CHRIST COLLEGE
(AUTONOMOUS) IRINJALAKUDA - KERALA

DEPARTMENT OF MATHEMATICS(SELF)

BACHELOR OF

MATHEMATICS

COURSE PLAN

2020-2021

EVEN SEMESTER

COORDINATOR: Dr JOJU K.T

LIST OF CONTENTS

CHRIST COLLEGE
(AUTONOMOUS) IRINJALAKUDA - KERALA

DEPARTMENT OF MATHEMATICS (SELF)

SEMESTER 2

Course	Title	Contact Hours	Credits	Internal	External	Total Marks
Complimentary	**STA 2C 02- PROBABILITY THEORY**	4	3	15	60	75
Complimentary	**ME2C02**	4	2	15	60	75
Core	**MTS2B02 Calculus Of Single Variable-1**	4	4	20	80	100

STA 2C 02- PROBABILITY THEORY.
Lecture Hours per week: 5, Credits: 3
Internal: 15, External: 60, Examination 2 Hours

Objectives

1. To make the students able to understand basic probability axioms and rules.
2. To give the knowledge of calculating probabilities and derive the marginal and conditional probability distributions.

Module 1

Introduction to Probability: Random experiment, Sample space, events, classical definition of probability, statistical regularity, field, sigma field, axiomatic definition of probability and simple properties, addition theorem (two and three events), conditional probability of two events, multiplication theorem, independence of events-pair wise and mutual, Bayes theorem and its applications.

(25 hours)

Module 2

Random variables: Discrete and continuous, probability mass function (pmf) and probability density function (pdf)-properties and examples, Cumulative distribution function and its properties, change of variables (univariate case only)

(12 hours)

Module 3

Mathematical expectations (univaraite): Definition, raw and central moments (definition and relationships), moment generation function and properties, characteristic function (definition and use only), Skewness and kurtosis using moments

(15 hours)

Module 4

Bivariate random variables: Joint pmf and joint pdf, marginal and conditional probability, independence of random variables, function of random variable. Bivariate Expectations, conditional mean and variance, covariance, Karl Pearson Correlation coefficient, independence of random variables based on expectation.

(20 hours)

References :

1. V. K. Rohadgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
2. S.C.Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. A.M. Mood, F.A. Graybill and D C Bose, Introduction to Theory of Statistics, McGraw Hill.
4. John E Freund, Mathematical Statistics, Pearson Edn, New Delhi
5. Hoel P.G. Introduction to mathematical statistics, Asia Publishing house.

Unit/ session/ hours (time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 Introduction to probability 25 hours	• Basic concepts of probability • Axiomatic definition • Bayes theorem	• Lecture • **Problems**	• Assignment-Problems	To understand the basic concepts of probability axioms and rules	Class tests, assignment
Module-2 Random variables **12 Hours**	• Discrete and continuous random variables • Change of avriables	• Lecture • **Problem solving** • **Discussion**	• Seminars • Assignment	To understand to derive probability density functions	Class Tests. Assignment
Module-3 Mathematical expectations **15 Hours**	• Raw moments and central moments • Skewness and kurtosis	• Lecture • Discussion • Problem solving	• Assignment	To understand the relationship between raw moments and central moments	Assignment test
Module-4 Bivariate random variables **20 Hours**	• Marginal and conditional probability • Karl Pearsons correlation coefficient	• Lecture • **Problem solving** • **Discussion**	• Seminar	To understand how to derive the marginal and conditional probability distributions.	Evaluation through class test.

Course outcomes

CO1	To understand the basic concepts of probability axioms and rules
CO2	To understand to derive probability density functions
CO3	To understand the relationship between raw moments and central moments
CO4	To understand how to derive the marginal and conditional probability distributions.

UNIT WISE BREAK UP

LECTURE HOURS: 90

OBJECTIVE

a) The major objective of probability theory is to provide the basic concepts of probability axioms and rules. Able to understand how to derive the probability density functions.

b) To understand the relationship between raw moments and central moments

To understand how to derive the marginal and conditional probability distributions. To understand the concepts of independence of two random variables

c) To understand to find skewness and kurtosis using moments.

Module Number	Topic	No. of Lecture Hours	Pre- class activity	Pedagogy (in class)	Out of class assignment
Module 1 :	**Introduction to probability theory**	**25**	Concept of probability, sample space, events	Lecture and Discussion	To make short notes
Unit 1.	Basic concepts of probability	6			
Unit 2.	Axiomatic definition	15			
Unit 3.	Bayes theorem	4			
Module 2	**Random variables**	**12**			
Unit 1.	Discrete and continuous random variables	9	Basic definitions and properties of random variables	Lecture and Problems	Class test
Unit 2.	Change of variables	3	Definitions and problems	Lecture and Problems	Assignment
Module 3	**Mathematical expectations**	**15**			
Unit 1	Raw and central moments	10	Relationship between raw and central moments	Lecture and Problems	Assignment
Unit 2.	Skewness and kurtosis	5	Skewness and kurtosis using moments	Lecture	Class test
Module Number	**Topic**	**No. of Lecture Hours**	**Pre- class activity**	**Pedagogy (in class)**	**Out of class assignment**
Module 4	**Bivariate random variables**	**20**			
Unit 1.	Joint probability density and probability mass functions	7	Concepts of marginal and conditional probability	Problems	Applied problems
Unit 2.	Bivariate expectations	7	Conditional mean and variance	Lecture and problems	Applied problems
Unit 2.	Karl Pearsons correlation coefficient	6	Independence based on expectation	Lecture and problems	Class test

Teacher in Charge : Geethu Gopinath

ME2CO2 MATHEMATICAL ECONOMICS
Lecture Hours per week: 4, Credits:2
Internal: 15, External: 60, Examination 2 Hours

Objectives

To familiarize student with the use of Mathematical tools in Economics

Module I(Text 1) (9 Hrs.)

