CHRIST
(DEEMED TO BE UNIVERSITY)
DELHI-NCR, INDIA

School of Humanities and Social Sciences

Delhi NCR Campus

Syllabus

Master of Science

(Economics and Analytics)

2021-23

CHRIST(Deemed to be University)
Delhi NCR Campus
www.ncr.christuniversity.in

DEPARMENT OF ECONOMICS

Syllabus Master of Science (Economics and Analytics)

Academic Year 2021-22

Batch 2021-2023

CHRIST (Deemed to be University), Delhi NCR, India
www.ncr.christuniversity.in

DEPARTMENT OVERVIEW

The Department of Economics at the Delhi NCR campus is functioning under the School of Humanities and Social Sciences in CHRIST (Deemed to be University). Established in the year 2019 with the commencement of the new Campus at Delhi NCR, the department has representation of faculty from all cultures and regions in India and with qualifications from the top institutions in the country and abroad. Together with rich experience in teaching, research and consultancy, they specialises in Monetary and Financial Economics, Environmental Economics, Behavioural Economics, Industrial Economics, Informal Economy and so on, involving in advanced research.

VISION

Establish an identity as a department of high standard in teaching and research in Economics.

MISSION

Equip students with advanced knowledge and skill sets to address real world economic problems and undertake cutting edge research on contemporary economic issues.

INTRODUCTION TO THE PROGRAMME

The Master of Science in Economics and Analytics is an intensive program that will guide students through economic modelling and theory to computational practice and cutting-edge tools, providing a thorough training in descriptive, predictive and prescriptive analytics. Students will be equipped with a solid knowledge of econometric and machine learning methods, optimization and computing. These big- data skills, combined with knowledge of economic modelling, will enable them to identify, assess and seize the opportunity for data-driven value creation in the private and public sectors. Students will be trained to contribute significantly to empirical and applied work in the upcoming field of Economics.

Programme Objective

- To enable learners to develop knowledge and skills in current and emerging areas of data analytics.
- To strengthen analytical and problem-solving skills through developing real-time applications.
- To empower students with tools and techniques for handling, managing, analysing, and interpreting data.
- To imbibe quality research and develop solutions to social issues.

Ethics and Human Values

1. Only proprietary or open-source software would be used for academic teaching and learning purposes.

2. Copying of programs from the internet, friends or other sources is strictly discouraged as it impairs the development of programming skills.

3. Unique Practical (Domain-based) exercises are given to ensure that the students don't involve in code plagiarism.

4. Projects undertaken by students during the course are done in teams to improve collaborative work and synergy between team members.

5. Projects involve modularization, which initiates students to take individual responsibility for common goals.

6. Passion for excellence is promoted among the students, be it in software development or project documentation.

7. Giving due credit to sources during the seminar and research assignment is promoted among the students

8. The course is designed so that it enforces the practice of proper referencing techniques to improve the sense of integrity.

9. The course involves group discussions and debates on ethical practices and human values, which sensitize the students in dealing with customers and members within the organization.

Programme Outcomes

On successful completion of the MSc programme students will be able to

PO1: Engage in continuous reflective learning in the context of technology and scientific advancement.

PO2: Identify the need and scope of Interdisciplinary research.

PO3: Enhance research culture and uphold scientific integrity and objectivity.

PO4: Understand the professional, ethical, and social responsibilities.

PO5: Understand the importance and the judicious use of technology for the sustainability of the environment.

PO6: Enhance disciplinary competency, employability, and leadership skills.

Programme Specific Outcomes (PSO)

PSO1: Problem Analysis and Design: Ability to identify analyze and design solutions for data analytics problems using fundamental principles of economics, mathematics, statistics, computing sciences, and relevant domain disciplines.

PSO2: Modern Software Tool Usage: Acquire the skills in handling data analytics programming tools towards problem-solving and solution analysis for domain-specific problems.

PSO3: Societal and Environmental Concern: Utilize the economics and analytics theories for societal and environmental concerns.

PSO4: Professional Ethics: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.

PSO5: Applications in Multidisciplinary Domains: Understand the role of statistical approaches and apply the same to solve real-life problems in the fields of economics and analytics.

PSO6: Project Management: Apply the research-based knowledge to analyze and solve advanced problems in economics and analytics.

Graduate Attributes

- High understanding of theory and concepts in economics
- Critical reflection
- Independent research
- Quantitative and qualitative methods of analysis
- Expertise in statistical and econometric software to examine real world issues
- Creativity and originality
- Problem solving ability
- Effective presentation and written communication
- Social sensitivity
- Responsiveness and responsibility
- Adaptability

Teaching and Learning Strategies

The outcomes and graduate attributes listed above will be accomplished through delivery of the following teaching and learning strategies

- Dissertation
- Lectures

- Guest lectures
- Problem solving in laboratory style environment
- Internship
- Industrial visits
- Field visits
- Rural exposure
- Seminars
- workshops

Assessment Strategy

- Internal assessment 70%
    - CIA1- written assignment, group work, presentations
    - CIA2 - midterm examination
    - CIA3 - written assignment, group work, presentations
- End Semester Examination 30%

The assessment strategy involves specific rubric for evaluation of each component.

Examination and Assessment

The evaluation is divided in to two components: Continuous Internal Assessment (CIA) including Mid Semester Examination (MSE), and the End Semester Examination (ESE).

Assessment Pattern

The Continuous Internal Assessment (CIA) will be assessed for seventy per cent weightage and the End Semester Examination (ESE) for thirty per cent weightage. The practical courses and the common core courses will be assessed out of hundred marks in various components including attendance. The Mid Semester and End Semester written examination question pattern consists of questions divided into two or three sections with short answers, short essays and long essays.

Curriculum Structure for MSc (Economics and Analytics) 2021-2023

SEM	SUBCODE	SUBJECT NAME	Hrs./WEEK	CREDIT	MAX MARKS	TYPE
I	MEA131N	Microeconomic Theory and Applications-I	4	4	100	CORE
	MEA132N	Macroeconomic Theory and Policy-I	4	4	100	CORE
	MEA133N	Advanced Mathematical Economics	4	4	100	CORE
	MEA134N	Fundamentals of statistics	4	4	100	CORE
	MEA135N	Principles of Data Science (CIA Only)	4	4	100	CORE
	MEA136N	Research Methodology (CIA Only)	2	2	50	CORE
	MEA171N	PythonProgramming(CIAOnly)	6	5	150	DSEP
	MHOL111N	Holistic Education	1	-	Grade	SEC
		Total	**29**	**27**	**700**	
SEM	**SUBCODE**	**SUBJECT NAME**	**Hrs./WEEK**	**CREDIT**	**MAX MARKS**	**TYPE**
II	MEA231N	Microeconomic Theory and Applications-II	4	4	100	CORE
	MEA232N	Macroeconomic Theory and Policy-II	4	4	100	CORE
	MEA233N	Econometric Methods	4	4	100	CORE
	MEA234N	Predictive Analytics	4	4	100	CORE
	MEA235N	Research Modelling (CIA Only)	2	1	50	DSEP
	MEA272N	Statistics using R (CIA Only)	6	5	150	DSEP
	MEA241N-A	Multivariate Analysis	4	4	100	DSE
	MEA241N-B	Stochastic Process	4	4	100	DSE
	MEA242N-A	AppliedInstitutionalEconomics	4	4	100	DSE
	MEA242N-B	Financial Economics	4	4	100	DSE
	MHOL211N	Holistic Education	1	2	Grade	SEC
		Total	**33**	**32**	**800**	

