Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Fax : +91 - 261 - 2227312
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન આંકડાશાસ્ત્ર (Statistics) કોર્સ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Statistics (Sem-2) નો & M.Sc. Applied Statistics (Sem-2) નો અભ્યાસક્રમ આંકડાશાસ્ત્ર વિષયની અભ્યાસ સમિતિનાં ચેરમેનશ્રીએ બોર્ડ વતી અને વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરી અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલ તા.૧૮/૧૨/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૫ થી સ્વીકારી મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૧૮/૧૨/૨૦૨૩ની ઠરાવ ક્રમાંકઃ ૫

:: **આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Statistics (Sem-2) નો & M.Sc. Applied Statistics (Sem-2) નો અભ્યાસક્રમ આંકડાશાસ્ત્ર વિષયની અભ્યાસ સમિતિનાં ચેરમેનશ્રીએ બોર્ડવતી અને વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરી અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.**

(બિડાણઃઉપર મુજબ)

ક્રમાંક : એસ./આંકડાશાસ્ત્ર/પરિપત્ર/૩૧૦૮૦/૨૦૨૩
તા.૧૯–૧૨–૨૦૨૩

કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન આંકડાશાસ્ત્ર કોર્સ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ. તથા ડિપાર્ટમેન્ટનાં વડાશ્રી. .....આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

STATISTICS

SYLLABUS FOR

M. Sc. (STATISTICS) SEM II

AS PER NEP 2020
TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2023-2024.
UNDER THE FACULTY OF SCIENCE

On behalf of BOS (Statistics).
I approve this Syllabus.
If any suggestion in the next meeting of BOS, I will take note on it.

06/12/23.
(Chairman).
BOS in statistics.

SYLLABI

OF

M. Sc. (STATISTICS)

SEMESTER-II

AS PER NEP 2020

TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2023-2024.

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	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 HRS FOR STUDETS			**30**		190	410	600	24
TOTAL HRS FOR THE DEPTT.			**42**					

✓ **NOTE: EXAM OF "SKILL BASED ELECTIVE COURSE" BE TAKEN ON COMPUTERS.**

CORE-I

201: Estimation Theory

Course Code	201
Course Title	Estimation Theory
Credit	4
Teaching per Week	4
Maximum weeks per semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of course	This paper deals with point estimation and interval estimation. From this paper the students are expected to build a foundation on Estimation theory.
Course Objective	The main objective of this course is to facilitate for investigate the properties of point estimators, impart the applications of various methods of findings point estimators and to learn techniques of construction of confidence intervals. Also, to learn computational skills to implement various statistical inferential concepts.
Course Outcomes	After completing this course, the students will be able to: CO1 Understand the concept of estimator with different properties CO2 Demonstrate and understanding the concept of unbiasedness and biasedness with theory CO3 Derive a foundation on different theorem based on estimators CO4 Describe the concept of BLUE, BAN, MVUE, MVBUE, UMVUE with theorems. CO5 Students have the knowledge methods of obtaining minimum variance unbiased estimators. CO6 Learn the methods for interval estimation for small and large sample size
Mapping with COs with PSOs	
Pre-requisite	Knowledge Probability theory, Probability distributions and calculus.
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.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

	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
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment (based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc.) and 70% External based on semester end University examination.
List of Practical	1. Method of Moments 2. Method of Maximum likelihood estimation 3. Method of Scoring 4. Method of least squares 5. Interval Estimation

Syllabus revised by: **(1) B. T. Naik and** **(2) S. S. Patel**

Chairperson: **A. J. Rajyaguru**

Core-II

202: Testing of Hypotheses

Course Code	202
Course Title	Testing of Hypotheses
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of this course is to teach classical theory of testing of hypotheses, use of the concept of likelihood for testing of hypotheses and Sequential testing of hypotheses for different types of hypotheses and their applications.
Course Objective	To make students aware of Neyman-Pearson Theory of testing of hypotheses, likelihood ratio based testing (For simple as well as composite hypotheses)and sequential testing procedures.
Course Outcomes	After successful completion of this course, student will be able to: CO1: Formulate null and alternative hypotheses; understand types of errors involved in the testing of hypotheses, concepts for comparisons of different possible test procedures to decide the best test for various types of null and alternative hypotheses for different real-life situations. CO2: Compute probabilities of types of errors and checking MLR property. CO3: Understand UMP and UMPU test with their applications and relevant results. CO4: Construct MP test, UMP test and UMPU test.-Knowledge of SLRT & GLRT and SPRT. CO5: Use the concept and related results of invariant testing of hypotheses and their applications. CO6: Construct best test for distributions, which are not well behaved. CO7: Use concepts of least favourable distribution for testing of hypotheses.
Mapping between COs with PSOs	
Pre-requisite	Detailed knowledge of Probability theory, Probability distributions and Estimation theory
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

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							
CO7							

B Naik

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	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 Statistical Hypotheses";3rd Edition, Springer, ISBN0-387-98864-5. 4. Rohatgi V. K.(1976):"An Introduction to Probability Theory and Mathematical Statistics"; John Wiley & Sons Incorporated, ISBN-10:0471731358, ISBN-13:9780471731351 5. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta. 6. Rao C. R.(2001): "Linear Statistical Inference and its Applications"; 2nd Edition, 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
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• Classical testing of hypotheses (Neyman-Pearson Theory) 1. MP test 2. UMP test 3. UMPU test • All applications of small sample tests 4. Applications of t-tests 5. Applications of F-test 6. Applications of Chi-Square test • All applications of Large sample tests 7. Z tests and Fisher's transformation • Sequential testing of hypotheses 8. SPRT

