DEPARTMENT OF STATISTICS

COURSE: M.Sc. STATISTICS

(CHOISE-BASED CREDIT SYSTEM)

VIKRAMA SIMHAPURI UNIVERSITY: NELLORE
DEPARTMENT OF STATISTICS
COURSE: M.Sc. STATISTICS
(Syllabus common for VS University College and affiliated by VSU area)
(Revised Scheme of Instruction, Course Pattern, Examination, and Syllabus etc., with effect from theAcademic Year 2020-21 for M.Sc. I, II, III and IV Semesters)

VIKRAMA SIMHAPURI UNIVERSITY::NELLORE
DEPARTMENT OF STATISTICS

Syllabus for M.A. Statistics (2 Year Course) for V.S. University Constituent College(s) and Affiliated Colleges under the jurisdiction of Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021

VISION AND MISSION OF THE DEPARTMENT

Vision

To enable and empower the women students - especially from the weaker sections of society with a rural background, with hard and soft skills and human values that contribute for the acquisition and development of a good career and multidimensional empowerment.

Mission

To provide education that embraces current and inclusive fields through which the needs of all the sections of the society can be addressed. To enhance quality through innovations in the curriculum by offering need-based courses. To promote research environment and further the prospects of transforming the college into a university. To impart and develop their soft skills and employability skills for better life. To inculcate human values among the students. To propagate the rich tradition and culture of India for the promotion of National Integration. To empower them with competencies in economic, social, psychological, legal and political arena. To employ innovative methods of Teaching – Learning and Evaluation. To encourage teachers to undertake research and consultancy. To create environmental consciousness among the students. To encourage participation in community development programs.

Curriculum Development

As the College is conferred with Autonomy Board of Studies meetings were organized and Curriculum was modified to some extent. The suggestions and ideas obtained from various bodies is thoroughlydiscussed by the experts in the Academic Council and carefully incorporated in the curriculum.

Eligibility

B.Sc. degree in Statistics or Mathematics with Statistics as a minor subject with a minimum 55% of marks.

Duration of the Course

The course duration shall normally be of two years duration spread over four semesters.

Intake

A total of 44 seats are available for the M.Sc.Program in Statistics

Medium

The medium of instruction shall be English.

Choice Based Credit System (CBCS)

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The M.Sc. Statistics program is offered through a unique CBCS. The salient features of the CBCS are that the program is offered through credit-based courses.

Weightage of marks

The weightage of marks for continuous internal assessment (CIA) and end semester examinations shall be 30 and 70 respectively. A student is declared passed in a given subject when he/she secures a minimum of 40% in the end semester examination in that subject.

Board Of Studies

1. Prof.K. Rosaiah - Chairman, BOS, Acharya Nagarjuna University, Guntur
2. Head, Department of Statistics, Ex-Officio Member, V.S. University, Nellore
3. Prof.A. Vasudeva Rao Member, Acharya Nagarjuna University, Guntur
4. Prof.P. Mohammad Akhtar, Member, S.K. University, Anantapur
5. Prof.B. Muni Swamy Member, Andhra University, Visakhapatnam
6. Dr.S. Yadavendra Babu, Industry Expert, Ford Motors Pvt Ltd, Chennai
7. A. Vasantha Komali, student, V.S. University, Nellore

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COURSE STRUCTURE:

S. No.	Course code	Course/Subject	No. of credits	Internal Marks	External Marks	Total
Semester – I						
1	20RMSCST101	Probability Theory-I	4	30	70	100
2	20RMSCST102	Linear Models and Applied Regression Analysis	4	30	70	100
3	20RMSCST103	Theory of Estimation	4	30	70	100
4	20RMSCST104	Distribution Theory	4	30	70	100
5	20RMSCST105	Statistical Computing	4	30	70	100
6	20RMSCST106	Practical –I	4	-	-	100
Semester – II						
1	20RMSCST201	Statistical Inference	4	30	70	100
2	20RMSCST202	Multivariate Analysis	4	30	70	100
3	20RMSCST203	Probability Theory - II	4	30	70	100
4	20RMSCST204	Stochastic Processes	4	30	70	100
5	20RMSCST205	Sampling Techniques	4	30	70	100
6	20RMSCST206	Practical-II	4	-	-	100
SEMESTER - III						
1	20RMSCST301	Econometrics	4	30	70	100

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2	20RMSCST302	Design of Experiments	4	30	70	100
3	20RMSCST303	Reliability	4	30	70	100
4	20RMSCST304	Operations Research-I	4	30	70	100
5	20RMSCST305	Demography and Official Statistics	4	30	70	100
6	20RMSCST306	Practical – III	4	-	-	100
1	20RMSCST401	Time Series Analysis and Forecasting Methods	4	30	70	100
2	20RMSCST402	R Programming and Data Analysis	4	30	70	100
3	20RMSCST403	Bio-Statistics	4	30	70	100
4	20RMSCST404	Operations Research - II	4	30	70	100
5	20RMSCST405	(a) Statistical Process and Quality Control	4	30	70	100
6	20RMSCST406	(b) Statistics for Research, Industry and Community Development	4	30	70	100

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Program Educational Objectives -M.Sc. (Statistics)

1. Students will learn statistical methods and applications in real-world settings.
2. Students will understand techniques required for managing data in the workplace environment with the help of well-equipped modern facilities available at the campus.
3. The course emphasizes the Development of computational and analytical skills of a student.
4. The "Industry Interface Program" has been initiated to keep the students abreast of the latest industry/research organizations' latest trends through industrial visits and guest lectures.
5. The curricular and extra-curricular activities are conducted for the overall development of students
6. Get employment in government, public, private, industrial, health, business, banking, agricultural and educational sectors
7. Expand their knowledge to set their career in research and higher studies
8. Comprehend the statistical concepts and principles for interdisciplinary research
9. Acquire proficiency in adopting statistical software for data analysis

ProgramOutcomes - M.Sc. (Statistics)

On successful completion of the Course a student will be able to:

PO1 - Computational Knowledge: Understand and apply mathematical foundation, computing and domain knowledge for the conceptualization of computing models from defined problems.

PO2 - Problem Analysis: Ability to identify, critically analyse and formulate complex computing problems using fundamentals of computer science and application domains.

PO3 - Design / Development of Solutions: Ability to transform complex business scenarios and contemporary issues into problems, investigate, understand and propose integrated solutions using emerging technologies

PO4 - Conduct Investigations of Complex Computing Problems: Ability to devise and conduct experiments, interpret data and provide well informed conclusions.

PO5 - Modern Tool Usage: Ability to select modern computing tools, skills and techniques necessary for innovative software solutions

PO6 – Environment and Sustainability: Understanding the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO7 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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PO8 - Individual & Team Work: Ability to work as a member or leader in diverse teams in multidisciplinary environment.

PO9 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO10– Life-Long Learning: Ability to recognize economic, environmental, social, health, legal, ethical issues involved in the use of computer technology and other consequential responsibilities relevant to professional practice.

Program Specific Outcomes

PS01:Domain Specific Knowledge: The students are expected to understand the principles, concepts and recentdevelopments in the Statistics.

PS02: Problem Solving Skills: To enhance student sense of enthusiasm for Statisticsand to involve them in an intellectually stimulating experience of learning in a supportive environment.

PS03: Software Product Development: The practical course is framed in relevance with the theory courses to improve theunderstanding of the various concepts in Statistics.

