AC/II(20-21).2.RUA14

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)



Syllabus for

Program: B. A.

Program Code: (STATISTICS) RUASTA

(Credit Based Semester and Grading System for academic year 2020–2021)



PROGRAM OUTCOMES

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.

PO	PO Description							
	A student completing Bachelor's Degree in Arts program will be able to:							
PO 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.							
PO 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.							
PO 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							
PO 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.							
PO 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							
2	diverse social world in which we live.							
PO 6	Develop a clear understanding of social institutional structures, systems,							
5	procedures, and policies existing across cultures, and interpret, compare and							
	contrast ideas in diverse social- cultural contexts, to engage reasonably with							
	diverse groups.							



PO 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.				
PO 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.				
PO 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 SPECIFIC OUTCOMES

PSO	Description			
	A student completing Bachelor's Degree in Arts program in			
	the subject of Statistics will be able to:			
PSO 1	Understand, condense, visualize, analyze and interpret the data			
	collected in daily walk of life.			
PSO 2	Understand the data generated in various scenarios of scientific,			
X ^o	industrial, or social problems.			
PSO 3	Pursue their higher education programs leading to post-graduate			
	or doctoral degrees.			
PSO 4	Enhance knowledge of Statistical tools.			
PSO 5	Enhance the theoretical rigor with technical skills which prepare			
	them to become globally competitive to enter into a promising			
	professional life after graduation.			



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.				
Seek employment in different sectors like Stock trading, Sports,				
Politics, Business, Financial services and Media Industry.				

PROGRAM OUTLINE

	YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
	FYBA	I	RUASTA101	DESCRIPTIVE STATISTICS - I	2
	FYBA	I	RUASTAP101	Practical based on RUASTA101	1
	FYBA	II	RUASTA201	DESCRIPTIVE STATISTICS - II	2
	FYBA		RUASTAP201	Practical based on RUASTA201	1
	SYBA	ŧ	RUASTA301	STATISTICAL METHODS - I	2
	SYBA	Ē	RUASTA302	OPERATIONS RESEARCH	2
2	SYBA	III	RUASTAP301	Practical based on RUASTA301 & RUASTA302	2
	SYBA	IV	RUASTA401	STATISTICAL METHODS – II	2
	SYBA	IV	RUASTA402	PROJECT MANAGEMENT AND INDUSTRIAL STATISTICS	2



SYBA	IV	RUASTAP401	Practical based on RUASTA401 & RUASTA402	2
ТҮВА	V	RUASTA501	1 PROBABILITY DISTRIBUTIONS	
ТҮВА	V	RUASTA502	THEORY OF SAMPLING	3
ТҮВА	V	RUASTA503	ELEMENTS OF ACTUARIAL SCIENCE	2.5
TYBA	V	RUASTAP501	Practical based on RUASTA501, RUASTA502 & RUASTA503	3
ТҮВА	VI	RUASTA601	PROBABILITY AND SAMPLING DISTRIBUTIONS	3
TYBA	VI	RUASTA602	ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS	3
ТҮВА	VI	RUASTA603	APPLIED STATISTICS	2.5
ТҮВА	VI	RUASTAP601 Practical based on RUASTA601, RUASTA602 & RUASTA603		3
		Right		



Course Code: RUASTA101 Course Title: DESCRIPTIVE STATISTICS - I Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION
OUTCOME	A student completing this course will be able to:
CO 1	Distinguish between different types of scales. Compare the different
	types of data and describe the various methods of data collection.
CO 2	Compute Yule's coefficient of association Q and Yule's coefficient of
	Colligation Y and associate two attributes, and relate Q and Y.
CO 3	Construct Univariate and Bivariate frequency distribution of discrete,
	continuous variables and Cumulative frequency distribution. Draw
	Graphs and Diagrams: Histogram, Polygon/curve, Ogives. Heat Map,
	Tree map.
CO 4	Describe the need of measures of central tendency, Explain the
	various measures of central tendencies. Relate mean, median and
	mode. Justify merits and demerits of using different measures.
CO 5	Compute and comprehend the measures of dispersion. Compare
	Absolute and Relative measures of dispersion.
CO 6	Relate raw moments and central moments. Understand Skewness
	and Kurtosis of data. Identify the outliers.

	Course	Unit	Course/ Unit Title	Credits/
	Code/ Unit			Lectures
	RUASTA101	Unit	Types of Data and Data Condensation:	15
		I	 Global Success stories of 	Lectures
			Statistics/Analytics in various fields.	
Q	6		 Concept of Population and Sample. Finite, Infinite Population, Notion of SRS, SRSWOR and SRSWR 	
			 Different types of scales: Nominal, Ordinal, Interval and Ratio. 	
			 Methods of Data Collection: i) Primary data: concept of a Questionnaire and a Schedule, ii) Secondary Data 	