Rajguru's Telephonic Suggestions

Syllabus revised by: **(1) A. J. Rajyaguru and** **(2) Rupal Shah**

Chairperson: **A. J. Rajyaguru**

Core III

M. Sc. Statistics 2nd Semester

Course 203: Multivariate Analysis

Course Code	203
Course Title	Multivariate Analysis
Credit	4
Teaching per Week	4
Maximum weeks per semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of course	The purpose of this course is to understand the extensions of univariate techniques to multivariate frameworks and learn to apply data reduction techniques used in the data analysis with the use of probability distributions.
Course Objective	In multivariate analysis students learn how to deal with the data analysis of several variables simultaneously. Necessary theoretical probability distributions of different multivariate technique use in classification, discriminate and data reduction techniques.
Course Outcomes	After completing this course, the students will be able to: CO1 Understand the development of multinomial and multivariate normal distribution with their properties. CO2 Understand the concept of Wishart distribution with various properties CO3 Understand the idea of partial and multiple correlation coefficient with testing of hypothesis CO4 Get Derivation of Hotelling T^2 statistic and their various application in real life problems CO5 Demonstrate the knowledge and understanding of the basic ideas behind classification and discriminant analysis CO6 Understand the concept of data reduction technique like factor, principal and Canonical correlation analysis

Mapping with COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

Pre-requisite	Univariate distribution in both cases discrete and continuous, concept of linear algebra
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-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. 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
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment (based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc.) and 70% External based on semester end University examination.

List of Practical	1. Multivariate Normal Distribution 2. Testing significance of partial correlation coefficient 3. Testing significance of multiple correlation coefficient 4. Testing a significance for single population mean vector 5. Testing significance of paired population mean vector 6. Testing Significance of two independent mean vector (equal population variance) 7. Testing Significance of two independent mean vector (unequal population variance) 8. MANOVA 9. Problem of symmetry 10. Classification Problem

Online/ Telephonic Sessions Patel

Syllabus revised by: (1) C. D. Bhavsar (2) S. S. Patel

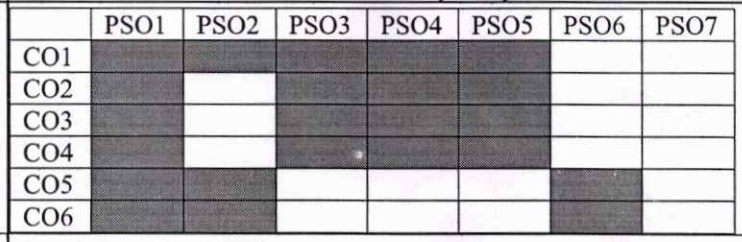
Chairperson: A. J. Rajyaguru

B Trivedi

M. Sc. Statistics 2rd Semester

Elective Paper

Course-2041: Industrial Statistics

Course Code	2041
Course Title	Industrial Statistics
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-2024
Purpose of Course	The purpose of the course is to develop scientific view to analyse the industrial data about specific perspective. To learn the statistical quality control techniques used in industries such as control charts, acceptance sampling plans, reliability analysis etc. To learn some advanced control charts, capability indices and the concept of six-sigma.
Course Objective	To make students acquainted with concepts of SQC, Reliability and Quality management.
Course Outcomes	After completing this course, students will be able to: CO1: Understand the basics of production process monitoring and apply concept of control charts on it. CO2: Apply the acceptance and continuous sampling plans in production process. CO3: Know and apply the concept of weighted control charts, six sigma, ISO:9000 series standard sand Taguchi design. CO4: Understand the concepts of quality control, chance and assignable causes of variation, control charts for variables and attributes, producer's and consumer's risk-Acceptance sampling plans. CO5: Get idea of important lifetime distributions such as for exponential, Weibull, gamma and lognormal distributions. CO6: Use of estimation in their liability analysis.
Mapping between COs with PSOs	
Pre-requisite	Knowledge of probability theory, probability distributions and estimation theory
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 10 0070941092, 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 Wiley ISBN-10 1119723094, ISBN-13 978-1119723097
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• $\bar{R}$ and $\bar{X}$-chart • np, p, c and u-chart

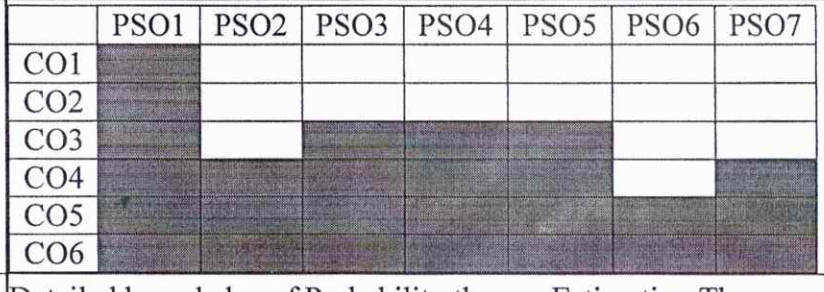
	• OC, ATI and AOQ curves • Estimation with complete sample for exponential distribution and gamma distribution • Estimation with failure censored sample for exponential distribution • Estimation with time censored samples for exponential distribution

Syllabus revised by: Dr. Sejal A. Desai

Chairperson: A. J. Rajyaguru

Elective paper

Course-2042: Decision Theory

Course Code	2042
Course Title	Decision Theory
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	To make students understand decision theory based on Bayesian probability i.e., making rational decisions against multiple criteria and testing of hypotheses using data sets which do not have any parametric information.
Course Objective	The main objective of this course is to provide the detailed knowledge of statistical inference under Bayesian framework and Non-Parametric inference.
Course Outcomes	After successful completion of this course, student will be able to: **CO1:** Identifying and dealing with the situations of decision making under risk and uncertainty **CO2:** Understand decision problem, loss function, risk function and decision rules, their admissibility and completeness **CO3:** Use of different decision rules under uncertainty and risk. **CO4:** Obtaining best decision rules using different types of prior, posterior distributions and loss functions **CO5:** Understand the applicability of different nonparametric statistical tests for one, two (paired as well as unpaired) and more than two populations. **CO6:** Solve hypothesis testing problems where the conditions for the traditional parametric inferential techniques are not fulfilled.
Mapping between COs with PSOs	
Pre-requisite	Detailed knowledge of Probability theory, Estimation Theory and Probability distribution.
Course Content	**UNIT I:** • **Review of basic elements of statistical decision problem:** Various inference problems viewed as decision problems. **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. Gibbons J.D. & Subhabrata Chakraborti (2003): "Nonparametric Statistical Inference"; McGraw Hills. ISBN: 0-8247-4052-1 3. Ferguson T.S. (1997): "Mathematical Statistics"; Academic Press. ISBN 0122537505, 9780122537509 4. Kendall M.G. and Stuart A. (1961): "The Advanced Theory of Statistics"; Vol. 2., Ed. IV, Charles and Griffin.ISBN 10: 0470233818ISBN 13: 9780470233818 5. 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 6. Sedney Seigal &N. John Castellan Jr (1988): "Nonparametric Statistics for Behavioural Sciences"; 2ed edition, McGraw Hill.ISBN-10**0070573573**, ISBN-13**978-0070573574** 7. Gibbons J.D. and Pratt J.W. (1982): "Concepts of Nonparametric Theory"; 1981st edition, Springer-Verlag. **ISBN-10:**0387905820**ISBN-13:**978-0387905822 8. Daniel W.W. (1990): "Applied Nonparametric Statistics"; 2ed edition, PWS-KENT publishing Co., Boston. ISBN: 0534919766 9. Conover W.J. (1999): "Practical Nonparametric"; 3rd edition, John Wiley & Sons Inc.**ISBN-10:**0471160687, **ISBN-13:**9780471160687 10. Wald A. (1947): "Sequential Analysis"; John Wiley & Sons

