllabi

of

M. Sc. (Statistics)

Semester-III

AS PER NEP 2020

To be implemented from the Academic Year 2024-2025.

UNDER THE FACULTY OF SCIENCE

OF VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

COURSES	NO.	TILTE	HRS/WEEK	EXAM SCHEDULE				
				DURATION (HRS)	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDIT
CORE-I	301	NON-PARAMETRIC INFERENCE	4	3	30	70	100	4
CORE-II	302	LINEAR MODEL	4	3	30	70	100	4
CORE-III	303	SAMPLING THEORY -II	4	3	30	70	100	4
ELECTIVE-I	3041	STATISTICAL SIMULATION	4	3	30	70	100	4
ELECTIVE-II	3042	DATA MINING						
ELECTIVE-III	3043	STOCHASTIC PROCESS						
PRACTICAL BASED ON 301 TO 3044 USING EXCEL, JAMOVI& SPSS	305	PRACTICAL PAPER –III	12	10-15	50	100	150	6
SKILL BASED ELECTIVE COURSE	306	PROGRAMMING LANGUAGE - PYTHON	2	2	20	30	50	2
TOTAL HRS. FOR STUDENS			30		190	410	600	24
TOTAL HRS. FOR THE DEPTT.			26(Fixed for theory paper)+12/batch of practical =26+(12*No. of batches)					

NOTE: EXAM OF "SKILL BASED ELECTIVE COURSE' BE TAKEN ON COMPUTERS

Core-I

Course: 301: Nonparametric Inference

Unit-I

Introduction:

(i) Introduction of Non-Parametric Test, Assumptions and its Applications,
(ii) Difference Between Parametric Tests and Non-Parametric Tests
(iii)Scale of Measurements and Selection Criteria of different Nonparametric Tests.

Unit-II

Quick overview of the following:

- **One population Test**

(i) The Binomial Test
(ii) The Chi-square Test
(iii) Kolmogorov-Smirnov Test
(iv) Run Test

- **Two Population Test**

(i) Rank Sum Test/Mann- Whitney U Test
(ii) McNemar's Test
(iii) Kolmogorov-Smirnov Test
(iv) Wilcoxon Signed rank test
(v) Spearman rank correlation coefficient

- **K Population case:**

Chi square test for K independent sample

Unit-III

- **Two Population Test (For Independent samples)**

(i) The Walsh Test
(ii) Fisher exact probability test
(iii) Median Test

- **Non-parametric correlation and Kendall-Theil-Sen Regression**

Unit-IV

K Population Case :

- **Independent samples:**

(i) Kruskal-Wallis Test
(ii) Kendall's W Test
(iii) Extension of Median Test
(iv) JonkheereTespstra Test

- **<u>Related Samples:</u>**

(i) Cochran's Q Test
(ii) Friendman Test
(iii) Kendall's W Test

- **Post Hoc Tests:**

(i) Dunn Test
(ii) Dunn Control Test
(iii) Steel Dwass Test
(iv) Nemenyi Test

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View at: Publisher Site | Google Scholar