SEM	SUBCODE	SUBJECT NAME	Hrs./WEEK	CREDIT	MAX MARKS	TYPE
III	MEA331N	International Economics	4	4	100	CORE
	MEA332N	Behavioural Economics	4	4	100	CORE
	MEA371N	Applied Econometrics (CIA Only)	5	4	100	DSEP
	MEA372N	Applied Machine Learning (CIA Only)	6	5	150	DSEP
	MEA341N-A	Economics of Growth and Development	4	4	100	DSE
	MEA341N-B	Public Economics	4	4	100	DSE
	MEA373N-A	Data Visualization using Tableau (CIA Only)	6	5	150	DSEP
	MEA373N-B	Data Visualization using Advanced Excel (CIA Only)	6	5	150	DSEP
		Total	**29**	**26**	**700**	
SEM	**SUBCODE**	**SUBJECT NAME**	**Hrs./WEEK**	**CREDIT**	**MAX MARKS**	**TYPE**
IV	MEA481IN	Industry Internship (CIA only)	2	10	300	-
	MEA482N	Research Publication (CIA only)	4	2	100	-
		Total	**6**	**12**	**400**	-

SEMESTER I

MEA131N MICROECONOMIC THEORY AND APPLICATIONS - I

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

This course aims at analyzing the Economic behavior of the firms and markets. It is mainly concerned with the objective of equipping the students in a comprehensive manner with various aspects of consumer behavior and demand analysis, Production theory and behavior of cost, equilibrium of firm and various forms of market.

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Demonstrate the analytical and critical skills relevant to economics thinking,
- Demonstrate the rigorous quantitative training that analytical economics requires,
- Apply the microeconomic theory to micro-level real world economic problems,

UNIT 1 **Hours: 05**

Methodology

Construction of theories: Deduction and induction; Empirical verification; Theories and tautologies.

UNIT 2 **Hours: 15**

Utility and Demand

Consumer preferences; Axioms of preference ordering; Utility function: existence and characteristics; concavity and quasiconcavity; Budget sets; Demand functions: Zero homogeneity; Income and substitution effects; Slutzky theorem: Indirect utility functions; Hicksian compensated demand functions; Expenditure functions; Substitutes and complements: gross and pure; Revealed preference.

UNIT 3 **Hours: 20**

Production and Supply

Production functions; Concavity and quasiconcavity; Returns to a factor and to scale; Total, marginal and average cost function; Long run cost curves: envelopes; Factor demand functions, Conditional factor demands; Profit maximization; Supply functions, cost minimization – first and second order conditions; Linear homogeneous production functions and their properties; Cobb-Douglas, CES, VES and Translog production

functions and their properties;Leontief's production functions, Elasticity of substitution, its derivation for C-D and CES functions; the impact of tax/subsidy.

UNIT 4 **Hours: 20**

Markets

Characterizing perfect competition; Pricing and output under perfect competitive markets; Monopoly markets: Pricing, discrimination; welfare costs; Monopolistic competition: Characteristics; Long run and short run behavior; Oligopoly: Cournot's model; Stackleberg framework: Instability; Dominant firm; Compensating variation; Price and output determination under monopsony and bilateral monopoly;

Text Books

1.Henderson, J.M. and R.E. Quandt (2003), Microeconomic Theory: A Mathematical Approach, McGraw Hill, New Delhi.

Reference Books

1.Andreu Mas-Colell, M D Whinston and J R Green (1995), Microeconomic Theory, Oxford University Press.

2.Kreps, David M. (1990), A Course in Microeconomic Theory, Princeton University Press, Princeton.

3.Krugman, Paul. and Wells, Robin. (2005), Microeconomics, Worth Publishers.

4.Koutsoyiannis, A. (1979), Modern Microeconomics, (2nd Edition), Macmillan Press, London.

5.Sen, Anindya (2007), Microeconomics: Theory and Applications, Oxford University Press, New Delhi.

6.Varian, H. (2000), Microeconomic Analysis, W.W. Norton, New York.

7.Pindyck, Robert & Rubinfeld, Daniel (2013), Micro Economics, 8th Edition, Pearson Education, USA.

MEA132N MACROECONOMIC THEORY AND POLICY - I

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

This paper aims at strengthening the knowledge of important macroeconomic variables and their role in determining the equilibrium level of output and employment and provides insights into the factors influencing the capital inflows and outflows in an open economy model. It helps the students to understand the theoretical foundation of

macroeconomics and the contribution of different schools of thought to the further development of macroeconomics.

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Identify the determinants of various macroeconomic aggregates such as output, unemployment, inflation, productivity and the major challenges associated with the measurement of these aggregates.
- Understand the theoretical foundation of macroeconomics and the contribution of different schools of thought to the further development of macroeconomics.
- Describe the main macroeconomic theories of short term fluctuations and long term growth in the economy.
- Analyze the existing idea of different schools of thought/ theories. To check whether the ideology of those theories is working practically? To have some idea on why those theories have not been able to influence/ different economic conditions
- Understand the factors influencing the Balance of Payment and analyse the cause of disequilibrium in the Balance of payment.

UNIT 1 **Hours: 10**

Definition of Money

Nature, functions, types and evaluation of money The debate relating to the definition of money Liquidity theory, Gurley and Shaw Hypothesis , Alternative money stock measures , The quantity and components of money stock in India and broad trend in them.

UNIT 2 **Hours: 10**

Supply of Money and Money Transmission Mechanics

Base money, money multipliers, and role of financial intermediaries Factors affecting money supply Balance sheet of Reserve Bank of India

UNIT 3 **Hours: 10**

Demand for Money

Quantity theory of money Demand for money Keynesian theory of demand for money Baumol-Tobin theory Issues regarding endogenous and exogenous supply of money

UNIT 4 **Hours: 10**

Money in Walrasian and non-Walrasian Economies and Theories of Disequilibrium

Dynamics Money in neo-classical models Money in non-neo-classical models Walrasian interpretation of Keynesian unemployment (Patinkin, Clower and Leijonhufvud) Post-Keynesian interpretation (Sidney Weintraub, Paul Davidson, Kelecki and Minsky)

UNIT 5 **Hours: 10**

Theories of the Interest Rate

Real and monetary theories of the interest rate Keynesian theory, Wicksellian theory, Fisher's theory, Hicksian theory Credit market imperfections Adverse selection and moral hazard

UNIT 6 **Hours: 10**

Monetary Institutions & Monetary Policy

Monetary transmission mechanism and targeting Inflation Money growth and interest rates Interest rate rules Taylor rule Rules versus discretion Central Bank autonomy Dynamic inconsistency of monetary policy credibility and reputation Coordination of fiscal and monetary policy, Rationale and impact of reforms since 1991 on BOP.

Text Books

1. 1N. Gregory Mankiw. (2012). Macroeconomics. 8th Edition, Worth Publishers.
2. Dornbusch, Fischer, Startz. (2010). Macroeconomics. 11th Edition, Tata McGraw Hill.

