



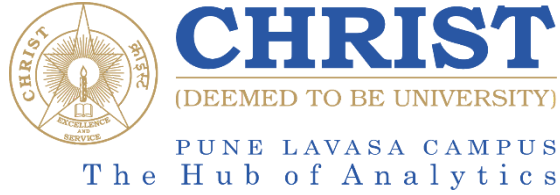
**CHRIST**  
(DEEMED TO BE UNIVERSITY)  
PUNE LAVASA CAMPUS  
*The Hub of Analytics*

# SYLLABUS



## MSC

**ECONOMICS & ANALYTICS  
(2023-24)**



## **Department of Data Science**

### **Proposed Syllabus Masters of Science (Economics and Analytics) Academic Year 2023-24**

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CHRIST (Deemed to be University), Pune

Lavasa Campus, Maharashtra, India

[www.lavasa.christuniversity.in](http://www.lavasa.christuniversity.in)

## **DEPARTMENT OVERVIEW**

The Department of Data Science at CHRIST (Deemed to be University), Pune Lavasa Campus was established to shape students into outstanding Data Scientists and Analytics professionals with ethical and human values. The department offers various undergraduate and postgraduate programmes viz., Bachelor of Science in Data Science, Master of Science in Data Science, Bachelor of Science in Economics & Analytics, and Doctor of Philosophy in the area of Computer Science and Engineering. The department has rich expertise in faculty resources who are trained in various fields like Data Science, Data Security, Data Analytics, Artificial Intelligence, Machine Learning, Networking, Data Mining, Big Data, Text Mining, Knowledge Representation, Soft Computing, and Cloud Computing. The department has a wide variety of labs set up, namely the Machine Learning Lab, Data Analytics Lab, Open Source Lab, etc., which are exclusively for students' hands-on training for their lab-oriented courses and research.

The department intermittently organizes hands-on workshops on recent technologies like Machine Learning, Cloud Computing, Hadoop, etc. for the students to make them ready for the industry. The department aims to equip students with a holistic education to make them better citizens.

## **VISION**

“Enrich Ethical Scientific Excellence”

## **MISSION**

“To develop Data Science professionals with ethical and social values.”

” To divulge state-of-the-art knowledge in the area of Data Science and Analytics.”

“To encourage research and innovation.”

“To accustom the students with current industry practices, teamwork, and entrepreneurship.”

## **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 Eligibility**

In order to pursue Master of Science in Economics and Analytics, the candidate should meet the below-mentioned eligibility criteria:

Candidates having 50% aggregate marks from any recognised University in India or abroad recognised by UGC / AIU in any of the following programmes are eligible with Mathematics as mandatory subject at Higher secondary level:

- (i) BA/BSc / BE / B.Tech with Mathematics/Statistics as a major or minor
- (ii) BCom / BBA with Business Maths or Data Analytics as Specialization

### **Programme Outcomes**

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

**P01:** Engage in continuous reflective learning in the context of technology and scientific advancement.

**P02:** Identify the need and scope of Interdisciplinary research.

**P03:** Enhance research culture and uphold scientific integrity and objectivity.

**P04:** Understand the professional, ethical, and social responsibilities.

**P05:** Understand the importance and the judicious use of technology for the sustainability of the environment.

**P06:** Enhance disciplinary competency, employability, and leadership skills.

### **Programme Specific Outcomes (PSO)**

**PSO1: Analyse, Evaluate and Create:** Ability to identify, analyse and design solutions for analytical problems using fundamental principles of economics, mathematics, statistics, computing sciences, and relevant domain disciplines.

**PSO2: Construct and execute modern Software Tools:** Acquire the skills in handling data analytics programming tools towards problem-solving and solution analysis for domain-specific problems.

**PS03: Societal and Environmental Concern:** Apply theories of economics and analytics to address for societal and environmental concerns.

**PS04: Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.

**PS05: Applications in Multidisciplinary Domains:** Analyse the Understand the role of statistical approaches and apply the same to solve real-life problems in the fields of economics and analytics.

**PS06: Project Management:** Apply research-based knowledge to analyse and solve advanced problems in economics and analytics.

**PS07: Acquainted with Economic Problems:** Solving skills, Reflective thinking, Apply analytically and scientific thinking

**PS08: Policy Analysis:** Critically analyse the effectiveness of various monetary and fiscal policy for stabilizing the economy

## EVALUATION PATTERN

**CIA - 70%**

**ESE - 30%**

## Curriculum Structure for MSc Economics and Analytics

### 2023-2025 Batch

SEM	SUBCODE	SUBJECT NAME	Hrs./ WEEK	CREDIT	MAX MARKS	TYPE
<b>I</b>	MEA131L	Microeconomic Theory and Applications-I	4	4	100	CORE
	MEA132L	Macroeconomic Theory and Policy-I	4	4	100	CORE
	MEA133L	Principles of Data Science	3	3	100	CORE
	MEA 134L	Mathematical Foundation for Data Analytics	4	4	100	CORE
	MEA135L	Statistical Methods for Economics	4	4	100	CORE
	MEA136L	Research Methodology (CIA Only)	2	2	50	CORE
	MEA171L	Python Programming (CIA Only)	5	4	100	CORE
	HOL111	Holistic Education	1	-	Grade	SEC
		<b>Total</b>	<b>27</b>	<b>25</b>	<b>650</b>	
SEM	SUBCODE	SUBJECT NAME	Hrs./ WEEK	CREDIT	MAX MARKS	TYPE
<b>II</b>	MEA231L	Microeconomic Theory and Applications-II	4	4	100	CORE
	MEA232L	Macroeconomic Theory and Policy-II	4	4	100	CORE
	MEA233L	Econometric Methods	4	4	100	CORE
	MEA234L	Advanced Mathematical Economics	4	4	100	CORE
	MEA235L	Research Modelling (CIA Only)	2	2	50	CORE
	MEA271L	R for Analytics (CIA Only)	6	5	150	CORE
	MEA241L	Elective - I	4	4	100	DSE
	MEA242L	Elective - II	4	4	100	DSE
	HOL211	Holistic Education	1	2	Grade	SEC
		<b>Total</b>	<b>33</b>	<b>33</b>	<b>800</b>	

## Curriculum Structure for MSc Economics and Analytics

### 2022-2024 Batch

SEM	SUBCODE	SUBJECT NAME	Hrs./WEEK	CREDIT	MAX MARKS	TYPE
<b>III</b>	MEA331L	International Economics	4	4	100	CORE
	MEA332L	Economics of Growth and Development	4	4	100	CORE
	MEA333L	Applied Econometrics	4	4	100	CORE
	MEA341L	Elective - III	4	4	100	DSE
	MEA371L	Applied Machine Learning (CIA Only)	6	5	150	CORE
	MEA372L	Elective - IV	5	4	100	DSE
	MEA 381PL	Specialization Project (CIA Only)	4	2	100	
		<b>Total</b>	<b>31</b>	<b>27</b>	<b>750</b>	
SEM	SUBCODE	SUBJECT NAME	Hrs./WEEK	CREDIT	MAX MARKS	TYPE
<b>IV</b>	MEA481IL	Industry Internship (CIA only)	–	10	300	-
	MEA482PL	Research Publication (CIA only)	–	2	100	-
		<b>Total</b>		<b>12</b>	<b>400</b>	-

ELECTIVES	
ELECTIVE -I	
MEA241AL	Multivariate Analysis
MEA241BL	Stochastic Process
ELECTIVE -II	
MEA242AL	Public Economics
MEA242BL	Financial Economics
ELECTIVE -III	
MEA341AL	Behavioral Economics
MEA341BL	Applied Institutional Economics
ELECTIVE -IV	
MEA372AL	Data Visualization (CIA Only)
MEA372BL	Business Intelligence (CIA Only)



# **SEMESTER I**

## **MEA131L MICROECONOMIC THEORY AND APPLICATIONS - I**

**Total Teaching Hours: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 firms and various forms of market.

### **Course Outcomes**

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

- Demonstrate an understanding, usage and application of basic economic principles.
- Describe and apply the methods for analyzing consumer behavior through demand and supply, elasticity and marginal utility
- Identify and appraise various models of how markets are organized, and the price and output decisions for maximizing profit.
- Demonstrate the rigorous quantitative training that analytical economics requires.
- Apply the microeconomic theory to micro-level real world economic problems.

### **UNIT 1**

**Hours: 10**

#### **Introduction, Demand and Supply Analysis**

Meaning and Definition, Scarcity, Resources and Opportunity Cost. Production Possibility Frontier, Micro vs. Macro Economics, Analyzing Economic Problems, relevance of microeconomics, key analytical tools.. Demand and Supply Analysis Concept of Demand, -Determinants of Demand, Law of Demand, Movement along vs. Shift in Demand Curve; Elasticity of Demand Supply-Meaning, Law of Supply, Exceptions to the Law of Supply, Changes or Shifts in Supply. Elasticity of supply, Factors Determining Elasticity of Supply, Other Elasticities, Elasticity in the long run versus short run.

### **UNIT 2**

**Hours: 15**

#### **Theory of Consumer Behavior**

Consumer Preferences and the concept of utility- Representation of preferences, assumptions about consumer preferences, ordinal and cardinal ranking, utility functions: marginal utility, total utility, indifference curves, Marginal rate of substitutions (MRS); Special preferences: perfect substitutes, perfect complements, the Cobb- Douglas utility function. Consumer Choice- The budget constraint, change in price affect the budget line, change in income affect the budget line, Optimal choice, consumer choice with composite goods.

The theory of Demand- Optimal choice and demand (change in price and change in demand), substitution effect and income effect (Hicks and Slutsky), consumer surplus, ordinary and compensated demand curves, inferior goods and Giffen goods, price consumption and income consumption curves, Revealed Preference Hypothesis (weak axiom and substitution). Case Studies on: Inferior goods, Compensated Demand Curves, Application of Hicks and Slutsky

### **UNIT 3**

**Hours: 20**

#### **Theory of Cost, Revenue and Production**

Theory of cost: Traditional and Modern, Iso-cost line cost minimization and expansion path of linear homogenous Production Function, Effect of changes in factor prices: factor substitution, substitute and complementary factors. Laws of production: Returns to scale, law of variable proportion, economies of scale, Technological progress and production function, Graphical derivation of cost curves from the production function, Production Possibility Curve of a firm Production Function: Cobb Douglas, self- work on: CES Elasticity of Supply. Cases of real world business models with least or no fixed cost Concept of revenue: Marginal and Average : Revenue under conditions of perfect and imperfect competition.