RUASTA101	Unit	 Types of data: Qualitative and Quantitative Data; Time Series Data and Cross Section Data, Discrete and Continuous Data Tabulation Dichotomous classification- for two and three attributes, Verification for consistency Association of attributes: Yule's coefficient of association Q. Yule's coefficient of Colligation Y, Relation between Q and Y (with proof). Univariate frequency distribution of discrete and continuous variables. Cumulative frequency distribution Data Visualization: Graphs and Diagrams: Histogram, Polygon/curve, Ogives. Heat Map, Tree map. Bivariate Frequency Distribution of discrete and continuous variables Measures of central tendency Concept of central tendency of data, Requirements of good measures of central tendency. Location parameters: Median, Quartiles, Deciles, and Percentiles Mathematical averages Arithmetic mean (Simple, weighted mean, combined mean), Geometric mean, Harmonic mean, Mode, Trimmed mean. Empirical relation between mean, median and mode. Merits and demerits of using different measures 	15 Lectures
	Unit	Massures of Dispersion, Skowness & Kurtosis	15
RUASTA101	Unit III	 Measures of Dispersion, Skewness & Kurtosis Concept of dispersion, Requirements of good measure Absolute and Relative measures of dispersion: Range, Quartile Deviation, Inter Quartile Range, Mean absolute deviation, Standard deviation. Variance and Combined variance, raw moments and central moments and relations between them. Their properties Concept of Skewness and Kurtosis: Measures of Skewness: Karl Pearson's, Bowley's and Coefficient of skewness based on moments. Measure of Kurtosis. Absolute and relative measures of skewness. Box Plot: Outliers 	15 Lectures



Course Code RUASTAP101					
Sr. No.	Practicals based on course				
1	Tabulation				
2	Classification of Data				
3	Attributes				
4	Diagrammatic representation				
5	Measures of central tendency				
6	Measures of dispersion				
7	Practical using Excel				
	i) Classification of Data and Diagrammatic representation				
	ii) Measures of central tendency				
	iii) Measures of dispersion				

References:

- 1. Medhi J.: "Statistical Methods, An Introductory Text", Second Edition, New Age International Ltd.
- 2. Agarwal B.L.: "Basic Statistics", New Age International Ltd.
- 3. Spiegel M.R.: "Theory and Problems of Statistics", Schaum's Publications series. Tata McGraw-Hill.
- 4. Kothari C.R.: "Research Methodology", Wiley Eastern Limited.
- 5. David S.: "Elementary Probability", Cambridge University Press.
- 6. Hoel P.G.: "Introduction to Mathematical Statistics", Asia Publishing House.
- 7.Hogg R.V. and Tannis E.P.: "Probability and Statistical Inference". McMillan Publishing Co. Inc.
- 8. Pitan Jim: "Probability", Narosa Publishing House.
- 9. Goon A.M., Gupta M.K., Dasgupta B.: "Fundamentals of Statistics", Volume II: The World Press Private Limited, Calcutta.
- 10. Gupta S.C., Kapoor V.K.: "Fundamentals of Mathematical Statistics", Sultan Chand &Sons
- 11. Gupta S.C., Kapoor V.K.: "Fundamentals of Applied Statistics", Sultan Chand & Sons



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	A B or C	20	Unit I
2	A B or C	20	Unit II
3	A B or C	20	Unit III
	TOTAL	60	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

	Particulars	Marks
X	Journal	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	30
marks each with internal choice)	0
Total	30

Overall Examination & Marks Distribution Pattern

Semester I

Course	RUASTA101		
	Internal	Total	
Theory	40	60	100
Practicals	20 30 50		

Course Code: RUASTA201 Course Title: DESCRIPTIVE STATISTICS - II

Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION			
OUTCOME A student completing this course will be able to:				
CO 1	Compute the numerical measures to identify the direction and strength of			
0	linear relationship between two variables using. Also, list their properties.			
CO 2	Build a simple linear regression model and interpret regression coefficients			
	and coefficient of determination.			
CO 3	Calculate and interpret various measures of associations between two attributes.			
CO 4	Identify various components of time series. Apply the appropriate methods			
	to evaluate and eliminate these components.			
CO 5	Comprehend the concept and construct various index numbers.			
CO 6	Use the basic mathematical operators in R for different data types. Apply different data management techniques and data visualisation.			



	Course	Unit	Course/ Unit Title	Credits/	
	Code/ Unit			Lectures	
	RUASTA201	UNIT	Correlation, Simple linear Regression Analysis	15	
		I	and Fitting of curves	LECTURES	
			Karl Pearson's Product moment correlation		
			coefficient and its properties.		
			 Spearman's Rank correlation. (With and without ties) 		
			 Concept of Simple linear regression. Principle of least squares. Fitting a straight line by method of least squares (Linear in December 1) 		
			 Relationship between regression coefficients 		
			and correlation coefficient, cause and effect		
			 Concept and use of coefficient of determination 		
			(R ²).		
			• Measures of association with the help of Tau A,		
			Tau B, Tau C, Gamma and Lambda, Somer's d		
			Fitting of curves reducible to linear form by transformation		
	RUASTA201	Unit	Time Series and Index numbers	15	
		Ш	 Definition of time series. Components of time 	LECTURES	
			series. Models of time series.		
			 Estimation of trend by: (i) Freehand Curve 		
			Method (ii) Method of Semi Average (iii) Method		
			of Moving Average (iv) Method of Least Squares		
			(Linear Trend Only)		
			of Simple Average (ii) Ratio to Moving Average		
			(III) Ratio to Trend Method		
			Stationary Time series		
		\sim	Index numbers:		
		0	 Index numbers as comparative tool. Stages in the 		
			construction of Price Index Numbers.		
			• Measures of Simple and Composite Index		
			Numbers. Laspeyre's, Paasche's, Marshal-		
			Edgeworth S, Dobisch & Bowley's and Fisher's		
	0		Quantity Index Numbers and Value Index		
			Numbers Time reversal test, Factor reversal test,		
4	~		Circular test		
			• Fixed base Index Numbers, Chain base Index		
			Numbers. Base shifting, splicing and deflating.		
			Cost of Living Index Number. Concept of Real Income		
			income.		