	IncISBN-10:0471918067, ISBN-13:978-0471918066 11. Hettmansperger, T.P. (1984). Statistical inference Based on Ranks, Wiley–Blackwell, ISBN-10: 047188474X, ISBN-13: 978-0471884743 12. Randles, R.H. and Wolfe, D.A. (1991): "Introduction to the Theory of Nonparametric Statistics"; New edition, Krieger Publishing Company;ISBN-10:0894645439, ISBN-13:978-0894645433 13. 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
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• Decision making under uncertainty-I • Decision making under uncertainty-II • Bayesian Decision rule-Posterior analysis • Decision Tree

Telephonic/ online Suggestions

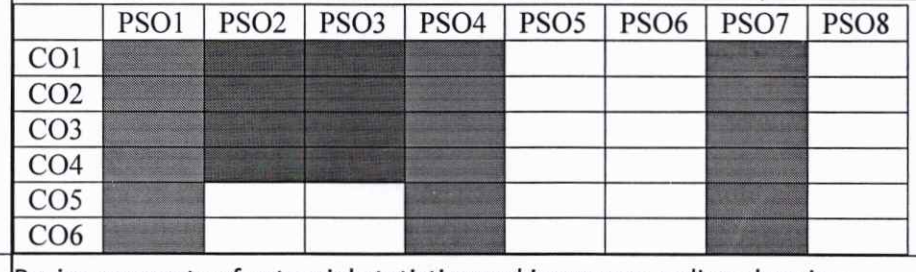
Syllabus revised by: (1) A. J. Rajyaguru (2) Rakesh S. Srivastava

Chairperson: A. J. Rajyaguru

By mail

Elective paper

Course-2043: Actuarial Statistics

Course Code	2043
Course Title	Actuarial Statistics
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of this course is to learn the life tables used in insurance products • To learn the concept of interest ,different life insurance products, life annuities, net premiums. • To motivate students to prepare for exams required for employment in the actuarial science profession.
Course Objective	To make students acquainted with actuarial science and implementation Of statistics in actuarial science
Course Outcomes	After completing this course, students will be able to: CO1:Understand the utility theory, insurance products and life tables. CO2:Understand the concept of interest. CO3:Understand the concept of life insurance and the existing insurance products of different insurance company. CO4:Know life annuities, net premium and net premium reserves. CO5:Understand the concept of Stationary population and various models
Mapping between Cos with PSOs	
Pre-requisite	Basics concepts of actuarial statistics and insurance policy planning
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 asset 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. 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)
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• Life Table-I • Life Table-II • Gompertz Law • Interest Theory

Suggestions through e-mail.

Syllabus revised by: (1) S. R. Sheikh (2) J. J. Pandey

Chairperson: A. J. Rajyaguru

Elective paper

Course: 2044: DATA BASE MANAGEMENT SYSTEMS

Course Code	**2044**
Course Title	**DATA BASE MANAGEMENT SYSTEMS**
Credit	4
Teaching per Week	4Hrs
Minimum weeks per Semester	15(Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of the course is to prepare the students to be capable of doing any kind of data management that will further help them to perform various activity of data science. The core objective of this course is to identify different database systems, their model sand to perform various data management task such as retrievation, insertion and Renovation of data using its tool.
Course Objective	To make students familiar with data base management theory and give Practical exposure to manage at a using Query language.
Course Outcomes	After completing this course, students will be able to: CO1: Understand and apply the concept of data base management system by comparing them with traditional data management techniques CO2: Perform data definition, data manipulation, data control and transaction control using Query language CO3: Learn fundamental data models and its application in real world domain. CO4: Extend the procedural structural query language using various Concept such as Procedures, Functions, Cursor and Triggers
Mapping between COs With PSOs	
Pre-requisite	Fundamental of computer programming
Course Content	**UNIT I:** • 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

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■			■		■	
CO2	■	■	■	■		■	
CO3			■	■	■	■	
CO4						■	

	UNIT II: • Data base System ➢ Data base Structure ➢ Levels of abstraction in DBMS ➢ View of data ➢ Role of Data base users and administrators ➢ Data base Structure: DDL, DML, DCL, TCL **UNITIII:** • Types of Data Models ➢ Hierarchical data bases ➢ Network data bases ➢ Relational data bases ➢ Object oriented data bases **UNITIV:** ➢ Stored Procedure ➢ PL/SQL ➢ Concepts Procedure, Functions, Cursors, Triggers