2) Farooqi, A Comparative Study of Kendall-Theil Sen, Siegel vs Quantile Regression with Outliers, Ph.D. dissertation, Wayne State University, Detroit, Michigan, 2019. https://digitalcommons.wayne.edu/oa_dissertations
3) C. Suwannapinan, T. Suppakorn, and L. Ingsriswang, “Comparison of efficiency of simple linear regression coefficient estimation methods using Theil, quantile, and least squares method as the data in the independent and dependent variables have outliers,” SWU Science Journal, vol. 32, no. 1, pp. 229–240, 2016.
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5) David J. Sheskin (2007): “Handbook of Parametric and Nonparametric Statistical Procedures”.
6) David J. Sheskin (2007) : “Handbook of Parametric and Nonparametric Statistical Procedures”; Chapman & Hall; 4th Edition, ISBN: 9781584888147, ISBN 10: 1584888148
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11) Gibbons, J., D., Chakraborti, S. (2003. 4th Edition). Nonparametric Statistical Inference, CRC Press
12) Granato, GE (2006): Kendall-Theil Robust Line (KTRLine—version 1.0)—A Visual Basic program for calculating and graphing robust nonparametric estimates of linear-regression coefficients between two continuous variables https://pubs.usgs.gov/tm/2006/tm4a7/
13) Hall, P. (1986), ”On the Bootstrap and Confidence Intervals.” Ann. Statist. 14 1431-1452
14) Hall, P. (1988), ”Theoretical Comparison of Bootstrap Confidence Intervals (with discussion).” Biometrika 75 661-671.
15) Hall, P. (1993), ”On Edgeworth Expansion and Bootstrap Confidence Bands in Nonparametric Curve Estimation.” Journal of the Royal Statisitcal Society, SerB 55 291-304.
16) Hardle, W. and Marron, J.S. (1991), ”Bootstrap Simultaneous Error Bars for Nonparametric Regression.” Ann. Statist. 19 778-796.
17) Hollander, M., Wolfe, D. A., and Chicken, E. (2014). Nonparametric Statistical Methods, 3rd Edition. John Wiley & Sons, Inc.
18) Kvam, P. H., Brani Vidakovic, B. (2007) Nonparametric statistics with applications to science and engineering. Wiley
19) Mao, W. and Zhao L.H. (2003), ”Free-Knot Polynomial Splines with Confidence Intervals.” Journal of the Royal Statisitcal Society, SerB 65 901-919.
20) N. Rodratsa, A Comparative Study of Three Linear Regression Model Estimations: Least Squares Method, Parametric and Nonparametric Bootstrap Method, Chulalongkorn University, Dissertation, 2010.
21) O. Idochi, O. Jude, O. C. Amarachi, and B. Uwabunkonye, “Parametric versus nonparametric simple linear regression on data with and without outliers,” International Journal of Innovation Science Mathematics, vol. 4, no. 5, pp. 175–180, 2016.

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22) Peter Sprent, Nigel C. Smeeton (2007): “Applied Nonparametric Statistical Methods”; 4th Edition, Taylor & Francis Ltd, ISBN: 9781584887010, ISBN 10: 158488701X
23) Rice, J. (1984), ”Bandwidth Choice for Nonparametric Kernel Regression.” Ann. Statist. 12 1215-1230.
24) Sen, P. K. (1968): Estimates of the regression coefficient based on Kendall’s tau
25) Sidney Siegel, N John Castellan, Nonparametric Statistics For Behavioral Sciences. McGraw Hill Kogakusha LTD.
26) Wayne W. Daniel (1990), Applied Nonparametric Statistics. PWS-KENT Publishing Company, Boston
View at: Google Scholar
27) Xia, Y. (1998): ”Bias-Corrected Confidence Bands in Nonparametric Regression.” Journal of the Royal Statistical Society. SerB 60, 797-811.
28) Y. P. Aggarwal (1988), Statistical Methods: Concepts, Application and Computation. Sterling Publishers Pvt. Ltd., New Delhi

Core-II

Course: 302: Linear Model

UNIT I:

- **Introduction**
- T**he general linear model: Gauss-Markoff set up**
  - **Simple Linear Regression:** Normal equations andOrdinary Least Squares Estimation, Least Squares Criterion, Properties of Least Squares Estimates, Confidence Intervals and *t*-Tests, The Coefficient of Determination, R^2,The Residuals.
  - **Multiple Regression:** Predictors and Regressors, Ordinary Least Squares, Properties of the Estimates, Hypotheses Concerning Coefficient, Predictions, Fitted Values, and Linear Combinations.

UNIT II:

Generalized Least Squares:

- Normal equations and least squares estimate
- Properties and Theorems
- Estimation of linear parametric functions, variances and covariance of least square estimates, estimation with correlated observations, Aitken's Criterion

UNIT III

- **Estimation under restrictions:** Least squares estimates with restrictions on parameters
- Simultaneous estimates of linear parametric functions
- Error and Estimation spaces.
- Generalised Inverse

UNIT IV:

Quadratic forms:

- Estimation of scale parameter in the general linear model by quadratic functions.
- Necessary and sufficient conditions for a
  (i) 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.