Reference Books

1. Burda and Wyplosz (2009). Macroeconomics: A European Text, Fifth Edition, Oxford University Press, New York.
2. Graeme Chamberline& Linda Yueh (2006). Thomson Learning.
3. N. Gregory Mankiw. (2012). Macroeconomics. 8th Edition, Worth Publishers.
4. Dornbusch, Fischer, Startz. (2010). Macroeconomics. 11th Edition, Tata McGraw Hill.
5. M. Maria John Kennedy (2011). Macroeconomic Theory, PHI Learning Private Limited, New Delhi.
6. H. L. Ahuja. (2012). Macroeconomics: Theory and Policy. 18th Revised Edition, Sultan Chand Publishers.
7. Brain Snowdown, Howard Vane and Peter Wynarczyk. (1995). A Modern Guide to Macro Economics: An Introduction to Competing School of Thought, Edward Elgar Publishing.
8. Edward Shapiro. (2011). Macroeconomic Analysis. 5th Edition, Galgotia Publication Ltd.
9. Ackley. G. (1978). Macroeconomics: Theory and Policy, Macmillan, New York.
10. Mishkin Frederic (2007), The Economics of Money Banking and Financial Markets, 8th ed Addison Wesley Longman Publishers.
11. Bain, Keith & Howells,Peter (2009), Monetary Economics: Policy and Its Theoretical Basis, Palgrave.
12. Friedman, Ben & Hahn F.H. (Eds.), (1990), Handbook of Monetary Economics, Vols.

1, 2, & 3, North Holland Publishers.
13.Langdana Farrokh (2009), Macroeconomic Policy: Demystifying Monetary and Fiscal Policy, 2nd Edition, Springer.
14.William. H. Branson (2005). Macroeconomic Theory and Policy, Third Edition, All India Traveller BookSeller Publishers, New Delhi.
15.D.N. Dwivedi. (2005). Macroeconomics: Theory and Policy. 2nd Edition, Tata McGraw Hill Education.

MEA133N ADVANCED MATHEMATICAL ECONOMICS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

The main objectives of the course are to train the students to grasp the use of mathematical techniques and operations to analyse economic problems and to initiate students into various economic concepts which are amenable to mathematical treatment.

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Exhibiting a sound understanding of mathematical techniques discussed.
- Formulating economic problems in mathematical terms.
- Applying the relevant tools for analyzing economic problems.

UNIT 1 **Hours: 12**

Introduction to Mathematical Economics -Equilibrium (Or Static) Analysis

Equilibrium analysis in Economics-Definition of equilibrium -Solution of equilibrium-Single vs. multiple equilibrium -Partial vs. general equilibrium.
Application: single vs. multiple commodity markets
Linear Models and Matrix Algebra -Matrix algebra -Determinants-Inverse-Eigenvalues and Eigen vectors -Cramer's Rule-Quadratic Forms
Applications: Multiple commodity markets- Heckscher-Ohlin model, IS-LM Model-Mundell-Fleming Model

UNIT 2 **Hours: 06**

Integration

Areas under curve-Definite and indefinite Integration, Application- Consumer Surplus and Producer Surplus

UNIT 3 **Hours: 15**

Unconstrained Optimization

Concavity, Convexity, Quasi concavity, Quasi convexity

Optimization of functions of one variable -Main concepts- First order conditions- Second order conditions (sufficient conditions)

Applications: Profit maximization (one product) under: - perfect competition -

monopoly. – Monopolistic –Oligopoly (Collusive and Non Collusive Oligopoly Models - Cournot model, stackelberg model)

Optimization of functions of more than one variable- The differential version of optimization conditions- Extreme values of function of two variables and comparative static aspect of optimization

Application: Profit maximization (two products) under perfect competition- extreme values of function of n variables. Applications: i)Monopolist selling in segmented markets

UNIT 4 **Hours: 15**

Constrained Optimization Problems

Two variables, one constraint-Lagrange-multiplier method-First order conditions- Second order conditions, Hessian Border Condition.

Applications: Utility maximization and consumer demand (two goods, one period)- Utility

maximization and consumer demand (one goods, two periods)- perfect access to international capital markets.-financial autarky -welfare implications

UNIT 5 **Hours: 12**

Difference and Differential Equations and Economic Applications

First order linear difference equations- Second order difference equations

First order differential equations- Second order differential equations

Application: Cobweb Market Model, Dynamic stability of Market price

Text Books

1. Simon, C. and L. Blume, Mathematics for Economists, Norton, London, 1994.
2. Edward Dowling (2000), *Introduction to Mathematical Economics*, McGraw Hill Ltd, New Delhi.
3. Chiang, Wainwright, Kevin (2005), *Fundamental Methods of Economics*, McGraw Hill Ltd, New Delhi.

Reference Books

1. Allen R G D (1974). *Mathematical Analysis for Economists*, McMillan Press and ELBS, London.
2. Allen R G D (1967). *Macroeconomic Theory*, McMillan Co., Ltd.,
3. Chiang A C (1986). *Fundamental Methods of Mathematical Economics*, McGraw Hill, New York.
4. Koutsoyiannis A. (1979). *Modern microeconomics*, 2nded, ELBS with McMillan.
5. Monga G S. (1996) *Mathematics and Statistics for Economics*, Vikas Publishing

House Pvt. Ltd., Delhi.
6. Yamane, Taro (1975) *Mathematics for Economists*, Prentice Hall of India, New Delhi.
7. Mehta-Madnani (2005) *Mathematics for Economists*, Sultan Chand and Sons, New Delhi.
8. Eugene Diulio, *Macroeconomics*, Schaum's Outlines, McGraw Hill.

MEA134N FUNDAMENTALS OF STATISTICS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

- To introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data.
- To introduce measurement of the relationship of quantitative and qualitative data and the concept of probability.
- To enable the students to understand and apply the descriptive measures and probability for Economics analysis.

Course Outcomes

After Successful completion of the course students will be able to

- Demonstrate the history of statistics and present the data in various forms.
- Infer the concept of correlation and regression for relating two or more related variables.
- Demonstrate the probabilities for various events.

UNIT 1 **Hours: 10**

Organization and Presentation of data: Origin and development of Statistics, Scope, limitation and misuse of statistics. Types of data: primary, secondary, quantitative and qualitative data. Types of Measurements: nominal, ordinal, discrete and continuous data. Presentation of data by tables: construction of frequency distributions for discrete and continuous data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods).

UNIT 2 **Hours: 15**

Descriptive Statistics Measures of location or central tendency: Arithmetic Mean, Median, Mode, Geometric mean, Harmonic mean. Partition values: Quartiles, Deciles and percentiles. Measures of dispersion: Mean deviation, Quartile deviation, Standard deviation, Coefficient of variation. Moments: measures of skewness, Kurtosis.

UNIT 3 **Hours: 10**

Correlation and Regression: Correlation: Scatter plot, Karl Pearson coefficient of correlation, Spearman's rank correlation coefficient, multiple and partial correlations

(for 3 variates only). Regression: Concept of errors, Principles of Least Square, Simple linear regression and its properties.

UNIT 4 **Hours: 10**

Basics of Probability : Random experiment, sample point and sample space, event, algebra of events. Definition of Probability: classical, empirical and axiomatic approaches to probability, properties of probability. Theorems on probability, conditional probability and independent events, Laws of total probability, Baye's theorem and its applications.

UNIT 5 **Hours: 15**

Probability Distribution: Binomial Distribution and their properties with practical examples, Poisson Distribution and their properties with practical examples, Normal Distribution and their properties with practical examples,

Text Books

1. Rohatgi V.K and Saleh E, An Introduction to Probability and Statistics, 3rd edition, John Wiley & Sons Inc., New Jersey, 2015.
2. Gupta S.C and Kapoor V.K, Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand & Sons, New Delhi, 2014.