Inequalities in Income Inequalities in Income-Causes of inequalities, Measures to reduce inequality, Measurement of inequality of income- Lorenz curve, Gini ratio. (9 Hrs)

Module II (Text 2) (18Hrs)

Chapter 14: Calculus of Several Variable: Directional Derivatives and Gradients, the gradient vector, Explicit functions from $\mathbb{R}^n$ to $\mathbb{R}$, Approximation by Differentials, Jacobian derivative, The Chain rule, Higher Order Derivative. Continuously differentiable functions, Second order derivatives and Hessians, Young's theorem, An economic application

Chapter 17 Unconstrained Optimization: Definitions, First Order Conditions, Second Order Conditions, sufficient conditions, necessary conditions, Global Maxima and Minima, Global Maxima of Concave Functions, Economic Applications, profit maximizing firm, discriminating monopolist, least squares analysis

Module III (Text 2) (18Hrs)

Chapter 18 Constrained Optimization I: First Order Conditions : Objective function, constraint functions, Examples, Equality Constraints, two variables and one equality constraint, several equality constraints, inequality constraints, one inequality constraint, several inequality constraints, Mixed Constraints, Constrained Minimization Problems, Kuhn-Tucker Formulation, Examples and Applications,
(Sec. 18.1,18.2,18.3,18.4,18.5,18.6,18.7)

Module IV(Text 3)(19Hrs)

Input Output Analysis Introduction – assumption-technological coefficient matrix-closed and open input output model-coefficient matrix and open model-the Hawkins-Simon conditions-solutions for two industries determination of equilibrium of prices- coefficient matrix and closed model-The Leontief production function-limitation of input output analysis (sec.19.1 to 19.7, 19.9,19.11,19.13)

Texts

Text (1)	M L Jhingan: Micro Economic Theory(6/e) *Vrinda Publications*
Text (2)	Carl P Simon, Lawrence Blume: Mathematics for Economists *W. W. Norton & Company, Inc (1994) ISBN 0-393-95733-O*
Text (3)	Mchta-Madnani: Mathematics for Economics *Revised Edn S Chand*

References:

1 .A C Chiang & K Wainwright: Fundamentals of Mathematical Economics (4/e) *McGraw Hill*

2 .R G D Allen: Mathematical Analysis for Economists *Macmillain*

3 .Urmila Diwekar: Introduction to Applied Optimization(2/e) *Springer*

Science+Business Media, LLC(2008) ISBN: 978-0-387-76634-8

4 .Michael D Intriligator: Mathematical Optimization and Economic

Theory *Classics in Applied Mathematics,SIAM(2002)*

5 .Akinson: Distribution and Inequality Measures *TMH*

OBJECTIVES

a) ***Understand the application of different types of optimization techniques***

b) ***Understand the application of Input Output Analysis***

LESSON PLAN

Unit/ session/ hours (time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 Income Inequalities **9 Hours**	Causes of inequalities, Measures to reduce inequality, Measurement of inequality of income	• Discussion • **Participative learning**	• Problem solving	To understand the importance of: • Income Inequalities •	Evaluation Through test paper
Module-2 Calculus of Several Variable, Unconstrained Optimization **18 Hours**	Directional Derivatives, Higher Order Derivative, Continuously differentiable functions, Definitions, First Order Conditions, Second Order Conditions,	• Lecture • Discussion	• Finding New examples	To understand the application of derivatives and optimization techniques in economic sector	Evaluation Through test paper
Module-3 Constrained Optimization **18 Hours**	First Order Conditions : Objective function, constraint functions, Equality Constraints constrained Minimization Problems, Kuhn-Tucker Formulation	• Lecture • Discussion	Finding New examples	To understand the Constrained optimization applications in economic sector	Evaluation Through test paper
Module IV Input Output Analysis **19 Hours**	Introduction – assumption closed and open input output model-coefficient matrix and open model-the -The Leontief production function-limitation of input output analysis	• Lecture • Discussion	• Problem solving	To understand the application and significance of Input output model in economics	Evaluation Through test paper

Course outcomes

CO1	Understand the inequalities in income
CO2	Understand the application of derivatives in economics
CO3	Understand and apply different types of constrained and unconstrained optimization
CO4	Understand the concept of Input Output analysis

UNIT WISE BREAK UP

LECTURE HOURS: 64

OBJECTIVE

a) Understand the application of different types of optimization techniques

b) Understand the application of Input Output Analysis

LESSON PLAN

Module Number	Topic	No. of Lecture Hours	Pre- class activity	Pedagogy (in class)	Out of class assignment
Module 1 :	**Income Inequalities**	**9**	Awareness about social injustices in income	Lecture and Discussion	To make a short note on world's labor policies,
Unit 1.	inequalities In income, cause of inequalities	1			
Unit 2.	Measures to reduce inequality.	5			
Unit 3.	Lorenz curve, Gini ratio	3			
Module 2	**calculus of several variable**	**18**			
Unit 1.	calculus of several variable, directional derivatives	5	To read about theory on directional derivatives	Lecture and Discussion	Problem solving
Unit 2.	young's theorem unconstrained optimization	5	To learn the basic idea about unconstrained optimization	Lecture and Discussion	Problem solving
Unit 3	globel maxima and minima profit maximizing firm discriminating monopolist least squares analysis	8	To understand derivatives	Lecture and Discussion	Problem solving
Module 3	**constrained optimization**	**18**			
Unit 1	constrained optimization equality constrained	5	To read on the concept of constraints and Optimization	Lecture and Discussion	Problems on Making different types of constraint
Unit 2	inequality constraint mixed constraints	5	To read on the concept of different types of constraints	Lecture and Discussion	Problems on Making different types of constraint
Unit 3	constrained minimization Kuhn-tucker formulation	8	To realize the concept of constraints and minimization	Lecture and Discussion	Problems on how to formulate constraint minimization
Module 4	Input Output Analysis	**19**			
Unit 1.	input output analysis hawkins-simon conditions	5	To understand the applications of input output analysis	Illustrations and problems	Problems solving on hawkins-simon

Unit 2.	determination of equilibrium of prices coefficient matrix and closed model	8	To understand the applications of matrix	Illustrations and problems	Problems solving using matrix
Unit 3.	the Leontief production function limitation of input output analysis	2	To understand the limitations	Lecture and Discussion	Short note on different application of input output analysis

Teacher in Charge: SREEDEVI P.N.