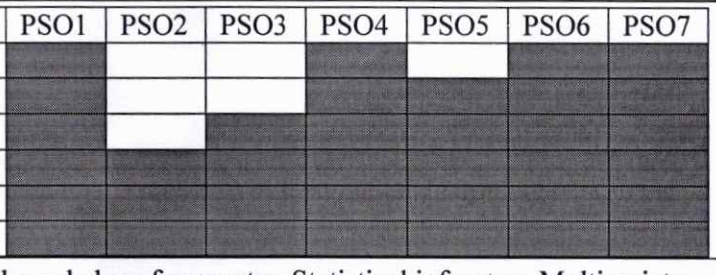
Reference Books	1. C.J. Date-Narosa (1999): "An Introduction to Data base System"; 7th Edition, Pearson. ISBN-10 0201385902 ISBN-13 978-0201385908 2. Henry F. Korth &Abraham Silberschatz & S. Sudarshan (2010): "Data base System Concepts"; 6th edition, McGraw-Hill education. ISBN-10 **0073523321** ISBN-13 **978-0073523323** 3. Jeffrey D. Ullman. (1994): "Principles of Data base System"; 3rd edition, Galgotia Pub. ISBN-10 **8175155450** ISBN-13 **978-8175155459** 4. Bipin C. Desai. (2010): "Introduction to data base system"; revised edition, Galgotia pub. ISBN-10 **8175156171** ISBN-13 **978-8175156173** 5. Fundamentals of Data base System-Elmasri Navathe, 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 Data based 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
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70%Externalbasedonsemesterend Universityexamination

Syllabus Revised by: (1) T R Ghadiyali (2) Kishor Atkotiya

Chairperson: A. J. Rajuaguru

M. Sc. Statistics 2nd Semester

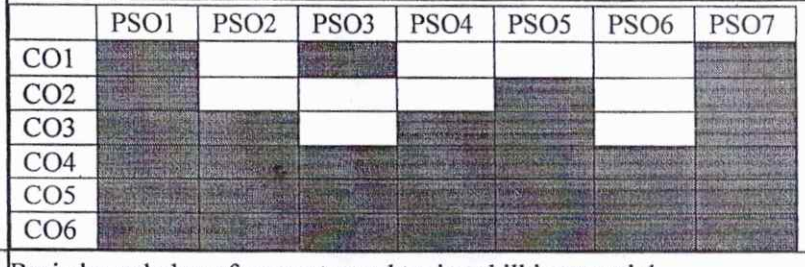
Course-205: Practical paper-II

Course Code	206
Course Title	Practical paper-II
Credit	6
Teaching per Week	12
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of this course is to enrich the computing power of students using Excel, JAMOVI and C language.
Course Objective	Learning analysis of various kinds of data using excel will help the students to understand how to go around with the computing part of some of the theoretical aspects.
Course Outcomes	After successful completion of this course, student will be able to: CO1: Solve Decision related real life problems using decision criteria, can solve life-table related problems. CO2: Perform the analysis with analysis tool pack in excel and generate/draw Quality control charts in excel. CO3: Understand and apply various functions available in excel. CO4: Estimate parameters using formula in excel by different methods CO5: Solve problems related to multivariate data with use of excel CO6: Apply parametric tests to solve real life problems using excel
Mapping between COs with PSOs	
Pre-requisite	Basics knowledge of computer, Statistical inference, Multivariate technique, Decision rules and Actuarial Statistics
Course Content	Based on theory paper 201 to 2044
Reference Books	Reference book mention in theory paper 201 to 2044
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc.70% External based on semester end University examination

Chairperson: **A. J. Rajyaguru**

Skill Based Course

Course-206: Computer Programming Language- "C"

Course Code	206
Course Title	Computer Programming Language – "C"
Credit	2
Teaching per Week	2
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of the course is to make the student capable of implementing the concepts, methods, and debugging tools of Programming and learn their implementation.
Course Objective	To make students acquainted with knowledge of programming using C language.
Course Outcomes	After completing this course, students will be able to: CO1: Understand the basic concepts and fundamentals of programming such as algorithm and flowchart. CO2: Understand the basic C fundamentals such as data types, operators etc. CO3: Design programs involving control statements such as conditional and unconditional statements. CO4: Implement advanced programming approach such as modular programming along with parameter passing techniques. CO5: Understand the concept of different data structures such as array, structure and union. CO6: Developthe programs that deal with various operations on data files.
Mapping between COs with PSOs	
Pre-requisite	Basic knowledge of computer and typing skill is essential.
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. 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 Bala Guruswamy (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.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Syllabus Revised by: (1) B.C. Patel (2) N. R. Patel

Chairperson: A. J. Rajyaguru

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

STATISTICS

SYLLABUS FOR

M. Sc. (APPLIED STATISTICS) SEM II

AS PER NEP 2020
TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2023-2024.
UNDER THE FACULTY OF SCIENCE

On behalf of BOS (Statistics), I approve this Syllabus.
If any suggestion in the next meeting of BOS, I will take note on it.

(B Naik)
(06/12/23)
(Chairman)
BOS in Statistics).

Syllabi

of

M. Sc. (Applied Statistics)

Semester-II

AS PER NEP 2020

To be implemented from the Academic Year 2023-2024.

UNDER THE FACULTY OF SCIENCE

COURSES	NO.	TILTE	HRS/ WEEK	EXAM SCHEDULE				
				DURATION (HRS)	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CRE DIT
CORE-I	201	STATISTICAL INFERENCE-I	4	3	30	70	100	4
CORE-II	202	STATISTICAL INFERENCE-II	4	3	30	70	100	4
CORE-III	203	APPLIED MULTIVARIATE ANALYSIS	4	3	30	70	100	4
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	38		190	410	600	24

✓ **NOTE: EXAM OF "SKILL BASED ELECTIVE COURSE" BE TAKEN ON COMPUTERS.**

M.Sc. Applied Statistics 2nd Semester
Core paper
Course: 201: Statistical Inference-I

Course Code	201
Course Title	Statistical Inference I
Credit	4
Teaching per Week	4
Maximum weeks per semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of course	The purpose of the course are explain the concept of Estimation theory which is divided in to two parts point estimation and interval estimation. From this paper the students are expected to build a foundation on inferential statistics.
Course Objective	Study the properties and methods of estimators. Develop skills to calculate small and large sample size confidence intervals with different methods.
Course Outcomes	After completing this course, the students will be able to: CO1 Understand the concept of estimator with different properties CO2 Demonstrate and understanding the concept of unbiasedness and biasedness CO3 Become aware of statements of different theorem based on estimators and applies it in suitable situations. CO4 Describe the concept of BAN, MVUE, MVBUE, and UMVUE. CO5 Have the knowledge of methods of obtaining minimum variance unbiased estimators. CO6 Learn the methods for interval estimation for small and large size confidence internal
Mapping with COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							
CO6							