Reference Books

1. Mukhopadhyay P, Mathematical Statistics, Books and Allied (P) Ltd, Kolkata, 2015.
2. Walpole R.E, Myers R.H, and Myers S.L, Probability and Statistics for Engineers and Scientists, Pearson, New Delhi, 2017.
3. Montgomery D.C and Runger G.C, Applied Statistics and Probability for Engineers, Wiley India, New Delhi, 2013.
4. Mood A.M, Graybill F.A and Boes D.C, Introduction to the Theory of Statistics, McGraw Hill, New Delhi,

MEA 135N PRINCIPLES OF DATA SCIENCE

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

The course is designed to impart the learning of principles of econometric methods and tools. This is expected to improve student's ability to understand econometrics in the study of economics. This course is intended to provide a thorough and sound understanding of the essential theoretical base, an introduction into the important and useful techniques of modelling and also an understanding of the broad applications of econometrics

Course Outcomes

The Upon successful completion of this course, the students will be able to

- Use modern econometrics for advanced data analysis
- Interpret the empirical findings
- Develop hands-on skills in the application of econometric and quantitative techniques to real world economic and business data.

UNIT 1 **Hours: 12**

Introduction to Data Science

Preparing and gathering data and knowledge - Philosophies of data science - data all around us: the virtual wilderness - Data wrangling: from capture to domestication - Data science in a big data world - Benefits and uses of data science and big data - facts of data - data science processes

UNIT 2 **Hours: 12**

Data Science Process

Overview of the data science process - retrieving data - Cleansing, integrating, and transforming data - Exploratory data analysis - Build the model - Presenting finding and building applications on top of them

UNIT 3 **Hours: 12**

Machine Learning

Machine learning – Modeling Process – Training model – Validating model – Predicting new observations –Supervised learning algorithms – Unsupervised learning algorithms

UNIT 4 **Hours: 12**

First Steps in Big Data

First steps in big data - Distributing data storage and processing with frameworks - Case study: Assessing risk when loaning money - Join the NoSQL movement - Introduction to NoSQL - Case Study

UNIT 5 **Hours: 12**

Databases

The rise of graph databases - Introducing connected data and graph databases - Text mining and text analytics - text mining in real world - text mining techniques

Data Visualization

Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools.

Text Books

1.Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.
2.Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications, 2016.
3.Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016

Reference Books

1.Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015.
2.Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
3.Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014

4.An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

MEA136N RESEARCH METHODOLOGY

Total Teaching Hours for Semester: 30 **No of Lecture Hours/Week: 2**

Max Marks: 50 **Credits: 2**

Course Objectives

Understanding of the importance of research in creating and extending the knowledgebase of their subject area; Ability to distinguish between the strengths and limitations of different research approaches regarding their subject/research area; Knowledge of the range of qualitative and quantitative research methods potentially available to them; The ability to differentiate between the role of practitioners and the role of researchers; An understanding of and begin to critically reflect upon issues of ethics and role of the researcher; The skills to work independently, to plan and to carry out a small-scale research project.

Course Outcomes

Upon successful completion of this course, the students will be able to:

- demonstrate the knowledge of the range of qualitative and quantitative research methods potentially available.
- should be able to differentiate between the role of practitioners and the role of researchers.
- should work independently, to plan and to carry out a small-scale research project.
- demonstrate the understanding of and ability to critically reflect upon issues of ethics and research

UNIT 1 **Hours: 8**

Introduction

The nature of knowledge and theory - Philosophy of Social Science Research **-** Relevance of Social Science Research - Objectivity and Values in Social Sciences; logic of Scientific Investigation: Theory Construction in Social Science Research - Approaches to Social Science Research, Theoretical, Applied and Action Research - Ethical Issues in Research on Human or Social Subjects - Non-sexist approach in Social Sciences

UNIT2 **Hours: 6**

Research Design

Review of Literature - Identification of Research Gaps and Research Needs - Identification, selection and formulation of research problem - Formulating Hypotheses/Propositions/Issues, conceptualizing research problem

UNIT 3 **Hours:8**

Overview of Social Science Methodology

Uni-disciplinary, interdisciplinary, multi-disciplinary methodologies - Quantitative Research Methods: An Overview - Qualitative Research Methods: An Overview - Historical Method - Case Study Method - Action Research - Monitoring and Evaluation - Triangulation (including/mixing Qualitative and Quantitative) Methods

UNIT4 **Hours:8**

Data analysis and Research Communication

Choice of Statistical and Processing Techniques - Interpretative Narrative Methods - Theory of the Testing of Hypotheses - Presentation of Research Findings, Products of Research, Thesis Writing - Factors conducive to research utilization

firm; Compensating variation; Price and output determination under monopsony and bilateral monopoly;

Text Books

1.Blair J, Czaja R, Blair E (2014). Designing Surveys: A Guide to Decisions and Procedures. SAGE Publications. 3rd
2.Kumar R (2010). Research methodology: a step by step guide for beginners. SAGE Publications Ltd; Third Edition.
3.Hay M Cameron (2015) Methods That Matter: Integrating Mixed Methods for More Effective Social Science Research

Reference Books

1.Bryman, Alan (2015). Social Research Methods. Oxford: Oxford University Press
2.Schutt Russell K. (2016), Investigating the social world: the process and practice of research

MEA171N PYTHON PROGRAMMING

Total Teaching Hours for Semester: 90 **No of Lecture Hours/Week: 6**

Max Marks: 150 **Credits: 5**

Course Objectives

The course aims to explain the basic concepts of python programming. The course aims to enable the students to do python programming using conditionals, loops, functions, various data structures and to implement file handling

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Write programs in python using basic constructs
- Apply various conditionals and iterative statements
- Implement algorithms using control structures like List, Tuples and Dictionary.
- Implement programs with file handling
- Formulate the results from data using various Data Processing and Visualization Libraries.

UNIT 1 **Hours: 12**

Introduction to Python:

Python Basics,

Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program,

Flow control,
Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(),

Functions,
def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number

UNIT 2 **Hours: 12**

Lists,
The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References,

Dictionaries and Structuring Data,
The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things

Manipulating Strings,
Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup

UNIT 3 **Hours: 12**

Pattern Matching with Regular Expressions,
Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and Nongreedy Matching, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re .IGNORECASE, re .DOTALL, and re .VERBOSE, Project: Phone Number and Email Address Extractor

Reading and Writing Files,
Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint. pformat() Function, Project: Generating Random Quiz Files, Project: Multiclipboard,

Organizing Files,

The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates, Project: Backing Up a Folder into a ZIP File,

D**ebugging,**
Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE's Debugger.

UNIT 4 **Hours: 12**

NumPy Libraries for Arrays, Pandas Library for Data Processing

UNIT 5 **Hours: 12**

Matplotlib for Visualization, Seaborn Library for Visualization, SciPy Library for Statistics

LAB **Hours: 30**

1. Installing python to your computer
2. Demonstrate the usage Conditional Statements
3. Demonstrate the use of Iterative statements
4. Demonstrate the usage of Functions.
5. Demonstrate the usage of different Data Types
6. Demonstrate the usage of String Functions
7. Demonstrate the Exception handling
8. Demonstrate creation and use of a class
9. Demonstrate the working of Inheritance concepts
10. Demonstrate seeking and finding of file.
11. Demonstrate opening a file and writing in to it
12. Demonstrate the usage of list data structure.
13. Demonstrate the usage of Tuples data structure.
14. Demonstrate the usage of a Dictionary data structure.
15. Demonstrate Sending an email using python.
16. Accessing Array index using NumPy
17. Aggregation function using NumPy
18. Implement
    a) Matplotlib
    b) Seaborn

Text Books

1. Al Sweigart,"Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 18)
2. Michael Bowles, Machine Leaning in Python, Essential techniques for predictive

analysis, Wiley

Reference Books

1.John V Guttag, —Introduction to Computation and Programming Using Python ‘‘, Revisedand expanded Edition, MIT Press, 2013

2.Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in

3.Python: An Interdisciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

4.Timothy A. Budd, —Exploring Python||, Mc-Graw Hill Education (India) Private Ltd 2015.