MTS2B02 CALCULUS OF SINGLE VARIABLE-1
Lecture Hours per week: 4, Credits:4
Internal: 20, External: 80, Examination 2.5 Hours

SYLLABUS.

Text : Calculus – Soo T Tan

OBJECTIVE : To introduce students to the fundamental ideas of limit, continuity and differentiability and also to some basic theorems of *differential calculus*. It is also shown how these ideas can be applied in the problem of sketching of curves and in the solution of some optimization problems of interest in real life

MODULE 1 (20 Hours)

(*Functions and Limits*)

0.2: Functions and their Graphs- Definition of a Function, Describing Functions, Evaluating Functions, Finding the Domain of a Function, The Vertical Line Test, Piecewise Defined Functions, Even and Odd Functions (quick review)

0.4: Combining functions- Arithmetic Operations on Functions, Composition of Functions, Graphs of Transformed Functions, *Vertical Translations, Horizontal Translations, Vertical Stretching and Compressing, Horizontal Stretching and Compressing, Reflecting*

1.1: Intuitive introduction to Limits- A Real-Life Example, Intuitive Definition of a Limit, One-Sided Limits, Using Graphing Utilities to Evaluate Limits

1.2: Techniques for finding Limits-Computing Limits Using the Laws of Limits, Limits of Polynomial and Rational Functions, Limits of Trigonometric Functions, The Squeeze Theorem.

1.3: Precise Definition of a Limit-$\varepsilon-\delta definition$,A Geometric Interpretation, Some illustrative examples

1.4: Continuous Functions- Continuity at a Number, Continuity at an Endpoint, Continuity on an Interval, Continuity of Composite Functions, Intermediate Value Theorem

1.5: Tangent Lines and Rate of change- An Intuitive Look, Estimating the Rate of Change of a Function from Its Graph, More Examples Involving Rates of Change, Defining a Tangent Line, Tangent Lines, Secant Lines, and Rates of Change

2.1: The Derivatives-*Definition*, Using the Derivative to Describe the Motion of the Maglev, Differentiation, Using the Graph of f to Sketch the Graph of f' Differentiability, Differentiability and Continuity

2.4: The role of derivative in the real world- Motion Along a Line, Marginal Functions in Economics

2.9: Differentials and Linear Approximations- increments, Differentials, Error Estimates, Linear

Approximations, Error in Approximating Δy by dy

MODULE 2 (17 Hours)

(Applications of the Derivative)

3.1 : Extrema of Functions -Absolute Extrema of Functions, Relative Extrema of Functions , *Fermat's Theorem* **,** Finding the Extreme Values of a Continuous Function on a Closed Interval, An Optimization Problem

3.2 : The Mean Value Theorem- Rolle's Theorem, *The Mean Value Theorem***,** Some Consequences of the Mean Value Theorem, Determining the Number of Zeros of a Function

3.3 : Increasing and Decreasing Functions- *definition , inferring the behaviour of function from sign of derivative,* Finding the Relative Extrema of a Function, *first derivative test*

3.4 : Concavity and Inflection points- Concavity, Inflection Points, The Second Derivative Test, The Roles of f' and f'' in Determining the Shape of a Graph

3.5 : Limits involving Infinity; Asymptotes- Infinite Limits, Vertical Asymptotes, Limits at Infinity, Horizontal Asymptotes, Infinite Limits at Infinity, Precise Definitions

3.6 : Curve Sketching-The Graph of a Function, Guide to Curve Sketching, Slant Asymptotes , Finding Relative Extrema Using a Graphing Utility

3.7 : Optimization Problems –*guidelines for finding absolute extrema* , Formulating Optimization Problems- *application involving several real life problems*

MODULE 3 (14 Hours)

(Integration)

4.1: Anti derivatives, Indefinite integrals, Basic Rules of Integration, *a few basic integration formulas and rules of integration,* Differential Equations, Initial Value Problems

4.3 : Area- An Intuitive Look, The Area Problem, Defining the Area of the Region Under the Graph of a Function- *technique of approximation ['Sigma Notation' and 'Summation Formulas' Omitted]* An Intuitive Look at Area (Continued), Defining the Area of the Region Under the Graph of a Function-*precise definition*, Area and Distance

4.4 : The Definite Integral- Definition of the Definite Integral, Geometric Interpretation of the DefiniteIntegral, The Definite Integral and Displacement, Properties of the Definite Integral , More General Definition of the Definite Integral

4.5 : The Fundamental Theorem of Calculus- How Are Differentiation and Integration Related?, The Mean Value Theorem for Definite Integrals, The Fundamental Theorem of Calculus: Part I,*inverse relationship between differentiation and integration*, Fundamental Theorem of Calculus: Part 2, Evaluating Definite Integrals Using Substitution, Definite Integrals of Odd and Even Functions, The Definite Integral as a Measure of NetChange

MODULE 4 (13 Hours)

(Applications of Definite Integral)

5.1 : Areas between Curves- A Real Life Interpretation, The Area Between Two Curves, Integrating with Respect to *y- adapting to the shape of the region*, What Happens When the Curves Intertwine?