### **UNIT 4**

**Hours: 15**

#### **Price and Output Determination**

Market Equilibrium and Changes in Market Equilibrium. Market Equilibrium and Government Policies . Characterizing perfect competition; Pricing and output under perfect competitive markets; Monopoly markets: Pricing, Multidimensional business platform discrimination; welfare costs; Monopoly Market structures: Multiplant firm, price discrimination and effects of price discrimination, price discrimination and elasticity of demand, group discussion on: Government regulated Monopoly, degree of monopoly

power Monopolistic competition: Characteristics; Long run and short run behavior. Case studies and discussions on the current scenario of the market.

### **Essential Readings**

1. Pindyck, Robert & Rubinfeld, Daniel (2013), Micro Economics, 8th Edition, Pearson Education, USA.
2. Besanko, D. and Braeutigam, R. (2015) Microeconomics, 5th Edition, Wiley India

### **Recommended References**

1. Andreu Mas-Colell, M D Whinston and J R Green (1995), Microeconomic Theory, Oxford University Press.
2. Kreps, D. M. (1990), A Course in Microeconomic Theory, Princeton University Press, Princeton.
3. Krugman, Paul. and Wells, R. (2005), Microeconomics, Worth Publishers.
4. Koutsoyiannis, A. (1979), Modern Microeconomics, (2nd Edition), Macmillan Press, London.
5. Sen, A (2007), Microeconomics: Theory and Applications, Oxford University Press, New Delhi.
6. Varian, H. (2000), Microeconomic Analysis, W.W. Norton, New York.
7. Henderson, J.M. and R.E. Quandt (2003), Microeconomic Theory: A Mathematical Approach, McGraw Hill, New Delhi.

## **MEA132L MACROECONOMIC THEORY AND POLICY - I**

**Total Teaching Hours: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**

#### **Introduction and Output Determination**

The development of macroeconomics- Circular flow of money and product, Actual and potential output- GNP identity on the product, income and disposition side-The government sector and foreign sector-Classical theory of income and employment-Behaviour of Aggregate demand and Aggregate supply, money and prices in classical model- Keynes' theory of employment- Role of Aggregate Demand- Consumption function, investment demand- Effective demand- Determination of equilibrium

income- Theory of multiplier-Derivation of Investment, expenditure and trade multiplier

## **UNIT 2**

**Hours: 10**

### **Product and Money Market Equilibrium**

Equilibrium income and the interest rate determination in the product market- Equilibrium income and the interest rate determination in the money market- Derivation of IS and LM curves-Shift in IS and LM curves-Simultaneous equilibrium- Fiscal and monetary policy effects on demand-Interaction of monetary and fiscal policies Aggregate supply in the short run and long run-Supply side disturbances and reactions-Demand side disturbances and reactions-Determination of equilibrium income, employment, rate of interest and price level.

## **UNIT 3**

**Hours: 10**

### **Supply of Money and Demand for Money**

Financial intermediation — a mechanistic model of bank deposit determination; A behavioural model of money supply determination, a demand determined money supply process; RBI approach to money supply; High powered money and money multiplier; budget deficits and money supply; control of money supply. Neo-classical and Keynesian Synthesis.

## **UNIT 4**

**Hours: 10**

### **Demand for Money and Post-Keynesian approaches**

Classical approach to the demand for money — Quantity theory approach, Fisher's equation, Cambridge quantity theory, Keynes's liquidity preference approach, transaction, precautionary and speculative demand for money — aggregate demand for money; demand for money — Patinkin and the Real Balance Effect, Approaches of Baumol and Tobin; Friedman and the modern quantity theory; Crisis in Keynesian economics and the revival of monetarism.

## **UNIT 5**

**Hours: 10**

### **Open-Economy Macroeconomics**

Mundell-Fleming model — Asset markets, expectations and exchange rates; Monetary approach to the balance of payments.

## 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.

### Essential Readings

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

### Recommended References

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.
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.



## **MEA133L PRINCIPLES OF DATA SCIENCE**

**Total Teaching Hours: 45**

**No of Lecture Hours/Week: 3**

**Max Marks: 100**

**Credits: 3**

### **Course Objectives**

The principles of data science deals with the econometric scientific methods of analyzing data. Today, we live in a big data world, where the amount of data generated everyday is very huge, therefore we need methods to clearly transform and analyze data. Therefore, machine learning, which is included in this syllabus, does the job. Also, the students here are introduced into different scenarios and methodologies to get results out of data.

### **Course Outcomes**

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

- Understand the modern big data econometric methods.
- Annotate empirical data modelling with machine learning algorithms.
- Experiment econometric prediction based on the data analytics.

### **UNIT 1**

**Hours: 9**

#### **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: 9**

#### **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: 9**

#### **Machine Learning**

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



## **UNIT 4**

**Hours: 9**

### **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: 9**

### **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.

### **Essential Readings**

1. Godsey, B. (2017). *Think Like a Data Scientist*, Manning Publications
2. Cielen, D. & Meysman A, (2016). *Introducing Data Science*, Manning Publications

### **Recommended References**

1. Grus, J. (2019). *Data science from scratch: first principles with python*. O'Reilly Media, Inc.
2. O'Neil, C., & Schutt, R. (2013). *Doing data science: Straight talk from the frontline*. " O'Reilly Media, Inc.
3. Rajaraman, A., & Ullman, J. D. (2011). *Mining of massive datasets*. Cambridge University Press.
4. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An introduction to statistical learning*, Springer

# **MEA134L-MATHEMATICAL FOUNDATION FOR DATA ANALYTICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Credits: 4**

**Max Marks:100**

## **Course Description and Course Objectives**

Linear Algebra plays a fundamental role in the theory of Data Analytics. This course aims at introducing the basic notions of vector spaces, Linear Algebra and the use of Linear Algebra in applications to Data Analytics.

## **Course Outcomes**

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

- Understand the properties of Vector spaces.
- Use the properties of Linear Maps in solving problems on Linear Algebra.
- Demonstrate proficiency on the topics Eigenvalues, Eigenvectors and Inner Product Spaces
- Apply mathematics for some applications in Data Analytics

## **Unit-1**

**Hours: 15**

### **INTRODUCTION TO VECTOR SPACES**

Vector Spaces:  $\mathbb{R}^n$  and  $\mathbb{C}^n$ , lists,  $F^n$  and digression on Fields, Definition of Vector spaces, Subspaces, sums of Subspaces, Direct Sums, Span and Linear Independence, bases, dimension.

## **Unit-2**

**Hours: 15**

### **LINEAR MAPS**

Definition of Linear Maps -Algebraic Operations on  $L(V,W)$  - Null spaces and Injectivity-Range and Surjectivity-Fundamental Theorems of Linear Maps-Representing a Linear Map by a Matrix-Invertible Linear Maps-Isomorphic Vector spaces-Linear Map as Matrix Multiplication - Operators - Products of Vector Spaces - Product of Direct Sum - Quotients of Vector spaces.

## **Unit-3**

**Hours: 15**

### **EIGENVALUES, EIGENVECTORS, AND INNER PRODUCT SPACES**

Eigenvalues and Eigenvectors - Eigenvectors and Upper Triangular matrices - Eigenspaces and Diagonal Matrices - Inner Products and Norms - Linear functionals on Inner Product spaces. Multiple commodity markets- IS-LM Model- Mundell-Fleming Model

## **Unit-4**

**Hours: 15**

### **BASIC MATRIX METHODS FOR APPLICATIONS**

Matrix Norms – Least square problem - Singular value decomposition- Householder Transformation and QR decomposition- Non Negative Matrix Factorization – bidiagonalization.

## **Essential Readings**

1. S. Axler, Linear algebra done right, Springer, 2017.

2. Eldén Lars, Matrix methods in data mining and pattern recognition, Society for Industrial and Applied Mathematics, 2007.

### **Recommended References**

1. E. Davis, Linear algebra and probability for computer science applications, CRC Press, 2012.
2. J. V. Kepner and J. R. Gilbert, Graph algorithms in the language of linear algebra, Society for Industrial and Applied Mathematics, 2011.
3. D. A. Simovici, Linear algebra tools for data mining, World Scientific Publishing, 2012.
4. P. N. Klein, Coding the matrix: linear algebra through applications to computer science, Newtonian Press, 2015.

# **MEA135L STATISTICAL METHODS FOR ECONOMICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

## **Course Objectives**

The course enables the students to

- Introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data.
- Introduce measurement of the relationship of quantitative and qualitative data and the concept of probability.
- 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.
- Identify various discrete and continuous distributions and their usage.
- Apply sampling distributions to various Economic data .

## **UNIT 1**

**Hours: 10**

### **Descriptive Statistics**

Origin and development of Statistics, Scope, limitation and misuse of statistics. Types of data. Types of Measurements. Graphical and tabular representation of data.

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

## **UNIT 2**

**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 3**

**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 4**

**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.

### **UNIT 5**

**Hours: 15**

#### **Jointly distributed Random Variables**

Joint distribution of vector random variables – joint moments – covariance – correlation – independent random variables conditional distribution – conditional expectation - sampling distributions: chi-square, t, F (central).

### **Essential Readings**

1. Rohatgi, V. K., & Saleh, A. M. E. (2015). *An introduction to probability and statistics*. John Wiley & Sons.
2. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics*. Sultan Chand & Sons.

### **Recommended References**

1. Mukhopadhyay, P. (2015): *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.
2. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (1993). *Probability and Statistics for Engineers and Scientists* (Vol. 5). New York: Macmillan.
3. Montgomery, D. C. (2013). *Applied statistics and probability for Engineers*, 6th edition. Wiley.
4. Mood, A., Graybill, F. A., & Boes, D. C. (1974). *Introduction to the theory of statistics*.