5.Kenneth A. Lambert, —Fundamentals of Python: First Programs||, CENGAGE Learning, 2012.

6.Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

SEMESTER II

MEA231N MICROECONOMIC THEORY AND APPLICATIONS -II

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

The main objective of the course is to introduce both traditional as well as modern ideas and theoretical concepts in microeconomics. It also deals with fundamental understanding of market theory, theory of factor pricing, theory of general equilibrium and welfare economics. It also includes understanding the role of institutions by focusing on transaction costs, absolute property rights and relative property rights.

Course Outcomes

After successful completion of the course students will be able to

- Define and explain the basic concepts and hypothesis in Microeconomic Theory and their relations
- Define market, categorize markets and analyse perfectly competitive markets
- Demonstrate basic knowledge and skill in the use of cost and managerial concepts and techniques as management tools for planning, controlling, evaluating performance and making decisions

UNIT 1 **Hours:10**

Game Theory

Extensive and normal form representation of games– Nash equilibrium (impure and mixed strategies); definition and existence – subgame perfection in dynamic games; Applications: strategic behaviour of firms in a market–Bertrand, Cournot and Stackleberg models – and entry deterrence.

UNIT 2 **Hours: 10**

Distribution

Neo-classical approach: Marginal productivity theory - in perfect and imperfect product and factor markets; Product exhaustion theorem; Elasticity of technical substitution, technical progress and factor shares; Macro theories of distribution – Ricardian, Marxian, Kalecki and Kaldor's.

UNIT 3 **Hours: 10**

General Equilibrium

Partial and general equilibrium; Walrasian excess demand and input-output approaches to general
Equilibrium; Existence, stability and uniqueness of partial equilibrium and general equilibrium; Relationship between relative commodity and factor prices (Stopler-Samuelson theorem);

UNIT 4 **Hours: 10**

Welfare Economics

Pigovian welfare economics; Pareto optimal conditions; Value judgement; Social welfare function;Compensation principle; Inability to obtain optimum welfare– Imperfections, market failure,decreasing costs; Uncertainty and non–existent and incomplete markets;Theory of second best –Arrow's impossibility theorem, Rawl's theory of Justice; Equity efficiency trade off.

UNIT 5 **Hours: 20**

New Institutional Economics

Definition of Transaction Cost and types of transaction costs; General Principles in Modelling Transaction Costs; Modelling Transaction Costs by modelling transaction activity. Emergence of Property Rights: The invisible hand and the optimistic theory; contracting for Property Rights: the role of political bargaining and the Liebcap Thesis. Principles of contractual obligations; economic theories of contract: agency theory, self-enforcing agreement theory and relational contract theory; types of private ordering and their dynamics.

Text Books

1. Henderson, J.M. and R.E. Quandt (2003), Microeconomic Theory: A Mathematical Approach, McGraw Hill, New Delhi.

Reference Books

1. Pindyck, Robert & Rubinfeld, Daniel (2013), Micro Economics, 8th Edition, Pearson Education, USA
2. Furburton & Richter, *'Institutions and Economic Theory'*, Dryden Press.
3. Andreu Mas-Colell, M D Whinston and J R Green (1995), Microeconomic Theory, Oxford University Press.
4. Kreps, David M. (1990), A Course in Microeconomic Theory, Princeton University Press, Princeton.
5. Krugman, Paul. and Wells, Robin. (2005), Microeconomics, Worth Publishers.
6. Koutsoyiannis, A. (1979), Modern Microeconomics, (2nd Edition), Macmillan Press, London.

7. Mukherjee, Anjan (2002), An Introduction to General Equilibrium Analysis, Oxford University Press.
8. Osborne, Martin J. (2009), An Introduction to Game Theory, Oxford University Press.
9. Sen, Anindya (2007), Microeconomics: Theory and Applications, Oxford University Press, New Delhi.
10. Varian, H. (2000), Microeconomic Analysis, W.W. Norton, New York.

MEA232N MACROECONOMIC THEORY AND POLICY- II

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

This Course aims at strengthening the knowledge of important macroeconomic variables and their role in determining the equilibrium level of output and employment and provides insights into factors influencing the capital inflows and outflows in an open economy model. It helps the students to understand the theoretical foundation of macroeconomics and the contribution of different schools of thought to the further development of macroeconomics. Upon successful completion of this course, the students will be able to: critically evaluate the consequences of basic macroeconomic policy options under differing economic conditions within a business cycle.

Course Outcomes

The Upon successful completion of this course, the students will be able to

- Identify the determinants of various macroeconomic aggregates such as output, unemployment, inflation, productivity and the major challenges associated with the measurement of these aggregates.
- Understand the theoretical foundation of macroeconomics and the contribution of different schools of thought to the further development of macroeconomics.
- Describe the main macroeconomic theories of short term fluctuations and long term growth in the economy.
- Analyse the existing idea of different schools of thought/ theories. To have some idea on why those theories have not been able to influence/ different economic conditions
- Understand the factors influencing the Balance of Payment and analyse the cause of disequilibrium in the Balance of payment.

- Evaluate the consequences of basic macroeconomic policy options under differing economic conditions within a business cycle.

UNIT 1 **Hours:15**

Inflation, Unemployment and Productivity

Classical dichotomy and monetary neutrality- Classical, Neo-classical and modern theories of inflation- Keynesian and monetarist views on inflation -Inflation in the static model -Wages, prices and productivity-The relation of wages to unemployment- Short run and long run Phillips curve and the policy implications- Modifications in Phillips curve- Natural rate of unemployment-Seigniorage and hyperinflation-disinflation.

UNIT 2 **Hours: 15**

Theories of Money Demand and Interest rates

The Classical and Neoclassical views on holding money- Real and monetary theories of the rate of interest: liquidity preference and loanable funds theories of interest- The term structure of interest rates: Pure Expectations, Pure segmentation and Substitutability theories- Portfolio theories of demand for money- Baumol-Tobin approach to transaction demand for money- Tobin's portfolio optimization approach-Friedman's quantity theory of money.

UNIT 3 **Hours: 15**

Business Cycles, post Keynesian Macroeconomics

Measurement, Endogenous theories (Hicks, Goodwin, Kaldor), Exogenous theories - Real Business Cycle Theories - Real Business Cycle School and inter temporal substitution of labour- Real Business Cycle theory- technology shocks- neutrality of money and flexibility of wages and prices- Real Business cycle view on great depression- The modern monetarism, major postulates-Keynesian policy framework- The New Classical macroeconomics- Stagflation trend-The Supply-Side economics- major implications.

UNIT 4 **Hours: 15**

External Sector and Emerging Issues

Rationale and impact of reforms since 1991 on BOP, Problems of India's international debt export policies, working and regulations of MNCs in India- The issues and policies towards financial stability- International reserves, Monetary integration- European Monetary System-Contemporary macroeconomic debates in India and the world.

Text Books

1. William. H. Branson (2005). Macroeconomic Theory and Policy, Third Edition, All India Traveller Book Seller Publishers, New Delhi.
2. D.N. Dwivedi. (2005). Macroeconomics: Theory and Policy. 2nd Edition, Tata McGraw Hill Education.
3. Levacic and Rebman. (1982). Macro Economics: An Introduction to Keynesian and Neoclassical Controversies. 2nd Edition, Macmillan Publishers.