5.2 : Volume –Solids of revolution,*Volume by* Disk Method, *Region revolved about the x-axis, Region revolved about the y-axisVolume by the* Method of Cross Sections *[' Washer Method' omitted]*

5.4 : Arc Length and Areas of surfaces of revolution- Definition of Arc Length, Length of a Smooth Curve,*arc length formula* , The Arc Length Function, *arc length differentials* , Surfaces of Revolution,*surface area as surface of revolution*,

5.5 : Work-Work Done by a Constant Force, Work Done by a Variable Force, Hook's Law, Moving non rigid matter, Work done by an expanding gas

References

1	Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) *Pearson (2018) ISBN 0134438981*
2	Robert A Adams & Christopher Essex : Calculus Single Variable (8/e) Pearson Education Canada (2013) ISBN: 0321877403
3	Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015) ISBN: 1319116450
4	Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc.(2016) ISBN: 1118883764
5	Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc.(2016) ISBN: 1118883764
6	Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY (1985) ISBN 0-387-90974-5 : ISBN 0-387-90975-3

MTS2B02 CALCULUS OF SINGLE VARIABLE-1
Lecture Hours per week: 4, Credits:
Internal: 20, External: 80, Examination 2.5 Hours

LESSON PLAN

Unit/ session/ hours (time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 Functions and Limits 20 hours	Concept of limit, Continuity and derivative of functions	• Discussion • **Participative learning**	• Group discussion	To understand the Concept of limit, Continuity and derivative of functions	Evaluation Through MCQ
Module-2 Applications of the Derivative **17 Hours**	Extrema of Functions, The Mean Value Theorem, Concavity and Inflection points, Optimization Problems.	• Lecture • Assignment • **Problem solving**	• Group discussion • Assignment	To understand applications of the derivative	Test paper
Module-3 Integration **14 Hours**	Area, The Definite Integral, The Fundamental Theorem of Calculus.	• Lecture • Discussion • **Experiential Learning**	• Seminar	To understand the the concept of Integration	Viva

Unit/ session/ hours (time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module-4: Applications of Definite Integral **13 Hours**	Areas between Curves, Volume, Arc Length and Areas of surfaces of revolution, Work, Moments and Center of Mass.	• Discussion • Lecture • **Participative learning**	• Seminar	To understand the applications of Definite Integral	Evaluation through MCQ

Course outcomes

CO1	To give an account of the concept of functions and their graphs
CO2	To determine the limit, continuity and differentiability of a function
CO3	To use derivatives in applications
CO4	To familiar with integration and Fundamental Theorem of Calculus
CO5	To use integrals for the computation of area of surface of revolution, arc length, work, moments and centre of mass

UNIT WISE BREAK UP

LECTURE HOURS: 64

OBJECTIVE

- To familiar with Functions and Limits.
- To understand the use of applications of Derivative.
- To introduce the concept of Integration.
- To give an account of applications of Definite Integral.

Module Number	Topic	No. of Lecture Hours	Pre- class activity	Pedagogy (in class)	Out of class assignment
Module 1:	Functions and Limits	**20**			
Unit 1.	limit, and of functions		The concept of limit, Continuity and derivative of functions.	Group discussion	PLG understand the geometry of limit, continuity and derivative of functions with the help of You Tube videos
Unit 2.	Continuity of functions	7			
Unit 3	Derivative of functions	7			
Module 2	Applications of the Derivative	**17**			
Unit 1.	Extrema of Functions, The Mean Value Theorem	6	Read basic information from Plus two text books	Lecture, Discussion and Illustration	Problems of previous question papers.
Unit 2.	Concavity and Inflection points	6			
Unit 3	Optimization Problems	5		Lecture and Discussions	Discussion of results in PLG
Module 3	Integration	**14**			
Unit 1	Area	5	The concept of Integration, the definite	Lecture, Seminar, discussion and Illustration	Problems of Integration.
Unit 2	The Definite Integral	5			

Unit 3	The Fundamental Theorem of Calculus	4	integral, the fundamental theorem of Calculus.	Discussion and Illustration	Discussion of results in PLG
Module 4	Applications of Definite Integral	**13**			
Unit 1.	Areas between Curves,	4	Read Basic information.	Seminar, Lecture and Illustration	Discussion of results in PLG
Unit 2.	Volume, Arc Length and Areas of surfaces of revolution,	4			Problems of arc length.
Unit 3.	Work, Moments and Center of Mass.	5			Application of integration in real life

Teacher in Charge: Jomesh Jose

CHRIST COLLEGE
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DEPARTMENT OF MATHEMATICS (SELF)

SEMESTER 4

Course	Title	Contact Hours	Credits	Internal	External	Total Marks
Complimentary	**STA4C04 Statistical Inference and Quality nControl**	5	3	15	60	75
Complimentary	**ME4C04**	5	2	15	60	75
Core	**MTS4 B04 Linear Algebra**	5	4	20	80	100

STA 4C 04 STATISTICAL INFERENCE AND QUALITY CONTROL.
Lecture Hours per week: 5, Credits: 3
Internal: 15, External: 60, Examination 2 Hours

Objectives

The major objective of statistical inference is to provide estimates of unknown parameters from sample statistics.