## **MEA136L RESEARCH METHODOLOGY**

**Total Teaching Hours:30**

**No of Lecture Hours/Week: 2**

**Max Marks: 50**

**Credits: 2**

### **Course Objectives**

This course enables the students to

- Understand the importance of research in creating and extending the knowledge base of their subject area;
- Distinguish between the strengths and limitations of different research approaches regarding their subject/research area;
- Know the range of qualitative and quantitative research methods potentially available to them;
- Differentiate between the role of practitioners and the role of researchers;
- Understand and analyze critically reflect upon issues of ethics and role of the researcher;
- Independently work, 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.
- Differentiate between the role of practitioners and the role of researchers.
- Demonstrate the small-scale research project independently
- Demonstrate the understanding of and ability to critically reflect upon issues of ethics and research

### **UNIT 1**

**Hours: 08**

#### **Introduction**

Definition and objectives of research– types of research; Steps in research process; Criteria of good research; Characteristics of a good research problem. Ethical issues in research.

### **UNIT 2**

**Hours: 06**

#### **Review of Literature**

Review of Literature - The place of the literature review in research; Identification of Research Gaps; Meaning and sources of a research problem; Identification, selection and formulation of research problem.

### **UNIT 3**

**Hours: 08**

#### **Sampling Design**

Concept of Population and a sample; Sampling techniques ; Types and sources of data; Methods of data collection; Design of questionnaire; Characteristics of a good questionnaire, Problems in data collection; Measurement scales.

### **UNIT4**

**Hours: 08**

#### **Hypothesis Testing and Report Writing**

Concept of Null and Alternative hypothesis, Testing of hypothesis; Type I and Type II error. Important parametric tests– applications of z– test, t– test, chi– square test. Presentation of research findings, writing a research report, Referencing and bibliography.

#### **Essential Readings**

1. Kumar R. (2010). *Research methodology: A step by step guide for beginners*. SAGE Publications Ltd; Third Edition.
2. Kothari C. R. (2019). *Research Methodology: Methods and Techniques (4th Edition)*, New Age International Publishers.

#### **Recommended References**

1. Keller G. (2017) *Statistics for Management and Economics, 11th Edition*. Cengage Learning.
2. Bairagi V. & Munot M. V. (2019). *Research Methodology-A Practical And Scientific Approach*. CRC Press Taylor & Francis Group.

## **MEA171L PYTHON PROGRAMMING**

**Total Teaching Hours:75**

**No of Lecture Hours/Week: 5(3+2)**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The objective of this course is to provide comprehensive knowledge of Python programming paradigms required for Data Science.

### **Course Outcomes**

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

- Demonstrate the use of built-in objects of Python
- Demonstrate significant experience with python program development environment
- Implement numerical programming, data handling and visualization through NumPy, Pandas and Matplotlib modules.

### **UNIT 1**

**Hours: 9**

#### **INTRODUCTION TO PYTHON**

Structure of Python Program-Underlying mechanism of Module Execution-Branching and Looping-Problem Solving Using Branches and Loops-Functions - Lists and Mutability-Problem Solving Using Lists and Functions

### **UNIT 2**

**Hours: 9**

#### **SEQUENCE DATA TYPES AND OBJECT-ORIENTED PROGRAMMING**

Sequences, Mapping and Sets- Dictionaries- -Classes: Classes and Instances-Inheritance-Exceptional Handling-Introduction to Regular Expressions using “re” module.

### **UNIT 3**

**Hours: 9**

#### **USING NUMPY**

Basics of NumPy - Computation on NumPy-Aggregations-Computation on Arrays-Comparisons, Masks and Boolean Arrays-Fancy Indexing-Sorting Arrays-Structured Data: NumPy's Structured Array.

### **UNIT 4**

**Hours: 9**

#### **DATA MANIPULATION WITH PANDAS -I**



Introduction to Pandas Objects-Data indexing and Selection-Operating on Data in Pandas- Handling Missing Data-Hierarchical Indexing - Combining Data Sets  
Aggregation and Grouping-Pivot Tables-Vectorized String Operations -Working with Time Series-High Performance Pandas- and query()

## **UNIT 5**

**Hours: 9**

### **VISUALIZATION AND MATPLOTLIB**

Basic functions of Matplotlib- Simple Line Plot, Scatter Plot-Density and Contour Plots- Histograms, Binnings and Density-Customizing Plot Legends, Color Bars-Three-Dimensional Plotting in Matplotlib.

### **Lab Programs**

**Hours: 30**

1. Demonstrate usage of branching and looping statements
2. Demonstrate Recursive functions
3. Demonstrate Lists
4. Demonstrate Tuples and Sets
5. Demonstrate Dictionaries
6. Demonstrate inheritance and exceptional handling
7. Demonstrate use of “re”
8. Demonstrate Aggregation
9. Demonstrate Indexing and Sorting
10. Demonstrate handling of missing data
11. Demonstrate hierarchical indexing
12. Demonstrate usage of Pivottable
13. Demonstrate use of andquery()
14. Demonstrate ScatterPlot
15. Demonstrate 3D plotting sciPy

### **Essential Readings**

1. Jake VanderPlas (2016) ,*Python Data Science Handbook - Essential Tools for Working with Data*, O'Reilly Media,Inc.
2. Zhang.Y (2016) ,*An Introduction to Python and Computer Programming*, Springer Publications

### **Recommended References**

1. JoelGrus (2016), *DataScience from Scratch First Principles with Python*, O'Reilly Media,
2. T.R.Padmanabhan(2016), *Programming with Python*, Springer Publications.

## **SEMESTER II**

### **MEA231L MICROECONOMIC THEORY AND APPLICATIONS -II**

**Total Teaching Hours: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.

#### **Course Outcomes**

After successful completion of the course students will be able to

- Assess the assumptions made in micro-economic literature that applies microeconomics, game theory and information economics.
- Acquire additional theoretical knowledge at an advanced level.
- Demonstrate the rigorous quantitative training that analytical economics requires.
- Design micro-economic models for various real-world problems.

#### **Unit 1**

**Hours:10**

##### **Factor Pricing**

Factor Pricing 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.

#### **Unit 2**

**Hours :10**

##### **Market Failure and Game Theory**

Asymmetric Information, Externalities and tragedy of commons .The Payoff Matrix of a Game, Nash Equilibrium, Mixed Strategies, The Prisoner's Dilemma, Repeated Games, Games of Coordination, Games of Competition and Games of Coexistence.

### **Unit 3**

**Hours: 10**

#### **Non- Collusive Oligopoly**

Applications: strategic behavior of firms in a market–Bertrand, Cournot and Stackleberg models – and entry deterrence.

### **Unit 4**

**Hours: 15**

#### **Theories of Distribution**

Macro theories of distribution – Ricardian, Marxian, Kalecki and Kaldor's. Theories of Profit (Clarks dynamic theory , Schumpeter's Innovation theory of profit, Risk and Uncertainty theory of Profit )

### **Unit 5**

**Hours: 15**

#### **General Equilibrium and Welfare Economics**

Existence, stability and uniqueness of partial equilibrium and general equilibrium. Pareto optimality; Fundamental Theorems of Welfare Economics; Theory of second best –Arrow's impossibility theorem.

#### **Essential Readings**

1. Pindyck, Robert & Rubinfeld, Daniel (2013), *Micro Economics*, 8th Edition, Pearson Education, USA
2. Henderson, J.M. and R.E. Quandt (2003), *Microeconomic Theory: A Mathematical Approach*, McGraw Hill, New Delhi.

#### **Recommended References**

1. Furubotn, E. G., & Richter, R. (2010). *Institutions and economic theory: The contribution of the new institutional economics*. University of Michigan Press.
2. Andreu Mas-Colell, M D Whinston and J R Green (1995), *Microeconomic Theory*, Oxford University Press.
3. Kreps, D. M. (1990). *A course in microeconomic theory*. Princeton university press.
4. Krugman, P., & Wells, R. (2015). *Macroeconomics*, 4th.edition.
5. Koutsoyiannis, A. (1979), *Modern Microeconomics, (2nd Edition)*, Macmillan Press, London.
6. Mukherjee, Anjan (2002), *An Introduction to General Equilibrium Analysis*, Oxford University Press.
7. Osborne, Martin J. (2009), *An Introduction to Game Theory*, Oxford University Press.

8. Sen, Anindya (2007), *Microeconomics: Theory and Applications*, Oxford University Press, New Delhi.
9. Varian, H. (2000), *Microeconomic Analysis*, W.W. Norton, New York.

## **MEA232L MACROECONOMIC THEORY AND POLICY- II**

**Total Teaching Hours: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**

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

- Understand the structure and various approaches of interest rate.
- Analyze the factors that influence the demand for money.
- Equip the student with skills to analyze the phases and working of the business cycles.
- To assist students in understanding the foundations of post-Keynesian economics and helping them apply these ideas to their own lives and the society they live in.

### **UNIT 1**

**Hours:15**

#### **Theories of the Interest Rate**

Real and monetary theories of the interest rate – Classical theory of interest, Neo-Classical theory of interest, Keynesian liquidity preference theory, Wicksellian theory, Fisher's theory, Modern theory of interest (Hicksian-Hansen theory), Credit market imperfections - Adverse selection and moral hazard.

### **UNIT 2**

**Hours: 15**

## **The Demand for Money and Term structure of Interest Rates**

The Classical view of the demand for money, Keynes's view of the demand for money, Post-Keynesian Approaches – Friedman's approach, Baumol's approach to demand for money, Tobin's portfolio optimization approach. Meaning of The term structure of interest rates, Theories of The term structure of interest rates - Pure Expectations, Pure segmentation and Substitutability theories.

### **UNIT 3**

**Hours: 15**

## **Business Cycles and post Keynesian Macroeconomics**

Meaning and Phases of Business cycle, Theories of business cycle – Sunspot theory, Psychological theory, Overproduction theory, Oversaving Theory, Hawtrey's theory, Hayek's theory, Samuelson's theory, Hicks's theory, Goodwin's theory, and Kaldor's theory. Real Business Cycle Theory, Inter temporal substitution of labour, Technology shocks, neutrality of money and flexibility of wages and prices. The modern monetarism, major postulates, Keynesian policy framework- The New Classical macroeconomics, The Supply-Side economics-major implications.

