ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయం आंध्रप्रदेश केंद्रीय विश्वविद्यालय

CENTRAL UNIVERSITY OF ANDHRA PRADESH

(Established by an act of Parliament in 2019)

School of Interdisciplinary and Applied Sciences

Department of Computational Social Science

Postgraduate Programme Structure
as per the UGC Credit Framework (NEP 2020)

Vidya Dadati Vinayam

(Education Gives Humility)

MSc. Computational Social Science

"The secrets of the universe lie within the stars; gaze upon them with wonder and curiosity"

– Aryabhatta

Programme Structure

(With effect from AY 2024 - 25)

CONTENTS

ఆంధ్రప్రదేశ్ కేంద్రీయ విశ్వవిద్యాలయం आंध्रप्रदेश केंद्रीय विश्वविद्यालय
CENTRAL UNIVERSITY OF ANDHRA PRADESH
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M.Sc. Computational Social Science

Introduction to the Programme

MSc. Computational Social Science is one of the new postgraduate programmes being offered by CUAP from the academic year 2024-2025 in tune with the National Education Policy, 2020. Computational social science is an exciting new field that combines the methods and tools from computer science and data science with the fundamentals of social science disciplines. It draws inspiration from the experimental, social, and behavioral sciences, merging their explanatory focus with the predictive capabilities of large-scale data. This integrative approach, combined with the creation of robust research infrastructure, allows computational social scientists to pursue replicable, cumulative, and ultimately useful solutions.

Programme Objectives

- To comprehend the foundations of interface between computer science and the traditional social sciences in order to uses computationally methods to analyze and model social phenomena, social structures, and collective behavior.
- To discover how social networks and human dynamics create social systems and recognizable patterns.
- To enable the students to undertake web scrape online data, create social network visualization with it, and use machine learning to analyze its content, opinions regarding contemporary national or international issues and policies.

Learning Outcomes

On successful completion of the programme students:

- Gain knowledge and understanding of the key theories and concepts of Computational Social Science, and insights into the theoretical advances in the discipline.
- Evaluate theories in the light of empirical evidence or normative repositions.
- Apply appropriate theories to understand and analyse social and computing phenomena.
- Understand the significantly contribute in the coming age of AI and data-driven technology.
- Carry out an independent research in Computational Social Science with appropriate findings.

M.Sc. Computational Social Science

Semester and Course wise Credits

Semester	Discipline Specific Core (DSC)	Discipline Elective (DSE) / Elective (EL)	Project Work/ Dissertation	Common Compulsory Course (CCC)	Inter Disciplinary Elective	Internship	Lab	Total Credits
I	DSC 1 (4) DSC 2 (3) DSC 3 (4) DSC 4 (4)	DSE 1 (4) / DSE 2 (4) / DSE 3 (4)	—	—	IDE 1 (3) Online	—	DSC 2 (1)	**23**
II	DSC 5 (3) DSC 6 (3) DSC 7 (4) DSC 8 (4)	DSE 4 (4) / DSE 5 (4) /	—	CCC 1: Introduction to R programming (4)	IDE 2 (3) Online	—	DSC 5 (1) DSC 6 (1)	**27**
III	DSC 9 (3) DSC 10 (4) DSC 11 (4)	DSE 6 (3) / DSE 7 (3) / DSE 8 (3) /	—	CCC 2: Building Mathematical Ability and Financial Literacy (4)	IDE 3 (3) Online	Internship (2)	DSC 9 (1) DSE 6 (1) / DSE 7 (1) / DSE 8 (1)	**25**
IV	DSC 12 (2)	—	Dissertation (16)	—	—	—	DSC 12 (2)	**20**
Total	**42**	**11**	**16**	**8**	**9**	**2**	**7**	**95**
Percentage	**44.21**	**11.58**	**16.84**	**8.42**	**9.47**	**2.11**	**7.37**	**100**

DSC: Discipline Specific Core Courses
DSE: Discipline Specific Elective Courses
CCC: Common Compulsory Courses
IDE: Inter-disciplinary Electives

