Resolution No.: AC/II(24-25).3.RUA14

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for

Program: B. A.

Program Code: (STATISTICS) RUASTA

(Choice Based Credit System for academic year 2024–25)

GRADUATE ATTRIBUTES

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

GA	GA Description **A student completing Bachelor's Degree in Arts program will be able to:**
GA 1	Demonstrate understanding and skills of application of knowledge of historical and contemporary issues in the social and linguistic settings with a transdisciplinary perspective to make an informed judgement.
GA 2	Analyse and evaluate theories of individual and social behaviour in the familiar contexts and extrapolate to unfamiliar contexts in order to resolve contemporary issues.
GA 3	Effectively and ethically use concepts, vocabularies, methods and modern technologies in human sciences to make meaningful contribution in creation of information and its effective dissemination
GA 4	Explore critical issues, ideas, phenomena and debates to define problems or to formulate hypotheses; as well as analyse evidences to formulate an opinion, identify strategies, evaluate outcomes, draw conclusions and/or develop and implement solutions.
GA 5	Demonstrate oral and written proficiency to analyse and synthesise information and apply a set of cognitive, affective, and behavioral skills to work individually and with diverse groups to foster personal growth and better appreciate the diverse social world in which we live.
GA 6	Develop a clear understanding of social institutional structures, systems, procedures, and policies existing across cultures, and interpret, compare and contrast ideas in diverse social- cultural contexts, to engage reasonably with diverse groups.
GA 7	React thoughtfully with emotional and moral competence to forms of expressive direct action and apply social strategies toward eradicating threats to a democratic society and a healthy planet.

GA 8	Articulate and apply values, principles, and ideals to the current societal challenges by integrating management and leadership skills to enhance the quality of life in the civic community through actions that enrich individual lives and benefit the community.
GA 9	Recognize and appreciate the diversity of human experience and thought, and apply intellect and creativity to contemporary scenario, to promote individual growth by practicing lifelong learning.

PROGRAM OUTCOMES

PO	Description **A student completing Bachelor's Degree in Arts program in the subject of Statistics will be able to:**
PO 1	Understand, condense, visualize, analyze and interpret various data types generated in various scenarios of scientific, industrial, or social problems.
PO 2	Apply Statistical tools for data analysis.
PO 3	Pursue their higher education programs leading to post-graduate and/or doctoral degrees in Statistics, Data Science, Business Analytics, Biostatistics, Econometrics, Management Studies.
PO 4	Compete globally to enter into promising careers.
PO 5	Make a pathway to a range of traditional avenues in Academia and Industry, Govt. Service, IAS, Indian Statistical/ Economic Services, Industries, Commerce, Investment Banking, Banks and Insurance Sectors, CSO and NSSO, Research Personnel/Investigator in Govt. organizations such as NCAER, IAMR, ICMR, Statistical and Economic Bureau & various PSUs., Market Research, Actuarial Sciences, Biostatistics, Demography etc.
PO 6	Seek employment or self-employment in different sectors like Stock trading, Pharmaceutical sector, Sports, Politics, Business, Financial

	services and Media Industry.

PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
TYBA	V	RUASTA501	PROBABILITY DISTRIBUTIONS	3
TYBA	V	RUASTA502	THEORY OF SAMPLING	3
TYBA	V	RUASTA503	ELEMENTS OF ACTUARIAL SCIENCE	2.5
TYBA	V	RUASTAP501	Practical based on RUASTA501, RUASTA502 & RUASTA503	3
TYBA	VI	RUASTA601	PROBABILITY AND SAMPLING DISTRIBUTIONS	3
TYBA	VI	RUASTA602	ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS	3
TYBA	VI	RUASTA603	APPLIED STATISTICS	2.5
TYBA	VI	RUASTAP601	Practical based on RUASTA601, RUASTA602 & RUASTA603	3