RUASTA201	UNIT	Fundamentals of R:	15
RUASTA201	UNIT	 Fundamentals of R: Introduction to R, features of R, installation of R, Starting and ending R session, getting help in R, Value assigning to variables, Basic Operations : +, -, *, ÷, ^, sqrt, Numerical functions : log 10, log , sort, max, unique, range, length, var, prod, sum, summary, dim, sort, five num etc. Data Types: Vector, list, matrices, array and data frame, Variable Type: logical, numeric, integer, complex, character and factor Data Manipulation: Selecting random N rows, removing, duplicate row(s), dropping a variable(s), Renaming variable(s), sub setting data, creating a new variable(s), selecting of random fraction of row(s), appending of row(s) and column(s), simulation of variables. Data Processing: Data import and export, setting working directory, checking structure of Data: Str(), Class(), Changing type of variable (for eg as.factor, as.numeric) Data Visualisation using ggplot: Simple bar diagram, subdivided bar diagram, multiple bar diagram pie diagram, frequency polygon, scatter 	15 LECTURES
		Scatter Diagram.	

	Course Code RUASTAP201				
Sr. No.	Sr. No. Practicals based on course				
1	Correlation analysis				
2	Regression analysis				
3	Fitting of curve				
4	Time series				
5	Index Numbers.				
6	6 Practical using R				
	i) Measures of Central Tendency	iv) Correlation analysis			
	ii) Measures of Dispersion	v) Regression analysis			
iii) Diagrams and Graphs vi) Fitting of curve					

- 1. Medhi J.: "Statistical Methods, An Introductory Text", Second Edition, New Age International Ltd.
- 2. Agarwal B.L.: "Basic Statistics", New Age International Ltd.



- 3. Spiegel M.R.: "Theory and Problems of Statistics", Schaum's Publications series. Tata McGraw-Hill.
- 4. Kothari C.R.: "Research Methodology", Wiley Eastern Limited.
- 5. David S.: "Elementary Probability", Cambridge University Press.
- 6. Hoel P.G.: "Introduction to Mathematical Statistics", Asia Publishing House.
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- 9. Goon A.M., Gupta M.K., Dasgupta B.:"Fundamentals of Statistics", Volume II: The World Press Private Limited, Calcutta.
- 10. Gupta S.C., Kapoor V.K.: "Fundamentals of Mathematical Statistics", Sultan Chand &Sons
- 11. Gupta S.C., Kapoor V.K.: "Fundamentals of Applied Statistics", Sultan Chand & Sons

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	А	20	L Init I
		B or C		Offici
	2	А	20	Lipit II
		B or C		Onit II
	2	А	20	
	5	B or C	20	
		TOTAL	60	



Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	5
Projects based on primary / secondary data	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 II

• (

	Course	RUASTA201		
		Internal	External	Total
	Theory	40	60	100
s'0'	Practicals	20	30	50
anna				

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Course Code: RUASTA301 Course Title: STATISTICAL METHODS- I Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION
OUTCOME	A student completing this course will be able to:
CO 1	Differentiate between random and non-random experiments
CO 2	Compute the probabilities of events
CO 3	Understand the concept of a random variable, its probability distribution of
	a random variable (one or two) and its properties
CO 4	Apply standard discrete probability distributions based on real life
	situations

Course	Unit	Course/ Unit Title	Credits/
Code/ Unit			Lectures
RUASTA301	Unit	Elementary Probability Theory	15
anna		 Trial, random experiment, sample point and sample space. Definition of an event, Operation of events, mutually exclusive and exhaustive events. Classical (Mathematical) and Empirical definitions of Probability and their properties. Theorems on Addition and Multiplication of probabilities Independence of events, Pair-wise and Mutual Independence for three events, Conditional probability, Bayes' theorem and its applications 	Lectures
RUASTA301	Unit	Discrete random variable	15
	11	 Random variable. Definition and properties of probability distribution and cumulative distribution function of discrete random variable. Raw and Central moments and their relationships. 	Lectures



		 Concepts of Skewness and Kurtosis and their uses. Expectation of a random variable. Theorems on Expectation & Variance. Concept of Generating function, Moment Generating function, Cumulant generating function, Probability generating function Joint probability mass function of two discrete random variables. Independence of two random variables. Marginal and conditional distributions. Theorems on Expectation &Variance, Covariance and Coefficient of Correlation.
RUASTA301	Unit	Some Standard Discrete Distributions 15
	III	 Degenerate (one point): Discrete Uniform, Bernoulli, Binomial, Poisson and Hypergeometric distributions derivation of their mean and variance for all the above distributions. Moment Generating Function and Cumulant Generating Function of Binomial and Poisson distribution. Recurrence relationship for probabilities of Binomial and Poisson distributions, Poisson approximation to Binomial distribution, Binomial approximation to hypergeometric distribution.