UNIT V:

- The General Linear Hypotheses
  - Testing linear hypotheses
  - Estimation under null hypothesis
  - The likelihood ratio test
  - ANOVA- one way and two-way classification

UNIT-VI:

- **Count Data Regression**
- Distributions for Counted Data: Bernoulli Distribution, Binomial Distribution, Negative Binomial Distribution and Poisson Distribution.
- Regression Models for Counts:
  - Binomial Regression
  - Poisson Regression
  - Negative Binomial Regression

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3. Montgomery, D. C., Peck, E. A., Vining, G. G. (2015). Introduction to Linear Regression Analysis. Wiley. 3rd edition. ISBN: 9781119180173, 1119180171
4. Seber, G. A. F. (1977). Linear regression analysis. Wiley. 2nd edition. ISBN: 9780471019671, 0471019674
5. Graybill, Franklin A. (1961). An Introduction to Linear Statistical Models. McGraw-Hill. ISBN: 9780070243316, 007024331X
6. Kshirsagar, A. M. (1983). A Course in Linear Models. M. Dekker.ISBN: 9780824715854, 0824715853
7. Weisberg, S. (2013). Applied Linear Regression. Wiley. 5th edition. ISBN: 9781119580140
8. Gujarati, D. N. (2003). Basic Econometrics. McGraw Hill. 5th edition. ISBN: 9780071276252
9. Chatterjee, S., Hadi, A. S. (2006). Regression Analysis by Example. Wiley. 5th edition. ISBN: 9780470055458, 0470055456

Core-III

Course 303: Sampling Theory -II

UNIT I:

- **Methods of estimation in sampling:**

  Ratio method of estimation -Ratio estimator, unbiased ratio estimator and almost unbiased ratio estimator, Product method of estimation, Regression method of estimation, Difference estimator

- **Systematic Random Sampling: -**

  Introduction, Sample Selection Procedures, Advantages and Disadvantages, Estimation of mean, total and proportion. Sampling Variance, Comparison of Systematic with Simple Random Sampling, and Stratified Random Sampling, Interpretation Systematic Sampling, Two-dimensional Systematic Sampling.

UNIT II:

- **Single-Stage Cluster Sampling: Clusters of Equal Sizes**

  Reasons for Cluster Sampling, A Simple Rule, Comparisons of Precision Made from Survey Data, Variance in Terms of Intracluster Correlation, Variance functions, A Cost Function, Cluster Sampling for Proportions

- **Single-Stage Cluster Sampling: Clusters of Unequal Size**

  Cluster Units of Unequal Sizes, Sampling with Probability Proportional to Size, Selection with Unequal Probabilities with Replacement, The Optimum Measure of Size, Relative Accuracies of Three Techniques, Sampling with Unequal Probabilities Without Replacement, The Horvitz-Thompson Estimator, Brewer's Method, Murthy's Method, Methods Related to Systematic Sampling, The Rao, Hartley, Cochran Method, Numerical Comparisons, Stratified and Ratio Estimates

UNIT III:

- **Sub-sampling With Units of Equal Size**

  Two-stage sampling, finding means and variances in two-stage sampling, Variance of the estimated mean in two-stage sampling, sample estimation of the variance, the estimation of proportions , optimum sampling and sub sampling fractions, estimation of m_{opt} from a pilot survey, three-stage sampling.

- **Sub-sampling With Units of Unequal sizes**

  Introduction, sampling methods when n = 1, sampling with probability proportional to estimated size, summary of methods form = 1, sampling methods when n > 1, two useful results, units selected with equal probabilities: unbiased estimator, units selected with equal probabilities: ratio to size estimate, units selected with unequal probabilities with replacement: unbiased estimator, units selected without replacement, comparison of the methods

UNIT IV:

- **Double Sampling**

  Description of the Technique, Double Sampling for Stratification, Optimum Allocation, Estimated Variance in Double Sampling for Stratification, Double Sampling for Analytical Comparisons, Regression Estimators, Optimum Allocation and Comparison with Single Sampling, Estimated Variance in Double Sampling for Regression, Ratio Estimators, Repeated Sampling of the Same Population Sampling on Two Occasions, Sampling on More than Two Occasions, Simplifications and Further Developments.