### **UNIT 4**

**Hours: 15**

## **Post Keynesian Macroeconomics and Rational Expectation revolution**

The New Classical critique of Micro-foundations, the New Classical Approach; Policy Implications of New Classical Approach — empirical evidence. Rational Expectation Revolution.

### **Essential Readings**

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*. 2<sup>nd</sup> Edition, Tata McGraw Hill Education.
3. Levacic and Rebman. (1982). *Macro Economics: An Introduction to Keynesian and Neoclassical Controversies*. 2<sup>nd</sup> Edition, Macmillan Publishers.

## Recommended References

1. Burda and Wyplosz (2009). *Macroeconomics: A European Text*, Fifth Edition, Oxford University Press, New York.
2. Graeme Chamberline & Linda Yueh (2006). *Macroeconomics*, Thomson Learning.
3. N. Gregory Mankiw. (2012). *Macroeconomics*. 8<sup>th</sup> Edition, Worth Publishers.
4. Dornbusch, Fischer, Startz. (2010). *Macroeconomics*. 11<sup>th</sup> 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*. 18<sup>th</sup> 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.



## **MEA233L ECONOMETRIC METHODS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

On completion of the course students should be able to:

- Understanding of simple and multiple linear regression, its assumptions, and the impact of violations of its assumptions.
- Developing their proficiency with the econometric software like EViews and Stata required to model economic data in practice.
- Formulating, estimating, testing, and interpreting suitable models for the empirical study of economic events.
- Ability to evaluate the performance of alternative econometric models through the appropriate use of tests.

### **Course Outcomes**

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

- Understand the methodology of econometric research.
- Comprehend the assumptions upon which different econometric methods are based and their implications.
- Demonstrate their understanding of applied econometric analysis with respect to model estimation and interpretation of results.
- Perform post-estimation diagnostic tests.
- Ability to estimate and interpret models with qualitative regressors.

### **Unit 1**

**Hours: 10**

#### **Introduction to Econometrics**

Meaning of econometrics- why a separate discipline, methodology of econometrics, the concept of population regression function (PRF) and sample regression function (SRF), statistical versus deterministic relationships, the significance of the stochastic disturbance term, regression versus correlation, regression versus causation, terminology and notation in econometric analysis.

## **Unit 2**

**Hours: 15**

### **Simple and Multiple Regression**

Simple and multiple regression, Assumptions, Gauss-Markov theorem, Approaches to hypothesis testing – individual and joint significance, partial effects, and elasticity, R-Squared and Adjusted R-Squared.

## **Unit 3**

**Hours: 15**

### **Relaxing OLS Assumptions**

Problems of Regression Analysis - Multicollinearity, Heteroskedasticity, and Autocorrelation; Nature of these problems, causes, consequences, detection,, and remedy.

## **Unit 4**

**Hours: 10**

### **Model Specification and Diagnostic Testing**

Attributes of a good econometric model, model selection criteria, types of specification errors, consequences of model specification errors, tests of specification errors – Omitted variables test, Redundant variable test, Ramsey RESET test.

## **Unit 5**

**Hours: 10**

### **Dummy Variables**

The nature and use of Dummy Variables, ANOVA models, Dummy variable trap and perfect multicollinearity, structural stability of regression models- Chow test, The Dummy Variable Alternative to the Chow Test.

### **Essential Readings**

1. Gujarati, D. N., Porter, D.C., & Gunasekar, S. (2017). Basic Econometrics. (5th ed.). McGraw-Hill.
2. Wooldridge, J. M. (2014). Introductory Econometrics: A Modern Approach (4th ed.). Cengage Learning.

### **Recommended References**

1. Koutsoyiannis, A. (1979). Theory of Econometrics (2nd Ed.) Palgrave Macmillan.
2. Maddala, G. S. (1992) Introduction to Econometrics (2nd Ed.) Macmillan Publishing Company.
3. Gujarati, D. N. & Porter, D. C. (2010). Essentials of Econometrics, 4th McGraw Hill International Edition.

4. Brooks, C. (2019). Introductory Econometrics for Finance 4th Edition Cambridge University Press.
5. Hill, C., Griffiths, W. E., & Lim G. C. (2018). Principles of Econometrics, 5th Edition Wiley.
6. Dougherty, C. (2016). Introduction to Econometrics, 5th Edition. Oxford University Press.
7. Patterson K. (2000). An Introduction to Applied Econometrics: A Time Series Approach. Palgrave Macmillan.
8. Asteriou, D., & Hall, S. G. (2021). Applied Econometrics (4th ed.). Red Globe Press.56
9. Gujarati, D. (2015). Econometrics by Example, (2nd Edition). Palgrave Macmillan.
10. Hilmer, C. E. & Hilmer, M. J. (2014). Practical Econometrics. McGraw Hill Education.
11. Ramanathan, R. (2002). Introductory Econometrics with Applications, 5th Edition. Thomson Asia Private Limited.

## **MEA234L ADVANCED MATHEMATICAL ECONOMICS**

**Total Teaching Hours: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 introduce students to various economic concepts which are amenable to mathematical treatment.

### **Course Outcomes**

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

- Exhibit a sound understanding of mathematical techniques discussed.
- Formulate economic problems in mathematical terms.
- Apply 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

### **UNIT 2**

**Hours: 10**

#### **Integration**

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

### **UNIT 3**

**Hours: 11**

#### **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. Application: 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

Applications: Cobweb Market Model and Dynamic stability of Market price

##### **Essential Readings**

1. Simon, C. P., & Blume, L. (1994). *Mathematics for economists* (Vol. 7). New York: Norton.
2. Dowling, E. T. (2001). *Introduction to mathematical economics*. McGraw-Hill.
3. Alpha Chiang and Kevin Wainwright (2004), *Fundamental Methods of Mathematical Economics*. McGraw-Hill Book Company, 4th Edition (Chiang)
4. Carl P. Simon and Lawrence Blume (2006), *Mathematics for Economists*, W.W. Norton & Company (Simon)
5. Hoy, M., Livernois, J., McKenna, C., Rees, R., & Stengos, T. (2011). *Mathematics for economics*. MIT press.

##### **Recommended References**

1. Allen R G D (1974). *Mathematical Analysis for Economists*, McMillan Press and ELBS, London.

2. Wainwright, K. (2005). *Fundamental methods of mathematical economics/Alpha C. Chiang, Kevin Wainwright*. Boston, Mass.: McGraw-Hill/Irwin,.
3. Allen R G D (1967). *Macro-economic Theory*, McMillan Co., Ltd.,
4. Chiang A C (1986). *Fundamental Methods of Mathematical Economics*, McGraw Hill, New York.
5. Koutsoyiannis A. 2003. *Modern microeconomics*, 2nded, ELBS with McMillan.
6. Monga G S. 2001 *Mathematics and Statistics for Economics*, Vikas Publishing House Pvt. Ltd., Delhi.
7. Yamane, Taro (1981) *Mathematics for Economists*, Prentice Hall of India, New Delhi.
8. Mehta and Madnani (2005) *Mathematics for Economists*, Sultan Chand and Sons, New Delhi.

## **MEA 235L - RESEARCH MODELLING**

**Total Teaching Hours: 30**

**No of Lecture Hours/Week:2**

**Max Marks: 50**

**Credits:2**

### **Course Description and Course Objective**

The course is designed to train and equip the students to carryout research. The course enables the students to

- Gain knowledge of core research techniques which forms a basis for understanding and critical analysis of the published work in economics.
- Develop the analytical skills required to conduct research in economics discipline.

### **Course Outcomes**

- Develop a strong theoretical background which would help the students to better understand applicability of various methods and tools in different economic contexts or scenarios.

### **Unit-1 Hours: 30**

#### **Research Modelling and Implementation**

There is only CIA for this paper. Research work carried out in this semester is divided in two parts.

Part A constitutes data collection and pre-processing in which students should carry out the following tasks and submit the document for the same before the MSE.

Literature survey of existing data sets or any primary data sets in the respective area

- Gather the datasets from various sources (like visiting websites, universities, person, creating individually, etc.)
- Steps in pre-processing

Part B constitutes modelling and implementation of their research work. Students should perform the following tasks:

- Methodology
- Evaluation and Discussion of Results
- Limitations, Conclusions and Scope for future enhancements
- Plagiarism report

Week 1 - Discussion and Identification of Research Domain (Updatons)  
Week 2 - Identification of Research Gap / OBJECTIVES OF RESEARCH  
Week 3 - Research Design Phase - I  
Week 4 - Research Design Phase - II  
Week 5 - Research Design Phase - III  
Week 6 - Methods of Data Collection - Processing - Analysis of Data  
Week 7 - Methods of Data Collection - Processing - Analysis of Data  
Week 8 - Methods of Data Collection - Processing - Analysis of Data  
Week 9 - Methods of Data Collection – Processing- Analysis of Data  
Week 10 - Methods of Data Collection - Processing - Analysis of Data  
Week 11 - Implementation Phase - I  
Week 12 - Implementation Phase - I (a)  
Week 13 - Implementation Phase - I (b)  
Week 14 - Implementation Phase - I (c)  
Week 15 - Implementation Phase - I (d)

### **Essential Readings**

1. Wooldridge, J. M. (2015). *Introductory econometrics: A modern approach*. Cengage learning.
2. Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.
3. Khandker, S. R., Koolwal, G. B., & Samad, H. A. (2009). *Handbook on impact evaluation: quantitative methods and practices*. World Bank Publications.
4. Gujarati, D. N. (2021). *Essentials of econometrics*. SAGE Publications.
5. Angrist, J. D., & Pischke, J. S. (2008). *Mostly harmless econometrics*. Princeton university press.

### **Recommended References**

6. Research articles and publication from peer reviewed journals and established government reports.



## MEA271L R FOR ANALYTICS

**Total Teaching Hours:90**

**No of Lecture Hours/Week: 6(4+2)**

**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
- Demonstrate graphical representation of data using R
- Apply their knowledge of various tools create R programs
- Design and create applications which can handle multivariate data.
- Evaluate the correlation between data and apply Exploratory Data Analysis

### UNIT 1

**Hours: 10**

#### 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: 10**

#### 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: 10**

**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: 10**

### **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: 10**

### **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

## **UNIT 6**

**Hours: 10**

### **Regression and Diagnostic Tests**

Multiple Regression, Qualitative Regressor Models, Qualitative Response Regression Models, Checking the assumptions of Regression Model and Model Diagnostics.