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	I
COURSE CODE & TITLE	20RMSCST101: **PROBABILITY THEORY– I**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To discuss about classes of sets and Probability measures 2. To discuss on random variables and convergence in probability and the important theorems 3. To discuss about Conditional Probability and Decomposition of Distribution Functions 4. To discuss about Convergence theorem for Expectation		

UNIT	CONTENT	NO. OF HOURS
I	Algebra of sets Fields Sigma field's Inverse function Measurable function Random Variables Induced Sigma Fields Limits of Random variables.	15
II	Probability Definition Simple Properties Discrete Probability Space General Probability Space Induced Probability Space Conditional Probability - Distribution Function of a Random Variable Decomposition of distribution functions Distribution function of random vectors.	15
III	Expectation and moments Definition and properties Moment Generating Function. Convergence: Modes of convergence Convergence in probability Convergence in distribution Convergence in rth mean Almost sure convergence and their interrelationships.	15
IV	Convergence theorem for expectation: Monotone Convergence theorem Fatou s theorem Dominated Convergence theorem - Definition of product space Fubini s Theorem (statement only) - Independence: Definition Multiplication properties Zero-one law.	15

REFERENCES	1. Ash, R.B (1972): Real Analysis and Probability, Academic Press. 2. Burril,C.W (1972): Measure, Integration and. Probability, Mc Graw Hill International. 3. Chow, Y.S and Teicher, H (1979): Probability Theory, Springer, Narosa. 4. Loeve, M (1985):Probability Theory, 3/e, Von Nostrand.		
COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Students understand and learn how to apply algebra of sets	
	CO2	Student able to understand the Decomposition of distribution functions Distribution function of random vectors.	
	CO3	Student able to understand the Convergence in probability	

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	CO4	Student able to understand the Dominated Convergence theorem	

COs – POs MAPPING

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	2	2	3	2	2	1	2	2
CO2	3	2	2	2	3	2	2	2	3	3	2	3	2
CO3	2	2	2	3	3	2	2	3	2	2	3	2	2
CO4	3	3	2	2	3	2	2	2	3	2	2	2	2
Low:1, Medium:2, High:3													

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	I
COURSE CODE & TITLE	20RMSCST102: **LINEAR MODELS AND APPLIED REGRESSION ANALYSIS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To discuss about linear regression models and their assumptions 2. To study about different criteria for model selection and their Goodness of fit measures 3. To explain Non normal disturbances and their consequences and statistical analysis of residuals 4. To discuss about Non-linear regression estimation methods		

UNIT	CONTENT	NO. OF HOURS
I	Two and Three Variable Linear Regression Models; General Linear Model:Assumptions; OLS Estimation; BLUE; Tests of Significance of Individual Regression Coefficients; Testing the Equality Between Two Regressions Coefficients; Test of Significance of Complete Regression.	15
II	Criteria for Model Selection; Goodness of Fit Measures; R^2 and Adjusted R^2 Criteria; C_p Criterion; Testing the General Linear Hypothesis; Chow Test for Equality between Sets of Regression Coefficients in Two Linear Models; Test for Structural Change; Restricted Least Squares Estimation; Generalized Mean Squared Error Criterion.	15
III	Non-Normal Disturbances and their Consequences; Test for Normality; Jarque-BeraTest; Shapiro-Wilk Test, Minimum Absolute Deviation (MAD) Estimation; Box-Cox Transformations.	15
IV	Non-Linear Regression; Non-Linear Least Squares Estimation; Maximum Likelihood Estimation; Idea of Computational Methods; Gradient Methods, Steepest Descent Method; Testing General Nonlinear Hypothesis; Wald Test, Lagrange Multiplier Test and Likelihood Ratio Test.	15

REFERENCES

1. Draper, N and Smith, B (1981): Applied Regression Analysis, Second Edition.
2. Guajarati, D (1979): Basic Econometrics, MC Graw Hill.
3. Johnston, J (1984): Econometric Methods, III rd edition. MC Graw Hill.
4. Judge, C.G., Griffiths, R.C. Hill, W.E., Lutkephol, H and Lee, T.C (1985): The Theory and Practice of Econometrics, John Wiley and Sons.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**

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	CO1	Students learnt about different linear and non-linear regression models and their appropriate computational procedures	
	CO2	Student understand R^2, Adjusted R^2 and C_p criteria for model selection	
	CO3	Student able to understand the Non-Normal Disturbances and know how to test for Normality	
	CO4	Student know about Non-Linear Regression,Wald Test, Lagrange Multiplier Test and Likelihood Ratio Test	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	2	2	2	3	2	1	3	2
CO2	2	2	3	2	3	2	3	3	3	2	2	2	2
CO3	2	2	2	3	2	2	3	3	3	1	2	2	2
CO4	3	2	2	2	3	2	2	3	3	1	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	I
COURSE CODE & TITLE	20RMSCST103: **THEORY OF ESTIMATION**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To discuss about a procedure of "guessing" properties of the population from which data are collected 2. To determine the approximate value of a Population Parameter on the basis of a Sample Statistic To discuss about different estimation methods		

UNIT	CONTENT	NO. OF HOURS
I	Point estimation- properties of estimates -Consistency and its different forms -Sufficient condition for consistency - Factorization theorem – Sufficient Statistic - Distributions admitting sufficient statistic, procedure for finding minimal sufficient statistic.	15
II	The information measure Cramer - Rao (CR) inequality - Kiefer Chapman - Robbins (KCR) inequality - Bhattacharya inequality - minimum variance bound estimator- Invariant (equivariant) estimators (concepts only)	15
III	Uniformly minimum variance unbiased estimators (UMVUE)- condition for the existence of UMVUE- Completeness and Bounded completeness- Relation between complete statistic and minimal sufficient statistic- Rao - Blackwell Theorem- Lehmann Scheffe s theorem.	15
IV	Methods of estimation method of moments- method of maximum likelihood and its properties-large sample properties of MLE - Method of minimum chi- square and its properties Methods of least squares Optimum properties of least square estimates in linear model.	15

REFERENCES

1. Goon, A.M, Gupta,M.K, and Das Gupta, B.C(1980) : An outline of Statistical Theory, Vol. II,The World Press, Calcutta.
2. Lehmann, E.L(1983) : Theory of Point Estimation, Wiley Eastern Ltd, 1983.
3. Mood, A.M., Graybill, F.A and Boers, D.C(1974) : Introduction to Theory of Statistics, Mc Graw-Hill Book Company.
4. Rao, C.R(1998): Linear Statistical Inference and its Applications, Wiley Eastern Ltd,.
5. Casella, G and Berger, R.L(2002):Statistical Inference , Duxubury Process, Belmont, USA.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Students must familiar with Point Estimation	

	CO2	Cramer - Rao Inequality	
	CO3	Uniformly minimum variance unbiased estimators	
	CO4	Methods of Estimation - Method of Moments	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	3	2	2	2	3	1	2	2
CO2	2	2	2	3	2	2	3	2	1	3	2	2	2
CO3	2	2	2	3	2	2	3	2	2	2	2	2	2
CO4	3	2	3	3	2	2	2	3	3	3	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	I
COURSE CODE & TITLE	20RMSCST104: **DISTRIBUTION THEORY**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. Discuss about to find the distributions and properties for various functions of random variables 2. To discuss about Sampling distributions and their inter-relationships 3. To discuss about Properties of order statistics 4. Multiple and Partial Correlation Coefficients		

UNIT	CONTENT	NO. OF HOURS
I	Brief Review of Basic Distribution Theory; Joint, Marginal and Conditional p.m.functions andp.d.functions. Rectangular, Lognormal, Exponential, Gamma, Beta, Cauchy, Laplace and Weibull Distributions; Functions of Random Variables and Their Distributions Using Jacobian Transformations and Other Tools.	15
II	Sampling Distributions: Review of Central Chi Square, t and F Distributions. Relation between t and F, F and χ^2; Fisher's Z-distribution, fisher's Z-transformation.Non-Central Chi Square, t and F Distributions and Their Properties.	15
III	Order Statistics and Their Uses; Joint and Marginal Distributions of Order Statistics:Distribution of Range. Extreme Values and Their Asymptotic Distributions (Statements Only).	15
IV	Multiple and Partial Correlation Coefficients, Multiple Linear Regression, Inter Relationship Among Partial, Multiple Correlation and Regression Coefficients. Null Distributions of Simple, Partial and Multiple Correlation Coefficients. Compound binomial distribution and compound Poisson distribution.	15

REFERENCES

1. ChaudaryB (1983): The Elements of Complex Analysis, Wiley Eastern.
2. Curtiss. I.H (1978): Introduction to the functions of Complex variables, Marcel Dekker
3. David H.A (1981): Order Statistics, II Edition, and John Wiley.
4. Dudewicz E.J and Mishra S.N (1988): Modern Mathematical Statistics, Wiley, International Students Edition.
5. Feller W (1966): Introduction to probability theory and its applications, Vol. III, second edition. Wiley Eastern.
6. Johnson, N.L and Kotz, S.M. (1972): Distributions in Statistics, Vol. I, II & III. Houghton and Miffin.
7. Mukhopadhyay, P (2002), Mathematical Statistics, Books and Allied (p) Ltd., Kolkata.
8. Pitman J. (1993): Probability, Narosa Publishing House.
9. Rao C.R (1973): Linear Statistical Inference and its Applications, 2/e, Wiley Eastern.
10. Rohatgi V.K. (1984): An Introduction to probability theory and mathematical

statistics.