- **Sources of Error in Surveys**

  Introduction, Effects of Nonresponse, Types of Nonresponses, Call – Backs, A mathematical model of the effects of call backs, Optimum Sampling Fraction Among the Non-respondents, Adjustment for Bias without call backs, A mathematical model for errors of measurement, Effect of constant bias.

REFERENCES

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Elective -I

Course 3041: 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), ISBN: 978-0387945279
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Elective –II

Course 3042: Data Mining

UNIT I: Introduction to Data Mining

- Introduction to Data mining
- Types of data mining techniques
- Process of data mining
- Data Pre-processing
- Application of data mining
- Exploratory data analysis (EDA)

UNIT II: Supervised Learning

- Introduction to Classification
- Multiple Linear Regression/Stepwise Regression
- Logistic Regression
- K-nearest neighbours (KNN)
- Bayes classifier
- Nearest neighbour classifier
- Decision tree algorithms (e.g., ID3, C4.5, CART)
- Ensemble Methods: Tree based algorithm (TBA), Random Forest, Bagging and Boosting techniques, Gradient Boosting Machines

UNIT III: Unsupervised Learning

- Introduction to Clustering
- Clustering procedures
- Association Rules
- Self-organizing map

UNIT IV: Optimization

- Neural Network
- Genetic Algorithm

REFERENCES

1. Jiawei Han, Micheline Kamber (2006): "Data Mining"; II-Ed., Morgan Kaufmann Publishers, ISBN: 1558609016, 9781558609013
2. HillolKargupta, 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
4. The elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, 2nd edition, Springer, 2009.
5. Data Mining: Practical Machine Learning Tools and Techniques, 4th Edition, Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, Elsevier (Morgan Kaufmann)
6. Introduction to Data Mining eBook: Global Edition, Pang-Ning Tan, Michael Steinbach, Vipin kumar , Anuj Karpathe, Pearson Eduction, 2019, M03 4, ISBN: 0273775324, 9780273775324
7. Data Mining: The Text Book, Charu C. Aggarwal, Springer

Elective -III

Course 3043: Stochastic Process

UNIT I:

- Stochastic Process, Markov Process and Markov chain.
- Markov chain with finite and countable state space, limiting behaviour of n-step transition probabilities, stationary process.

UNIT II:

- Markov Processes in continuous time (Poisson Process, Birth and death processes), Classification of states of a Markov chain.
- Random walks, Gambler's ruin.

UNIT III:

- Queuing Theory: Definition, Characteristics of a queuing system, Poisson Process and Exponential distribution, Classification of queues, Birth model, Death model, Birth death model.

UNIT IV:

- Detailed study of M/M/1 and M/M/C queuing models.

REFERENCES

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9. Ivo Adan and Jacques Resing (2002): "Queuing Theory: A Linear Algebraic Approach" Springer, 1st Edition, ISBN: 9780387952638
10. Srinivas R. Chakravarthy (2013): "Stochastic Processes and Queuing Theory" Springer 1st Edition, ISBN: 9781447142629
11. Donald Gross, John F. Shortle, James M. Thompson, and Carl M. Harris (2019): "Fundamentals of Queuing Theory"** by Donald Gross, John F. Shortle, James M. Thompson, and Carl M. Harris , Wiley, 5th Edition, ISBN: 9781119493604

Course 305 : Practical Paper –III

Based on Theory Paper 301 to 304

SKILL BASED ELECTIVE COURSE
Course 306: PROGRAMMING LANGUAGE- PYTHON

Unit I

Overview of the Course, Installing Python, Learning Jupyter note book and Spyder, variable types, mathematical and logical operator, conditional statement. If.. Else, For loop, while loop. Data structure in python part1 defining: List, tupple, array, set, dictionary, Lemda function.