## **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. 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 the ggplot2 package to plot 1D, 2D and 3D plots for a given dataset.
14. Demonstrate Pearson correlation and Spearman rank correlation.
15. Demonstrate the use of Qualitative and Quantitative Response Regression Models in establishing statistical association between variables.

### **Essential Readings**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
2. Kerns, J. (2010). "Introduction to Probability and Statistics Using R" (First Edition).

### **Suggested Readings**

1. John V Guttag, —Introduction to Computation and Programming Using Python “, Revised and 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.

## **MEA241AL MULTIVARIATE ANALYSIS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The Course enables students to

- Introduce the historical development of statistics, presentation of data, descriptive measures and fitting mathematical curves for the data.
- Introduce the measurement of the relationship of quantitative and qualitative data and the concept of probability.
- 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, Canonical Analysis and Factor Analysis.

### **UNIT 4**

**Hours: 12**

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

## **UNIT 5**

**Hours: 12**

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

### **Essential Readings**

1. Hardle, W. K. & Simar, L. (2019). *Applied Multivariate Statistical Analysis* (5th ed.) Springer.
2. Anderson, T. W. (2003). *An Introduction to Multivariate Statistical Analysis* (3rd ed.) John Wiley.
3. Muirhead, R. J. (1982). *Aspects of Multivariate Statistical Theory*. John Wiley.
4. Kshirsagar, A.M. (1972). *Multivariate Analysis* (1st ed.) Marcel Dekker.

### **Recommended References**

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

## **MEA241BL STOCHASTIC PROCESS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

This course enables the students to understand 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

- Identify classes of states in Markov chains and characterize the classes.
- Compute probabilities of transition between states and return to the initial state after long time intervals in Markov chains.
- Determine limit probabilities in Markov chains after an infinitely long period.
- Solve 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.

### **Essential Readings**

1. Gallager, R. G. (2013). Stochastic Processes. Cambridge University Press.
2. Ross, S. M. (2008). Stochastic Processes. Wiley India Pvt. Ltd.

### **Recommended References**

1. Moral, P. D. & Penev, S. (2016). Stochastic Processes from Applications to Theory . CRC Press.
2. Liliana, B.C., Viswanathan, A. & Dharmaraja, S.(2012). Introduction to Probability and Stochastic Processes with Applications. Wiley India Pvt. Ltd.
3. Medhi, J. (2019). Stochastic Processes. New Age International Publication, New Delhi.

## **MEA242AL PUBLIC ECONOMICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The objective of this course is to present an introduction to public economics, which analyzes the impact of public policy on the allocation of resources and the distribution of income and wealth in the economy. We study various market failures as a justification for public action, and analyze how government policies can improve market outcomes. We address the financing side of government and consider key issues in tax policy along with contemporary issues in redistribution and social policy. Finally, selected analytical tools in public economics are discussed.

### **Course Outcomes**

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

- Apply the basic tools, central concepts and models to solve problems in key topics in Modern Public Economics;
- Summarize the assumptions, relevance, and limitations of the models;
- Identify and analyse policy problems in public economics
- Apply analytical tools to assess arguments appearing in the policy debates.

### **UNIT 1**

**Hours: 10**

#### **Introduction and Background**

Public Economics, Theory and Policy, Positive Versus Normative Analysis of Government Action Pareto-Criterion, Theory of The Second Best, General Vs. Partial Equilibrium Theory, Theorems of Welfare Economics.

### **UNIT 2**

**Hours: 15**

#### **Externality Theory and Public Goods**

Economics of Externalities, Properties of Public Goods, Optimum's Provision of Public and Private Goods, Political Economy: Lindahl Pricing, Voting Theory-Arrow's Impossibility Theorem, Clarke-Grove's Mechanism.

### **UNIT 3**

**Hours: 15**



### **Taxation in Theory and Practice**

Taxation In Economics and Around the World, The Equity Implications of Taxation: Tax Incidence, Tax Inefficiencies and Their Implications for Optimal Taxation, Taxation and Evidence: Commodity, Income and Capital , taxation in India: Different types of taxes Canons of taxation Commission on direct and indirect taxes.

### **UNIT4**

**Hours: 10**

### **Redistribution and the Social Policies**

Social Insurance and Security: The New Function of Government, Public expenditure ( Wagners law , Wiseman Peacock Hypothesis, Effects of public expenditure ) Private Saving for Retirement, Political Economy of Redistribution, Income Distribution and Welfare Programs.

### **UNIT 5**

**Hours: 10**

### **Empirical Methods for Public Economics**

Cost-Benefit Analysis, Decision Criteria for Benefit–Cost Analysis, Policy Analysis Involving Risk and Uncertainty, The Expected Utility Model, Risk Aversion and The Willingness to Pay.

### **Essential Readings**

1. Gruber, J. (2019). *Public Finance and Public Policy*. Worth Publishers.
2. Myles, G. D. & Hindriks, J. (2013). *Intermediate Public Economics*. MIT Press Limited.

### **Recommended References**

1. Atkinson, A. B. & Stiglitz, J. E. (2015). *Lectures on Public Economics*. Princeton University Press.
2. Bellinger, W. K. (2015). *The Economic Analysis of Public Policy*. Taylor & Francis.
3. Varian, H. R. (2019). *Intermediate Microeconomics with Calculus*. W.W. Norton.

## **MEA242BL FINANCIAL ECONOMICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The course enables the students to

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

### **Course Outcomes**

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

- Apply economics models to understand the functions of financial markets and products.
- 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 Efficiency of 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**

#### **Financial Instruments**

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

#### **Essential Readings**

1. Chandra, P. (2017), *Investment Analysis and Portfolio Management* (5th edition), McGraw Hills Education.
2. Shapiro, A. C. (2012), *Multinational Financial Management* (9th edition), Wiley.
3. Campbell, J. Y., Lo, A. W., & Mackinlay, A. C. (1997). *The Econometrics of Financial Markets* (2nd edition) Princeton University Press.

## Recommended References

1. Houthakker H. S. & Williamson P. J. (1996), *The Economics of Financial Markets*, Oxford University Press
2. Eichberger, J and Harper, I. R. (1997), *Financial Economics*, Oxford University Press
3. Ross, S. A., & Westerfield, R. (2018), *Fundamentals of Corporate Finance* (12th edition), McGraw Hill Education.
4. Fabozzi (2009), *Bond Markets* (7th revised edition), Pearson Publications, USA, February 27
5. Fama E.F. (1970), *Efficient Capital Markets: A Review of Theory and Empirical Work*, Journal of Finance, 25 May, pp. 383-417
6. Fama, E. F. (2021). Efficient capital markets II (pp. 122-173). University of Chicago Press.
7. Graves, Affleck, Hegde, J.S. & Miller, R. (1994), *Trading Mechanisms and the Components of the Bid Ask Spread*, Journal of Finance, 44, pp. 1471-1488.
8. Barsky, R. and Long, J. De (1993), *Why Does the Stock Market Fluctuate*, Quarterly Journal of Economics, 108, pp. 291-311
9. Black, F., Jensen, M.C. & 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.

## **SEMESTER III**

### **MEA331L INTERNATIONAL ECONOMICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

#### **Course Objectives**

The course provides a deep understanding about the broad principles and theories, which tend to govern the flow of trade in goods, services and capital — both short-term and long-term — at the global level. The contents of the course help them to examine the impact of the trade policies followed both at the national and international levels as also their welfare implications at macro level and the distribution of gains from trade to North and South with particular reference to India, also the likely consequences on income, employment and social standards and possible policy solutions.

#### **Course Outcomes**

This course enables students to Understand international and inter regional trade,

- Identify and understand various trade theories, analyze the various types of restrictions of international trade
- Analyze the links between trade, international finance, economic growth and globalization, with a particular emphasis on the experiences of developing countries.
- Analyze the relationship between Foreign Trade Theory and Economics Development.
- Critically evaluate the consequences of some of the International Trade policy.
- Critically comment on and participate in current debates on international economic policy.

#### **UNIT 1**

**Hours: 12**

#### **Core Trade Models**

Inter-regional versus international trade - Mercantilist doctrine of balance of trade - Adam Smith and absolute advantage theory of trade - Ricardo and comparative advantage, its limitations - production possibility curve - Community indifference curve. The Standard Theory of International trade-The PPC with increasing cost,

Community Indifference Curves and Equilibrium, The Basis for and Gains from Trade-Small country with increasing cost, Demand and Supply, Offer Curves and Terms of Trade (ToT), Trade flows, Economic Geography and the Gravity model

## **UNIT 2**

**Hours: 12**

### **Heckscher-Ohlin Theory and Empirics**

Comparative advantage in Heckscher Ohlin Model - definitions of factor abundance - relationship between factor prices and commodity prices - Factor price equalization theorem - Factor intensity reversal - the empirical evidence on Heckscher Ohlin theory- the Leontief Paradox

## **UNIT 3**

**Hours: 12**

### **New Trade Theories**

Economies of Scale and International Trade, Imperfect Competition and International Trade-Trade Based on Product Differentiation, Measuring Intra-Industry Trade, Trade Based on Dynamic Technological Differences- Product Cycle Models, “New new” trade theory: Melitz Model and extensions

## **UNIT 4**

**Hours: 12**

### **Trade Policies under Alternative Assumptions**

The rationale of tariffs- infant industry argument Partial equilibrium analysis of a Tariff, General Equilibrium Analysis of a Tariff in a Small Country The Stolper–Samuelson Theorem Effective Protection and Optimum Tariff, Non-tariff Barriers- quotas and subsidies, VER, Dumping, Economic Integration-Customs Unions and Free Trade Areas, Trade creation and Trade diversion , The Theory of second best

## **UNIT 5**

**Hours: 12**

### **Balance of Payment and Exchange rate**

The Balance of Payments and National Account; Accounting Balances and the Balance of Payments, Case Study: The BoP of India

Exchange Rates: Meaning, Determinants, Equilibrium in FX market, Spot and Forward Rates, Currency Swaps, Futures, and Options, Purchasing Power Parity; Sluggish Price and Overshooting Exchange Rate Model; Effect of Interventions in the Foreign Exchange Market, The Exchange-Rate Regime Choice and a Common Currency Area: Policy Assignment Problems; International Policy Coordination

**International Trade & Financial Organizations-** The International Trading and Monetary System: Past, Present, and Future, The Role of the IMF, WTO, and Other International Financial Organizations

## Essential Readings

1. Krugman, P. R., Obstfeld, M. & Melitz, M.(2018). *International Economics: Theory and Policy* (11th ed.).
2. Grossman, G. M. & Rogoff K. (1997). *Handbook of International Economics* (Vol. 3). North-Holland.