Pre-requisite	Basic of probability distributions and calculus
Course Content	**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- Raoinequality, 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. (theorems without proof) **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. **UNIT IV:** 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.
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. 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

Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment (based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc.) and 70% External based on semester end University examination.
List of Practical	1. Method of Moments 2. Method of Maximum likelihood estimation 3. Method of Scoring 4. Method of least squares 5. Interval Estimation

Syllabus revised by: (1) B. T. Naik and (2) S. S. Patel

Chairperson: A. J. Rajyaguru

M.Sc. Applied Statistics Sem-II

Core paper

Course: 202: Statistical Inference-II

Course Code	**MAS-202**
Course Title	**Statistical Inference-II**
Credit	4
Teaching per Week	4 Hrs.
Minimum weeks per Semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2023
Purpose of Course	The purpose of the course is to explain classical testing of hypotheses as well as sequential testing of hypotheses and to explain their practical applicability.
Course Objective	To make students acquainted with testing of hypothesis and draw inferences.
Course Outcomes	After completing this course, the students will be able to: CO1: Get the knowledge about formulating the hypotheses, deciding appropriate test for concern parameters of interest and testing a hypothesis, using critical values to draw conclusions and determining probability of errors in hypotheses tests. CO2: Get the knowledge about large sample and small tests and its applications CO3: Get knowledge about classical testing of hypotheses testing and sequential testing of hypotheses testing. CO4: Understand the difference between classical and sequential testing of hypotheses. CO5: Compare two classical tests as well as sequential tests. CO6: Understand the situation for applying suitable test.
Mapping between COs with PSOs	
Pre-requisite	Basics concept of testing of hypotheses and decision theory
Course Content	**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, . UNIT **II:** • **MP and UMP tests (without proof)**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■	■	■			■
CO2	■	■	■	■	■		■
CO3	■	■	■	■	■		■
CO4	■	■	■	■	■		■
CO5	■	■	■	■	■		■
CO6	■	■	■	■	■		■

	Neyman–Pearson's Lemma & Generalized Neyman–Pearson's Lemma and its applications to find Most Powerful test and UMP tests for families of distributions admitting monotone likelihood ratio, two sided hypotheses • **Parametric tests:** Large sample test for mean, variance, proportion and correlation ,Small sample tests: χ_2, t, F & Z-transformation , ANOVA **UNIT III:** • **Unbiasedness for testing of hypotheses: (Without proof)** Similar test, relationship with UMP unbiased test, UMP similar test and its application for one parameter exponential family, Similarity and completeness, tests with Neyman structure, UMP unbiased tests for multi-parameter exponential families • Likelihood Ratio Test & Test of significance as its particular case **UNIT IV:** • **Concept of Invariance in testing of hypotheses:** Maximal invariant test, most powerful invariant test , • Concept of least favorable distribution and its use in testing of hypotheses • **SPRT:** Wald's sequential probability ratio test, its properties and applications
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 Statistical Hypothesis"; 3rd Edition, Springer, ISBN 0-387-98864-5. 4. Rohatgi V.K. (1976): "An Introduction to Probability Theory and Mathematical Statistics"; John Wiley& Sons Incorporated, ISBN-10:0471731358,ISBN-13:9780471731351 5. Mukhopadhyay, P. (1996): "Mathematical Statistics"; New Central Book Agency, Calcutta. 6. Rao C. R. (2001): "Linear Statistical Inference and its Applications"; 2nd Edition, Wiley-Interscience. **ISBN-10:** 0471218758, **ISBN-13:** 978-0471218753 7. Wald A. (2004): "Sequential Analysis"; Dover Pubns, **ISBN:** 0486439127, **ISBN-13:** 9780486439129, 978-0486439129 8. David J. Sheskin (2007): "Handbook of Parametric and Nonparametric Statistical Procedures"; Chapman & Hall; 4th Edition, **ISBN:** 9781584888147, **ISBN 10:** 1584888148
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation,class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

List of Practicals	• Neyman Pearson Theory(MP tests) • Neyman Pearson Theory(UMP tests) • Neyman Pearson Theory(UMPU tests) • Applications of t, F, χ^2 , Z • Sequential Probability Ratio Test (SPRT)

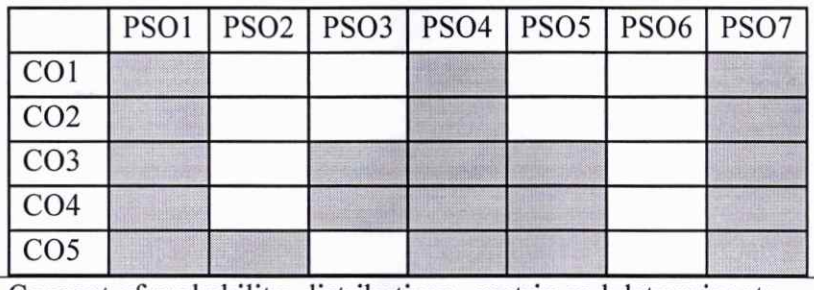
Syllabus Revised by: (1) A. J. Rajyaguru (2) Kishor Atkotiya (Telephonic Suggestions)

Chairperson: A. J. Rajyaguru

Core III

M. Sc. Applied Statistics 2nd Semester

Course 203: Applied Multivariate Analysis

Course Code	203
Course Title	Applied Multivariate Analysis
Credit	4
Teaching per Week	4
Maximum weeks per semester	15 (Including Class work, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of course	The purpose of this course is to learn how to deal with the multivariate data set and to learn necessary theoretical concepts of different multivariate techniques and data reduction techniques.
Course Objective	The main objective of this course are to acquaint with the basic ideas, applicability and method of multivariate data analysis.
Course Outcomes	After completing this course, the students will be able to: CO1 Understand the concept of multinomial and multivariate normal distribution with their properties. CO2 Understand the idea of partial and multiple correlation coefficient with testing of hypothesis CO3 Demonstrate Hotelling T^2 statistic and their various application in real life problems CO4 Demonstrate the knowledge and understanding of the basic ideas behind classification and discriminant analysis CO5 Understand concept of data reduction technique like factor analysis and principal component
Mapping with COs with PSOs	
Pre-requisite	Concept of probability distributions, matrix and determinants
Course Content	**UNIT I:** i. Need of multivariate analysis ii. Multinomial distribution and multivariate Normal distribution – its properties (without proof). **UNIT II:** i. Hotelling T^2 distribution (without derivation) & its applications.