Data structure in python part: operations on Inbuilt methods. Installing and understanding various basic libraries viz Numpy, Pandas, statsmodel, matplotlib and seaborn, sklearn. Reading file, writing Files, merging files, sort, index

Unit II

Descriptive statistics and Visualization Data Frequency, Mean, median, Range, Quartile max, min, correlation, percentile. Exploring the data, Summarizing the Data, handling missing value, visualizing the data and interpret summaries for univariate and multi variate data, Scatter plot, Stem and Leaf plot, Line plot, Bar and pie plot, Histogram, Box plot, Heat map.

Unit III

Inferential Statistical Analysis in python-ANOVA, Correlation, Construction of confidence Interval, Parametric Test and Non parametric test.

Unit IV Multivariate techniques- Principal component analysis, Factor analysis, MANOVA and Statistical Modelling- Time series, Linear Regression, Logistic regression and Non-linear regression techniques.

REFERENCES

1. Matthes, E. (2019). **Python Crash Course: A Hands-On, Project-Based Introduction to Programming.** No Starch Press. 2nd edition. ISBN: 9781593279288
2. Sweigart, A. (2015). **Automate the Boring Stuff with Python: Practical Programming for Total Beginners.** No Starch Press. ISBN: 9781593275990
3. Zelle, J. M. (2004). **Python Programming: An Introduction to Computer Science.** Franklin, Beedle & Associates Inc. 2nd edition. ISBN: 9781590282755
4. McKinney, W. (2017). **Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython.** O'Reilly Media. 2nd edition. ISBN: 9781491957660
5. Ramalho, L. (2015). **Fluent Python: Clear, Concise, and Effective Programming.** O'Reilly Media. ISBN: 9781491946008
6. Lutz, M. (2013). **Learning Python.** O'Reilly Media. 5th edition. ISBN: 9781449355739
7. Slatkin, B. (2019). **Effective Python: 90 Specific Ways to Write Better Python.** Addison-Wesley Professional. 2nd edition. ISBN: 9780134853987

SYLLABI
OF
M. Sc. (STATISTICS)
SEMESTER-IV
AS PER NEP 2020
TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2024-2025.
UNDER THE FACULTY OF SCIENCE
OF
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

COURSES	**NO.**	**TILTE**	**HRS/ WEEK**	**EXAM SCHEDULE**				
				DURATION (HRS)	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CRE DIT
CORE-I	401	OPERATIONS RESEARCH	4	3	30	70	100	4
CORE-II	402	DESIGN OF EXPERIMENTS	4	3	30	70	100	4
CORE-III	403	ECONOMETRICS	4	3	30	70	100	4
SELECT ANY ONE ELECTIVE COURSE FROM 4041 TO 4043								
ELECTIVE-I	4041	BIOSTATISTICS & CLINICAL RESEARCH	4	3	30	70	100	4
ELECTIVE-II	4042	ECONOMICS & BUSINESS STATISTICS						
ELECTIVE-III	4043	PROJECT/ DISSERTATION						
PRACTICAL BASED ON 401 TO 4043 USING EXCEL, JAMOVI & R	405	PRACTICAL PAPER-IV	12	10-15	50	100	150	6
SKILL BASED ELECTIVE COURSE	406	PROGRAMMING LANGUAGE "R"	2	2	20	30	50	2
TOTAL HRS FOR STUDETS			**30**		190	410	600	24
TOTAL HRS FOR THE DEPTT.			**38**					

Core-I

Course 401: Operations Research

UNIT I:

(Quick revision of Linear Programming Problem)

- 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:

- Goal Programming:
- Definitions and Concepts
- Formulation of Goal Programming Problem (GPP)
- Solution of GPP by Graphical and Extended Simplex Methods
- 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:

- Replacement Theory:
- Types of Replacement Problem
- Replacement of Items that Deteriorate
- Replacement of Items that fails completely and that of Staff
- Sequencing Problems:
- 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): "OperationsResearch"; S. Chand & Co., New Delhi, ISBN: 8180545350, ISBN: 13: 9788180545351
2. G. Hadley (2002): "Linear Programming"; Narosa Book DistributorsPvt Ltd, ISBN: 8185015910, ISBN-13: 9788185015910
3. Murthy K.G.(1988): Linear complementarity, linear and nonlinearprogramming, Heldermann Verlag, ISBN: 3885384035,9783885384038
4. Kasana H.S. and Kumar K.D.(2005) : "Introductory OperationResearch: Theory & Applications"; Springer Verlag , ISBN:8181282827, 9798181282827.
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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
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9. Rathindra P. Sen (2010): "Operations Research Algorithms and Applications" PHL Learning PVT. LTD., ISBN: 978-81-203-3930-9

Core – II
Course 402: Design of Experiments

UNIT I:

- General properties of incomplete block design; Concepts of connectedness, balance and Orthogonality.
- Construction of MOLS and their application.

UNIT II:

- Balanced incomplete block design (BIBD)
- Symmetric balanced incomplete block designs
- Resolvable BIBD, Affine Resolvable BIBD.
- Intra Block Analysis of BIBD

UNIT III:

- General theory of analysis of experimental designs with one way and two way elimination of heterogeneity (intrablock analysis only).
- Missing plot technique, its application to randomized block, Latin square and balanced incomplete block designs.
- Youden square and Crossover design.

UNIT IV:

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

REFERENCES

1. Montgomery, D. C. (2006): "Design and Analysis of Experiments"; 5thEd, Wiley (India), ISBN: 812651048X, ISBN-13: 9788126510481,978-8126510481.
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5. 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.
6. Federer W.T. (1993) : "Statistical Design And Analysis ForIntercropping Experiments"; Springer-verlag, ISBN: 0387979239, ISBN 13: 9780387979236, 978-0387979236.
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10. Fisher R. A. (2005): "Statistical Methods for Research Workers";Cosmo Publications, ISBN: 8130701332, ISBN-13: 9788130701332,978-8130701332.
11. Panse, V.G. and Sukhatme, P.V. (1978): "Statistical methods foragricultural workers"; ICAR, New Delhi.

Core-III

Course-403: Econometrics

Unit-I

Introduction:

- Review of **Single Equation method OLS estimation:** Estimation, Prediction, and tests of hypotheses, G.L.M. and generalized least squares estimation. Aitken's generalized least square (G.L.S) estimator
- Introduction to Econometrics and econometric models.
- Types of measurements and Data
- Problems with different types of data
- Problems associated with violation of assumptions of GLM

Unit-II

Multicollinearity:

- Nature and meaning of Multicollinearity.
- Consequences
- Detection
- Remedial Measures

Unit-III

Heteroscedasticity:

- Nature and meaning of Heteroscedasticity.
- Consequences
- Detection
- Remedial Measures

Unit-IV

Autocorrelation:

- Nature and meaning of Autocorrelation.
- Consequences
- Detection
- Remedial Measures

Unit-V

Dummy Variable Models:

- The Nature of Dummy Variables
- ANOVA Models
    - Caution in the Use of Dummy Variables
- ANOVA Models with Two Qualitative Variables
- Regression with a Mixture of Quantitative and Qualitative Regressors: The ANCOVA Models
- The Dummy Variable Alternative to the Chow Test
- Interaction Effects Using Dummy Variables
- The Use of Dummy Variables in Seasonal Analysis

Unit-VI

Stochastic Regressors and Instrumental Variable Estimation:

- Nature and meaning
- Parameter estimation and its properties
- Asymptotic properties
- Instrumental variable methods: Wald, Bartlett, Durbin, MLE.

Unit-VII

Simultaneous equation system:

- Structure and models, typology of economic relations, structural form, reduced form and final form of an economic, model.
- Problem of identification under linear homogeneous and Covariance restrictions. Rank and Order conditions of Identification
- Restrictions on structural parameters.
- **Methods of estimation:** Limited information and full information methods, indirect least squares. Two stage least squares.