## Recommended References

1. Feenstra, R. C. (2004), *Advanced International Trade: Theory and Evidence*. Princeton University Press.
2. Leamer, E. (2001). *International Economics*. Worth Publishers.
3. Markusen, J. R., Melvin, J. R., Kaempfer, W. H. & Maskus, K. E. (1995). *International Trade: Theory and Evidence*. McGraw-Hill.
4. Sodersten, B. & Reed, G. (1994). *International Economics* (3rd ed.). Macmillan.
5. Appleyard, D. & Field, J. (2013). *International Economics*. McGraw-Hill.
6. Vanags, A. (2001). *International Economics*. University of London, Subject Guide.
7. Ethier, W. (1997) *Modern International economics* (3rd ed.). W.W. Norton & Co.
8. Winters, A. P. (1991) *International Economics* (4th ed.). Routledge.
9. Bhagwati, J. N. (1987). *International Trade: Selected Readings* (2nd ed.). Cambridge, MA: MIT Press.
10. Bhagwati, J. N., Panagariya, A. & Srinivasan, T. N. (1998). *Lectures on International Trade* (2nd ed.). MIT Press.
11. Cline, W. R. (1997). *Trade and Income Distribution*. Institute for International Economics.
12. Cohen, S. D., Blecker, R. A. & Whitney, P. D. (2003). *Fundamentals of U.S. Foreign Trade Policy: Economics, Politics, Laws, and Issues* (2nd ed.). Westview.
13. Collins, S. M. (Ed.) (1998). *Imports, Exports, and the American Worker*. Brookings Institution.
14. Dosi, G., Pavitt, K. & Soete, L. (1990). *The Economics of Technical Change and International Trade*. NYU Press.
15. Findlay, R. (1995). *Factor Proportions, Trade, and Growth*. MIT Press.
16. Foray, D. & Freeman, C. (Eds.) (1993). *Technology and the Wealth of Nations: The Dynamics of Constructed Advantage*. Pinter.

## **MEA332L ECONOMICS OF GROWTH AND DEVELOPMENT**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The course discusses about fundamental models used to analyse theoretical and empirical issues in economic growth and development. The main objective of the course is to familiarize students with the problem of development in underdeveloped and developing economies. In addition, this course also discusses the major theoretical developments in areas of Growth economics and policy discourses.

### **Course Outcomes**

By the end of this course, students should be able to:

- Use both classical and modern theories of growth and development to analyze the problems of the developing world.
- Understand the roles of population growth and human capital in the development problem.
- Analyze macroeconomic policies aimed at facilitating development and their implications.
- Use the tools developed in this course to analyse the development problems of selected nations.
- Enable students to understand critical issues in Neo-classical and other growth models.

### **UNIT 1**

**Hours: 10**

#### **Introducing Economic Development**

Meaning of Economic Growth and Economic Development. Measures of Economic Development- GDP, GDP per capita, PQLI and HDI, The New Economic View of Development; Amartya Sen's "Capability" Approach; Development and Happiness ; Three Core Values of Development;; The Three Objectives of Development. The Millennium Development Goals; Sustainable Development Goals.

### **UNIT 2**

**Hours: 16**

#### **Classic Theories of Economic Growth and Development**



Four Approaches of classical theories of growth; Development as Growth and the Linear Stages Theories ; Rostow's Stages of Growth; The Harrod- Domar Growth Model; Obstacles and Constraints Necessary versus Sufficient Conditions: Some Criticisms of the Stages Model; Structural-Change Models-The Lewis Theory of Development;;Structural Change and Patterns of Development; The International-Dependence Revolution- The Neocolonial Dependence.

### **UNIT 3**

**Hours: 16**

#### **The Neoclassical Models of Growth**

Growth Models with Exogenous Saving Rates (the Solow–Swan Model); The Fundamental Equation of the Solow–Swan Model; The Steady State; The Golden Rule of Capital Accumulation and Dynamic Inefficiency; Meade's Model of Economic Growth, Kaldor's Model of Growth, Ricardian equivalence; Models of Endogenous Growth-Theoretical Dissatisfaction with Neoclassical Theory- The AK Model - Long run AK model – AK model with externalities New Growth theory: Human capital, Externalities and ideas; endogenous technological progress and development.

### **UNIT 4**

**Hours: 8**

#### **Contemporary Models of Development and Underdevelopment**

Theories of endogenous growth with special reference to Romer's model, underdevelopment as coordination failure, multiple equilibria, the big push theory and Lebenscence Theory of Critical Minimum Efforts.

### **UNIT 5**

**Hours :10**

#### **Cambridge Capital Controversy in the Neo-classical Analysis of Growth**

The Capital Controversy, The Neo-Classical Capital Theory- Assumptions, The Cambridge Criticisms, Joan Robinson's Critique, Samuelson's Critique and the Surrogate Production Function, convergence and its types.

#### **Essential Readings**

1. Barro, R. J. & X. Sala-i-Martin (2003). *Economic Growth* (2nd ed.). MIT Press.
2. Todaro, M.P. & Smith S.C. (2015). *Economic Development* (12th ed.). Addison-Wesley.
3. Meier, G. M. & James E. R. (2005). *Leading issues in Economic Development* (8th ed.). Oxford University Press.
4. Thirlwall, A.P. (2006). *Growth and Development* (8th ed.). Palgrave Macmillan.

### **Recommended References**

1. Ray, D. (2009). *Development Economics*. Princeton University Press.
- 2 . Pomeranz, K. (2000). *The Great Divergence: China, Europe and the Making of the Modern World*. Princeton University Press.

## **MEA333L APPLIED ECONOMETRICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week:4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The course enables students to

- Understand core concepts and techniques in econometrics, with a special focus on the time series and panel data econometrics.
- Understand the assumptions upon which different econometric methods are based and their implications.
- Demonstrate the rigorous quantitative training that analytical economics requires.
- Formulate, estimate, test and interpret suitable models for the empirical study of economic events.
- Develop practical skills, which are necessary to perform independent research.
- Read and interpret applied economic articles.

### **Course Outcomes**

After completing the course, the students will:

- Understand core concepts and methods used in the estimation of economic relationships.
- Demonstrate the analytical and critical skills relevant to economic thinking.
- Apply econometric software packages to employ various techniques taught using various types of data.
- Interpret and critically evaluate applied work and econometric findings.

### **UNIT 1**

**Hours:15**

#### **A Review of Regression Analysis**

Simple and multiple linear regression model – Assumptions; OLS and properties of estimators; Gauss-Markov theorem; partial regression coefficients; The coefficient of determination  $r^2$  and the adjusted  $r^2$ . Hypothesis testing - The Confidence-Interval Approach, The Test-of-Significance Approach, and the p-value approach.

### **UNIT 2**

**Hours: 10**

### **Model Specification and Diagnostic Testing**

Model selection criteria, types of specification errors, omission of relevant variables, inclusion of irrelevant variables, incorrect functional form, errors in measurement, tests of specification errors.

### **UNIT 3**

**Hours: 10**

#### **Qualitative response models**

The Nature of Qualitative Response Models, The Linear Probability Model (LPM), applications of LPM, alternatives to LPM – Logit and Probit models.

### **UNIT 4**

**Hours: 15**

#### **Time Series Econometrics**

Nature of the time series data, stationarity, testing stationarity- graphical analysis, correlogram, unit roots tests - ADF and PP, Spurious regression, Cointegration and Error Correction Mechanism.

### **UNIT 5**

**Hours: 10**

#### **Panel Data Econometrics**

Nature of Panel data, Panel data models and estimation techniques: pooled OLS regression, fixed and random effects models.

### **Essential Readings**

1. Wooldridge, J. M. (2014). Introductory Econometrics: A Modern Approach (4th ed.). New Delhi: Cengage Learning
2. Gujarati, D. N., Porter, D.C., & Gunasekar, S. (2017). Basic Econometrics. (5th ed.). McGraw-Hill.

### **Recommended References**

1. Koutsoyiannis, A. (1979). Theory of Econometrics (2nd Ed.) Palgrave Macmillan.
2. Maddala, G. S. (1992) Introduction to Econometrics (2nd Ed.) Macmillan Publishing Company.
3. Gujarati, D. N. & Porter D. C. (2010). Essentials of Econometrics, 4th McGraw Hill International Edition.
4. Brooks, C. (2019). Introductory Econometrics for Finance 4th Ed. Cambridge Univ. Press.
5. Hill, C., Griffiths, W. E., & Lim G. C. (2018). Principles of Econometrics, 5th Edition. Wiley.

6. Dougherty, C. (2016). Introduction to Econometrics, 5th Edition. Oxford University Press.
7. Patterson K. (2000). An Introduction to Applied Econometrics: A Time Series Approach. Palgrave Macmillan.
8. Asteriou, D., & Hall, S. G. (2021). *Applied Econometrics* (4th ed.). Red Globe Press.
9. Gujarati, D. (2015), *Econometrics by Examples*, Second Edition. Palgrave Macmillan.
- Hilmer, C. E & Hilmer, M. J. (2014). *Practical econometrics*. McGraw Hill Education.

## **MEA341AL BEHAVIOURAL ECONOMICS**

**Total Teaching Hours: 60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

To provide the students with an in-depth understanding of the work done by some of these scholars and practitioners, and make them an expert at understanding, diagnosing and designing behavioural change interventions that help people make better decisions and achieve policy or social welfare outcomes.

### **Course Outcomes**

Upon the successful completion of this course. The student will be able to:

- An understanding of the theoretical and empirical underpinnings of behavioural economics
- Demonstrate how we can meaningfully predict and influence human behaviour 'for good'
- Examine applications and case studies from real world policy settings
- Develop a methodology, mindset, and framework to design and implement behavioural change techniques to policy problems

### **UNIT 1**

**Hours: 10**

#### **Introduction**

What is behavioural economics? - History and evolution- relation with other disciplines objectives, and scope- themes and methodology of behavioural economics (theory, evidence, consilience) – application. Anticipation and information avoidance as introductory example.