Course Code RUASTAP301(A)						
Sr. No.	Practicals based on course					
1	Probability					
2	Discrete Random Variables					
3	Bivariate Probability Distributions					
4	Binomial Distribution					
5	Poisson Distribution					
6	Hypergeometric Distribution					
7	Practical using Excel					
	i) Binomial distribution					
	ii) Poisson distribution					
	iii) Hypergeometric distribution					

References:

- 1. Medhi J.: "Statistical Methods, An Introductory Text", Second Edition, New Age International Ltd.
- 2. Agarwal B.L.: "Basic Statistics", New Age International Ltd.



- 3. Spiegel M.R.: "Theory and Problems of Statistics", Schaum's Publications series. Tata McGraw-Hill.
- 4. Kothari C.R.: "Research Methodology", Wiley Eastern Limited.
- 5. David S.: "Elementary Probability", Cambridge University Press.
- 6. Hoel P.G.: "Introduction to Mathematical Statistics", Asia Publishing House.
- Hogg R.V. and Tannis E.P.: "Probability and Statistical Inference". McMillan Publishing Co. Inc.
- 8. Pitan Jim: "Probability", Narosa Publishing House.
- 9. Goon A.M., Gupta M.K., Dasgupta B.: "Fundamentals of Statistics", Volume II: The World Press Private Limited, Calcutta.
- 10. Gupta S.C., Kapoor V.K.: "Fundamentals of Mathematical Statistics", Sultan Chand & Sons
- 11. Gupta S.C., Kapoor V.K.: "Fundamentals of Applied Statistics", Sultan Chand & Sons

Course Code: RUASTA302

Course Title: OPERATIONS RESEARCH

Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION
OUTCOME	
	A student completing this course will be able to:
CO 1	Formulate and solve a linear programming problem graphically and
	using simplex method.
CO 2	Obtain dual of a given problem and solve the primal from the optimum
	solution of a primal.
CO 3	Solve a transportation problem and its variants using various methods
	and optimise it.
CO 4	Solve an assignment problem and its variants using Hungarian
	methods.
CO 5	Process sequencing problems using Johnson's Method



Course Code/	Unit	Course/ Unit Title	Credits/
Unit			Lectures
RUASTA302	Unit	Linear Programming Problem (L.P.P.):	15
	I	Mathematical Formulation: Maximization &	Lectures
		Minimization. Concepts of Solution, Feasible	
		Solution, Basic Feasible Solution, Optimal	
		solution.	
		 Graphical Solution for problems with two 	
		variables. Simplex method of solving problems	S
		with two or more variables. Big M method.	
		• Concept of Duality. Its use in solving L.P.P.	
		Relationship between optimum solutions to	
		Primal and Dual. Economic interpretation of	
		Dual.	
RUASTA302	Unit	Transportation Problem:	15
	II	• Concept, Mathematical Formulation. Concepts	Lectures
		of Solution, Feasible Solution. Initial Basic	
		Feasible Solution by North-West Corner Rule,	
		Matrix Minima Method, Vogel's Approximation	
		Method. Optimal Solution by MODI Method.	
		Optimality test, Improvement procedure.	
		• Variants in Transportation Problem:	
		Unbalanced, Maximization type, Restricted	
		allocations.	
RUASTA302	Unit (Assignment Problem:	15
		Concept. Mathematical Formulation	Lectures
		Solution by: Complete Enumeration Method and	
		Hungarian method.	
×	O	• Variants in Assignment Problem: Unbalanced,	
		Maximization type.	
		Airline Operating Problem	
		I ravelling Salesman Problem	
		Sequencing:	
6		Processing n Jobs through 2 and 3 Machines, 2	
		Jobs through m Machines and n jobs through m	
•		machines	



	Course Code RUASTAP301(B)	
Sr. No.	Practicals based on course	
1	Formulation and Graphical Solution of L.P.P.	2
2	Simplex Method.	,0
3	Duality.	
4	Transportation.	
5	Assignment.	
6	Sequencing.	
7	Problems solving using TORA.	