Course Code: RUASTA501
Course Title: PROBABILITY DISTRIBUTIONS

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Identify various Standard Discrete Probability Distributions and their use.
CO 2	Distinguish between different types of Standard Discrete Probability Distributions and prove their properties and apply those for problem solving.
CO 3	Recognize the underlying distribution in different situations.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
RUASTA501	Unit I	**Univariate Random Variables (Discrete and Continuous):** • Moment Generating Function, Cumulant generating Function-Their important properties. Relationship between moments and cumulants and their uses. • Characteristic Function- Its properties (without proof). • Transformation of random Variable	15 Lectures
RUASTA501	Unit II	**Standard Discrete Probability Distributions:** • Uniform, Bernoulli, Binomial, Poisson, Geometric, Negative Binomial & Hypergeometric distributions. • The following aspects of the above distributions (wherever applicable) to be discussed: • Mean, Mode and Standard deviation. Moment Generating Function, Cumulant • Generating Function, Additive property, Recurrence relation for central • Moments, Skewness and Kurtosis (without proof), Limiting distribution.	15 Lectures
RUASTA501	Unit III	**Bivariate Probability Distributions:** • Joint Probability mass function for Discrete random variables**,** Joint Probability density function for continuous random variables. Their properties.	15 Lectures

		• Marginal and conditional Distributions. Independence of Random Variables. Conditional Expectation & Variance. • Regression Function. Coefficient of Correlation. Transformation of Random Variables and Jacobian of transformation with illustrations.	

Distribution of topics for Practicals

Course Code RUASTAP501(A)	
Sr. No.	**Practicals based on course**
1	Moment Generating Function, Moments.
2	Cumulant generating Function, Cumulants, Characteristic function.
3	Standard Discrete Distributions
4	Fitting Standard Discrete Distributions.
5	Bivariate Probability Distributions, Marginal & Conditional distributions, Conditional Mean, Conditional Variance, Correlation
6	Transformation of discrete & continuous random variables.

REFERENCES:

1. A. M. Mood, F.A. Graybill, D. C. Boyes, Third Edition; McGraw-Hill Book Company. Introduction to the theory of statistics
2. R.V. Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers: Introduction to Mathematical Statistics
3. R.V. Hogg, E. A. Tannis, Third Edition; Collier McMillan Publishers: Probability and Statistical Inference
4. I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.: John E. Freund's Mathematical Statistics
5. P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.: Introduction to Mathematical Statistics
6. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics

7. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics
8. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods: An Introductory Text
9. A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.: An Outline of Statistical Theory Vol. 1

Course Code: RUASTA502

Course Title: THEORY OF SAMPLING

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the importance and use of sampling and its various methods.
CO 2	Calculate population parameters using Simple Random Sampling, Stratified Sampling, and Systematic Sampling techniques.
CO 3	Differentiate between types of probability sampling methods.
CO 4	Apply Ratio and Regression methods of estimation to incorporate auxiliary information into surveys.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
RUASTA502	**Unit I**	**Concepts:** • Population, Population unit, Sample, Sample unit, Parameter, Statistic, Estimator, Bias, Unbiasedness, Mean square error & Standard error. • Census survey, Sample Survey. Steps in conducting a sample survey. Concepts of Sampling and Non-sampling errors. • Concepts and methods of Probability and Non-Probability sampling.	15 Lectures

		Simple Random Sampling (SRS): • Description of Simple Random Sampling with & without replacement. • Lottery method & use of Random numbers to select Simple random sample. • Estimation of population mean & total. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. • Estimation of population proportion. Expectation & Variance of the estimators, • Unbiased estimator of variance of these estimators. • Estimation of Sample size based on a desired accuracy in case of SRS for variables & attributes.	
RUASTA502	**Unit II**	**Stratified Sampling:** • Need for Stratification of population with suitable examples. Description of Stratified Random Sample. • Advantages of stratified random Sampling. **Stratified Random Sampling:** • Estimation of population mean & total in case of Stratified Random Sampling (WOR within each stratum). Expectation & Variance of the unbiased estimators, Unbiased estimators of variances of these estimators. • Equal Allocation, Proportional allocation, Optimum allocation with and without varying costs. • Comparison of Simple Random Sampling, Stratified Random Sampling using • Proportional allocation & Neyman allocation	15 Lectures
RUASTA502	**Unit III**	**Ratio & Regression Estimation assuming SRSWOR:** • Ratio Estimators for population Ratio, Mean & Total. Expectation & MSE of the Estimators. Estimators of MSE. Uses of Ratio Estimator. • Regression Estimators for population Mean & Total. Expectation & Variance of the Estimators assuming known value of regression coefficient 'b'. • Estimation of 'b'. Resulting variance of the estimators. Uses of regression • Estimator. Comparison of Ratio, Regression & mean per Unit estimators.	15 Lectures

		Systematic sampling: • Estimator of Population Mean and its Variance. Comparison of Systematic Sampling with Simple Random sampling • Introduction to Cluster sampling & Two Stage sampling with suitable illustrations.	