11. Sharma J.N (1996), Functions of Complex Variable, Krishna Prakasam Media, Meerut.
12. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics. Sulthan and Chand Company.
13. Yule, U and M.G. Kendall: An introduction to the theory of Statistics.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
CO1	Students know about discrete and Continuous Probability Distributions	
CO2	They identify the difference between Central and Non-Central Distributions	
CO3	Student Understand how to use non-central distributions in real life problems	
CO4	Student must familiar with Non-Linear Regression, Wald Test, Lagrange Multiplier Test and Likelihood Ratio Test	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	3	3	3	2	1	2	3
CO2	2	2	2	3	2	2	2	3	2	2	2	3	2
CO3	2	2	2	3	2	3	2	3	2	2	2	2	2
CO4	3	2	2	2	3	2	3	2	3	2	3	2	3

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	I
COURSE CODE & TITLE	20RMSCST105: **STATISTICAL COMPUTING**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To learn about MS Word with Creating, Editing and Formatting 2. To study Excel operations to statistical charts, distributions both discrete and continuous, matrix operations like transpose, product and inverse 3. To learn MS-access working with tables and forms entry of queries and their operations, SQL code for queries. 4. To learn about C and writing programs		

UNIT	CONTENT	NO. OF HOURS
I	**MS Office: MS-Word:** Creating, Editing and formatting a document using MS – word, inserting text, Deleting Text, Finding and replacing text, Spell Check, using tabs, Enhancing documents, Columns, tables and other features, Graphics, templates and wizards, Mail merge, Splitting the screen, operating multiple documents, Inserting symbols in a word document, word art.	15
II	**MS-Excel:** Excel work sheet, creating data files in Excel, formatting cells, Sorting, Filtering and Pivot tables. Graphs and Charts, Curve fitting and interpretation of the output. Statistical functions in Excel – Calculating theoretical probabilities using Binomial, Poisson and Normal Distributions. Mathematical functions – Matrix operations - Transpose, Product and Inverse operations using Excel (Stress on operational procedures only).	15
III	**MS Access:** Introduction to databases, creating tables, Updating tables, working with forms, generating reports. **MS power Point:** Power Point window, Creating and saving a presentation, adding graphs, charts and tables, formatting a slide master, using slide transactions, Printing and closing the slides.	15
IV	**Programming in C:** Identifiers and Key words, data types and their declaration. Data input and output, operators and expressions. Control statements, if, if-else, case, go to statements. Loops, while, do-while and for statements. One and two-dimensional arrays. Concept of structures, Unions and pointers. Simple programs.	15

REFERENCES	1.Dennis, P, Curtin, Kim Foley, Kunal Sen, Cathleen Morin (2000), Information Technology, Tata Publishing McGraw-Hill Publishing Ltd. 2. Russel A Stultz (1997), Learn Microsoft Office 97, BPB Publications.

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3.Sarma K.V.S. (2010), Statistics Made Simple Do It Yourself on PC, Prentice Hall.
4.Taxali, R.K (2000), PC Software made simple, Tata Publishing McGraw-Hill

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Students understood about MS-word and how to export data to excel	
	CO2	Student understand about MS-Excel for statistical distributions, charts and matrix operations	
	CO3	Students know MS-Access for tables and forms and their SQL codes	
	CO4	Students wrote programs in C	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	3	3	2	2	1	2	3
CO2	2	2	2	3	2	2	2	3	2	3	2	3	2
CO3	2	2	3	2	3	2	2	2	3	3	2	2	2
CO4	3	2	2	3	2	2	2	3	3	2	2	2	3

Low:1, Medium:2, High:3

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20RMSCST106: Practical – I

Practical exercise of all papers such that there must be at least 4 practical problems on each paper (training is expected on manual practice work and practical work on system using available software). (75 marks for practical examination + 25 marks for Recordin the Semester I).

Course Objectives

1. To write different problems manually solving through calculators
2. To write problems and solving them on computers using Statistical software like Excel and other relevant software

Course Outcomes

1. Student can able to understand and analyse the Numerical problems related to Probability Theory, Distribution Theory, and Statistical Computing etc., are solved by executing programs on computers

Mapping of Course ST-106

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	2	2	3	2	2	2	2

Note: 1 – Low 2 – Medium 3 - High

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Syllabus for M.A. Statistics (2 Year Course) for V.S. University Constituent College(s) and Affiliated Colleges under the jurisdiction of Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021

PROGRAMME	M.Sc. Statistics	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCST201: **STATISTICAL INFERENCE**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. perform the appropriate statistical analyses based on the business question and the type of data; 2. interpret the results of statistical analyses; 3. make inferences about the population from sample data; 4. apply inferential statistics to make evidence-based business decisions.		

UNIT	CONTENT	NO. OF HOURS
I	Point Estimation – Concept of Unbiasedness – Consistency – Minimum Variance Unbiased Estimation – Information In A Sample – Cremer-Rao Inequality – Efficiency Of An Estimator – Bhattacharya Bounds – Definition Of Can Estimator.	15
II	Concept Of Sufficiency – Single Parameter Case – Minimal Sufficient Statistics – Exponential Families – Distribution Admitting Sufficient Statistics – Rao-Blackwell Theorem – Completeness	15
III	Methods Of Estimation – Minimum Variance Method – M.L. Method Of Estimation – For Complete Samples M.L. Estimation For Failure Censored And Time Censored Sample – Interval Estimation – Confidence Interval – Shortest Confidence Interval	15
IV	Elements Of Decision Theory – Loss And Risk Functions And Admissibility – Minimum Decision Rules – Randomized Decision Rules.	15

REFERENCES

1. Kendal And Stuart : Advanced Theory Of Statistics Vol-IiChapt 17,18,20ϖ&24
2. Mood, Grybill And Boes : Introduction To The Theory Of Statistics
3. V.K.Rohatgi : An Introduction To Probability Theory And Mathematical Statistics
4. A.M.Goon, M.Gupta And Das Gupta : An Outline Of Statistical Theory Vol-Ii
5. Kapur And Gupta : Fundamental Of Mathematical Statistics
6. Wilks S.S. : Mathematical Statistics
7. B.K.Kale&Sinha : Reliability &Life Testing, Wiley Eastern, India.
8. B.K.Kale (1999): The First Course On Parametric Inference.
9. Book On Spss For Research Work,Himalaya Publications.

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Apply various estimation and testing procedures to deal with real life problems	
	CO2	Understand Point Estimation, Consistency, Efficiency of an Estimator, Bhattacharya Bounds	

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	CO3	Minimum Variance Method, Interval Estimation	
	CO4	Elements Of Decision Theory, Loss and Risk Functions	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	3	3	2	2	2	1	2	3
CO2	2	2	3	2	2	2	3	2	2	3	2	2	2
CO3	2	3	2	2	3	2	3	2	3	2	3	2	2
CO4	3	2	3	3	2	2	2	2	3	3	2	1	3

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCST202: **MULTIVARIATE ANALYSIS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. The main objective of this course is to introduce students to the analysis of observations on several correlated random variables for a number of individuals. 2. The analysis becomes necessary in Anthropology, Psychology, Biology, Medicine, Education, Agriculture and Economics when one deals with several variables simultaneously. 3. Analyze multivariate data using the different statistical software packages		

UNIT	CONTENT	NO. OF HOURS
I	Multivariate Normal Distribution, Marginal and Conditional Distributions, Characteristics Functions, Maximum Likelihood Estimators of Parameters, Distribution of Sample Mean Vector and Dispersion Matrix, Distribution of Quadratic Forms, Fisher – Cochran Theorem on Ranks of Quadratic Forms (Statement Only) Its Use.	15
II	Hoteling's T^2 and its applications: T^2 Distribution, Application of T^2 to Single Sample and Two Sample, Optimum Properties of T^2 Test. Mahalanobis D^2 Statistic and its Distribution, Multivariate Analysis of Variance (MANOVA) of One and Two-Way Classified Data.	15
III	Classification and Discrimination: Procedures for Classification of Observational Vector into Two Multivariate Normal Populations, Fisher's Discriminant Function, Classification into More Than Two Multivariate Normal Populations, Wishart Distribution and its Properties, Concept of Sample Generalized Variance and its Distribution.	15
IV	Multivariate Linear Regression Model - Estimation of Parameters, Inferences Concerning the Regression Parameters, Likelihood Ratio Test for the Regression Parameters, Canonical Variates and Correlations, Concept of Principal Components and their Estimates.	15

REFERENCES

1. Anderson, T.W (1983), An introduction to Multivariate Statistical Analysis, Wiley, 2nd Edition.
2. Johnson A.R and Wishern, D.W (1996), Applied Multivariate Statistical Analysis, Prentice Hall of India
3. K.C. Bhuyan (2005): Multivariate Analysis and its Applications, CentralBook Agency (P) Ltd, Kolkata.
4. Morrison, F (1985): Multivariate Statistical Methods, Mc Graw Hill Book Company.
5. Ksheera Sagar, A.M (1972), Multivariate Analysis, Marcel Dekker.
6. Rao, C.R (1973), Linear Statistical Inference and its applications, 2nd edition, Wiley.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Student understand account for important theorems	

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		and concepts in multivariate analysis	
	CO2	Student can Summarize and interpret multivariate data	
	CO3	Student can able to conduct statistical inference about multivariate means including hypothesis testing, confidence region calculation, etc.	
	CO4	Student can understand the link between multivariate regression techniques and corresponding univariate techniques	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	1	3	3	2	2	2	3	2	3	2	1
CO2	2	2	2	3	3	2	2	2	3	2	2	3	2
CO3	2	2	3	2	2	3	3	2	2	3	1	2	2
CO4	2	1	3	3	2	2	2	3	3	2	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCST203: **PROBABILITY THEORY - II**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. The objective of the course is to impart necessary knowledge about theoretical aspects of two and multidimensional random variables and their distributions. 2. The course is also oriented towards the formulation of probability distributions and densities with their practical applications. 3. The course also introduces central and non-central distributions and distributions of quadratic forms.		