Reference Books

1. Burda and Wyplosz (2009). Macroeconomics: A European Text, Fifth Edition, Oxford University Press, New York.
2. Graeme Chamberline& Linda Yueh (2006). Thomson Learning.
3. N. Gregory Mankiw. (2012). Macroeconomics. 8th Edition, Worth Publishers.
4. Dornbusch, Fischer, Startz. (2010). Macroeconomics. 11th Edition, Tata McGraw Hill.
5. M. Maria John Kennedy (2011). Macroeconomic Theory, PHI Learning Private Limited, New Delhi.
6. H. L. Ahuja. (2012). Macroeconomics: Theory and Policy. 18th Revised Edition, Sultan Chand Publishers.
7. Brain Snowdown, Howard Vane and Peter Wynarczyk. (1995). A Modern Guide to Macroeconomics: An Introduction to Competing School of Thought, Edward Elgar Publishing.
8. Edward Shapiro. (2011). Macroeconomic Analysis. 5th Edition, Galgotia Publication Ltd.
9. Ackley. G. (1978). Macroeconomics: Theory and Policy, Macmillan, New York.

MEA233N ECONOMETRIC METHODS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

This course aims at analyzing the Economic behavior of the firms and markets. It is mainly concerned with the objective of equipping the students in a comprehensive manner with various aspects of consumer behavior and demand analysis, Production theory and behavior of cost, equilibrium of firm and various forms of market.

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Demonstrate the analytical and critical skills relevant to economics thinking,
- Demonstrate the rigorous quantitative training that analytical economics requires,
- Apply the microeconomic theory to micro-level real world economic problems,

UNIT 1 **Hours: 12**

Regression Analysis

Linear regression model, two variables and multi variables, BLUE property, general and confidence approach to hypothesis testing, partial effects and elasticity, goodness of fit, model evaluation, matrix approach to linear regression models

UNIT 2 **Hours: 12**

Extension of Linear Regression Models

Consequences and detection of multicollinearity, heteroskedasticity, and autocorrelation; and remedial measures

UNIT 3 **Hours: 12**

Dummy Variables

Regression on qualitative and quantitative variables, dummy variable trap, structural stability of regression models, Chow test, piecewise linear regression model

UNIT 4 **Hours: 12**

Simultaneous Equation Models

Simultaneity bias, structural versus reduced form, identification: rank versus order condition, exact and over identifications, triangular model, methods of estimation including indirect least squares, two-stage least squares and three-stage least squares, LIML and FIML

UNIT 5 **Hours: 12**

Distributed Lag Models

Formation of expectations, naïve expectation versus adaptive expectations models, partial adjustment models, distributed lag models; Koyck's model, Almon lag, polynomial distributed lag models, end point restriction, rational expectations models

Text Books

1. Wooldridge, J., *Introductory Econometrics: A Modern Approach*, South-Western
2. Gujarati, N.D., *Basic Econometrics*, fourth edition, McGraw Hill, 2003

Reference Books

1. Johnston, J., *Econometric Methods*, third edition, McGraw Hill
2. Ramanathan, R., *Introductory Econometrics with applications*, fifth edition, Thomson Asia Private Limited, 2002
3. Brooks, C., *Introductory Econometrics for Finance*, first edition, Cambridge University Press, 2003

MEA234N PREDICTIVE ANALYTICS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week:4**

Max Marks: 100 **Credits:4**

Course Objectives

Predictive analytical tools are increasingly used in business decision making. The course will introduce the participants to business problems where models that involve prediction, classification, clustering and association can be applied. The course is designed as a hands on exercise using data available in the public domain. The course requires that the participants are familiar with basic working in R and have sufficient understanding of basic statistics.

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Classify predictive models and distinguish which models are suitable for a particular problem.
- Solve performance and accuracy problems of predictive models as and when they arise and be able to fix them
- Apply Time series, regression, classification and clustering models.

UNIT 1 **Hours: 12**

Introduction

Understanding Data- Core Components of a Model – Types of Models- Supervised- Unsupervised- Semi supervised and Reinforcement Learning Models – Parametric and Non Parametric Models- Regression and Classification Models

Defining the Model's Objective- Collecting Data- Picking a Model- Preprocessing Data- Exploratory Data Analysis- Data Transformations-Missing Data- Outliers- Training and Assessing the Model- Exploring Alternate models – Model Deployment

UNIT 2 **Hours: 12**

Predictive Models- Regression

Introduction to Linear Regression- Assumptions- Estimating a Simple Linear Regression- Multiple Linear Regression (MLR)- Assessing Linear Models- Residual Analysis- Significance Tests- Performance Metrics for Linear Regression- Problems with MLR- Multicollinearity- Outliers

Classifying with Linear Models-Introduction to Logistic Regression-Generalized Linear Models- Assumptions-Interpretation of Coefficients- Maximum Likelihood Estimation-Assessing Logistic Regression Models- Model Deviance – Test Performance-Introduction to Multinomial Logistic Regression

UNIT 3 **Hours: 12**

Time Series Analysis

Fundamental Concepts of Time Series- White Noise- Fitting White Noise Time Series-Random Walk- Fitting Random Walk- Stationarity- Stationary Time Series Models-Moving Average Models- Autoregressive Models- Autoregressive Moving Average Models- Non Stationary Time Series Models- Autoregressive Integrated Moving Average Models- Autoregressive Conditional Heteroscedasticity Models- Generalized Autoregressive hetero scedasticity Models.

UNIT 4 **Hours: 12**

Classification and Clustering Methods

Introduction to classification techniques-Nearest Neighbor Method- K- Nearest Neighbor algorithm-Discriminant Analysis-Fisher's Linear Discriminant Function-Decision Trees; Introduction to Clustering- k-Means Clustering-Expectation Maximization Algorithm- Hierarchical Clustering Procedures

UNIT 5 **Hours: 12**

Association Techniques

Introduction to Association techniques-Quick Review of Probability- Bayesian Probability Methods-Market Basket Analysis- Association Rules and Lift

Text Books

1.Forte, R. M. (2015). *Mastering Predictive Analytics with R.* Packt Publishing Ltd.

Reference Books

1.Wu, J., & Coggeshall, S. (2012). Foundations of Predictive Analytics. Boca Raton: CRC Press, Taylor & Francis Group LLC.
2.Albright C. S., Winston Wayne L. and Zappe C. J (2009). *Decision Making Using Microsoft Excel (India Edition).* Cengage Learning.
3.Evans J. R (2013). *Business Analytics Methods, Models and Decisions.* Pearson, Upper Saddle River, New Jersey.

MEA272N STATISTICS USING R

Total Teaching Hours for Semester: 90 **No of Lecture Hours/Week: 6**

Max Marks: 150 **Credits: 5**

Course Objectives

This course is planned to give the students the basic knowledge in R programming language and to make them familiar with the flexible graphical capabilities of R. It also covers the Statistical computational features of R and exploratory analysis and modeling using R

Course Outcomes

Upon successful completion of this course, the students will be able to:

- Understanding data using statistical tool
- Perform graphical representation of data using R
- Apply their knowledge of various tools create R programs
- Design and create applications which can handle multivariate data.
- Find correlation and apply data visualization

UNIT 1 **Hours: 12**

Introduction and preliminaries

The R environment, R and statistics, R commands, Data permanency and removing objects, Simple manipulations, Numbers and Vectors, Objects- modes and attributes, Ordered and unordered Factors, Arrays and Matrices

UNIT 2 **Hours: 12**

Lists and Data Frames

Lists and Data Frames- Constructing and modifying lists, Making Data frames, attach( ) and detach( ), Working with data frame, Reading data from files using read.table( ), scan( ), Grouping, Conditional execution: if statements, Repetitive execution: for loops, repeat and while loops, Functions.