Distribution of topics for Practicals

Course Code RUASTAP501(B)	
Sr. No.	**Practicals based on course**
1	Designing of Questionnaire.
2	Simple Random Sampling for Variables.
3	Simple Random Sampling for Attributes.
4	Estimation of Sample Size in Simple Random Sampling.
5	Stratified Random Sampling.
6	Ratio Estimation- Regression Estimation.
7	Systematic Sampling

REFERENCES:

1. W.G. Cochran; 3rd Edition; Wiley (1978): Sampling Techniques
2. M. N. Murthy; Statistical Publishing Society. (1967): Sampling Theory and methods
3. Des Raj; McGraw Hill Series in Probability and Statistics. (1968): Sampling Theory
4. P.V. Sukhatme and B.V. Sukhatme; 3rd Edition; Iowa State University Press (1984): Sampling Theory of Surveys with Applications
5. S. C. Gupta and V.K. Kapoor; 3rd Edition; Sultan Chand and Sons (2001): Fundamentals of Applied Statistics
6. Daroga Singh, F.S.Chaudhary, Wiley Eastern Ltd. (1986): Theory and Analysis of Sample Survey Designs:
7. S. Sampath, Second Edition (2005), Narosa: Sampling Theory and Methods
8. Parimal Mukhopadhyay, (1998), Prentice Hall Of India Pvt. Ltd.: Theory and Methods of Survey Sampling

Course Code: RUASTA503

Course Title: ELEMENTS OF ACTUARIAL SCIENCE

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Understand the purpose of Mortality Tables and compute the likelihood of survival and death.
CO 2	Distinguish between different types of annuities, assess their worth now and in the future.
CO 3	Explain the need for various assurance plans and determine the premiums for each.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
RUASTA503	Unit I	**MORTALITY TABLES:** • Various mortality functions. Probabilities of living and dying. • The force of mortality. Estimation of μ_x from the mortality table. • Central Mortality Rate. Laws of mortality: Gompertz's and Makeham's first law. Select, Ultimate and Aggregate mortality tables. Stationary population. Expectation of life and Average life at death.	15 Lectures
RUASTA503	Unit II	**COMPOUND INTEREST AND ANNUITIES CERTAIN:** • Accumulated value and present value, nominal and effective rates of interest. • Varying rates of interest. Equation of value. Equated time of payment. • Present and accumulated values of annuity certain (immediate and due) with and without deferment period.	15 Lectures

		• Present value for perpetuity (immediate and due) with and without deferment Period. • Present and accumulated values of (i) increasing annuity (ii) increasing annuity when successive instalments form (i) arithmetic progression (ii) Geometric progression (iii) annuity with Frequency different from that with which interest is convertible. Redemption of loan.	
RUASTA503	**Unit III**	**LIFE ANNUITIES AND ASSURANCE BENEFITS:** • Present value in terms of commutation functions of Life annuities and Temporary life annuities (immediate and due) with and without deferment period. • Present values of Variable, increasing life annuities and increasing Temporary life annuities (immediate and due). • Present value of Assurance benefits in terms of commutation functions of: (i) pure endowment assurance (ii) temporary assurance (iii) endowment assurance (iv) whole life assurance (v) special endowment assurance (vi) deferred temporary assurance (vii) Double Endowment • Net premiums: Net level annual premiums (including limited period of payment) for various assurance plans. • Office premiums.	**15 Lectures**

Distribution of topics for Practicals

Course Code: RUASTAP501(C)	
Sr. No.	**Practicals based on course**
1	Mortality tables 1
2	Mortality tables 2
3	Annuities 1
4	Annuities 2
5	Life annuities
6	Assurance benefits

REFERENCES:

1. Neill A. : Life Contingencies, First edition, Heineman educational books London

2. Dixit S.P., Modi C.S., Joshi R.V.: Mathematical Basis of Life Assurance, First edition Insurance Institute of India.
3. Gupta S. C. &. Kapoor V. K.: Fundamentals of Applied Statistics, Fourth edition, Sultan Chand & Sons.
4. Ajaykumar Srivastava and Gorakhnath Agarwal: Mathematical Basis of Life Assurance

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	20
2	Class Test/ Project / Assignment / Presentation	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks
Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
1	Any 2 out of 3 sub-parts	20	Unit I
2	Any 2 out of 3 sub-parts	20	Unit II
3	Any 2 out of 3 sub-parts	20	Unit III
	TOTAL	**60**	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal and attendance	5
Assignments using Statistical Software	15
Total	**20**

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:
Duration - These examinations shall be of **one and half hour** duration.