UNIT	CONTENT	NO. OF HOURS
I	Characteristic function - Definition and properties Inversion formula and its application Characteristic Function and Moments Bochner s theorem (statement only) Simple problems. Weak and complete convergence of distribution functions Helly's First and Second limit theorems	15
II	Law of large numbers: Kolmogrov Inequality Weak law of large numbers (Khinchin s and Kolmogrov) - Kolmogrov Strong law of large numbers Glinvenko-Cantelli Theorem (statement only)	15
III	Central Limit Theorem :iid case Lindeberg-Levy and Liapounov s form - Lindeberg - Feller form Infinitely Divisible distributions definition, elementary properties and examples canonical representation (without proof)	15
IV	Conditioning: Radon Nikodym theorem and derivative (without proof) - Conditional expectation definition properties (probability and expectation properties) - conditional probability and its applications Definition and properties of Martingales and Sub-martingales Martingale convergence theorem	15

REFERENCES	1. Ash, R.B (1972) : Real Analysis and Probability, Academic Press . 2. Billingsley .P.(1979): Probability and Measure , Wiley . 3. Kingman and Taylor (1966) : Probability Theory , Narosa. 4. Tucker. H.G. (1967) : A Graduate course in probability , Academic Press . 5.Loeve. M.(1985) : Probability theory , 3/e, Von Nostrand . 6. Burrill, C.W. (1972): Measure, Integration and Probability, Mc Graw Hill		
COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	To discuss about Characteristic functions and related theorems	
	CO2	To discuss on weak law of large numbers and Strong law of large numbers	
	CO3	To discuss about Central Limit Theorem	

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	CO4	To discuss about Martingales and Sub-martingales Martingale convergence theorem	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	3	2	2	2	3	2	2	2	2	3
CO2	1	2	3	2	3	2	2	2	1	3	1	2	2
CO3	1	2	2	3	2	2	2	3	2	2	3	2	2
CO4	2	3	2	3	2	2	3	2	2	3	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCST204: **STOCHASTIC PROCESSES**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To explain stochastic process and their classification according to space and domain 2. To discuss about Birth and death process, Renewal theory and its applications, stochastic process and their importance, Markov chains, Poisson process, Renewal theory, Branching process etc.		

UNIT	CONTENT	NO. OF HOURS
I	Introduction to Stochastic Processes (SP's): Classification of SP's according to State Space and Time Domain. Countable State Markov Chains (MC's), Chapman – Kolmogorov Equations, Calculation of n – Step Transition Probability and its Limit. Stationary Distribution, Classification of States, Transient MC, Random Walk and Gambler's Ruin Problem.	15
II	Discrete State Space Continuous Time MC: Kolmogorov – Feller Differential Equations, Poisson Process, Birth and Death Process; Applications to Queues and Storage Problems. Wiener Process as a Limit of Random walk, First– Passage Time and Other Problems.	15
III	Renwal Theory: Elementary Renewal Theorem and Applications. Statement and Uses of Key Renewal Theorem, Study of Residual Life Time Process: Weakly Stationary and Strongly Stationary Process; Moving Averages and Auto Regressive Process.	15
IV	Branching Process: Galton – Watson Branching Process, Probability of Ultimate Extinction, Distribution of Population Size. Martingale in Discrete Time, Inequality, Convergence and Smoothing Properties. Statistical Inference in MC and Markov Process.	15

REFERENCES	1.Adke, S.R and Manjunath, S.M (1984): An Introduction to Finite Markov Processes, Wiley 2.Bhat, B.R (2000): stochastic Models: Analysis and Applications, New Age International, 3.Cinlar, E (1975): Introduction to Stochastic Processes, Prentice Hall. 4.Feller, W (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern. 5.Harris, T.E (1963): The Theory of Branching Processes, Springer – Verlag.		
COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Students understood stochastic processes	
	CO2	Students understood discrete state space	
	CO3	Students understood concept of renewal theory	
	CO4	Students understood the concepts of branching	

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process

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	2	2	2	2	2	1	3	2
CO2	2	2	3	2	2	3	2	3	2	2	2	3	2
CO3	2	2	3	2	3	2	3	2	2	2	3	2	2
CO4	3	2	2	3	2	2	2	2	2	1	2	2	3

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCST205: **SAMPLING TECHNIQUES**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. Discuss about basic concepts of sampling techniques PPS WR/WOR models 2. To study about Hurwitz Thompson estimator, PPS scheme 3. To learn about Ratio and Regression methods and their properties 4. To explain Double sampling for difference estimators using ratio regression and PPS's, Non- sampling error and their remedies		

UNIT	CONTENT	NO. OF HOURS
I	Review of basic concepts of sampling theory such as sampling design, sampling scheme, sampling strategy etc., Sampling with varying probability with and without replacement, PPS WR/WOR methods – Lahiri's sample scheme, Hansen – Hurwitz, Des Raj estimators for a general sample size and Murthy estimator for a sample of size 2, Symmentrized Des Raj estimator.	15
II	Hurwitz – Thompson estimator (HTE) of a finite population total / mean, expression for V(HTE) and its unbiased estimator. IPPS scheme of a sampling due to Midzuno – Sen and JNK Rao (sample size 2 only). Rao – Hartley-Cochran sampling scheme for a sample of size n with random grouping.	15
III	Ratio and Regression methods of estimation, two stage sampling, Multi stage sampling, Cluster sampling. Resampling methods and its applications.	15
IV	Double sampling for difference, ratio, regression and PPS estimators; Large scale sample surveys, Errors in surveys, A mathematical model for errors of measurement, Sampling and Non-sampling errors, Sources and types of non-sampling errors, Remedies for non-sampling errors.	15

REFERENCES

1. Chaudhuri. A and Mukherjee. R (1988): Randomized Response Theory and Techniques,
New York, Marcel Dekker Inc.
2. Cochran W.G (1988): Sampling Techniques III Edition (1977) Wiley.
3. Des Raj and Chandak (1988): Sampling Theory. Narosa.
4. Murthy M.N (1977): Sampling Theory and Methods. Statistical Publishing Society.
5. Sukhatme et al (1984): Sampling Theory of Surveys with Applications. Iowa State
University Press &IARS
6. Mukhopadhyay P (1996): Inferential problems in Survey Sampling. New

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	Age International.		
COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Students learnt different sampling techniques of with replacement/ without replacement and Different sampling models	
	CO2	Students studied different sampling schemes and estimators	
	CO3	Student able to familiar with Two stage sampling and Multi stage sampling	
	CO4	Student learn about difference between sampling and non-sampling errors	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	3	2	1	2	3
CO2	2	2	2	3	2	2	3	2	3	2	3	2	2
CO3	2	2	2	2	2	2	2	2	3	3	2	2	2
CO4	3	2	2	2	3	3	2	3	2	3	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	II
COURSE CODE & TITLE	20RMSCST206: **PRACTICAL – II**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	Practical exercise of all papers such that there must be at least 4 practical problems on each paper (training is expected on manual practice work and practical work on system using available software). (75 marks for practical examination + 25 marks for Record in the Semester II).		