- 1. Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons: Operations Research
- 2. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.: Schaum Series book in O.R.
- 3. Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons: Operations Research
- 4. J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.: Mathematical Models in Operations Research
- 5. Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.: Principles of Operations Research with Applications to Management Decisions
- 6. S.D.Sharma.11th edition, Kedar Nath Ram Nath & Company.: Operations Research
- 7. H. A.Taha.6th edition, Prentice Hall of India.: Operations Research
- 8. J.K.Sharma, (2001), MacMillan India Ltd.: Quantitative Techniques For Managerial Decisions



Modality of Assessment

Theory Examination Pattern:

C) 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

D) 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	A B or C	20	Unit I
2	A B or C	20	Unit II
3	A B or C	20	Unit III
	TOTAL	60	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	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	30
marks each with internal choice)	
Total	30

Overall Examination & Marks Distribution Pattern

Semester III

Course	RUASTA301			RUASTA301 RUASTA302			Grand Total
	Internal	External	Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Course Code: RUASTA401 Course Title: STATISTICAL METHODS - II

Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION				
OUTCOME	A student completing this course will be able to:				
CO 1	Obtain a probability density function and cumulative distribution				
	function for continuous random variable				
CO 2	Apply standard continuous probability distributions to different situations				
CO 3	Distinguish between point estimation and interval estimation				
CO 4	Define the various terminologies of testing of hypotheses and apply large sample tests				



Code/ Unit Lecture RUASTA401 UNIT Continuous random variable and some Standard 15 Lecture I Continuous Distributions 15 Lecture	tures
RUASTA401UNITContinuous random variable and some Standard15 LecIContinuous Distributions	tures
I Continuous Distributions	2
	$\mathbf{A}\mathbf{O}$
Concept of Continuous random variable and	
properties of its probability distribution	YO .
Probability density function and cumulative	
distribution function.	
Their graphical representation.	
Expectation of a random variable and its	
properties. Concept of M.G.F. and C.G.F.	
characteristics. Measures of location, dispersion,	
Rewiness and control momente (cimple illustrations)	
Iniform Exponential distribution (location and	
scale parameter) memory less property of	
exponential distribution. Derivations of mean,	
median, variance, MG.F. and C.G.F. for Uniform	
and Exponential distributions.	
RUASTA401 UNIT Normal Distribution and Sampling Distribution 15 Lec	tures
II • Normal distribution	
Properties of Normal distribution/curve (without	
proof). Use of normal tables.	
Normal approximation to Binomial and Poisson distribution (statement only)	
Sample from a distribution: Concept of a statistic	
estimate and its sampling distribution. Parameter	
its estimator and bias, unbiasedness, standard	
error of an estimator.	
 Concept of Central Limit theorem (statement 	
only)	
 Sampling distribution of sample mean and 	
sample proportion	
onerence between two population means and two	
Standard errors of sample mean and sample	
proportion.	
RUASTA401 UNIT Basics of Theory of Estimation and Testing of 15 Lec	tures
III hypothesis	
Point and Interval estimate of single mean, single	
proportion from sample of large size.	
Statistical tests: Concept of hypothesis, Null and	
Alternative Hypothesis, Types of Errors, Critical	

	Large sample tests For testing specified value of population mean For testing specified value in difference of two magnetic
	means
	For testing specified value of population proportion
	For testing specified value of difference of
	population proportion
AX	Concept of p-value
	For testing specified value of population means For testing specified value of population proportion For testing specified value of difference of population proportion Concept of p-value

	Course Code RUASTAP401(A)					
Sr. No.	Practicals based on course					
1	Continuous Random Variables					
2	Uniform and Exponential Distributions					
3	Normal Distribution					
4	Sampling Distribution					
5	Testing of Hypothesis					
6	Large sample Tests					
7	Practical using Excel and R					
	(i) Binomial and Poisson 🔪 (ii) Uniform and Exponential					
	(iii) Normal Distribution (iv) Sampling Distribution					
	(v) Testing of Hypotheses (vi) Large Sample Tests					

- 1. Medhi J.: "Statistical Methods, An Introductory Text", Second Edition, New Age International Ltd.
- 2. Agarwal B.L.: "Basic Statistics", New Age International Ltd.
- 3. Spiegel M.R.: "Theory and Problems of Statistics", Schaum's Publications series. Tata McGraw-Hill.
- 4. Kothari C.R.: "Research Methodology", Wiley Eastern Limited.
- 5. David S.: "Elementary Probability", Cambridge University Press.
- 6. Hoel P.G.: "Introduction to Mathematical Statistics", Asia Publishing House.
- 7.Hogg R.V. and Tannis E.P.: "Probability and Statistical Inference". McMillan Publishing Co. Inc.
- 8. Pitan Jim: "Probability", Narosa Publishing House.
- 9.Goon A.M., Gupta M.K., Dasgupta B.:"Fundamentals of Statistics", Volume II: The World Press Private Limited, Calcutta.
- 10. Gupta S.C., Kapoor V.K.: "Fundamentals of Mathematical Statistics", Sultan Chand &Sons
- 11. Gupta S.C., Kapoor V.K.: "Fundamentals of Applied Statistics", Sultan Chand & Sons

Course Code: RUASTA402

Course Title: PROJECT MANAGEMENT AND INDUSTRIAL STATISTICS Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION
OUTCOME	A student completing this course will be able to:
CO 1	Draw project networks for probabilistic and deterministic time estimates to obtain critical path.
CO 2	Crash activities to optimise the project cost and update networks from time to time.
CO 3	Construct various control charts for variables and attributes to obtain standard values for future use.
CO 4	Design a single sampling plan and obtain its various characteristics and understand the concept of Double Sampling Plan