M.Sc. Computational Social Science

Programme Structure with Course Titles

S. No	Course Code	Title of the Course	Total Credits	Credits Distributions		
				L	T	P
Semester– I						
1.	MCS101	CC: Fundamentals of Computational Social Sciences	4	3	1	0
2.	MCS102	CC: Quantitative methods for social sciences	4	3	0	1
3.	MCS103	CC: Macroeconomic theory	4	3	1	0
4.	MCS104	CC: Behavioral theories in social sciences	4	3	0	1
5.	**DSE: Any one of the following/MOOCs**		4	3	0	1
	MCS111	Introduction to Artificial Intelligence				
	MCS111	Fundamentals of Geographic Information System (GIS)				
	MCS111	Understanding Social realities				
6.	MCS112	IDE : Online (MOOCs)	3	3	0	0
Total			**23**	**18**	**2**	**3**
Semester– II						
1	MCS201	CC: Computational Demography	4	3	0	1
2.	MCS202	CC: Qualitative methods for social sciences	4	3	0	1
3.	MCS203	CC: Data harvesting for social science research	4	3	1	0
4.	MCS204	CC: Econometrics – Theory and Applications	4	3	0	1
5.	**DSE: Any one of the following/MOOCs**		4	3	0	1
	MCS211	Data Analytics with Python				
	MCS211	Machine learning				
6.	MCS212	IDE: Online (MOOCs)	3	3	0	0
7.	MCS213	CCC: Introduction to R programming	4	3	0	1
Total			**27**	**21**	**1**	**5**
Semester– III						
1.	MCS301	CC: Causal inferences for Social sciences	4	3	0	1
2.	MCS302	CC: Social and Ethical Issues of Big Data and AI	4	3	1	0
3.	MCS303	CC: Introduction to Public Policy	4	3	1	0
4.	**DSE: Any one of the following/MOOCs**		4	3	0	1
	MCS311	Data Analytics with R				
	MCS311	Advanced Geospatial Analysis				
	MCS311	Qualitative data analysis using software				
5.	MCS312	IDE: Online (MOOCs)	3	3	0	0
6.	MCS313	CCC: Building Mathematical Ability and Financial Literacy	4	3	1	0
7.	MCS314	Internship*	2	0	0	2
Total			**25**	**18**	**3**	**4**

M.Sc. Computational Social Science

S.No	Course Code	Title of the Course	Total Credits	Credits Distribution		
				L	T	P
Semester– IV						
1.	MCS401	CC: Survey Research Methods and Data analysis using software	4	2	0	2
2.	MCS411	Dissertation	16	0	0	16
Total			**20**	**2**	**0**	**18**
Total Credits			**95**	**59**	**7**	**29**

***Internship shall be completed during the summer vacation.**

CC: Core Course
DSE: Discipline Specific Elective
IDE: Interdisciplinary Elective
CCC: Common Compulsory Course
L: Lectures
T: Tutorials
P: Practical /Project

Note: MOOCs are chosen by the student based on the availability of the courses offered on SWAYAM & other related platforms suggested or approved by the Department

The program template and the title of the courses are tentative, any changes are required may be made

Semester-Wise Credit Distribution

Semester	Total Credits	Cumulative credit at the end of the semester
I	23	23
II	27	50
III	25	75
IV	20	95

Important Information to Students

1. Programme: MSc. Computational Social Science
2. Eligibility: Bachelor's Degree with at least 50% marks or Equivalent Grade in Social Sciences or Humanities subjects or 55 % marks in any other subject.

3. The minimum duration for completion of any PG Program is four semesters (two academic years) and the maximum duration is eight semesters (four academic years) or as per amendments made by the regulatory bodies from time to time.