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							

	ii. Comparisons of several multivariate means: multivariable analysis of variances (one way classification) **UNIT III:** i. Partial correlation and multiple correlations and their significance ii. Multiple linear regression model, least square estimation and its inference. **UNIT IV:** i. Concept and application of (i) Factor analysis (ii) Principal Component analysis and (iii) Canonical Correlation analysis. ii. 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.
Reference Books	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(2ingapore) 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. 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
Teaching Methodology	Class work, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment (based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc.) and 70% External based on semester end University examination.
List of Practical	1. Multivariate Normal Distribution 2. Testing a significance of mean vector for single population mean vector 3. Testing significance of paired population mean vector 4. Testing Significance of two independent mean vector (equal population variance) 5. Testing Significance of two independent mean vector (unequal population variance) 6. MANOVA 7. Problem of symmetry 8. Significance of partial correlation coefficient 9. Significance of multiple correlation coefficient 10. Classification Problem

Telephonic Suggestions Patel

Syllabus revised by: **(1) C. D. Bhavsar (2) S. S. Patel**

Rajyaguru

Chairperson: **A. J. Rajyaguru**

B Trivedi

Elective Paper

Course-2041: Industrial Statistics

Course Code	2041
Course Title	Industrial Statistics
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2019-20
Purpose of Course	The purpose of the course is to develop scientific view to analyse the industrial data about specific perspective. To learn the statistical quality control techniques used in industries such as control charts, acceptance sampling plans etc. To learn some advanced control charts, capability indices and the concept of six-sigma.
Course Objective	To make students acquainted with concepts quality management.
Course Outcomes	After completing this course, students will be able to: CO1: Understand basic of production process monitoring and apply concept of control charts on it. CO2: Apply the acceptance and continuous sampling plans in production process. CO3: Know and apply the concept of weighted control charts, six sigma, SO:9000 series standards and Taguchi design. CO4: Understand the concepts of quality control, chance and assignable causes of variation, control charts for variables and attributes, producer's and consumer's risk-Acceptance sampling plans. CO5: Get idea of important life time distributions such as for exponential, Weibull, gamma and lognormal distributions. CO6: Use of estimation in the reliability analysis.
Mapping between COs with PSOs	
Pre-requisite	Basics of quality control management and reliability analysis
Course Content	**Unit - I** • **Statistical Quality control Methods** • **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**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■	■	■	■		
CO2	■		■	■	■		
CO3	■		■	■	■		
CO4	■		■	■	■		
CO5	■	■				■	
CO6	■	■				■	

	• **Statistical Quality Control techniques to control process** • **Theory of Control charts** • **Control charts for variables : X-bar ,R-chart and sigma chart** • **Control charts for attributes : p-chart, np-chart, c-chart and u-chart** • **Comparison between for variables and control charts for attributes.** • **Cumulative sum chart** • **Statistical Quality Control techniques to control product** • **Principle of acceptance sampling plans.** • **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** • **Multiple Sampling plan and Sequential sampling plan** • **Plan for acceptance sampling by measurement.** **Unit - III** • **Introduction to six sigma** • **overview of six sigma, lean manufacturing and Total Quality Management(TQM)** • **Organizational structure and six sigma training plans- Selection criteria for six -sigma roles and training plans** • **Voice of customers(VOC)** • **Importance and VOC data collection** • **criteria to Quality** • **Introduction to DMAIC using one case study: Define Phase, Measure Phase, Analyze phase, Improve Phase and control phase.** **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.**
Reference Books	1. Hopper A.G. (1969): "Basic Statistical Quality Control"; McGraw Hill, London. ISBN: 070941092 2. Gupta R.C. (1998): "Statistical Quality Control"; Latest edition, Khanna Publishers, New Delhi. ISBN-10 **8174091114**, ISBN-13 **978-8174091116** 3. Ryan T.P. (2011): "Statistical Methods for Quality Improvement"; John Wiley & Sons, ISBN:9780470590744 Online ISBN:9781118058114 4. Omachonu V.K. and Ross J.E. (2004): "Principles of Total Quality"; CRC Press, New Delhi. ISBN 1574443267, ISBN-13: 9781574443264 5. Sinha S.K. (1986): "Reliability and Life Testing"; Wiley Eastern Ltd., New Delhi. ISBN 10: 0852267355 ISBN 13: 9780852267356 6. Bazovksy I. (2004): "Reliability Theory and Practice"; Prentice Hall International Series in Engineering. ISBN-10 **0486438678** ISBN-13 **978-0486438672**

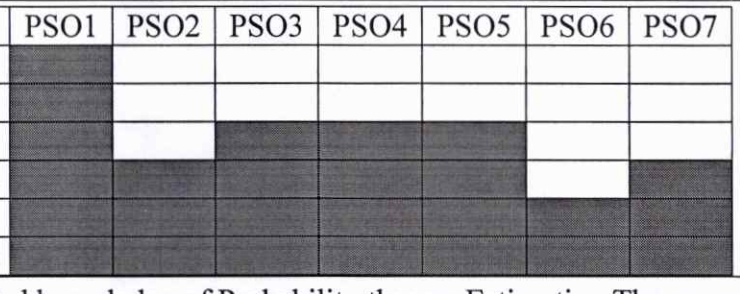
	7. Grant E. L. and Leavenworth R. (2008): "Statistical Quality Control"; Tata Mc Graw Hill Publishing Co. Ltd., New Delhi. ISBN: 0070435553, ISBN-13: 9780070435551 8. Irving W.B. (1979): "Elementary Statistical Quality Control"; Marcel Dekker, Inc., New York. ISBN: 0824766865, 9780824766863 9. Douglas C. Montgomery. (2008): "Introduction to statistical quality control"; 6th edition, ISBN-10 **0470169923**, ISBN-13 **978-0470169926**
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• $\bar{R}$ and $\bar{X}$-chart • np, p, c and u-chart • OC, ATI and AOQ curves • Estimation with complete sample for gamma distribution • Estimation with failure censored sample for exponential distribution • Estimation with complete sample for exponential distribution • Estimation with time censored samples for exponential distribution.