UNIT 3 **Hours: 12**

Data Exploration for Univariate and Bivariate

Data Exploration for Univariate and Bivariate Data-Univariate Data - Handling categorical data and numerical data using R, Bivariate Data -Handling bivariate categorical data using R, Categorical vs. Numerical, Numerical vs. Numerical

UNIT 4 **Hours: 12**

Data Exploration for Multivariate Data

Data Exploration for Multivariate Data-Multivariate Data -Storing multivariate data in R data frames, Accessing and manipulating data in R data frames, view multivariate data, apply( ) family functions - apply( ), sapply( ), lapply( ), tapply( ), dplyr package-select( ), filter( ), arrange( ), rename( ), mutate( ), group_by( ), %>%, summarize( ).

UNIT 5 **Hours: 12**

Correlation and Data Visualization

Pearson correlation, Spearman rank correlation lattice package in R - 1D, 2D, 3D plots using lattice, ggplot2 package in R- 1D, 2D, 3D plots using ggplot2

Lab Programs **Hours: 30**

1. Demonstrate the usage of Numbers and Vectors in R
2. Simple manipulations on Numbers and Vectors, Objects- modes and attributes, Ordered and unordered Factors
3. Implement the concepts of Arrays and Matrices
4. Demonstrate the usage of Data Frames and Lists and its attributes -attach, detach, scan and importing a file
5. Implement the concept of grouping and conditional execution on Data Frames and Lists
6. Demonstrate repetitive executions on Data Frames
7. Use a Dataset to handle the Categorical and numerical data
8. Use a Dataset to handle the Bi-variate categorical data
9. Use a Dataset to handle the Multivariate categorical data
10. Demonstrate the usage of apply () functions.
11. Implement the usage of dplyr package
12. Utilize a lattice package to plot 1D, 2D and 3D plots for a given dataset.
13. Utilize ggplot2 package to plot 1D, 2D and 3D plots for a given dataset.
14. Demonstrate Pearson correlation and Spearman rank correlation.

Text Books

1. 1.Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016

Reference Books

1. 1.John V Guttag, —Introduction to Computation and Programming Using Python ", Revisedand expanded Edition, MIT Press, 2013
2. 2.Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in
3. 3.Python: An Interdisciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. 4.Timothy A. Budd, —Exploring Python||, Mc-Graw Hill Education (India) Private Ltd 2015.
5. 5.Kenneth A. Lambert, —Fundamentals of Python: First Programs||, CENGAGE Learning, 2012.
6. 6.Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

MEA241N-A MULTIVARIATE ANALYSIS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

The Course enables Students to

- To introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data.
- To introduce measurement of the relationship of quantitative and qualitative data and the concept of probability.
- To enable the students to understand and apply the descriptive measures and probability for data analysis.

Course Outcomes

After Successful completion of the course students will be able to

- Demonstrate knowledge and understanding of parametric and nonparametric tests
- Understand discriminant analysis, factor analysis
- Apply Principal component analysis in medical, industrial, engineering, business and many other scientific areas.
- Solve the Industrial and real world problems

UNIT 1 **Hours: 12**

Bivariate Normal Distribution (BVN): p.d.f. of BVN, properties of BVN, marginal and conditional p.d.f. of BVN. Multivariate Data: Random Vector: Probability mass/density functions, Distribution function, Mean vector & Dispersion matrix, Marginal & Conditional distributions.

UNIT 2 **Hours: 12**

Multivariate Normal distribution and its properties. Sampling distribution for mean vector and variance- covariance matrix. Multiple and partial correlation coefficient and their properties.

UNIT 3 **Hours: 12**

Applications of Multivariate Analysis: Discriminant Analysis, Principal Components Analysis and Factor Analysis.

UNIT 4 **Hours: 12**

Nonparametric Tests: Introduction and Concept, Test for randomness based on total number of runs, Empirical distribution function.

UNIT 5 **Hours: 12**

Kolmogrov Smirnov test for one sample, Sign tests- one sample and two samples, Wilcoxon-Mann-Whitney test, Kruskal-Wallis test.

Text Books

1. Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis,
   3rdEdn., John Wiley
2. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, John Wiley.
3. Kshirsagar, A.M. (1972): Multivariate Analysis, 1stEdn. Marcel Dekker.

Reference Books

1. 1. Johnson, R.A. and Wichern, D.W. (2007): Applied Multivariate Analysis, 6th Edn., Pearson & Prentice Hall
2. Mukhopadhyay, P. :Mathematical Statistics. Books and Allied, January 2016
3. Gibbons, J. D. and Chakraborty, S (2003): Nonparametric Statistical Inference. 4th Edition. Marcel Dekker, CRC.

MEA241N-B STOCHASTIC PROCESS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

- A stochastic process is a set of random variables indexed by time or space.
- Student will study the basic concepts of the theory of **stochastic processes** and explore different types of stochastic processes including Markov chains, Poisson processes and birth-and-death processes

Course Outcomes

After Successful completion of the course students will be able to

- Compute probabilities of transition between states and return to the initial state after long time intervals in Markov chains.
- Identify classes of states in Markov chains and characterize the classes.
- Determine limit probabilities in Markov chains after an infinitely long period.
- Queuing Models help to solve industrial problems.
- solving the Industrial and real-world problems

UNIT 1 **Hours: 12**

INTRODUCTION TO STOCHASTIC PROCESSES

Classification of Stochastic Processes, Markov Processes – Markov Chain - Countable State Markov Chain. Transition Probabilities, Transition Probability Matrix, Graphs of t.p.m, Calculation of n - step Transition Probability and its limit.

UNIT 2 **Hours: 12**

POISSON PROCESS

Classification of States, Recurrent and Transient States - Transient Markov Chain, Random Walk and Gambler's Ruin Problem. Continuous Time Markov Process: Poisson Processes, Birth and Death Processes.

UNIT 3 **Hours: 12**

BRANCHING PROCESS

Branching Processes – Galton – Watson Branching Process - Properties of Generating Functions – Extinction Probabilities – Distribution of Total Number of Progeny. Concept of Weiner Process.

UNIT 4 **Hours: 12**

RENEWAL PROCESS

Renewal Processes – Renewal Process in Discrete and Continuous Time – Renewal Interval – Renewal Function and Renewal Density – Renewal Equation – Renewal theorems: Elementary Renewal Theorem. Probability Generating Function of Renewal Processes.

UNIT 5 **Hours: 12**

STATIONARY PROCESS

Stationary Processes: Discrete Parameter Stochastic Process – Application to Time Series. Auto-covariance and Auto-correlation functions and their properties. Moving Average, Autoregressive, Autoregressive Moving Average, Autoregressive Integrated Moving Average Processes. Basic ideas of residual analysis.

Text Books

1. Stochastic Processes, R.G Gallager, Cambridge University Press, 2013.

2. Stochastic Processes, S.M Ross, Wiley India Pvt. Ltd, 2008.

Reference Books

1. Stochastic Processes from Applications to Theory, P.D Moral and S. Penev, CRC Press, 2016

2. Introduction to Probability and Stochastic Processes with Applications, B..C. Liliana, A Viswanathan, S. Dharmaraja, Wiley Pvt. Ltd, 2012.