### **UNIT 2**

**Hours: 10**

#### **Making Choices Under Risk: Prospect Theory**

Values, preferences and choice- believes- heuristic and biases- state dependent preferences (such as habit formation and addiction)- mis-prediction and projection bias-anticipation and information avoidance-decision making under risk and uncertainty- prospect theory- the role of reference- dependent preference in both risky (loss aversion) and risk free (endowment) choices-mental accounting- applications. How do people care about those around them? Both distributional social preferences (altruism, inequality aversion) and intentions-based social preferences (reciprocity, fairness). The possibility of self-deception.

### **UNIT 3**

**Hours: 10**

#### **Inter temporal choice**

The discounted utility model (origin, features, methodology, anomalies with discounted utility models)- alternative inter temporal choice models (time preferences, time inconsistent preferences- hyperbolic discounting- modifying the instantaneous functions)- applications. How do people make predictions about their own future utility? State-dependent preferences (e.g. habit-formation and addiction) and projection bias.

### **UNIT 4**

**Hours: 10**

#### **Strategic interaction**

Behavioural game theory (nature, equilibrium, mixed strategies, bargaining, iterated games, signalling, learning)- application Modelling of social preferences –nature and factors affecting social preferences distributional social preferences based on altruism, inequality aversion models- reciprocity models, evidence and policy implications. How do people make predictions about their opponents in strategic interactions? Models of limited social inference (level-k reasoning, cursedness).

### **UNIT 5**

**Hours: 10**

#### **Nudges, Policy and Happiness**

Nudges, Policy, and Happiness- the application. How and when should governments intervene if people are “behavioural”? The theory of nudges, and happiness as an outcome.

### **UNIT 6**

**Hours: 10**

#### **Animal Spirits**

What are animal spirits? How does Human Psychology drive the economy? We overview five different aspects of animal spirits and how they affect economic decisions.

#### **Essential Readings**

1. Wilkinson, N., & Klaes, M. (2012). *An introduction to behavioural economics* (2 p.) Palgrave Macmillan. New York.
2. Akerlof, G. A., & Shiller, R. J. (2009). *Animal Spirits: How Human Psychology Drives the Economy, and Why It Matters for Global Capitalism* Princeton University Press.
3. Bernheim, B. D., DellaVigna, S., & Laibson, D. (2019). *Handbook of Behavioral Economics-Foundations and Applications 2*. Elsevier.
4. Diamond, P. A., & Vartiainen, H. (2007). *Behavioral economics and its applications* (pp. 1-336). Princeton, NJ: Princeton University Press.
5. Dhimi, S. (2020). *The Foundations of Behavioral Economic Analysis: Volume VII: Further Topics in Behavioral Economics* (Vol. 7). Oxford University Press, USA.
6. Iannole, R. (Ed.). (2016). *Applied Behavioral Economics Research and Trends*. IGI Global.

### **Recommended References**

1. Loewenstein (1987) "Anticipation and the Valuation of Delayed Consumption". *Economic Journal*, 97(387): 666—684.
2. Oster, Emily, Ira Shoulson, and E. Ray Dorsey. 2013. "Optimal Expectations and Limited Medical Testing: Evidence from Huntington Disease." *American Economic Review*, 103(2): 804-30.
3. Brunnermeier, Markus, K., and Jonathan A. Parker (2005). "Optimal Expectations." *American Economic Review*, 95(4): 1092-1118.
4. Kahneman and Tversky (1979) "Prospect Theory: An Analysis of Decision Under Risk", *Econometrica*, 47(2): 263-291.
5. List (2003) "Does Market Experience Eliminate Market Anomalies?", *Quarterly Journal of Economics*, 118(1): 41-71.
6. Koszegi and Rabin (2006), "A Model of Reference-Dependent Preferences", *Quarterly Journal of Economics*, 121(4): 1133-1165.
7. Sydnor, Justin. 2010. "(Over)insuring Modest Risks." *American Economic Journal: Applied Economics*, 2(4): 177-99.
8. Charness and Rabin (2002) "Understanding Social Preferences with Simple Tests" *Quarterly Journal of Economics*, 117(3): 817-869.
9. Lazear, Edward P., Ulrike Malmendier, and Roberto A. Weber. 2012. "Sorting in Experiments with Application to Social Preferences." *American Economic Journal: Applied Economics*, 4(1): 136-63.
10. DellaVigna, List, Malmendier. 2012. "Testing for Altruism and Social Pressure in Charitable Giving". *Quarterly Journal of Economics*, 127(1): 1-56.
11. Rabin (1993) "Incorporating Fairness into Game Theory and Economics", *American Economic Review*, 83(5): 1281-1302.
12. Fehr and Gächter, (2000), "Fairness and Retaliation: The Economics of Reciprocity", *Journal of Economic Perspectives*, 14(3): 159-181.



13. Fehr, E. and Schmidt, K. (1999) "A Theory of Fairness, Competition, and Cooperation" *The Quarterly Journal of Economics*, 114(3): 817—868.
14. Thaler, Richard H. 1988. "Anomalies: The Ultimatum Game." *Journal of Economic Perspectives*, 2(4): 195-206.
15. Tversky, A. and Kahneman, D. (1974) "Judgment Under Uncertainty: Heuristics and Biases", *Science*, 185(4): 1124–1131.
16. Rabin (2002) "Inference by Believers in the Law of Small Numbers", *Quarterly Journal of Economics*, 117(3): 775–816.
17. Matthew Rabin, Joel L. Schrag (1999) "First Impressions Matter: A Model of Confirmatory Bias", *The Quarterly Journal of Economics*, 114(1), 37–82.
18. Stigler, G., & Becker, G. (1977). "De Gustibus Non Est Disputandum". *The American Economic Review*, 67(2), 76-90.
19. Loewenstein, G, O'Donoghue, T, and M Rabin (2003) "Projection Bias in Predicting Future Utility", *Quarterly Journal of Economics* 118(4), 1209-1248.
20. Meghan R. Busse, Devin G. Pope, Jaren C. Pope, Jorge Silva-Risso (2015) "The Psychological Effect of Weather on Car Purchases", *Quarterly Journal of Economics*, 130(1), 371–414.
21. Acland and Levy (2015) "Naivete, Projection Bias, and Habit Formation in Gym Attendance", *Management Science*, 61(1):146-160.
22. Stahl, Dale and Wilson, Paul. "On Players' Models of Other Players: Theory and Experimental Evidence". *Games and Economic Behavior*, 10, 1995.
23. Thaler, Richard H. 1988. "Anomalies: The Winner's Curse." *Journal of Economic Perspectives*, 2(1): 191-202.
24. Kahneman and Krueger (2006) "Developments in the Measurement of Subjective WellBeing", *Journal of Economic Perspectives*, 20(1): 3–24.
25. Thaler and Sunstein (2003) "Libertarian Paternalism", *American Economic Review (Papers and Proceedings)*, 93(2): 175–179.

## **MEA341BL APPLIED INSTITUTIONAL ECONOMICS**

**Total Teaching Hours:60**

**No of Lecture Hours/Week: 4**

**Max Marks: 100**

**Credits: 4**

### **Course Objectives**

The course enables the students to

- 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
- Apply 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.

### **Essential Readings**

1. Groenewegen, John., Spithoven, Antoon., & Berg, Annette Van Den. (2010). *Institutional Economics – An Introduction*. UK: Palgrave Macmillan.
2. Furburton & Richter (2005), 'Institutions and Economic Theory', Dryden Press The University of Michigan Press; Second edition (31 May 2005).
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.

### **Recommended References**

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. (2021). *Microeconomics*. (8th Ed.). Pearson.

## **MEA371L - APPLIED MACHINE LEARNING**

**Total Teaching Hours:90**

**No of Lecture Hours/Week: 6(4+2)**

**Max Marks: 150**

**Credits: 5**

### **Course Description and Course Objectives:**

This course enables students to

- Understand the differences between supervised and unsupervised machine learning models
- Optimize the models and understand the effect of algorithm parameters' modification
- Combine various models and create strategies to overcome commonly faced challenges in machine learning algorithm implementation
- Implement machine learning models in various economics-related applications

### **Course Outcomes**

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

- Understand the basic concepts, applications and different types of learning in respect of Machine Learning Algorithms
- Apply various supervised and unsupervised algorithms to various datasets and analyze the impact of hyperparameter tuning
- Compare and evaluate the performance of machine learning algorithms
- Evaluate advanced machine learning models with respect to benchmark discoveries and applications
- Create machine learning models to facilitate the application needs in economics domain

### **UNIT 1**

**Hours: 10**

Learning: Human Comprehension, Cognition, Past Experiences, Predicting Future, Thought Process, Inputs and Output System, Human Memory, Information, Machine Comprehension of Information, Data, Representation of Data, Data Processing, Data Storage, Data Processing, Types of Data: Structured, Unstructured, Semi-Structured, Human-Machine Mapping of Peripherals

Machine Learning: Definition, Objectives, Components, Features, Applications. Traditional Programming v/s Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi-supervised and Reinforcement Learning, Predictive Models, Techniques, Statistical Inferences

Subsets of Machine Learning: Natural Language Processing, Image Processing, Computer Vision, Robotics, Expert Systems, Neural Networks, Deep Learning, Generative Networks, Big

Data Analysis, ASR, Text-to-speech, Extreme Learning Machines, Genetic Algorithms, Optimization Problems, Latest Advancements in Artificial Intelligence and Machine Learning, Learning from Examples.

## **UNIT 2**

**Hours: 15**

### **SUPERVISED LEARNING**

Regression and Classification Problems, Linear Regression, KNN for Regression, Types of Classification Methods, Multi Class and Multiple Class Classification, Logistic Regression, Naive Bayes Classifier, Decision Trees, Support Vector Machines, Hyperparameter Tuning, Comparison of multiple algorithms.