Module I

Estimation theory: Parametric space, sample space, point estimation. Nayman Factorization criteria, Requirements of good estimator: Unbiasedness, Consistency, Efficiency, Sufficiency and completeness. Minimum variance unbiased (MVU) estimators. Cramer-Rao inequality (definition only). Minimum Variance Bound (MVB) estimators. Methods of estimation: Maximum likelihood estimation and Moment estimation methods (Detailed discussion with problems); Properties of maximum likelihood estimators (without proof); Least squares and minimum variance (concepts only). Interval estimation: Confidence interval (CI); CI for mean and variance of Normal distribution; Confidence interval for binomial proportion and population correlation coefficient when population is normal. (30 Hours)

Module II

Testing of Hypothesis: Level of significance, Null and Alternative hypotheses, simple and composite hypothesis ,Types of Errors, Critical Region, Level of Significance, Power and pvalues. Most powerful tests, Neyman-Pearson Lemma (without proof), Uniformly Most powerful tests. Large sample tests: Test for single mean, equality of two means, Test for single proportion, equality of two proportions. Small sample tests: t-test for single mean, unpaired and paired t-test. Chi-square test for equality of variances, goodness of fit, test of independence and association of attributes. Testing means of several populations: One Way ANOVA, Two Way ANOVA (assumptions, hypothesis, ANOVA table and problems) (30 Hours)

Module III

*Non-parametric methods***:** Advantages and drawbacks; Test for randomness, Median test, Sign test, Mann-Whiteny U test, Wilcoxon test; Kruskal Wallis test (Concept only) (10 hours)

Module IV

Quality Control: General theory of control charts, causes of variations in quality,

control limits, sub-grouping, summary of out-of-control criteria. Charts of variables - X bar chart, R Chart and sigma chart. Charts of attributes – c-charts, p-chart and np-chart. (Concepts and problems).(20 hours)

Reference Books:

1. V. K. Rohadgi, *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern.
2. Gupta, S.P. *Statistical Methods*. Sultan Chand and Sons: New Delhi.
3. S.C.Gupta and V. K. Kappor, *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons
4. A.M. Mood, F.A. Graybill and D C Bose, *Introduction to Theory of Statistics*, McGraw Hill
5. John E Freund, *Mathematical Statistics*, Pearson Edn, NewDelhi
6. Grant E L, *Statistical quality control*, McGraw Hill
7. Montegomery D C, *Introduction to Statistical Quality Control*, John Wiley and sons.

OBJECTIVES

c) The major objective of statistical inference is to provide estimates of unknown parameters from sample statistics. Researchers make point estimates and interval estimates. Point estimates are sample statistics used to estimate the exact value of a population parameter.

d) The main objective of statistical quality control (SQC) is to achieve quality in production and service organizations, through the use of adequate statistical techniques.

LESSON PLAN

Unit/ session/ hours (time Required)	**Topics for student preparation (input)**	**Procedure (process) Student centric Method of teaching**	**Activity**	**Learning outcome (output)**	**Assessment**
Module 1 Estimation Theory 30 hours	• Requirements of good estimator • Methods of estimation • Interval estimation	• Lecture • **Problems**	• Assignment-Problems	To understand the importance of estimation theory in Statistical Inference	Evaluation Through MCQ
Module-2	• Basic definitions	• Lecture	• Case study	To test the	Class Tests.

Testing of Hypothesis 30 Hours	of testing of hypothesis • Large sample tests • Small sample tests • Analysis of Variance	• **Problem solving** • **Discussion**	• Assignment	significant difference of population parameters.	
Module-3 Non-parametric methods 10 Hours	• Different non-parametric methods	• Lecture • Discussion	• Seminar	To understand the significance of distribution free tests.	Assignment test
Module-4: Quality control 20 Hours	• Theory of control charts • Control charts for variables • Control charts for attributes	• Lecture • Lecture with the help of power Point presentation • **Problem solving**	• Case Study	Implementation process of Statistics and Quality Control	Evaluation through class test.

Course outcomes

CO1	To understand the importance of estimation theory in Statistical Inference
CO2	To test the significant difference of population parameters.
CO3	To understand the significance of distribution free tests.
CO4	Implementation process of Statistics and Quality Control

UNIT WISE BREAK UP

LECTURE HOURS: 90

OBJECTIVE

a) The major objective of statistical inference is to provide estimates of unknown parameters from sample statistics. Researchers make point estimates and interval estimates. Point estimates are sample statistics used to estimate the exact value of a population parameter.

b) The main objective of statistical quality control (SQC) is to achieve quality in production and service organizations, through the use of adequate statistical techniques.

Module Number	Topic	No. of Lecture Hours	Pre- class activity	Pedagogy (in class)	Out of class assignment
Module 1 :	**Estimation Theory**	**30**	Concept of population, sample , parameter and statistic	Lecture and Discussion	To make short notes of parameters, statistics
Unit 1.	Point Estimation	18			
Unit 2.	Interval Estimation	12			
Module 2	**Testing of Hypothesis**	**30**			
Unit 1.	Large sample tests	10	Basic definitions of testing, meaning of sample size	Lecture and Problems	Short case study presentation of problems
Unit 2.	Small sample tests	12	When we consider a sample size as small	Lecture and Problems	Short case study presentation of problems
Unit 3	Testing means of several populations	8	To understand the estimation	Lecture and Problems	Short case study presentation of problems
Module 3	**Non-parametric methods**	**10**			
Unit 1	Different types of non-parametric tests	10	Difference between	Lecture and Problems	Applications of non-parametric

			parametric and non-parametric tests		tests
Module Number	**Topic**	**No. of Lecture Hours**	**Pre- class activity**	**Pedagogy (in class)**	**Out of class assignment**
Module 4	**Quality Control**	**20**			
Unit 1.	Control charts for variables	5	Meaning of 'Quality ' of a product	Illustrations and Work sheet	Applied problems
Unit 2.	Control charts for attributes	5	Meaning of attribute, defect, defective	Illustrations and Work sheet	Applied problems

Teacher in Charge : Ms Jiji M B

ME4CO4 MATHEMATICAL ECONOMICS
Lecture Hours per week: 5, Credits:2
Internal: 15, External: 60, Examination 2 Hours

Objectives

To familiarize student with the use of Mathematical tools in Economics

Module I(Text 1) (18 Hrs.)