MEA242N-A APPLIED INSTITUTIONAL ECONOMICS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

- Introduce the main concepts that describe the institutional structure of the society
- Provide an overview of the recent developments in the field of institutional economics
- Help the students to understand the role of institutional environment in economic theory and in business practice
- Enable to use the concepts and methods of institutional economics in the analysis of institutions of the society

Course Outcomes

Upon successful completion of this course, the students will be able to

- Identify the types and nature of institutions and their impact on economic development. Identify the reason for institutional failures and its impact on the economic prosperity of nations.
- Analyse of the institutional structure of society
- Use the concept of transaction costs in the explanation of institutions, business practices and contract types
- Analyse the behaviour of the firm based on its property rights structure
- Conduct economic analysis of the behaviour of the state
- Analyse institutional changes

UNIT 1 **Hours: 12**

Introduction to Institutional Economics

Institutional Economics as a departure from Neo-Classical and Marxian Economics –

Historic development of Institutional Economics - Core issues in New Institutional

Economics. Rational choice model. Full and perfect information. Bounded rationality. Incomplete and imperfect information. Ultimate game. Beauty contexts game. Assumptions of New Institutional Economics. Incomplete specification of rules.

UNIT 2 **Hours: 12**

Transaction Costs and Bounded Rationality

Defining Transaction: Williamson, Ronald coase and Hobbs meaning of Transaction - Types of Transaction Cost: Information cost, Bargaining cost, Monitoring cost- Market, Managerial and Political transaction costs - Identification and measurements of transaction costs: some general principals - Modeling Transaction Costs by modeling the transaction activity.

UNIT 3 **Hours: 12**

Contract Theories

Incomplete contracts. Grossman-Hart model. Decision rights. Principal-agent framework. Asymmetric information. Adverse selection. Signaling. Screening. Moral hazard. Hidden action and information. Delegation. Agency costs. Incentive contracts. Opportunistic behavior.

UNIT 4 **Hours: 12**

Institutions of Property Rights

Definition of property rights. The Coase theorem and externalities. Categories of property rights. Property rights regimes. Collective property. Common property. Residual rights. Land rights. The naive theory of property rights emergence.

UNIT 5 **Hours: 12**

Applications of NIE

The New Institutional Economics of the Market: Market as Organisation, Price Rigidity, Market Organisation as Market Cooperation and Neo-institutionalist view of Market Organisation – The New Institutional Economics of the Firm: The Orthodox Neo – Classical Firm, The Incentives and the Limits to Integration, Ownership and Control, Institutional Models within the Neo – Classical Framework, Co – Determination and Comparison of the Formal Models of the Firm.

Text Books

1. Groenewegen, John., Spithoven, Antoon., & Berg, Annette Van Den. (2010). *Institutional Economics – An Introduction.* UK: Palgrave Macmillan.
2. Furburton & Richter, 'Institutions and Economic Theory', Dryden Press.
3. Michaels, Robert J. (2012). *Economics for Managers – Transactions and Strategies*. (1st Ed.). Cengage Learning.

4. Santhakumar, V. (2011). *Economic Analysis of Institutions – A Practical Guide*. SAGE.
5. Relevant Journal Articles wherever feasible.

Reference Books

1. North, Douglas C. (2004). *Institutional Change and Economic Performance*. Cambridge University Press.
2. Eggertson, Thrainn. (1999). *Economic Behaviour and Institutions*. Cambridge University Press.
3. Olson Mancur. (1965). *The Logic of Collective Action.* Cambridge: Harvard University Press.
4. Shaw, M E. (1971). Group Dynamics: The Psychology of Small Group Behaviour. New York: McGraw Hill.
5. Frank, Robert H. (1991). *Microeconomics and Behaviour*. McGraw Hill International Editions.
6. Pindyck, Robert S., Rubinfeld, Daniell L., & Mehta, Prem L. (2009). *Microeconomics*. (7th Ed.). Pearson.

MEA242N-B FINANCIAL ECONOMICS

Total Teaching Hours for Semester: 60 **No of Lecture Hours/Week: 4**

Max Marks: 100 **Credits: 4**

Course Objectives

- To familiarize students with the financial system and its components viz. financial instruments, financial institutions, financial markets and financial regulations.
- To familiarize them with contemporary theories about the workings of different financial markets including money market, capital markets (bonds, stocks and hybrids) and derivative markets.
- To familiarize them with the policy and regulatory framework within which financial institutions are required to function.

Course Outcomes

- Use economics models to understand the functions of financial markets and products. l economic decisions.
- Analyze, interpret and present financial data
- Explain the alternative approaches to economic problems

UNIT 1 **Hours: 10**

The demand for securities

The time dimension – Present value and duration – The calculation of yields on zero-coupon bonds – The term structure of interest rates – The risk dimension – Measurement of risk. Bivariate distributions–Conditional probabilities and expected values – Estimating the mean and variance of returns – Expected utility.

UNIT 2 **Hours: 10**

The supply of securities Regulations governing supply of securities

– General characteristics of securities – Government bonds – Index linked bonds – Corporate Securities – equities, bonds, convertible securities – Stock market operations – Money market funds – Claims on financial institutions.

UNIT 3 **Hours: 10**

Securities markets and their efficiency Stock exchanges

– The over the counter stock market – Operational efficiency and the Efficient Market Hypothesis(EMH) – The weak, semi-strong and the strong form of EMH.

UNIT 4 **Hours: 10**

The determination of equity prices

Shares as claims on future dividends and on corporate net worth – The Capital Asset Pricing Model (CAPM) – The simplest form – Estimating betas- Implications for portfolio management – Validity of CAPM – Arbitrage Pricing theory. An alternative approach – Stock indices – Bombay Sensitive Index, Bombay National Index, Dow Jones Industrial Index(DJI), New York Stock exchange composite index(NYSE).

UNIT 5 **Hours: 10**

Security analysis and market efficiency

A modern view of security analysis – Macroeconomic developments and securities markets– Performance of securities markets – Industry growth, structure and firm specific factors- Uses and pitfalls of Price / Earnings ratios

UNIT 6 **Hours: 10**

Derivatives Uses of Derivatives – Futures contracts and futures markets – Forward contracts – The origins of Futures trading – Basic elements and organization of futures contracts.

Text Books

1. Chandra, Prasanna (2008), Investment Analysis and Portfolio Management, Tata McGraw Hills

2. Shapiro, Alan C. (1999), 4th edition, Multinational Financial Management, International McGraw Hills, , Prentice-Hall of India
3. John Y. Campbell, Andrew W.Lo and A. Graig Mackinlay, (1997) The Econometrics of Financial Markets, Princeton University Press,

Reference Books

1. Houthakkar H.S. and Williamson P.J. (1996), The Economics of Financial Markets, Oxford University Press
2. Jurgen Echberger and Ian R. Harper (1997), Financial Economics, Oxford University Press
3. Ross Stephan A. and Rudolph W. Westerfield (1998), Fundamentals of Corporate Finance, McGraw Hill International edition
4. Fabozzi (2009), Bond Markets, 7th revised edition, Pearson Publications, USA, February 27
5. Basu, S., (1977), "The Investment Performance of Common Stocks in Relation to their Price to Earnings Ratios: A Test of the Efficient Market Hypothesis", Journal of Finance, 32, pp. 663- 682
6. Fama E.F. (1970), "Efficient Capital Markets: A Review of Theory and Empirical Work", Journal of Finance, 25 May, pp. 383-417
7. Fama, E.F. (1991), "Efficient Capital Markets II", Journal of Finance, 46, (December), pp. 1575-617 Module 4:
8. Graves, Affleck, Hegde, J.S. and Miller, R. (1994), "Trading Mechanisms and the Components of the Bid Ask Spread", Journal of Finance, 44, pp. 1471-1488.
9. Barsky, R. and Long, J. De (1993), "Why Does the Stock Market Fluctuate?", Quarterly Journal of Economics, 108, pp. 291-311
10. Black, F., Jensen, M.C. and Scholes, M.A. (1972), "The Capital Asset Pricing Model: Some Empirical Tests", in M.C. Jensen (ed.), Studies in the Theory of Capital Markets, (Praeger, New York