Particulars	Paper
Exam (There shall be **Three** COMPULSORY Questions of 10 marks each with internal choice**)**	30
Total	**30**

Overall Examination & Marks Distribution Pattern

Semester V

Course	RUASTA501			RUASTA502			RUASTA503			Grand Total
	Internal	External	Total	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	40	60	100	300
Practicals	20	30	50	20	30	50	20	30	50	150

Course Code: RUASTA601

Course Title: PROBABILITY AND SAMPLING DISTRIBUTIONS

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Know different types of Standard Continuous Probability Distributions and their importance.

CO 2	Differentiate between various Standard Continuous Probability Distributions and use their properties for solving various problems.
CO 3	Implement Exact Sampling distribution methods.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
RUASTA601	**Unit I**	**Standard Continuous Probability Distributions:** • Rectangular, Triangular, Exponential, Gamma (with Single & Double parameter), Beta (Type I & Type II). • The following aspects of the above distributions (wherever applicable) to be discussed • Mean, Median, Mode & Standard deviation. Moment Generating Function, Additive property, Cumulant Generating Function. Skewness and Kurtosis (without proof). Interrelation between the distributions. **Normal Distribution:** • Mean, Median, Mode, Standard deviation, Moment Generating function, Cumulant Generating function, Moments &Cumulants (up to fourth order). Recurrence relation for central moments, skewness& kurtosis, Mean absolute deviation. Distribution of linear function of independent Normal variables. Fitting of Normal Distribution. • Central Limit theorem for i.i.d. random variables. • Log Normal Distribution: Derivation of mean & variance.	**15 Lectures**
RUASTA601	**Unit II**	**Chi-Square Distribution:** • Concept of degrees of freedom. Mean, Median, Mode & Standard deviation. Moment generating function, Cumulant generating function. Additive property, Distribution of the sum of squares of independent Standard Normal variables. Sampling distributions of sample mean and sample variance and their independence for a sample drawn from Normal distribution (without proof). • **Applications of Chi-Square:** Test of significance for specified value of	**15 Lectures**

		variance of a Normal population. Test for goodness of fit & Test for independence of attributes (derivation of test statistics is not expected).	
RUASTA601	**Unit III**	**t-distribution:** • Mean, Median, Mode & Standard deviation. Derivation of t distribution using Fisher's t. Student's t. Asymptotic properties. • **Applications of t:** Confidence interval for: Mean of Normal population, difference between means of two independent Normal populations having the same variance. Test of significance of: mean of a Normal population, difference in means of two Normal populations (based on: (i) independent samples with equal variances. (Effect Size, Cohen's d) (ii) dependent samples). • **F-distribution:** Mean, Mode & Standard deviation. Distribution of: reciprocal of an F variate, Ratio of two independent Chi-squares divided by their respective degrees of freedom. Interrelationship of F with: t-distribution, Chi-square distribution & Normal distribution. • **Applications of F:** Test for equality of variances of two independent Normal populations.	**15 Lectures**

Distribution of topics for Practicals

Course Code: RUASTAP601(A)	
Sr. No.	**Practicals based on course**
1	Standard Continuous distributions.
2	Normal Distribution
3	Central Limit Theorem
4	Chi Square distribution
5	t distribution

6	F distribution
7	Practical using Excel/R software

REFERENCES:

1. A M Mood, F.A. Graybill, D C Boyes; Third Edition; McGraw-Hill Book Company.: Introduction to the theory of statistics
2. R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.: Introduction to Mathematical Statistics
3. R.V.Hogg, E. A.Tannis, Third Edition; Collier McMillan Publishers.: Probability and Statistical Inference
4. I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.: John E. Freund's Mathematical Statistics
5. P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.: Introduction to Mathematical Statistics
6. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics
7. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics
8. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods- An Introductory Text
9. A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.: An Outline of Statistical Theory Vol. 1