Introduction to Econometrics-The nature of Regression Analysis-Two variable Regression Analysis

(pages 1 to 59 of Text)

Module II (Text 2) (22 Hrs)

Two variable Regression Model

(sec. 3.1 to 3.9 ; pages 60 to 103)

Classical normal linear regression model-two variable Regression-Internal Estimation and Hypothesis testing,

(sec. 4.1 to 4.5 and 5.1 to 5.13)

Module IV(Text 3)(18 Hrs)

Extensions of the two variable linear regression model

(sec. 6.1 to 6.10)

Texts

Text	Damodar N Gujarati & Sangeetha : Basic Economics(4/e) *TMH Indian Reprint 2008*

References:

1 .Jeffrey M. Wooldridge :Introductory Econometrics: A Modern Approach (6/e) *Cengage Learning(2016)*

2 .S P Singh, A P Parashar, H P Singh: Econometrics and Mathematical Economics *S. Chand*

3 .Douglas C. Montgomery, Elizabeth A. Peck, Geoffrey Vining: Introduction to Linear Regression Analysis (5/e) *John Wiley & Sons (2012)*

4 .Christopher Dougherty :Introduction to Econometrics(3/e) *Oxford University Press(2007)*

OBJECTIVES

e) Understand the application of regression analysis in economic theory

LESSON PLAN

Unit/ session/ hours (time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 Introduction to Econometrics **18 Hours**	Introduction to econometrics Simple linear regression Nature and sources of data Two variable regression model basic idea The sample regression function	• Discussion • Participative learning	• Discuss on econometrics	To understand the importance of: • Statistics in economic models • Mathematics in economic models	Evaluation Through test paper
Module-2 Two variable Regressi on Model **22 Hours**	Properties of OLS Test of significance of parameter estimate Guass markov theorem Coefficient of determination Coefficient of correlation Monte carlo experiment	• Lecture • Discussion	• Discuss on regression	To understand the application of regression in economic theory	Evaluation Through test paper
Module-3 Classical normal linear regression model **22 Hours**	Introduction to classical normal linear regression model Properties of OLS under normality assumption Introduction to interval estimation and hypothesis testing Confidence interval of variance Hypothesis testing	• Lecture • Discussion	• Discuss on estimation and testing of hypothesis	To understand the application of estimation and testing of hypothesis in economic theory	Evaluation Through test paper
Module IV Extensions of the two variable linear regression model **18 Hours**	Regression through origin Functional forms of regression model Reciprocal models	• Lecture • Discussion	• Discuss on different types of regression models other than linear regression	To understand the application of other regression modles	Evaluation Through test paper

Course outcomes

CO1	Understand the concept of econometrics
CO2	Understand the theoretical concept of regression analysis
CO3	Apply regression analysis in economic problems.

UNIT WISE BREAK UP

LECTURE HOURS: 80

OBJECTIVE

a) Understand the application of regression analysis in economic theory

LESSON PLAN

Module Number	Topic	No. of Lecture Hours	Pre- class activity	Pedagogy (in class)	Out of class assignment
Module 1 :	Introduction to Econometrics	**18**		Lecture and Discussion	To make a short note on regression analysis,
Unit 1.	Introduction to econometrics Simple linear regression model Nature and sources of data	6	Understand the concept of econometrics		
Unit 2.	Two variable regression model basic idea	6	Understand the concept of regression		
Unit 3.	The sample regression function	6	Understand the concept of regression		
Module 2	**Two variable Regression**	**22**			

	Model				
Unit 1.	Problem of estimation Properties of OLS	10	Understand different types of methods for finding parameters and the concept of correlation	Illustrations and problems	Problem solving
Unit 2.	Test of significance of parameter estimate Gauss markov theorem	6			
Unit 3	Coefficient of determination Coefficient of correlation Monte carlo experiment	6			
Module 3	**Classical normal linear regression model**	**22**			
Unit 1	Introduction to classical normal linear regression model Properties of OLS under normality assumption	7	Understand the normality assumption	Illustrations and problems	Problems solving
Unit 2	Introduction to interval estimation and hypothesis testing Confidence interval of variance Hypothesis testing	10	Understand the concept of estimation of parameters and testing of hypothesis	Illustrations and problems	Problems solving
Unit 3	Regression analysis and Analysis of variance	5	Understand the concept of ANOVA	Illustrations and problems	Problems solving
Module 4	**Extensions of the two variable linear regression model**	**18**			
Unit 1.	Regression through origin	5	Understand the concept of regression models in economics	Lecture and Discussion	Problems solving
Unit 2.	Functional forms of regression model	8	Understand the concept of regression models in economics	Lecture and Discussion	Problems solving
Unit 3.	Reciprocal models	5	Understand the concept of regression models in economics	Lecture and Discussion	Problems solving

Teacher in Charge: SREEDEVI P.N.

FOURTH SEMESTER

MTS4 B04 LINEAR ALGEBRA

5 hours/week 4 credits

Syllabus

Text Book: Elementary Linear Algebra: Application Version(11/e): Howard Anton & Chris Rorres Wiley (2014) ISBN 978-1-118-43441-

Module I: **Systems of Linear Equations & Matrices (17 Hours)**

1.1: Introduction to Systems of Linear Equations- linear equation in n variables, linear system of m equations in n variables, solution, Linear Systems in Two and Three Unknowns, solution by geometric analysis, consistent and inconsistent systems, linear system with no, one, and infinite number of solutions, augmented matrix and elementary row operations

1.2: Gaussian elimination - Considerations in Solving Linear Systems, Echelon Forms, reduced row echelon form, Elimination Methods, Gauss–Jordan elimination, Gaussian elimination, Homogeneous Linear Systems, Free Variables, Free Variable Theorem for Homogeneous Systems, Gaussian Elimination and Back- Substitution, Some Facts about Echelon Forms