UNIT	CONTENT	NO. OF HOURS
I	PRACTICAL – II	15
II	PRACTICAL – II	15
III	PRACTICAL – II	15
IV	PRACTICAL – II	15

REFERENCES

1. Chaudhuri. A and Mukherjee. R (1988): Randomized Response Theory and Techniques,
New York, Marcel Dekker Inc.
2. Cochran W.G (1988): Sampling Techniques III Edition (1977) Wiley.
3. Des Raj and Chandak (1988): Sampling Theory. Narosa.
4. Murthy M.N (1977): Sampling Theory and Methods. Statistical Publishing Society.
5. Sukhatme et al (1984): Sampling Theory of Surveys with Applications. Iowa State
University Press &IARS
6. Mukhopadhyay P (1996): Inferential problems in Survey Sampling. New Age
International.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Students know about the solving of Numerical problems related to semester –II	
	CO2 To exercise different practical problems manually through calculators	
	CO3 To discuss problems relates to semester - II papers.	
	CO4 -	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	3	2	3	2	2	3	2	2
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-

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		CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	
		CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Low:1, Medium:2, High:3														

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCST301: **ECONOMETRICS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To explain about heteroscedasticity, multicollinearity and their sources, consequences and tests 2. To discuss about Autocorrelation, different orders of Autocorrelation and their estimation procedures 3. To explain different lag models and their estimate procedures 4. To discuss about simultaneous linear equations model and their different methods and estimation		

UNIT	CONTENT	NO. OF HOURS
I	Quick Review of Inference in General Linear Model; **Multicollinearity:** Sources and Consequences, Detection, Farrar-Glauber Test; Remedies, Ridge Family of Estimators and its Properties; **Heteroscedasticity:** Sources and Consequences; Tests for Heteroscedasticity; Glejser's Test Goldfeld-Quandt Test; Remedies, Estimation Under Heteroscedasticity.	15
II	Sources and Consequences; First Order Auto Regressive Scheme; Durbin-Watson Test; Remedies; Estimation Under Autocorrelation; Stochastic Regressors; Errors-in-Variables Linear Model; IV and ML Estimation Methods.	15
III	**Finite Distributed lag models;** Arithmetic Lag; Inverted V-Lag; Almon'sPolynomial Lag and Shiller's Lag Models; **Infinite Distributed Lag Models;** Geometric Lag Model; OLS and IV Methods of Estimation; Koyck's Two Step and Wallis Three Step Procedures; Pascal Lag Model.	15
IV	**Simultaneous Linear Equations Models:** Identification; Rank and Order Conditions; Indirect Least Squares, IV and LIML Methods; Two Stage Least Squares; k-Class Estimators; Three Stage Least Squares and FIML Methods of Estimation.	15

REFERENCES	1. Guajarati, D (1979): Basic Econometrics, Mc Graw hill. 2. Intrilligator, M.D (1980): Econometric Models, Techniques and Applications, Prentice Hall. 3. Johnston, J (1984): Econometric Methods, III rd Edition, MC Graw Hill. 4. Judge, C.G., Griffith, W.E., Hill, R.C.,Lutkepohl, H., and Lee. T. (1985): Theory and Practice of Econometrics, John Wiley.	
COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Students learnt heteroscedasticity and	

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		multicollinearity and their estimation procedures	
	CO2	Students learnt autocorrelation and their estimation procedures	
	CO3	Students able to understand and learn how to use different lag models	
	CO4	Students understood about simultaneous linear equations model with their estimation methods	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	3	2	1	3	2
CO2	2	2	2	3	2	2	2	2	3	2	3	2	2
CO3	2	2	3	2	2	2	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	3	2	3	2	3	2	3

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCST302: **DESIGN OF EXPERIMENTS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. Theory of probability and statistics will be explained with regards to this course 2. The effect of more than one factor will be explained by ANOVA method 3. To calculate factor levels that optimizes the outcome of an experiment 4. To learn the factorial design of experiments 5. Regression model for factorial analysis will be developed		

UNIT	CONTENT	NO. OF HOURS
I	Linear Model; Estimability of Linear Parametric Functions; BLUE, Gauss-Markoff Theorem; Generalized Gauss-Markoff Theorem, ANOVA Model, ANOVA for Two Way and Three-Way Classifications, ANCOVA Technique for One Way and Two-Way Classifications.	15
II	Latin Squares and Their Construction, Mutually Orthogonal Latin Squares; Missing Plot Technique in Latin Square Design, Graeco-Latin Square Design; Analysis of Factorial Experiments Involving Factors with Two and Three Levels in Randomized Blocks.	15
III	Necessity of Confounding, Types of Confounding, Complete and Partial Confounding in 2^n, 3^2 and 3^3 Factorial Designs, Analysis of Confounded Factorial Designs; Fractional Replication, Split Plot Design.	15
IV	Incomplete Block Designs; BIBD, Analysis of a BIBD, Types of BIBD, Construction of BIBD's using Mutually Orthogonal Latin Square, Youden Square, Two – Associate PBIB design, Analysis of PBIBD; Concept of Lattice Design.	15

REFERENCES

1. Angela Dean and Daniel Ross (1999), Design and Analysis of Experiments, Springer-Verlag.
2. Aloke Day (1986), Theory of Block Designs, Wiley Eastern, Pvt. Ltd., New Delhi.
3. C.D. Montgomery (1976), Design and Analysis of Experiments, Wiley & Sons, New York
4. D.D. Joshi (1987), Linear Estimation and Design of Experiments, Wiley Eastern, Pvt. Ltd., New Delhi.
5. D.Raghava Rao (1971), Construction and combinatorial problems in Design of

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Experiments, Wiley & Sons
6. F. Pukelshiem (1993), Optimal Design of Experiments, Wiley & Sons
7. M.C. Chakbravarthy, (1962), Mathematics of Design of Experiments, Asia Publishing House, Calcutta.

COURSE OUTCOME

	On the successful completion of course students will be able to	Knowledge
CO1	Student understand the importance of Design of Experiments	
CO2	Given a number of factors which affects the experiment, the student should be able to determine the most important factor	
CO3	Student learn the factorial design of experiments Design a learn regression model for an experiment and construct confidence intervals for each parameter	
CO4	Student asses the importance of curvature in regression and construct response surface	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	2	2	3	2	2	3	2	2
CO2	2	2	2	3	2	2	2	2	3	2	2	2	2
CO3	2	2	3	2	2	3	2	2	3	2	3	2	3
CO4	3	2	2	2	2	3	2	2	2	3	2	2	2

Low:1, Medium:2, High:3

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Syllabus for M.A. Statistics (2 Year Course) for V.S. University Constituent College(s) and Affiliated Colleges under the jurisdiction of Vikrama Simhapuri University, Nellore with effect from the Academic Year 2020-2021

PROGRAMME	M.Sc. Statistics	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCST303: **RELIABILITY**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. Demonstrate the approaches and techniques to assess and improve process and/or product quality and reliability. 2. Illustrate the basic concepts and techniques of modern reliability engineering tools.		

UNIT	CONTENT	NO. OF HOURS
I	Importance of reliability, definition of reliability and its measures, concept of failure. General provision of a reliability specification, Methods of achieving reliability, Broad functions of reliability. Bath tub curve, causes of early failure and methods to avoid them, failure distributions: exponential, Weibull, truncated normal, log normal - their properties and uses.	15
II	Series, parallel and r-out of n configurations; their block diagram, reliability graph and determination of reliability through combinatorial methods. Events space, cut set and tie set. Multistate models.	15
III	System reliability with exponential components in series, parallel and r- out of - n system. Usefulness of redundancy and improvement factor. MTTF, MTBF, Equivalents MTBF of series and parallel system. Cold and hot redundancy, reliability of stand-by system. Weakest link model, chain model, stress-strength model, non-parametric estimation of reliability.	15
IV	Problem of life testing, estimation of parameters and reliability in standard probability models (Exponential, Weibull, Normal) using complete samples. Probability plotting and graphical procedures for estimating the parameter and testing validity of model by some standard statistical tests.	15

REFERENCES

1. Statistical Analysis of Reliability and Life-Testing Models, Bain, L.J, Dekker, NewYork
2. Statistical Models and Methods for Lifetime Data, Lawless, J.F., Wiley, New York
3. Bayesian Reliability Analysis, Martz, H.E. & Weller, A., Willey New York,
4. Statistical Theory of Reliability and Life Testing Probability Models, Barlow R.E. &
Proschan,F., Holt, Rinehart and Winston, New York.
5. Reliability and Life Testing, Sinha, S.K., Wiley Eastern Limited.
6. Software Engineering: Design, Reliability and Management, Shooman,

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M.L., McGraw-Hill,New York.