Syllabus Revised by: S. A. Desai

Chairperson: A. J. Rajuaguru

Elective paper

Course-2042: Decision Theory

Course Code	2042
Course Title	Decision Theory
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	To make students understand decision theory based on Bayesian probability i.e., making rational decisions against multiple criteria and testing of hypotheses using data sets which do not have any parametric information.
Course Objective	The main objective of this course is to provide the detailed knowledge of statistical inference under Bayesian framework and Non-Parametric inference.
Course Outcomes	After successful completion of this course, student will be able to: **CO1:** Identifying and dealing with the situations of decision making under risk and uncertainty **CO2:** Understand decision problem, loss function, risk function and decision rules, their admissibility and completeness **CO3:** Use of different decision rules under uncertainty and risk. **CO4:** Obtaining best decision rules using different types of prior, posterior distributions and loss functions **CO5:** Understand the applicability of different nonparametric statistical tests for one, two (paired as well as unpaired) and more than two populations. **CO6:** Solve hypothesis testing problems where the conditions for the traditional parametric inferential techniques are not fulfilled.
Mapping between COs with PSOs	
Pre-requisite	Detailed knowledge of Probability theory, Estimation Theory and Probability distribution.
Course Content	**UNIT I:** • **Review of basic elements of statistical decision problem:** Various inference problems viewed as decision problems. **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. Gibbons J.D. & Subhabrata Chakraborti (2003): "Nonparametric Statistical Inference"; McGraw Hills. ISBN: 0-8247-4052-1 3. Ferguson T.S. (1997): "Mathematical Statistics"; Academic Press. ISBN 0122537505, 9780122537509 4. Kendall M.G. and Stuart A. (1961): "The Advanced Theory of Statistics"; Vol. 2., Ed. IV, Charles and Griffin.ISBN 10: 0470233818ISBN 13: 9780470233818 5. 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 6. Sedney Seigal &N. John Castellan Jr (1988): "Nonparametric Statistics for Behavioural Sciences"; 2ed edition, McGraw Hill.ISBN-10**0070573573**, ISBN-13**978-0070573574** 7. Gibbons J.D. and Pratt J.W. (1982): "Concepts of Nonparametric Theory"; 1981st edition, Springer-Verlag. **ISBN-10:**0387905820**ISBN-13:**978-0387905822 8. Daniel W.W. (1990): "Applied Nonparametric Statistics"; 2ed edition, PWS-KENT publishing Co., Boston. ISBN: 0534919766 9. Conover W.J. (1999): "Practical Nonparametric"; 3rd edition, John Wiley & Sons Inc.**ISBN-10:**0471160687, **ISBN-13:**9780471160687 10. Wald A. (1947): "Sequential Analysis"; John Wiley & Sons

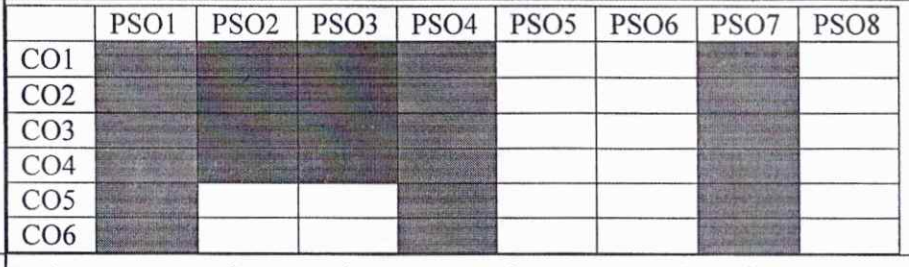
	IncISBN-10:0471918067, ISBN-13:978-0471918066 11. Hettmansperger, T.P. (1984). Statistical inference Based on Ranks, Wiley–Blackwell, ISBN-10: 047188474X, ISBN-13: 978-0471884743 12. Randles, R.H. and Wolfe, D.A. (1991): "Introduction to the Theory of Nonparametric Statistics"; New edition, Krieger Publishing Company;ISBN-10:0894645439, ISBN-13:978-0894645433 13. 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
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• Decision making under uncertainty-I • Decision making under uncertainty-II • Bayesian Decision rule-Posterior analysis • Decision Tree

Syllabus revised by: (1) A. J. Rajyaguru (2) Rakesh S. Srivastava

Chairperson: A. J. Rajyaguru

Elective paper

Course-2043: Actuarial Statistics

Course Code	2043
Course Title	Actuarial Statistics
Credit	4
Teaching per Week	4
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of this course is to learn the life tables used in insurance products • To learn the concept of interest ,different life insurance products, life annuities, net premiums. • To motivate students to prepare for exams required for employment in the actuarial science profession.
Course Objective	To make students acquainted with actuarial science and implementation Of statistics in actuarial science
Course Outcomes	After completing this course, students will be able to: CO1:Understand the utility theory, insurance products and life tables. CO2:Understand the concept of interest. CO3:Understand the concept of life insurance and the existing insurance products of different insurance company. CO4:Know life annuities, net premium and net premium reserves. CO5:Understand the concept of Stationary population and various models
Mapping between Cos with PSOs	
Pre-requisite	Basics concepts of actuarial statistics and insurance policy planning
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 asset 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. 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)
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination
List of Practical	• Life Table-I • Life Table-II • Gompertz Law • Interest Theory