Course	Unit	Course/ Unit Title	Credits/
Code/ Unit			Lectures
RUASTA402	Unit	CPM and PERT:	15
	2	 Objective and Outline of the techniques. Diagrammatic representation of activities in a project: Gantt Chart and Network Diagram. Slack time and Float times. Determination of 	Lectures
and		Critical path. Probability consideration in project scheduling.Project cost analysis.Updating.	
RUASTA402	Unit	Statistical Quality Control-I:	15
	II	 Principles of control. Process quality control of variables. X bar and R, Xbar and Sigma Chart and their uses. Problems involving setting up standards for future use. Exponentially weighted moving average (EWMA) control charts, Cumulative Sum 	Lectures

		 (CUSUM) control chart, Introduction to Six sigma limits. Concept of Natural Tolerance Limits, Specification Limits and Detection of shift 	
RUASTA402	Unit	Statistical Quality Control-II:	15
	III	• Principles of control. Process quality control of	Lectures
		attributes p, c, np charts and their uses. p-	
		chart and C-chart with variable sample size.	
		Problems involving setting up standards for	
		future use	
		Acceptance sampling plan	\bigcirc
		Single Sampling Plans (without curtailment).	
		• OC function and OC curves. AQL, LTPD, ASN,	
		ATI, AOQ, Consumer's risk, Producer's risk.	
		Double Sampling Plan (Concept only)	

Course Code: RUASTAP401(B)				
Sr. No.	Practicals based on course			
1	PERT			
2	СРМ			
3	Project cost analysis			
4	Updating			
5	Control Charts for attributes			
6	Control Charts for variables			
7	Acceptance Sampling Plans.			
8	Practical using EXCEL and TORA software			
2				

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
- 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
- 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	A	20	
I	B or C	20	Onit I
2	A	20	l Init II
Z	B or C	20	Offiction
2	A	20	Linit III
3	B or C	20	
	TOTAL	60	

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	5
Projects based on primary / secondary data	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	30
each with internal choice)	
Total	30

Overall Examination & Marks Distribution Pattern

Semester IV

Course	RUASTA401			RUASTA402			Grand Total
	Internal External		Total	Internal	External	Total	
Theory	40	60	100	40	60	100	200
Practicals	20	30	50	20	30	50	100

Course Code: RUASTA501 Course Title: PROBABILITY DISTRIBUTIONS

Academic year 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION				
OUTCOME	A student completing this course will be able to:				
CO 1	Understand different Standard Discrete Probability Distributions.				
CO 2	Differentiate between the Standard Discrete Probability Distributions, understand their properties.				
CO 3	Solve problems after identifying the underlying distribution.				

Course Cod	le/ Unit	Course/ Unit Title	Credits/
Unit			Lectures
RUASTA50	1 Unit I	Univariate Random Variables (Discrete and	15
		Continuous):	Lectures
		 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 	
RUASTA50	1 Unit	Standard Discrete Probability Distributions:	15
	ι O Έ	• Uniform, Bernoulli, Binomial, Poisson,	Lectures
0		Geometric, Negative Binomial &	
~	J	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.	

RUASTA501	Unit	Bivariate Probability Distributions:	15
	111	 Joint Probability mass function for Discrete random variables, Joint Probability density function for continuous random variables. Their properties. 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. 	Lectures

	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.
7	Applications of R.

- 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 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION			
OUTCOME				
OUTCOME	A student completing this course will be able to:			
CO 1	Understand the need of sampling and define the principal concepts in			
	sampling			
	Sampling			
CO 2	Formulate and calculate estimates of population parameters for Simple			
	Dondom Compling Stratified Compling and Systematic compling			
	Random Sampling, Stratilied Sampling and Systematic sampling			
00.1	Contract to man of much ability a gran line			
	Contrast types of probability sampling			
CO 4	Utilize auxiliary information in survey by means of Ratio and Regression			
	method of estimation			

Course	Unit	Course/ Unit Title	Credits/
Code/ Unit			Lectures
RUASTA502	Unit	Concepts:	15
LO.	I	 Population, Population unit, Sample, Sample unit, 	Lectures
		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.	
		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	
PUASTA502	Unit	Stratified Sampling:	15
NUAUTAJUZ		Need for Stratification of population with suitable	Lectures
	•	examples. Description of Stratified Random	Lectures
		Sample	
		• Advantages of stratified random Sampling	
		• Advantages of stratilied random Sampling.	
		• Estimation of population mean 8 total in case of	
		• Estimation of population mean & total in case of Stratified Pandom Sampling (MOP within each	
		stratum Expectation & Variance of the unbiased	
		stratum). Expectation & variance of the unbiased	
		these estimators	
		Fruel Allegation Drapartianal ellegation Optimum	
		Equal Allocation, Proportional allocation, Optimum	
		anocation with and without varying costs.	
		Comparison of Simple Random Sampling, Other title of Devidence Converting Automations	
	t O	Stratified Random Sampling using	
		Proportional allocation & Neyman allocation	
RUASTA502	Unit	Ratio & Regression Estimation assuming	15
		SRSWOR:	Lectures
		Ratio Estimators for population Ratio, Mean & Tatal Europetation & MOE of the Estimators	
		Lotal. Expectation & MSE of the Estimators.	
		Estimators of MSE. Uses of Ratio Estimator.	
		• Regression Estimators for population Mean &	
		I OTAL 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.	
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.	6