REFERENCES

1. Damodar N. Gujarati, Dawn C. Porter: "Basic Econometrics"; McGraw Hill2008. 5th edition. ISBN: 0071276254, 9780071276252
2. John Johnston, John Enrico DiNardo "Econometric Methods"; McGraw Hill, Kogakusha Ltd2007. 4th edition. ISBN: 9780071153423
3. Koutsoyiannis, A.. Theory of Econometrics: An Introductory Exposition of Econometric Methods. Taiwan, Macmillan,2001. 2nd edition. ISBN: 9780333778227
4. Apte P.G.: "Text Book of Econometrics"; Tata McGraw Hill,1990. ISBN:9780074515211, 0074515217
5. C. F. Charist: "Econometric Models and Methods"; John Wiley,1968. ISBN: 9780471156208, 0471156205
6. C.R. Rao, H. Toutenburg, Shalabh, and C. Heumann (2008): Linear Models and Generalizations - Least Squares and Alternatives, Springer Berlin Heidelberg,2008. 3rd edition. ISBN:9783540742272, 3540742271
7. Samprit Chatterjee, Bertram Price.: "Regression Analysis by Example"; John Wiley & Sons, 2015.4th edition. ISBN:9780471015215, 0471015210
8. Cramer, Jan Salomon. Empirical Econometrics. Netherlands: North-Holland Publishing Company, 1971. 1st edition.ISBN:9780720430509, 072043050X.
9. Intriligator, Michael D.. Econometric models, techniques, and applications. India: Prentice-Hall, 1978. 7thedition. ISBN: 9780132232555, 0132232553.
10. Kendall, M. G., Stuart, A. The Advanced Theory of Statistics. United Kingdom: Griffin, 1968. 2nd edition. ISBN-13: **978-0470665305**
11. Klein, Lawrence Robert. An Introduction to Econometrics. United States, Greenwood Press, 1962. 2nd edition ISBN: 9780837198385, 0837198380.
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13. Maddala, G.S Introduction to Econometrics. United Kingdom, Macmillan, 1992. 3rd edition. ISBN: 9780029460467
14. Recent Advances in Linear Models and Related Areas: Essays in Honour of Helge Toutenburg. Germany, Physica-Verlag HD, 2008. ISBN: 9783790820645, 3790820644.
15. Theil, Henri. Introduction to econometrics. United Kingdom, Prentice-Hall, 1978. ISBN:9780134810287, 0134810287.

Course-4041:Bio-Statistics&ClinicalResearch

UNITI:

- Introduction to Bio-statistics, Sources of medical uncertainties, managing medical uncertainties. Applications 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 trilas, overview of Phase I-IV trials, multi-center trials. Data management: data definitions, data collection system for food clinical practice, protocol definition.

UNITII:

- 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

UNITIII:

- 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.

UNITIV:

- 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):"Hand book of Statistical Genetics",Indian Agricultural Statistics Research Institute, I.C.A.R., New Delhi. Print ISSN: 0019-5200, Online ISSN: 0975-6906
2. J. P. Jain(1982):"Statistical techniques in quantitative genetics", 2nd ed., Hindustan Publishing corporation, ISBN-10: 8170750946, ISBN-13: 978-8170750949
3. Govindarajulu Z.(2000):"Statistical Techniques in Bioassay", 2nd revised edition, Karger, ISBN-10: 9783805571197, ISBN-13: 978-3805571197
4. Finney,D.J(1971):"Statistical Method In Biological assay", 2nd ed., C. Griffin and company limited. ISBN-10: 0852640145, ISBN-13: 978-0852640142
5. Finney, D.J(1971):"ProbitAnalysis"3rd ed., Cambridge University Press, Cambridge, ISBN: 9780521080415, 052108041X
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9. J.L. Fleiss(1989):"The Designand Analysis of Clinical Experiments". 1st ed.,Wileyand Sons, ISBN: 978-1-118-03117-9
10. Ettore Marubini, Maria Grazia Valsecchi(2004):"Analyzing Survival Data From ClinicalTrialsandObservationalStudies",1st ed., Wiley and Sons. ISBN: 978-0-470-09341-2
11. Lawrence M. Friedman, Curt D. Furberg, David L. DeMets (1998): "Fundamental of clinical Trials", 3rded.SpringerPublication, ISBN 978-1-4419-1585-6 e-ISBN 978-1-4419-1586-3