Syllabus revised by: (1) S. R. Sheikh (2) J. J. Pandey

Suggestions through e-mail

Chairperson: **A. J. Rajyaguru**

Elective paper

Course: 2044: DATA BASE MANAGEMENT SYSTEMS

Course Code	**2044**
Course Title	**DATA BASE MANAGEMENT SYSTEMS**
Credit	4
Teaching per Week	4Hrs
Minimum weeks per Semester	15(Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of the course is to prepare the students to be capable of doing any kind of data management that will further help them to perform various activity of data science. The core objective of this course is to identify different database systems, their model sand to perform various data management task such as retrievation, insertion and Renovation of data using its tool.
Course Objective	To make students familiar with data base management theory and give Practical exposure to manage at a using Query language.
Course Outcomes	After completing this course, students will be able to: CO1: Understand and apply the concept of data base management system by comparing them with traditional data management techniques CO2: Perform data definition, data manipulation, data control and transaction control using Query language CO3: Learn fundamental data models and its application in real world domain. CO4: Extend the procedural structural query language using various Concept such as Procedures, Functions, Cursor and Triggers
Mapping between COs With PSOs	
Pre-requisite	Fundamental of computer programming
Course Content	**UNIT I:** • 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

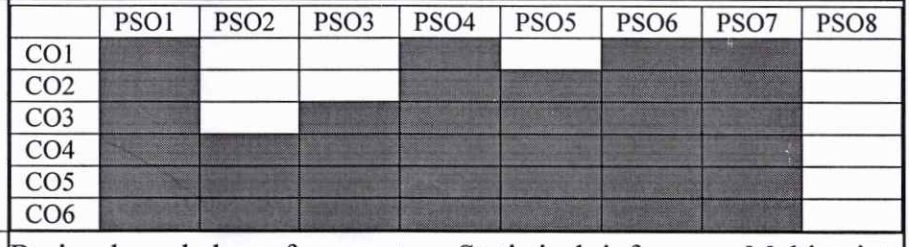
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■			■		■	
CO2	■	■	■	■		■	
CO3			■	■	■	■	
CO4						■	

	UNIT II: • Data base System ➢ Data base Structure ➢ Levels of abstraction in DBMS ➢ View of data ➢ Role of Data base users and administrators ➢ Data base Structure: DDL, DML, DCL, TCL **UNITIII:** • Types of Data Models ➢ Hierarchical data bases ➢ Network data bases ➢ Relational data bases ➢ Object oriented data bases **UNITIV:** ➢ Stored Procedure ➢ PL/SQL ➢ Concepts Procedure, Functions, Cursors, Triggers
Reference Books	1. C.J. Date-Narosa (1999): "An Introduction to Data base 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 Data base System"; 3rd edition, Galgotia Pub. ISBN-10 **8175155450** ISBN-13 **978-8175155459** 4. Bipin C. Desai. (2010): "Introduction to data base system"; revised edition, Galgotia pub. ISBN-10 **8175156171** ISBN-13 **978-8175156173** 5. Fundamentals of Data base System-Elmasri Navathe, 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 Data based 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
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70%ExternalbasedonsemesterendUniversityexamination

Syllabus Revised by: (1) T R Ghadiyali (2) Kishor Atkotiya

Chairperson: A. J. Rajuaguru

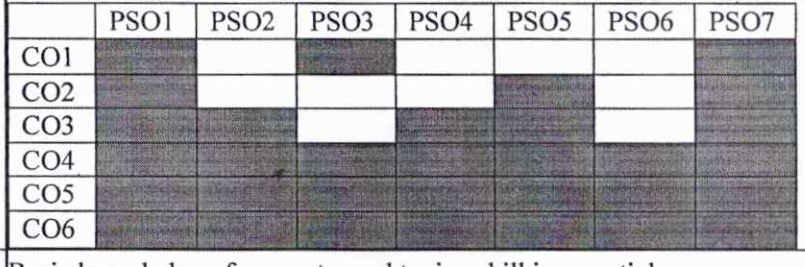
M. Sc. Applied Statistics 2nd Semester
Course-205: Practical paper-II

Course Code	205
Course Title	Practical paper-II
Credit	6
Teaching per Week	12
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of this course is to enrich the computing power of students using MS office tools Excel and C language.
Course Objective	Learning analysis of various kinds of data using excel will help the students to understand how to go around with the computing part of some of the theoretical aspects.
Course Outcomes	After successful completion of this course, student will be able to: CO1: Solve Decision related real life problems using decision criteria, can solve life-table related problems. CO2: Perform the analysis with analysis tool pack in excel and generate/draw Quality control charts in excel. CO3: Understand and apply various functions available in excel. CO4: Estimate parameters using formula in excel by different methods CO5: Solve problem related multivariate data with use of excel CO6: Apply parametric tests to solve real life problem using excel and
Mapping between COs with PSOs	
Pre-requisite	Basics knowledge of computer, Statistical inference, Multivariate technique, Decision rules and Actuarial Statistics
Course Content	Based on theory paper 201 to 204
Reference Books	Reference book mention in theory paper 201 to 204
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test,quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Chairperson: **A. J. Rajyaguru**

Skill Based Course

Course-206: Computer Programming Language- "C"

Course Code	206
Course Title	Computer Programming Language – "C"
Credit	2
Teaching per Week	2
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holidays etc.)
Effective From	2023-24
Purpose of Course	The purpose of the course is to make the student capable of implementing the concepts, methods, and debugging tools of Programming and learn their implementation.
Course Objective	To make students acquainted with knowledge of programming using C language.
Course Outcomes	After completing this course, students will be able to: CO1: Understand the basic concepts and fundamentals of programming such as algorithm and flowchart. CO2: Understand the basic C fundamentals such as data types, operators etc. CO3: Design programs involving control statements such as conditional and unconditional statements. CO4: Implement advanced programming approach such as modular programming along with parameter passing techniques. CO5: Understand the concept of different data structures such as array, structure and union. CO6:Developthe programs that deal with various operations on data files.
Mapping between COs with PSOs	
Pre-requisite	Basic knowledge of computer and typing skill is essential.
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. 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 Bala Guruswamy (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.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

Syllabus Revised by: (1) B.C. Patel (2) N. R. Patel

Chairperson: A. J. Rajuaguru