7. Reliability in Engineering Design, Kapur, K.C. and Lamberson, L.R., John Wiley, New York.

COURSE OUTCOME

	On the successful completion of course students will be able to	**Knowledge**
CO1	Student attain the basic techniques of quality improvement, fundamentalknowledge of statistics and probability	
CO2	Student able to determination of reliability through combinatorial methods	
CO3	Student acquire basic knowledge of System reliability with exponential components and model building	
CO4	Student understand the concepts of reliability and maintainability	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	2	3	2	2	1	3	2
CO2	2	2	2	3	2	2	3	2	2	3	2	2	2
CO3	2	2	3	2	3	2	2	2	3	2	3	2	3
CO4	3	2	2	2	2	2	3	2	2	2	3	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCST304: **OPERATIONS RESEARCH - I**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. Operations Research is the discipline of applying advanced analytical methods to help make better decisions. 2. By using techniques such as mathematical modeling to analyze complex situations 3. Operations Research gives executives the power to make more effective decisions and build more productive systems.		

UNIT	CONTENT	NO. OF HOURS
I	Introduction, Definition and scope of Operations research; phases in Operations Research; models and their solutions. Concept of Optimal Solution, General Linear Programming Problem (LPP), Properties to Solution of LPP, Graphical Method, Simplex Method.	15
II	**Non-linear programming** - Kuhn Tucker conditions. Wolfe' s algorithm for solving quadratic programming problems. Integer programming – Branch and bound algorithm and cutting plane algorithm.	15
III	**Project Management:** Flows in networks max-flow-min-cut theorem. Project Management; PERT and CPM, probability of project completion, PERT – crashing.	15
IV	**Game Theory:** Decision making in the face of competition, two-person games, pure and mixed strategies, existence of solution and uniqueness of value in zero- sum games, finding solution in 2x2, and 2xm, and mxn games. Non – zero sum games, co-operative and competitive games, equilibrium solutions and their existence in bi-matrix games. Nash equilibrium solution.	15

REFERENCES	1. Taha H.A (1982) Operational Research: An Introduction; Macmillan. 2. Hiller F. Sand Lieberman G.J. (1962) Introduction to Operations Research; Holden Day 3. Kanti Swarup; Gupta P.K and Singh M.M (1985) Operations Research; Sultan Chand. 4. Philips D.T, Ravindran A and Solberg J Operations Research, Principles and Practice. 5. Curchman C.W; Ackoff R.L and Arnoff E.L(1957) introduction to Operations Research; John Wiley 6. Hadley G (1964) Non-Linear and Dynamic programming Addison Wesley. 7. Mckinsey J.C.C (1952) Introduction to the theory of games Mc Graw Hill. 8.P.K. Gupta; D.S. Hira Operations Research S. Chand.	
COURSE	**On the successful completion of course students will be**	**Knowledge**

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OUTCOME	**able to**		
	CO1	Student understand the concept of Operations Research, Graphical Method and Simplex Method	
	CO2	Student able to understand the concepts Non-Linear Programming and Integer Programming	
	CO3	Student conceptualize optimum event management through Network scheduling	
	CO4	Student familiar with Game Theory, Pure and Mixed Strategies, Two Person Zero Sum Game	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	3	2	2	3	3	1	2	3
CO2	2	2	2	3	2	3	2	2	2	2	3	2	2
CO3	2	3	2	2	3	2	3	2	3	2	3	2	3
CO4	3	2	3	3	2	2	3	2	2	3	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCST305: **DEMOGRAPHY AND OFFICIAL STATISTICS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To study about demography and their importance, different reproduction **2.** To explain population Genetics, CSO, NSSO and their scope and contents in population census in India		

UNIT	CONTENT	NO. OF HOURS
I	Nature, Scope and limitations of demography; Sources of Demographic data in India; Measures of Mortality; life-tables; construction of abridged life table; Measures of fertility Stochastic models for reproduction, Reproduction rates: GRR and NRR; Concepts of Migration and Urbanization.	15
II	Population Projections: Stable and Stationary populations, Lotka's model; Use of Leslie matrix. Population estimates; Chandrasekhar and Deming's method, component method, Stochastic models of population growth, Exponential and logistic population growth models: Birth and death model, Birth- death and migration model.	15
III	Population Genetics: Concepts of Genotypes and Phenotypes; Basic Mating from Single gene cross, Punnet Square method, Mendal's laws of heredity; Random mating; Hardy-Weinberg Equilibrium law; Calculation of Gene frequencies, Estimation of Gene frequencies in ABO blood group system.	15
IV	Statistical systems in India; CSO, NSSO and their functions; scope and content of population Census in India; Methods of conducting population census, Economic census and Agricultural census in India and defects; Sources of forest statistics.	15

REFERENCES	1. Suddender Biswas (1988), Stochastic Process in Demography and Applications, Wiley Eastern Ltd, New Delhi. 2. K.B. Pathak and F. Ram (1992), Techniques of Demographic Analysis, Himalayan Publishing House, Bombay. 3. OscarKempthorne (1973), An Introduction to Genetic Statistics, Jagmohan Book Agency, New Delhi 4. B.N. Gupta (1994), Statistics, SahityaBhavan, Agra. 5. B.L. Agrawal (1994), Basic Statistics, 2nd Edition, Wiley Eastren, New Delhi. 6. Asthana (1970), Indian Official Statistics.	
COURSE	**On the successful completion of course students will be**	**Knowledge**

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OUTCOME	**able to**		
	CO1	Students know the growth rates	
	CO2	Students understood about gene frequencies	
	CO3	Students learnt about population census methods	
	CO4	Student able to collect data from CSO and NSSO	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	3	2	3	2	2	2
CO2	2	3	2	3	2	2	3	2	3	2	2	3	2
CO3	1	2	1	2	2	2	3	3	2	3	2	1	2
CO4	2	2	3	3	2	2	2	3	2	3	2	3	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	III
COURSE CODE & TITLE	20RMSCST306: **PRACTICAL -III**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	Practical exercise of all papers such that there must be at least 4 practical problems on each paper (training is expected on manual practice work and practical work on system using available software. (75 marks for practical examination + 25 marks for Recordin the Semester III).		

UNIT	**CONTENT**	**NO. OF HOURS**
I	**PRACTICAL**	
II	**PRACTICAL**	
III	**PRACTICAL**	
IV	**PRACTICAL**	

REFERENCES

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Students know about the solving of Numerical problems related to semester –III	
	CO2 To exercise different practical problems manually through calculators	
	CO3 To discuss problems relates to semester - III papers.	
	CO4 -	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	2	2	3	2	2	2	3
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST401: **TIME SERIES ANALYSIS AND FORECASTING METHODS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES			

UNIT	CONTENT	NO. OF HOURS
I	Review of Time Series Analysis. Growth models: Modified Exponential Curve,Gompertz curve, Logistic Curve and their Fitting; Measurement of Cyclical Component: Harmonic Analysis, Auto Regression Series: Markoff and Yule's Series, Periodogram and Correlogram Analysis, Measurement of Irregular Component: Variate Difference Method.	
II	Need and Uses of Forecasting, Classification and Characteristics of Forecasts, Forecasting Based on Regression Techniques: Simple and Multiple Linear Regression and Non-Linear Regression Techniques, Moving Averages, Smoothing Methods: Simple and Double, Multi Average Methods; Explanatory Version Time Series Forecasting, Test for Trend Seasonality.	
III	Exponential Smoothing Methods: Trend Adjusted Exponential Smoothing, Double and Triple Exponential Smoothing, Winter's Method, Chow's Adaptive Control Methods, Brown's One Parameter Adaptive Method: Box-Jenkins Three Parameter Smoothing, Harrison's Harmonic Smoothing Methods, Tracking Signal.	
IV	Box-Jenkin's Time Series Methods: 1. Moving Average(MA) 2. Auto Regressive (AR) 3. ARMA and 4.AR Integrated MA (ARIMA) Models, Estimation of ARIMA Model Parameters, Forecasting with ARIMA Models, Diagnostic Checking of the Model: Analysis of Residuals, Forecasting Using Transfer Function Model, Concept of Kalman's Filters.	

REFERENCES

1. Anderson, T.W (1971): The Statistical Analysis of Time Series, John Wiley, New York.
2. Bovas, Abraham and Johannes Ledolter (1983): Statistical Methods for Forecasting, John Wiley & Sons. New York.
3. Box, G.E.P and Jenkkins, G.M (1976): Time Series Analysis Forecasting and Control, Holden Day, San Francisco.
4. Gupta. S.C and V.K. Kapoor (1995): Fundamentals of Applied Statistics, Sulthan& Chand Sons. New Delhi.
5. Markidakis, S Steven C. Wheel Wright and Victor E. McGee (1983): Forecasting: Methods and Applications, 2nd Edition, New York, John Wiley & Sons.