1.3: Matrices and Matrix operations- Matrix Notation and Terminology, row vector, column vector, square matrix of order n, Operations on Matrices, Partitioned Matrices, Matrix Multiplication by Columns and by Rows, Matrix Products as Linear Combinations, linear combination of column vectors, Column-Row Expansion, Matrix Form of a Linear System, Transpose of a Matrix, Trace of a Matrix

1.4: Inverses and algebraic properties of matrices- Properties of Matrix Addition and Scalar Multiplication, Properties of Matrix Multiplication, Zero Matrices and Properties, Identity Matrices, Inverse of a Matrix, Properties of Inverses, Solution of a Linear System by Matrix Inversion, Powers of a Matrix, Matrix Polynomials, Properties of the Transpose

1.5: Elementary matrices and a method for finding A^{-1}-row equivalence, elementary matrix, Row Operations by Matrix Multiplication, invertibility of elementary matrices, invertibility and equivalent statements, A Method for Inverting Matrices, Inversion Algorithm, illustrations.

1.6: More on linear systems and invertible matrices - Number of Solutions of a Linear System, Solving Linear Systems by Matrix Inversion, Linear Systems with a Common Coefficient Matrix, Properties of Invertible Matrices, equivalent statements for unique solution of $Ax = b$, determining consistency

1.7: Diagonal, Triangular and Symmetric Matrices-Diagonal Matrices, Inverses and Powers of Diagonal Matrices, Triangular Matrices. Properties of Triangular Matrices, Symmetric Matrices, algebraic properties of symmetric matrices, Invertibility of Symmetric Matrices

1.8: Matrix transformation- definition, Properties of Matrix Transformations, standard matrix, A Procedure for Finding Standard Matrices

2.1: Determinants by cofactor expansion- minors, cofactors, cofactor expansion, Definition of a General Determinant, A Useful Technique for Evaluating 2× 2 and 3 × 3 Determinants

2.2: Evaluating determinants by row reduction- a few basic theorems, elementary row operations and determinant, determinant of elementary matrices, determinant by row reduction

Module II: General vector spaces (18 hrs)

4.1: Real vector space - Vector Space Axioms, examples, Some Properties of Vectors

4.2: Subspaces- definition, criteria for a subset to be a subspace, examples, Building Subspaces, linear combination, spanning, Solution Spaces of Homogeneous Systems as subspace, The Linear Transformation Viewpoint, kernel, different set of vectors spanning the subspace.

4.3: Linear Independence- Linear Independence and Dependence, illustrations, A Geometric Interpretation of Linear Independence, Wronskian, linear independence using Wronskian

4.4: Coordinates and basis-Coordinate Systems in Linear Algebra, Basis for a Vector Space, finite and infinite dimensional vector spaces, illustrations, Coordinates Relative to a Basis, Uniqueness of Basis Representation

4.5: Dimension- Number of Vectors in a Basis, dimension, Some Fundamental Theorems, dimension of subspaces,

Module III (22 hrs)

4.6: Change of basis -Coordinate Maps, Change of Basis, Transition Matrices, Invertibility of Transition Matrices, An Efficient Method for Computing Transition Matrices for $\mathbb{R}^n$, Transition to the Standard Basis for $\mathbb{R}^n$

4.7: Row space, Column space and Null space- vector spaces associated with matrices, consistency of linear system, Bases for Row Spaces, Column Spaces, and Null Spaces, basis from row echelon form, Basis for the Column Space of a Matrix, row equivalent matrices and relationship between basis for column space, Bases Formed from Row and Column Vectors of a Matrix

4.8: Rank Nullity and Fundamental matrix spaces- equality of dimensions of row and column spaces, Rank and Nullity, Dimension Theorem for Matrices**,** The Fundamental Spaces of a Matrix, rank of a matrix and its transpose, A Geometric Link Between the Fundamental Spaces, orthogonal complement, invertibility and equivalent statements, Applications of Rank, Overdetermined and Underdetermined Systems

4.9: Basic matrix transformations in R^2 and R^3 -Reflection Operators, Projection Operators, Rotation Operators, Rotations in $\mathbb{R}^3$, Dilations and Contractions, Expansions and Compressions, Shears, Orthogonal Projections onto Lines Through the Origin, Reflections About Lines Through the Origin

4.10: Properties of matrix transformation- Compositions of Matrix Transformations, One-to-One Matrix Transformations, Kernel and Range, fundamental relationship between invertibility of a matrix and its matrix transformation, Inverse of a One-to-One Matrix Operator

Module IV (23 hrs)

4.11: Geometry of matrix operators-Transformations of Regions, Images of Lines Under Matrix Operators, Geometry of Invertible Matrix Operators, Elementary matrix and its matrix transformation, consequence

5.1: Eigen values and Eigen Vectors- definition, Computing Eigenvalues and Eigenvectors, characteristic equation, alternative ways of describing eigen values, Finding Eigenvectors and Bases for Eigenspaces, Eigenvalues and Invertibility, Eigenvalues of General Linear Transformations,

5.2: Diagonalization- The Matrix Diagonalization Problem, linear independence of eigen vectors and diagonalizability, Procedure for Diagonalizing a Matrix, Eigenvalues of Powers of a Matrix, Computing Powers of a Matrix, Geometric and Algebraic Multiplicity

6.1: Inner Product – definition of General inner product, Euclidean inner product (or the standard inner product) on $\mathbb{R}^n$, norm of a vector, properties (up to and including theorem 6.1.1), a few examples (only example7 and example 10) [rest of the section omitted]

6.2: Angle and orthogonality in Inner product spaces- only the definition of orthogonality in a real inner product space (to be motivated by the relation in the definition (3) of section 3.2) and examples(2),(3) and (4)