	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

- 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 2020-21

COURSE OUTCOMES:

OURSE OUTC	COMES:				
COURSE	DESCRIPTION				
OUTCOME A student completing this course will be able to:					
CO 1	Understand the functions of Mortality Table and should be able to				
	relate them with the rate of mortality and calculate probabilities of				
	living and dyeing				
CO 2	Differentiate between Nominal and Effective rate of interest.				
	Analyse and evaluate various types of annuities certain, and also				
	calculate the present values and accumulated values				
CO 3	Distinguish between the Life annuities and Temporary annuities				
	and calculate the present values of various Life and Temporary				
	annuities				
CO 4	Understand the difference between assurance and insurance.				
	Evaluate the single premiums and level annual premiums for				
	various assurance schemes. Distinguish between the Net				
	premiums and the Office premiums				

	Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
	RUASTA503	Unit	MORTALITY TABLES:	15
2	0	I	 Various mortality functions. Probabilities of living and dying. The force of mortality. Estimation of µx from the mortality table. Central Mortality Rate. Laws of mortality: Gompertz's and Makeham's first law. Select, Ultimate and Aggregate mortality tables. 	Lectures

			Stationary population. Expectation of life and Average life at death	
RIIAST	Δ 5 03	Unit		15
NUASI	A303			Lectures
			Accumulated value and present value, nominal	Lectures
			 Accumulated value and present value, nominal and effective rates of interest 	
			And effective rates of interest.	. 0
			 Varying fales of interest. Equation of value. 	61
			Equaled lime of payment.	
			Present and accumulated values of annulty actual (immediate and due) with and without	
			deferment period	
			determent period.	\mathbf{O}
			Present value for perpetuity (immediate and	
			due) with and without determent Period.	
			Present and accumulated values of (i)	
			increasing annuity (ii) increasing annuity when	
			successive instalments form	
			(i) arithmetic progression (ii) Geometric	
			from that with which interest is convertible	
			Redemption of loan	
RUAST	A503	Unit	LIFE ANNUITIES AND ASSURANCE BENEFITS:	15
		III	Present value in terms of commutation	Lectures
			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	
	5	0	assurance (iii) endowment assurance (iv)	
			whole life assurance (v) special endowment	
	$\sqrt{\mathcal{O}}$		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.	
1		1	•	

	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	\sim

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
2	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	A	20		
I	B or C	20		
2	A	20		20
2	B or C	20	Unit II	
2	A	20		
5	B or C			
	TOTAL	60		

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

Particulars	Marks
Journal	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	30
each with internal choice)	
Total	30

Overall Examination & Marks Distribution Pattern

Semester V

Course	RUASTA501		e 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 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION
OUTCOME	A student completing this course will be able to:
CO 1	Understand different Standard Continuous Probability Distributions.
CO 2	Differentiate between the Standard Continuous Probability Distributions, understand their properties and solve problems based on these distributions.
CO 3	Apply Standard Continuous Probability Distributions in real life examples.

Ī	Course Code/	Unit		Course/ Unit Title	e	Credits/
	Unit					Lectures
	RUASTA601	Unit	Standard	Continuous	Probability	15
2	Unit RUASTA601	Unit	Standard Distributions • Rectangula (with Singl I & Type II • The follor distribution discussed • Mean, Me Moment property, Skewness Interrelation • Mean, Me	Continuous ar, Triangular, Expo e & Double parame bowing aspects of as (wherever app dian, Mode & Star Generating Fund Cumulant Generat and Kurtosis (bution: bution: bution:	Probability mential, Gamma eter), Beta (Type of the above blicable) to be indard deviation. ction, Additive ating Function. without proof). ibutions.	Lectures 15 Lectures
			Moment Generating (up to fou central mo absolute function of Fitting of N	Generating funct g function, Momen rth order). Recurre ments, skewness& deviation. Distribu of independent No lormal Distribution.	ion, Cumulant nts &Cumulants nce relation for kurtosis, Mean ution of linear ormal variables.	

		 Central Limit theorem for i.i.d. random variables. Log Normal Distribution: Derivation of mean & variance. 	
DUASTAGO1	Unit	Chi Squara Distribution	15
RUASTAUUT	II	 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 	Lectures
		 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 variance of a Normal population. 	
		Test for goodness of fit & Test for independence of attributes (derivation of test statistics is not expected).	
RUASTA601	Unit	t-distribution:	15
annar		 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. 	Lectures

	Course Code: RUASTAP601(A)	
Sr. No.	Practicals based on course	.0
1	Standard Continuous distributions.	
2	Normal Distribution	
3	Central Limit Theorem	0
4	Chi Square distribution	
5	t distribution	
6	F distribution	
7	Practical using Excel, R software	

- 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 2020-21

COURSE OUTCOMES:

COURSE	DESCRIPTION
OUTCOME	A student completing this course will be able to:
CO 1	Demonstrate analysis of one-way and two-way classification
CO 2	Explain the different components of ANOVA Table
CO 3	Define fundamental concepts in Designs of Experiment, describe the
	principles of designs of experiment and list the different types of
	experimental designs
CO 4	Analyse CRD, RBD and LSD using ANOVA
CO 5	Construct factorial experiments, analyse them and understand the
	concept of confounding

[Course Code/	Unit	Course/ Unit Title	Credits/
	Unit			Lectures
	RUASSTA602	Unit	Analysis of Variance:	15
			 Introduction, Uses, Cochran's Theorem 	Lectures
			(Statement only).	
			 One-way classification with equal & unequal 	
	~0`		observations per class,	
			 Two-way classification with one observation 	
			per cell.	
			• For both the cases: Mathematical Model,	
	0		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.	

	RUASSTA602	Unit	Design Of Experiments:	15
			Concepts of Experiments Experimental unit	
			Treatment Yield Block Replicate	Lectures
			Experimental Error, Precision	
			 Principles of Design of Experiments: 	
			Replication Randomization & Local Control	
			 Efficiency of design D4 with respect to design 	
			D_2	6
			 Choice of size shape of plots & blocks in 	
			agricultural & non-agricultural experiments	
			Completely Randomized Design (CRD) &	
			Randomized Block Design (RBD):	N
			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	
			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	Latin Square Design (LSD):	15
		111	• Mathematical Model, Assumptions,	Lectures
			Expectation of various sums of squares, F-	
			test, Analysis of variance table.	
			• Least square estimators of the parameters,	
		\sim	Variance of the estimators, Estimation of	
			treatment contrasts, Standard error and	
			Confidence limits for elementary treatment	
			contrasts.	
	~0`		• Efficiency of the design relative to RBD, CRD.	
			Missing plot technique for one missing	
			observation in case of LSD.	
	\sim		Factorial Experiments: Definition, Purpose &	
	0		Advantages. 2 ² , 2 ³ Experiments.	
			• Calculation of Main & interaction Effects. Yates'	
Ť			method. Analysis of 2 ² & 2 ³ factorial	
			Experiments. Concept of Confounding.	
			(partial and total)	

	Course Code: RUASTAP601(B)	
Sr. No.	Practicals based on course	60
1	Analysis of Variance- One Way	
2	Analysis of Variance- Two Way	D
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 and R software]

- 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 2020-21

COURSE OUTCOMES:

OURSE OUIC	COMES:	Ζ
COURSE	DESCRIPTION	5
OUTCOME	A student completing this course will be able to:	
CO 1	Understand the concept of Predictive modelling and use techniques	
	like regression analysis, time series for real life situations.	
CO 2	Simulate random numbers and random observations for various probability distributions. Apply Monte-Carlo technique to solve problems in Inventory and Queueing Theory.	
CO 3	Understand the various terminologies of Micro Economics and its applications.	

	Course Code/ Unit	Unit	Course/ Unit Title	Credits/ Lectures
	RUASTA603	Unit	LINEAR REGRESSION	15
5	annar		 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 R² and adjusted R². 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. 	Lectures

		 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 A guara & t ratios (iii) Variance Inflation Factor	
		(VIF)	Ó
RUASTA603	Unit	SIMULATION	15
	II	 Scope of simulation applications. Types of 	Lectures
		simulation. Monte Carlo Technique of Simulation	
		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.	
		DECISION THEORY	
		Decision making under uncertainty: Laplace oritorion Maximax (Minimin) critorion Maximin	
		(Minimax) criterion Hurwicz a criterion Minimax	
		Rearet criterion.	
		• Decision making under risk: Expected Monetary	
		Value criterion, Expected Opportunity Loss	
		criterion, EPPI, EVPI. Bayesian Decision rule for	
		Posterior analysis.	
DULADITAGO		Decision tree analysis.	4.5
KUASTA603		Mathematical Economics:	15 Loctures
	ш	functions. Cost and Revenue functions. The	Lectures
		elasticity of a function Flasticity of (i) Demand (ii)	
.	0	Cost.	
		•Normal conditions of (i) demand (ii) cost. Features	
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		of prefect competition.	
		<ul> <li>Monopoly (including effects of taxation and</li> </ul>	
		subsidy), Duopoly.	
		<ul> <li>Production function. Euler's theorem linear</li> </ul>	
S		homogenous production functions, Cobb-Douglas	
		production function, CES production function.	
		I he elasticity of substitution.	

![](_page_44_Picture_1.jpeg)

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							

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- 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
- 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.
- Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley
   & Sons.: Operations Research: Methods and Problems
- 10. JK Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.:
  - Mathematical Models in Operations Research
- 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

![](_page_45_Picture_1.jpeg)

#### **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	A B or C	20	Unit I
2	A B or C	20	Unit II
3	A B or C	20	Unit III
	TOTAL	60	

#### **Practical Examination Pattern:**

A) Internal Examination: 40%- 40 Marks

	Particulars	Marks
X	Journal	5
	Projects based on primary / secondary data	15
	Total	20

![](_page_46_Picture_1.jpeg)

#### 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			se 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

Raminarain