12. Duolao Wang, Ameet Bakhai (2006): " Clinical Trials A Practical Guide to Design, Analysis, and Reporting", Published by Remedica, USA, ISBN-10: 1 901346 72 2, ISBN-13: 978 1 901346 725
13. Indrayan and L. Satyanarayana (2006): " Biostatistics for medical, nursing and pharmacy students", Eastern Economy Edition, Prentice hall India, ISBN 81-203-3054.
14. B. K. Mahajan (1997): " Method in Biostatistics for medical students and research work", Sixth edition, Jaypee Brothers medical publisher LTD. ISBN 81-7179-520-X.

Elective II

Course 4042: Economic & Business Statistics

UNIT I:

Index Numbers: Price, Quantity and Value indices. Price IndexNumbers: Construction, Uses, Limitations, Tests for indexnumbers, Chain Index Number. Consumer Price Index, WholesalePrice Index and Index of Industrial Production – Construction ofindex numbers and uses. Cost of Living Index Number and variousOfficial Index Numbers, HDI (Human Development Index).

UNIT II:

Demand Analysis: Concept related to demand and supply, price elasticities of demand and supply, Methods of determining demand and supply curves forcross section data and time series data, Leontief's method, Pigou'sMethod, Engels Curves, Pareto's Law of Income Distribution.

UNIT III:

Time Series Analysis: Definition and importance of time series analysis. Components of a Time series. Different methods for determination of trend, Methods for elimination of seasonal components. Determination of cyclic components. Variate difference method and their merits and demerits.

UNIT IV:

Stationary Time series, Box-Jenkins Models, Introduction toAutoregressive (AR) Models, Moving Average (MA) Models,Mixed Autoregressive Moving Average (ARMA)Models.Autoregressive Integrated Moving Average (ARIMA) Models. Properties of these models. Forecasting Techniques, Seasonal ARIMA model, Introduction to conditional Heteroscedasticity model; Volatility models, ARCH model, GARCH model, properties, estimation and forecasting of these models.

REFERENCES

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3. Box and Jenkins: Time Series Analysis: Forecasting and Control; Holden Day Pub, ISBN-13. 978-0816211043.
4. Chatfield C. : The Analysis of Time Series : Theory and Practice; Chapman and Hall, ISBN-13: 978-0412716409.
5. Waller Vancuels : Applied Time Series and Box Jenkins Models, ISBN 13: 9780127126500.
6. Karmel P.H. : "Applied Statistics for Economics", ISBN-13. 978-0273402954.
7. Sen A.K.: Growth Economics: Penguin Modern EconomicReading Edition, ISBN 13: 9780140801392.
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Course 405 : Practical Paper –IV

Based on Theory Paper 401 to 404

Skill Based Course

Course-406: Programming Language 'R'

UNIT I:

- **Introduction to R**
  - Background and resources
  - Installing R and R Studio
  - 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
- **Data management**
  - Split
  - Find and replacement
  - Manipulations with alphabets
  - Evaluation of strings
  - Data frames.
- **Conditional executions and loops**
  - If loop
  - While loop
  - For loop

UNIT II: Statistical Analysis in R

- **Data Visualization of R**
  (Creating, Modifying the points, line, title, subtitle, axes of the plot/graph, Adding additional elements and legends to graph etc.)
  - Pie Chart

- Bar graph
- Line Graph
- Scatter plot
- Stack Plot
- Box-Plot
- Special graph
- Multiple plots

- **Frequencies & Descriptive Statistics**

- Frequency
- Measure of central tendency
- Measure of Dispersion
- Measure of skewness

- **Statistical Testing**

- Cross tabulation
- One sample t test
- Independent sample t test
- Paired sample t test
- One way ANOVA

- **Statistical Modelling**

- Correlation
- Simple linear regression
- Multiple linear regression

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