## **UNIT 3**

**Hours: 15**

### **UNSUPERVISED LEARNING, DIMENSIONALITY REDUCTION AND ENSEMBLE LEARNING**

Types of Unsupervised Learning, Challenges in Unsupervised Learning, Distance Measures in Clustering, Elbow Method, Silhouette method.

K-Means Clustering, Hierarchical Clustering, DBSCAN, Comparison of Clustering Algorithms.

Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Ensemble Learning Methods, Random Forest, Applications of Dimensionality Reduction.

## **UNIT 4**

**Hours: 10**

### **STRATEGIES TO OVERCOME CHALLENGES**

Challenges in ML: Insufficient Quantity of Data, Non-representative and Poor-Quality Data, Irrelevant Features, Estimation of Missing Values, Parameter Estimation

Preparing Data for ML Algorithms: Generalization, Normalization, Sampling, Overfitting, Underfitting, Bias, Variance, Bias-Variance Tradeoff, Relation between Bias, Variance Overfitting and Underfitting.

Learning Noise in a Dataset, Ideal Machine Learning Model, Process of Model Selection, Effect of Data Preparation on Results, Encoding, Nominal and Ordinal Representation, Feature Transformation and Feature Engineering, Feature Selection - Various Methods

Testing and Validating: Performance measures - Confusion matrix, Precision-Recall Tradeoff, F1 Score, ROC Curve, Error Analysis, Changing Parameters of Algorithm, Hyperparameter Tuning, Model Selection, Algorithm Tuning

## UNIT 5

Hours: 10

### MACHINE LEARNING IN ECONOMICS

Evaluation of Time-Series Data, Big Data Analysis, Stock Exchange Analysis, Role of Recurrent Neural Networks in Time Series Data Prediction, Modelling Supply and Demand Functions, Forecasting, Identifying Loan Defaulters, Decision Making in Financial Sectors, Impact in Agricultural Economics.

### Lab Programs

Hours: 30

1. Introduction to Machine Learning Libraries in Python
2. Data Exploration and Prediction of Numeric Values
3. Classification - Logistic Regression
4. Classification - KNN, Naive Bayes
5. Classification - Support Vector Machines
6. Clustering - K Means, Elbow Method
7. Clustering - Agglomerative Clustering
8. Dimensionality Reduction - PCA and LDA
9. Analysis of Time Series Data - Stock Market Prediction
10. Analysis of Supply and Demand Based Applications
11. Identifying Insurance/Loan Defaulters
12. Geographic Location based Data Analysis

### Essential Readings

1. Müller, A. C. & Guido, S. (2017). *Introduction to Machine Learning with Python A Guide For Data Scientists*. O'Reilly book.
2. Alpaydin, E. (2005). *Introduction to Machine Learning*. Prentice Hall of India.
3. Russell, S. & Norvig, P. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

### Suggested Readings

1. Murphy, K. P. (2012). *Machine Learning: A Probabilistic Perspective*. MIT Press.
2. Hastie, Tibshirani & Friedman (2008). *The Elements of Statistical Learning* (2nd ed.). Springer.
3. Basuchoudhary, Atin, Bang, James, T., Sen, Tinni (2017). *Machine-learning Techniques in Economics*. Springer International Publishing.

## **MEA372AL DATA VISUALIZATION**

**Total Teaching Hours:90**

**No of Lecture Hours/Week: 5(3+2)**

**Max Marks: 150**

**Credits: 4**

### **Course Objectives**

The course enables students to

- Understand and Analyze Visualization case studies
- Understand the nuances of Data Visualization
- Analyze data using Tabular Reports and Charts
- Catch and Debug data errors
- Visualize Data to derive actionable insights
- Create reports based on specifications
- Study patterns in data using charts
- Derive Actionable insights from raw data

### **Course Outcomes**

After successful completion of the course, students will be able to

- Import data and prepare data in Tableau
- Conceptual understanding of charts and functions
- Visualise/Analyse Data using different types of Charts
- Create dashboards in Tableau
- Explain and Present data insights using Visualization Techniques

### **UNIT 1**

**Hours: 9**

#### **Working with Data in Tableau**

Foundational principles of Tableau, basics of connecting to data, exploring and analyzing the data visually, examine and filter data, clean and shape data, joins and blends. Connecting to data sets, data section and worksheets

### **UNIT 2**

**Hours: 9**

#### **Data Visualization Best Practices**

Data Science overview, Data Visualization, modelling, data preparation, communication and presentation. Descriptive, predictive and prescriptive analytics. Techniques for making Data Visualization useful and beautiful. Case Study: (Minard's Map, Broadstreet Cholera Map, Interactive Government Budget, US Population study, Film Dialogue, Selfie City)

### **UNIT 3**

**Hours: 9**



## **Tableau Fundamentals**

Marks and Filters, Charts Types: Scatter, Bar, Line, Gantt, Heat Map, Tree Map, creating calculated field, dates in tableau, jittering, multiple mark types, and dual axis chart.

## **UNIT4**

**Hours: 9**

### **Tableau Advanced**

Working with Time Series, Understanding Aggregation and Granularity, Area Charts, Highlighting and Filters, Animation

**Additional Charts:** Pareto Chart, Box and Whisker plot, Map Chart, Calculate Z Score, Population Pyramid

## **UNIT 5**

**Hours: 9**

### **Tableau Interactive Dashboard**

Trends, Clustering, Distributions, and Forecasting, enhance your data visualizations with statistical analysis. Trend models, clustering, distributions, and forecasting

Telling a Data Story with Dashboards, demonstrates how Tableau allows you to bring together related data visualizations in a single dashboard. Static view of various aspects of the data, or a fully interactive environment (dynamically filter, drill down, and interact with the data visualizations)

## **Lab Programs**

**Hours: 30**

1. Install Tableau and create different kind of basic charts on existing dataset in Tableau (like Superstore) ***Scatter, Bar, Line, Gantt, Heat Map, Tree Map***
2. Create advanced charts on existing dataset
3. ***Pareto Chart, Box and Whisker plot, Map Chart, Population Pyramid***
4. Design and auto generate a dataset on an assigned domain (using Python or Excel)
5. Identify key reports in the assigned domain, Create and visualise key reports
6. Creating a Dashboard to support a business case, use a couple of calculated fields in the same
7. Designing a Key Performance Indicator (KPI) (eg. Best Striker in Football in EPL, Team Ranking in Cricket)
8. Telling a story using visual reports and a dashboard
9. Collate all work done in this course into a single pdf based report

### **Essential Readings**

1. Milligan, Joshua N(2019). *Learning Tableau 10*. Packt Publishing Ltd,.
2. Sleeper, Ryan(2018). *Practical Tableau: 100 tips, tutorials, and strategies from a Tableau Zen master*. " O'Reilly Media, Inc."

### **Suggested Readings**

1. Few, Stephen(2003), "Information dashboard design."
2. Knaflitz, Cole Nussbaumer(2019),*Storytelling with Data: Let's Practice!*. John Wiley & Sons,
3. Ware, Colin(2010). *Visual thinking for design*. Elsevier

# MEA372BL BUSINESS INTELLIGENCE

**Total Teaching Hours:75**

**No of Lecture Hours/Week:5 (3+2)**

**Max Marks: 150**

**Credits: 4**

## **Course Objectives**

The course enables students to,

- Create an Interactive dashboard from different datasets.
- Illustrate importing data from different data sources and then learn to clean data with tool.
- Visualize data using graphs and plots. The graphs so build can give you the overall information of the data.

## **Course Outcomes**

After successful completion of the course students be able to

- Acquainted with Power BI
- Create Datasets and Data Models.
- Create Reports and apply animation and Analytics Technique
- Explore Dashboards, and model Data for Analytics

## **Unit 1**

**Hours: 15**

### **Introduction to Power BI**

Power BI deployment models, Dataset design process, Dataset Planning,

### **Transforming Data**

Query design design, SQL Views, M Queries, Query Folding, M query Examples, M editing tools.

### **Designing Import and Direct Query Data Models**

The data model, Relationships, Model Metadata, Optimizing Performance

**Hours:15**

## **Unit 2**

### **Creating and Formatting Power BI Reports**

Report Planning, Live Connections to Power BI datasets, Visual interactions, Slicers, Report filter scopes, Visualization Formatting, Map Visuals, Mobile optimized reports.

### **Applying Custom Visuals, Animation, and Analytics**

Drillthrough report pages, Bookmarks, Waterfall chartbreakdown, Analytics Pane, Custom Visuals, Animation and Data Storytelling

## **Unit 3**

**Hours:15**

### **Designing Power BI Dashboards**

Dashboard Vs Reports, Dashboard Design, Multi-dashboard architectures, Dashboard titles, Live report pages, Mobile optimized dashboards,

### **Creating Power BI Apps**

Power BI Apps, Sharing dashboards and reports, SharePoint Online embedding, Custom application embedding, Publish to Web Power BI Admin Portal.

### **Essential Readings**

1. Brett Powell, "Mastering Microsoft Power BI", Packt Publishing, 2018.

### **Recommended References**

1. Mike Morris, "Power BI: A complete step-by-step Guide for beginners in Understanding Power BI", Albano Publishing, 2019.
2. Rob Collie, Avichal Singh "Power Pivot and Power BI: The Excel User's Guide to DAX, Power Query, Power BI & Power Pivot in Excel", 2016.

### **Lab Programs**

**Hours:30**

1. Create workspace
2. Set up power BI desktop option
3. Get data from SQL Server
4. Create Model Relationships
5. Create and publish a Report
6. Create a Drill through page add bookmarks buttons and publish the report
7. Create a Dashboard, edit title details, configure an alert
8. Create an animated scatter chart,
9. Create a forecast
10. Publish an App

## **MEA381PL SPECIALIZATION PROJECT**

**Total Teaching Hours:60**

**No of Lecture Hours/Week:4**

**Max Marks: 100**

**Credits: 2**

### **Course Objectives**

The course is designed to provide a real-world project development and deployment environment for the students

### **Course Outcomes**

After successful completion of the course students be able to

- Apply appropriate design/development strategy and tools.
- Identify the problem and relevant analytics for the selected domain.

### **Unit 1**

**Hours: 60**

#### **Specialization Project**

Project will be based on the specialization domains which students are opted for during this semester.

### **Essential Readings**

NA

### **Recommended References**

NA