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6. Sullivan, William G. and Wayne Claycambe. W (1977): Fundamentals of Forecasting. Prentice Hall. Virginia.
7. Wheel Wishart, S.C; and S. Markidakis (1980): Forecasting Methods for Management. III edition, New York. John Wiley.

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Acquire knowledge of various advanced Timeseries models, estimation methods and related Timeseries theories	
	CO2	Conduct Forecasting analysis of data	
	CO3	Understand Auto-covariance, auto-correlation function and Vector Autoregression	
	CO4	Apply statistical techniques to model relationships between variables and make predictions	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	3	2	2	2	3	2
CO2	2	2	2	3	3	2	3	2	2	2	3	2	1
CO3	2	2	2	2	2	3	2	3	3	2	2	2	2
CO4	3	2	3	2	3	2	2	3	3	2	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST402: **R PROGRAMMING AND DATA ANALYSIS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To Understand the Purpose and Function of R Software 2. To Understand Control Stations and Group Manipulations 3. To become familiar with basic methods of R Software		

UNIT	CONTENT	NO. OF HOURS
I	Familiarizing with R environment, R atomic types, methods of creating vectors, combining vectors and repeating vectors, different ways of sub setting vectors using indexing. Arithmetic and logical operations. Creating Matrices, getting values in and out of matrices, performing matrix calculations; Working with multidimensional Arrays; creating data frames, modifying data frames; creating lists, extracting components from a list; Reading CSV files, EXCEL files, SPSS files and working with other data types.	15
II	Writing Scripts and functions in R. writing functions with named, default and optional arguments, functions using as arguments. Control statements in R - conditional control using if, if-else; looping control using for, while, repeat; transfer of control using break and next. Manipulating and processing data - creating subsets of data, use of merge () function, sorting and ordering of data. Group manipulation using apply family of functions - apply, sapply, lapply, tapply.	15
III	Base graphics. Use of high-level plotting functions for creating histograms, scatter plots, box-whiskers plot, bar plot, dot plot, Q-Q plot and curves. Controlling plot options using low level plotting functions - Adding lines, segments, points, polygon, grid to the plotting region; Add text using legend, text, mtext; and Modify/add axes, Putting multiple plots on a single page. Creating faceted graphics with lattice packages; making scatterplot, bar chart and box-and-whisker plot using lattice, changing plot options; ggplot2 - understanding plot elements as layers, using geoms and stats, creating bar chart, scatterplot and line chart.	15
IV	Working with probability distributions - Binomial, Poisson, Normal and other distributions. Summary statistics, hypothesis testing - one and two-sample Student's t-tests, Wilcoxon U-test, paired t-test, correlation and covariance, correlation tests, tests for association-Chi-squared test and goodness-of-_fit tests. Formula notation, one-way and two-way ANOVA and post-hoc testing, graphical summary of ANOVA and post-hoc testing, extracting means and summary statistics; Simple linear regression, multiple linear regression and	15

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	curvilinear regression, Stepwise, Forward, Backward procedures and analysis of residuals.	

REFERENCES

1.Mark Gardener (2012), Beginning R - The Statistical Programming Language, Wiley India PvtLtd.

2. Andrie de Vries and Joris Meys (2015), R Programming for Dummies, Wiley India Pvt Ltd.

3. Jared P. Lander (2014), R for Everyone - Advanced Analytics and Graphics, Pearson Education Inc.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
CO1	Student familiar with Reading CSV files, EXCEL files, SPSS files and working with other data types	
CO2	Student ready to Creating faceted graphics with lattice packages	
CO3	Student working with probability distributions, ANOVA, Linear Regression	
CO4	Student working with stepwise regression analysis procedures and analysis of residuals.	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	3	3	3	2	3	2	3	1	2	2
CO2	2	2	3	2	2	2	3	2	3	2	2	3	2
CO3	2	3	2	2	2	2	3	3	2	3	2	2	3
CO4	3	3	3	2	3	2	2	3	2	2	2	2	3

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST403: **BIO-STATISTICS**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. Explore the basic principles of statistics and some of its common uses. 2. Understand the basic principles of probability, descriptive statistics, and data analysis. 3. Understand how to generate descriptive statistics from data		

UNIT	CONTENT	NO. OF HOURS
I	Structure of Biological assay, Types of Biological assays: Direct assays, Potency ratio, Fieller's theorem, Behren's distribution, Two generalizations of Fieller's theorem.	15
II	Quantitative dose-response relationships, Linear dose-response regression, Parallel line bioassay, Slope Ratio Bioassay, Quantal responses, Estimation of median effective dose, Transformations: Probit and Logit transformations.	15
III	Basic Biological concepts: Gene, Chromosomes, Alleles, Concepts of Geno types and Phenotypes, Family studies, Basic mating from single gene cross, Matrix approach to basic matings of single gene cross, Checker board method, Mendal's law of heredity: Geneotypes and Pheno type ratios, Branching system method	15
IV	Types of matings, Random Mating, Concept of Gene pool, Gene frequency, Hardy–Weinberg law of equilibrium, Calculation of Gene frequencies, Genotypic frequency, Generation matrix approach to inbreeding, Estimation of Gene frequencies in ABO blood group system, Maximum Likelihood Method, Minimum Chi-Square method, Genetic parameters; Heritability Coefficients, Genetic Correlations, Repeatability, selection index; Inbreeding coefficient.	15

REFERENCES

D.J. Finney (1971): Statistical Methods in Biological Assay, Charles Griffen and Company, London.

D.J. Finney (1971): Probit Analysis, 3rd Edition, S.Chand and Company Ltd, New Delhi.

William D. Stansfield. (1969): Theory and Problems of Genetics, Schaum's Outline Series, MC Graw Hill, New York.

Oscar Kempthorne (1973): An Introduction to Genetic Statistics, Jagmohan Book agency,NewDelhi.

Basu, S. B. (1996), Quantitative Genitics Research Technique, Kalyani Publishers, New Delhi.

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Student apply basic statistical concepts commonly used	

		in Health and Medical Sciences	
	CO2	Student use basic analytical techniques to generate results	
	CO3	Student able to interpret results of commonly used statistical analyses in written summaries	
	CO4	Student able to demonstrate statistical reasoning skills correctly and contextually	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	2	2	3	3	2	1	2	2
CO2	2	2	2	3	2	2	3	2	2	3	2	3	2
CO3	2	2	3	2	2	3	2	3	3	2	2	2	3
CO4	3	3	2	2	2	3	2	2	2	3	3	2	3

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST404: **OPERATIONS RESEARCH - II**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To perform Dynamic programming and their applications and computation procedure with illustration 2. To discuss different Queuing models and steady state solutions with examples 3. To understand Replacement problems such as block and age replacement problems, individual and group replacement policies with examples 4. To discuss different Sequencing methods through examples		

UNIT	CONTENT	NO. OF HOURS
I	Bellman's principle of optimality, general formulation, computational methods and application of Dynamic programming. Multi-stage decision processes and Dynamic programming and Goal Programming.	15
II	Queuing Models, Specifications and Effectiveness Measures. Steady State Solutions of M/M/1 and M/M/C Models with Associated Distributions of Queue Length and Waiting Time .M/G/1 Queue and Pollack-Khinchine Result. Steady State Solutions of M/Ek/1 and Ek/M/1 Queues and Bulk Queues.	15
III	Replacement problems; block and age replacement policies; dynamic programming approach for maintenance problems; replacement of items with long life. Group and individual replacement policies.	15
IV	Sequencing and Scheduling Problems: '2' Machine 'n' Job, '3' Machine 'n' Job, 'm' Machine 'n' Job Problems with Identical Machine. Sequence for all Jobs, '2' Job 'n' Machine Problem with Different Routings.	15

REFERENCES

1. Churchman C.W; Ackoff R.L and Arnoff E.L(1957) introduction to Operations Research; John Wiley
2. Hadley G (1964) Non-Linear and Dynamic programming Addison Wesley.
3. Hiller F. Sand Lieberman G.J. (1962) Introduction to Operations Research; Holden Day
4. Kanti Swarup; Gupta P.K and Singh M.M (1985) Operations Research; Sultan Chand.
5. McKinsey J.C.C(1952) Introduction to the theory of games Mc Graw Hill.
6. Murthy. K.G(1976), Linear and combinatorial programming, John Wiley.
7. Philips D.T, Ravindran A and Solberg J Operations Research,