6.3: Gram–Schmidt Process- definition of Orthogonal and Orthonormal Sets, examples, linear independence of orthogonal set, orthonormal basis, Coordinates Relative to Orthonormal

Bases ['Orthogonal Projections' omitted] The Gram–Schmidt Process [only statement of Theorem 6.3.5 and the step by step construction technique are required; derivation omitted], illustrations- examples 8 and 9, Extending Orthonormal Sets to Orthonormal Bases [rest of the section omitted]

7.1: Orthogonal Matrices- definition, characterisation of orthogonal matrices, properties of orthogonal matrices, Orthogonal Matrices as Linear Operators, a geometric interpretation [rest of the section omitted]

7.2: Orthogonal Diagonalization- The Orthogonal Diagonalization Problem, Conditions for Orthogonal Diagonalizability, Properties of Symmetric Matrices, Procedure for Orthogonally Diagonalizing an n × n Symmetric Matrix, Spectral Decomposition (up to and including example 2) [rest of the section omitted]

References

1. Jim De Franza, Daniel Gagliardi: Introduction to Linear Algebra with Applications Waveland Press, Inc (2015) ISBN: 1-4786-2777-8
2. Otto Bretscher: Linear Algebra with Applications(5/e) Pearson Education, Inc (2013) ISBN: 0-321-79697-7
3. Ron Larson, Edwards, David C Falvo: Elementary Linear Algebra (6/e) Houghton Mifflin Harcourt Publishing Company (2009) ISBN: 0-618-78376-8
4. David C. Lay, Steven R. Lay, Judi J. McDonald: Linear Algebra and its Application (5/e) Pearson Education, Inc (2016) ISBN: 0-321-98238-X
5. Martin Anthony, Michele Harvey: Linear Algebra: Concepts and Methods Cambridge University Press (2012) ISBN: 978-0-521-
6. Jeffrey Holt: Linear Algebra with Applications W. H. Freeman and Company (2013) ISBN: 0-7167-8667-2

OBJECTIVES

a) To develop a deep knowledge about matrices and matrix operations also provide methods to solve system of linear equations.
b) To understand the concept of vector spaces.
c) To understand the connection between real vector spaces and matrices.
d) To develop basic knowledge about eigen vectors, inner product spaces and matrix diagonalization.

LESSON PLAN

Unit/ session/ hours (time Required)	Topics for student preparation (input)	Procedure (process) Student centric Method of teaching	Activity	Learning outcome (output)	Assessment
Module 1 Systems of linear equations & Matrices 17 hours	Elementary operations in matrix; Determinant, rank and inverse of a matrix; System of linear equations	• Lecture • Discussion • Problem solving	• Peer group discussion on how to solve a system of linear equations in two or more variables	To understand: • Various methods for solving a system of linear equations	Evaluation through MCQ and test paper
Module-2 General vector spaces **18 Hours**	Vector space, Subspace, Dimension	• Lecture • Discussion • Participative learning • Problem solving	• Student seminars to explain vector spaces and subspaces	To understand the concept of vector space and its dimension	Evaluation Through test paper
Module-3 **22 Hours**	Change of basis, Matrix spaces, Matrix transformation	• Lecture • Discussion • Participative learning • Problem solving	• Students' seminar on matrix transformations in R^2 and R^3	To understand the connection between vector spaces and matrix	Evaluation Through MCQ
Module-4 **23 Hours**	Eigen values and Eigen vectors, Diagonalization, Inner product, Orth	• Lecture • Discussion • Problem solving	• Assignment to find the eigen vectors of square matrices	To understand: • The concept pf eigen vectors • Diagonalization and orthogonality • Inner product	Evaluation Through MCQ and test paper

Course Outcomes

CO1	To solve systems of linear equations
CO2	To understand the concept of matrices, operations on matrices and its properties
CO3	To understand the concept of vector spaces
CO4	To learn deeply about matrix transformations and determine eigen values of a given matrix and diagonalization process

CO5	To understand the concept of inner product and orthogonalization

UNIT WISE BREAK UP

LECTURE HOURS: 80

Module Number	Topic	No. of Lecture Hours	Pre- class activity	Pedagogy (in class)	Out of class assignment
Module 1:	**Theory of numbers**	**17**			
Unit 1.	System of linear equations	7	Read the basic concept of matrix and matrix operations from Plus Two Maths text book (Part 1)	Lecture, Discussion and Problem solving	Discussion of problems from previous question papers
Unit 2.	Inverse of matrices	5			
Unit 3	Determinants	8			
Module 2	**General Vector Spaces**	**18**			
Unit 1.	Vector space and subspaces	8	Read the concept of binary operations and their properties from Plus Two Maths text book (1)	Group discussion	Discussion of results in PLG
Unit 2.	Linear independence	4			
Unit 3	Dimension	6		Lecture, Discussions and Problem solving	Assignments to find the dimensions of some vector spaces
Module 3		**22**			
Unit 1	Change of basis, row and column spaces	8	Understand the concept of vector space and matrices	Lecture, Discussion, Illustration and Problem solving	Discussion of results in PLG
Unit 2	Rank-nullity and matrix spaces	6			
Unit 3	Matrix transformations	8			Discussion of problems from previous question papers
Module 4		**23**			
Unit 1.	Matrix operators; Eigen values and eigen vectors	7	Understand the concepts of matrix and matrix spaces from previous modules	Lecture, Discussion, Illustration	Assignment to find the eigen vectors of 4×4 matrices

				and Problem solving	

Unit 2.	Diagonalization	5			
Unit 3.	Inner product	4			Previous question paper discussion
Unit 4	Orthogonality: Gram-Schmidt process, Orthogonal diagonalization	7			Discussion of results in PLG

Teacher in Charge :Naveen V.V