Course Code: RUASSTA602

Course Title: ANALYSIS OF VARIANCE & DESIGNS OF EXPERIMENTS

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Explain and illustrate the analysis of one-way and two-way classification.
CO 2	Define key concepts in Experimental Design, outline the principles of experimental design, and enumerate various types of experimental

	designs.
CO 3	Examine Completely Randomized Designs (CRD), Randomized Block Designs (RBD), and Least Significant Difference (LSD) using Analysis of Variance (ANOVA).
CO 4	Create factorial experiments, analyze their results, and grasp the concept of confounding.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
RUASSTA602	**Unit I**	**Analysis of Variance:** • Introduction, Uses, Cochran's Theorem (Statement only). • One-way classification with equal & unequal observations per class, • Two-way classification with one observation per cell. • For both the cases: Mathematical Model, Assumptions, Expectation of various sums of squares, F- test, Analysis of variance table. Least square estimators of the parameters, Expectation and Variance of the estimators, Estimation of linear contrasts, Standard Error and Confidence limits Testing for significance of elementary linear contrasts.	**15 Lectures**
RUASSTA602	**Unit II**	**Design of Experiments:** • Concepts of Experiments, Experimental unit, Treatment, Yield, Block, Replicate, Experimental Error, Precision. • Principles of Design of Experiments: Replication, Randomization & Local Control. • Efficiency of design D_1 with respect to design D_2. • Choice of size, shape of plots & blocks in agricultural & non-agricultural experiments. **Completely Randomized Design (CRD) & Randomized Block Design (RBD):** • Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table.	**15 Lectures**

		• Least square estimators of the parameters, Variance of the estimators, Estimation of linear contrasts, Standard Error and Confidence limits Testing for significance of elementary linear contrasts. Efficiency of RBD relative to CRD. • Missing plot technique for one missing observation in case of CRD, RBD	
RUASSTA602	**Unit III**	**Latin Square Design (LSD):** • Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. • Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. • Efficiency of the design relative to RBD, CRD. • Missing plot technique for one missing observation in case of LSD. **Factorial Experiments:** Definition, Purpose & Advantages. 2^2, 2^3 Experiments. • Calculation of Main & interaction Effects. Yates' method. Analysis of 2^2 & 2^3 factorial Experiments. Concept of Confounding. **(partial and total)**	**15 Lectures**

Distribution of topics for Practicals

Course Code: RUASTAP601(B)	
Sr. No.	**Practicals based on course**
1	Analysis of Variance- One Way
2	Analysis of Variance- Two Way
3	Completely Randomized Design
4	Randomized Block Design

5	Latin Square Design.
6	Missing Observations in CRD, RBD & LSD
7	Factorial Experiments
8	Practical using Excel /R software

REFERENCES:

1. W.G. Cochran and G.M.Cox; Second Edition;John Wiley and Sons.: Experimental Designs
2. Oscar Kempthorne, John Wiley and Sons.: The Design and Analysis of Experiments
3. Douglas C Montgomery; 6th Edition;John Wiley & Sons.: Design and Analysis of Experiments
4. M.N.Das and N.C.Giri, 2nd Edition; New Age International (P) Limited; 1986: Design and Analysis of Experiments
5. Walter T Federer; Oxford & IBH Publishing Co. Pvt. Ltd.: Experimental Design, Theory and Application
6. S.C.Gupta and V.K.Kapoor; 3rd Edition; Sultan Chand and Sons (2001): Fundamentals of Applied Statistics
7. B.J. Winer, McGraw Hill Book Company.: Statistical Principles in Experimental Design

Course Code: RUASTA603

Course Title: APPLIED STATISTICS

Academic year 2024-25

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION A student completing this course will be able to:
CO 1	Grasp the idea of Predictive Modeling and employ techniques such as regression analysis for practical applications.

CO 2	Generate random numbers and observations following different probability distributions.
CO 3	Apply Monte Carlo techniques to address challenges in Inventory and Queueing Theory.
CO 4	Utilize the properties of mathematical functions relevant to Economics and understand their interrelationships.