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Principles and Practice

8. P.K. Gupta; D.S. Hira Operations Research S. Chand.
9. S.D. Sharma (2008), Operations Research, Kedar Nath and Ram Nath publications, Meerut
10. Taha H.A (1982) Operational Research: An Introduction; Macmillan

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Students understood about Bellman Principle of Optimality, Dynamic Programming and Goal Programming	
	CO2	Student understand Queuing Models, Steady State Solutions,Pollack-Khinchine Result	
	CO3	Student able to know how to apply replacement problems,Group and individual replacement policies	
	CO4	Student learnt about Sequencing and Scheduling Problems	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	2	3	2	2	1	3	2
CO2	2	2	3	2	3	2	3	2	3	2	2	3	2
CO3	2	2	2	3	2	3	2	2	2	3	2	3	3
CO4	3	2	3	3	2	2	3	2	3	2	2	2	3

Low:1, Medium:2, High:3

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DEPARTMENT OF STATISTICS

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST405A: **STATISTICAL PROCESS AND QUALITY CONTROL**		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	**1.** To Understand the Purpose and Function of Statistical Quality Control **2.** To Understand the differences between Attributes and Variables **3.** To become familiar with basic methods of Statistical Process Control		

UNIT	CONTENT	NO. OF HOURS
I	Basic concepts of quality, causes of variation, principle of Shewart's control chart, control chartsfor attributes and variables. Control limits and probability limits. Process monitoring and control,process capability, modified control chart. Capability indices C_p, C_{pk}, and C_{pm}. Concept of Six sigma and its relationship with process capability.	15
II	The OC and ARL of Shewart's control charts. Control by gauging, Moving Average and Exponentially Weighted Moving Average charts. CUSUM charts using V-mask and decision interval methods. Multivariate control charts – Control Ellipsoid, Hotelling's T^2 chart.	15
III	Acceptance sampling plans for attribute inspection – Type-A and Type-B OC curves. Single, double and sequential sampling plans and their properties. Sampling plans with rectifying inspection concept of AOQ, AOQL. Design of Single sampling plan with given ATI. Plans for inspection by variables with one-sided and two-sided specifications.	15
IV	Sampling plans for continuous inspection-construction of Dodge CSP-1, CSP-2 and Multi level plans and their properties. Chain sampling and its applications. Design of Skip lot sampling plan and its ASN. Sampling plans with inspection error- derivation of AOQ and ATI in presence of errors.	15

REFERENCES

1. Montgomery D.C (2009), Introduction to Statistical Quality Control, 6/e, John Wiley and Sons,New York.
2. Edward G. Schilling, Dean V. Neubauer, (2009), Acceptance sampling in quality control SecondEdition, Taylor & Francis.
3. Mittage, H.J and Rinne, H (1993): Statistical Methods of Quality Assurance, ChapmannHall,London, UK.
4. Ott. E.R (1975), Process Quality Control, Mc Graw Hill.
5. Phadke, M.S (1989), Quality Engineering through Robust Design, Prentice Hall.
6. Duncan, A.J (1974), Quality Control and Industrial Statistics, 3rd Ed.,

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New York, Irwin.

7. Philip J. Ross (1989), Taguchi techniques for quality engineering, McGraw Hill

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Student identify the causes of variation, principle of Shewhart's control chart	
	CO2	Student understand about CUSUM charts and Multivariate control charts	
	CO3	Student familiar with Acceptance sampling plans for attribute inspection, AOQ, AOQL	
	CO4	Student know how to use Sampling plans for continuous inspection and Skip lot sampling plan	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	2	3	2	2	2	3	2	2	3	2
CO2	2	1	2	3	2	2	3	3	2	2	1	3	2
CO3	2	2	3	2	2	3	2	2	3	2	2	1	3
CO4	2	3	2	2	3	2	3	2	2	3	2	3	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST405B: STATISTICS FOR RESEARCH, INDUSTRY AND COMMUNITY DEVELOPMENT		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	1. To understand Response surface models, and non-stepwise, partially linear parametric regression models with their applications 2. To discuss Simulation models, demand analysis and their related tools 3. To explain social server, steps in social server measurements with examples		

UNIT	CONTENT	NO. OF HOURS
I	Response Surface Designs: First and Second Order Response Surface models; Rotatable designs; concept of connected design; outliers and Winsorized t - statistic; Stepwise regression; Specification of Random Coefficients Regression model; Specification of variance components model;MINQUE Theory; Non parametric regression, the partially linear regression model.	15
II	Simulation: Scope and limitations; Simulation models; Generation of Random Numbers; Monte-Carlo simulation; Simulation of Queueing, Inventory Systems; Networks and Job sequencing. Data Envelopment Analysis (DEA): Non parametric approach to productive efficiency; Input, output correspondences for Frontier production function; Mathematical Programming forproductive efficiency: Farrell and Timmer approaches with reference to Cobb-Douglas production function.	15
III	Demand Analysis: Laws of Demand and Supply; price and partial elasticities of demand; Pigous method for Time Series and Family Budget data; Engel' s curve; Pareto law of Income distribution; Production Functions: Basic concepts; Isoquants; Cobb-Douglas, CES and TranslogProduction functions and their properties and estimation; Tools for Data Mining.	15
IV	Social Surveys for Community Development: Objects, Types of Social Survey; Steps in social survey; Gallop polls; Psephology, Data collection; Kinds of measurement; Scaling methods:Thurstone, Likert and Guttman methods; Concepts of Validity and Reliability; Methods of calculating reliability coefficients; Test Reliability; ANOVA for Ranked data: Kruskal-Wallis and Friedman tests; Elements of cluster analysis, Factor analysis., path coefficient analysis and Discriminant analysis.	15

REFERENCES

1. Das, M.N. and Giri, N.C. (1979), Design and Analysis for Experiments, Wiley Eastern (P) Ltd.New Delhi.
2. Montgomery, C.D. (1976), Design and Analysis of Experiments,

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Wiley & Sons, New York

3. Johnston, J., and Dinardo, J. (1997), Econometric Methods, Fourth Edition, Mc Graw-Hill International Editions, New York
4. Judge., C.G., et.al (1985), Theory and Practice of Econometrics, John Wiley.
5. Taha, H.A. (1992), Operations Research, An Introduction, Fourth Edition

COURSE OUTCOME	**On the successful completion of course students will be able to**		**Knowledge**
	CO1	Students have done Simulation models, response surface models, demand analysis, social survey and their related measures.	
	CO2	Student able to understand Non parametric approach to productive efficiency	
	CO3	Student learnt about Production functions and their properties and estimation	
	CO4	Student able to familiar with Social Surveys for Community Development	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	2	3	2	2	1	2	3
CO2	3	2	2	2	3	2	2	3	2	2	3	2	2
CO3	2	3	2	3	2	2	2	2	3	2	3	2	3
CO4	3	2	3	2	3	2	2	3	2	3	2	2	2

Low:1, Medium:2, High:3

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PROGRAMME	M.Sc. Statistics	**SEMESTER**	IV
COURSE CODE & TITLE	20RMSCST406: PRACTICAL – IV		
NUMBER OF CREDITS	4	**HOURS/WEEK**	6
COURSE OBJECTIVES	Practical exercise of all papers such that there must be at least 4 practical problems on each paper (training is expected on manual practice work and practical work on system using available software). (75 marks for Practical examination + 25 marks for Record and Viva-Voce in the Semester IV).		

UNIT	CONTENT	NO. OF HOURS
I	Practical – IV	15
II	Practical – IV	15
III	Practical – IV	15
IV	Practical – IV	15

REFERENCES

COURSE OUTCOME	**On the successful completion of course students will be able to**	**Knowledge**
	CO1 Students know about the solving of Numerical problems related to semester –IV	
	CO2 To exercise different practical problems manually through calculators	
	CO3 To discuss problems relates to semester - IV papers.	
	CO4 -	

COs – POs MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	2	2	2	3	2	2	3
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-

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MODEL QUESTION PAPER
M.Sc., DEGREE EXAMINATIONS
COURSE: M.Sc., STATISTICS
Common to All Semesters (Semester I, II, III & IV)
All Semester Question Papers are having the same format
Effect from Batch 2020-2022

Time: 3 Hours **Max.Marks:100**

PART-A
Marks: 4x5M=20M Answer Any Four Questions
Each Question Carries 5 Marks

1)
2)
3)
4)
5)
6)
7)
8)

PART-B
Marks: 4x12.5M=50M Answer All Questions (Internal Choice) – Unit I to Unit IV
Each Question Carries 12.5 Marks

UNIT-I

9)

or

10)

UNIT-II

11)

or

12)

UNIT-III

13)

or

14)

UNIT-IV

15)

or

16)

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