DETAILED SYLLABUS

Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
RUASTA603	**Unit I**	**LINEAR REGRESSION** • Linear regression model with one or more explanatory variables. Assumptions of the model, Derivation of Ordinary Least Square (OLS) estimators of regression coefficients, (for one and two explanatory variables models). Properties of least square estimators (without proof). Coefficient of determination R^2 and adjusted R^2. • Procedure of testing: ➢ Overall significance of the model ➢ Significance of individual coefficients • Significance of incremental contribution of explanatory variable for two explanatory variables model. • Confidence intervals for the regression coefficients. • Multiple Linear Regression with Qualitative Independent Variable. • Autocorrelation: Concept, Detection using Durbin Watson Test, Generalized Least Square (GLS) method. • Heteroscedasticity: Concept, Detection using Breusch-Pagan-Godfrey test. Weighted Least Square (WLS) estimators • Multicollinearity: Concept, Detection using • R square & t ratios (ii) Variance Inflation Factor (VIF)	**15 Lectures**
RUASTA603	**Unit II**	**SIMULATION** • Scope of simulation applications. Types of simulation. Monte Carlo Technique of Simulation	**15 Lectures**

		and Bootstrapping. • Elements of discrete event simulation. • Generation of random numbers. Sampling from probability distribution. Inverse method. Generation of random observations from i) Uniform distribution ii) Exponential distribution iii) Gamma distribution iv) Normal distribution. • Application of Simulation techniques to real life situations.	
RUASTA603	**Unit III**	**Mathematical Economics:** • Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Cost. • Normal conditions of (i) demand (ii) cost. Features of prefect competition. • Monopoly (including effects of taxation and subsidy), Duopoly. • Production function. Euler's theorem linear homogenous production functions, Cobb-Douglas production function, CES production function. • The elasticity of substitution.	15 Lectures

Distribution of topics for Practicals

Course Code: RUASTAP601(C)	
Sr. No.	**Practicals based on course**
1	Multiple regression model 1
2	Multiple regression model- 2
3	Simulation
4	Mathematical Economics 1
5	Mathematical Economics 2
6	Use of R in MLR

REFERENCES:

1. E.L. Grant. (2nd edition) McGraw Hill, 1988.: Statistical Quality Control
2. Duncan. (3rd edition) D. Taraporewala sons & company.: Quality Control and Industrial Statistics
3. Bertrand L. Hansen, (1973), Prentice Hall of India Pvt. Ltd.: Quality Control: Theory and Applications

4. Douglas Montgomery, Arizona State University. John Wiley & Sons, Inc. (6th Edition): Statistical Quality Control
5. Gupta S.C., Kapoor V.K., Fundamentals of Applied Statistics, Sultan Chand &Sons
6. Srinath. 2nd edition, East-west press Pvt. Ltd.: PERT and CPM, Principles and Applications
7. Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons.: Operations Research
8. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.: Schaum Series book in O.R.
9. Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons.: Operations Research: Methods and Problems
10. J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.: Mathematical Models in Operations Research
11. S.D.Sharma.11th edition, Kedar Nath Ram Nath & Company.: Operations Research
12. H. A. Taha, 6th edition, Prentice Hall of India.: Operations Research
13. J.K.Sharma, (2001), MacMillan India Ltd.: Quantitative Techniques for Managerial Decisions

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

Sr No	Evaluation type	Marks
1	Class Test/ Project / Assignment / Presentation	20
2	Class Test/ Project / Assignment / Presentation	20
	TOTAL	**40**

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:

Paper Pattern:

Question	Options	Marks	Questions Based on
1	Any 2 out of 3 sub-parts	20	Unit I

2	Any 2 out of 3 sub-parts	20	Unit II
3	Any 2 out of 3 sub-parts	20	Unit III
	TOTAL	**60**	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal and attendance	5
Assignments using Statistical Software	15
Total	**20**

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:
Duration - These examinations shall be of **one and half hour** duration.

Particulars	Paper
Exam (There shall be **Three** COMPULSORY Questions of 10 marks each with internal choice**)**	30
Total	**30**

Overall Examination & Marks Distribution Pattern

Semester VI

Course	RUASTA601			RUASTA602			RUASTA603			Grand Total
	Internal	External	Total	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	40	60	100	300

Practicals	20	30	50	20	30	50	20	30	50	150