4. A student should attend at least 75 % of the classes, seminars, practical/ lab in each course of study.
5. All theory courses in MSc. Computational Social Science carry Continuous Internal Assessment (CIA) component of 40 marks and Semester-end component of 60 marks. The minimum pass marks for a course are 50%.
6. In case of courses with lab component, Continuous Internal Assessment (CIA) component shall be of 60 marks and Semester-end component for 40 marks. The minimum pass marks for a course are 50%.
7. The student is given 3 Continuous Internal Assessment (CIA) tests per semester in each course from which the best 2 performances are considered for the purpose of calculating the marks in CIA. A record of the continuous assessment is maintained by the academic unit. The 3 internal tests are conducted for 15 Marks each; out of the best 2 tests scores are considered for 30 marks. Remaining 10 marks are awarded for assignments, class presentations and class participation.
8. A student should pass separately in both CIA and the ESE, i.e., a student should secure 20 (50% of 40) out of 40 marks for theory and 30 (50% of 60) out of 60 marks for lab components in the CIA. Therefore, a student should secure 30 (50 % of 60) out of 60 marks for theory and 20 (50% of 40) out of 40 marks for lab components in the End-semester examination (ESE).
9. Semester-end examination shall consist of objective type questions, descriptive type questions, short answer questions and case studies or any other recommended by the BoS.
10. A student failing to secure the minimum pass marks in the CIA is not allowed to take the end semester examination of that course. She/he has to redo the course by attending special classes for that course and get the pass percentage in the internal tests to become eligible to take the end semester examination.
11. Students failing a course due to lack of attendance should redo the course.
12. Re-evaluation is applicable only for theory papers and shall not be entertained for other components such as practical /thesis/ dissertation/ internship etc.
13. An on-campus elective course is offered only if a minimum of ten or 40% of the students registered, whichever is higher.

SEMESTER – I

Course code : MCS101 Core/ Elective : Core No. of Credits : 4	Course title **Fundamentals of computational social science**

Course Objectives

- To provide comprehensive understanding on the foundational concepts and some operational definitions in computational social sciences
- To enable students to integrate knowledge from different disciplines, including social sciences

Learning Outcomes

- Demonstrate the ability to integrate interdisciplinary knowledge, combining insights from social sciences with computational methods, to understand complex societal issues

Course Outline

Unit – I: Introduction 14 hours

- Introduction to Computational Social Sciences (CSS)
- Brief history of CSS
- Scope of CSS
- Main areas of CSS
- Theories in CSS

Unit – II: Automated Information Extraction (AIE) 10 hours

- Introduction to AIE
- Principles of content analysis
- Cross-cultural Universality of Meaning
- Data mining – Overview, and Methodological Process

Unit – III: Social Networks 12 hours

- Meaning, and History of Social Networks
- Relational types of social networks
- Elementary Social Network Structures
- Quantitative Measures of Social Network

Unit – IV: Social Complexity **14 hours**

- What is Social Complexity?
- Origins and Evolution of Social Complexity
- Features of Social Complexity
- Measurement of Social Complexity
- Laws of Social Complexity – Serial, Parallel, and Hybrid Complexity
- Power Law Analysis, and Theoretical Analysis
- Theories of Social Complexity

Unit – V: Simulations **10 hours**

- Introduction to Simulation
- Types of Social Simulation
- Methodology of Social Simulation
- System Dynamic Models

Suggested Readings

Claudio Cioffi-Revilla. (2017). Introduction to computational social science.

Uwe Engel, Anabel Quan-Haase, Sunny Liu, Lars E Lyberg. (2022). Handbook of computational social science: Theory, Case studies, and Ethics.

Matti Nelimarkka. (2022). Computational thinking and social science: Combining programming, Methodologies and Fundamental concepts

John H Miller, and Scott. E. Page. (2009). Complex Adaptive Systems: An Introduction to computational models of social life

Simon Herbert, A. (1996). The Sciences of the Artificial.

Course code : MCS102 Core/ Elective : Core No. of Credits : 4	Course title **Quantitative methods for social sciences**

Course Objectives

- To develop an understanding on the quantitative methods used in social science research
- To familiarize students with basic quantitative methods so that later they can use these techniques in their research work

Learning Outcomes

- Demonstrate ability to apply basic quantitative methods to analyse social science data
- Gain methodological knowledge in social science research

Course Outline

Unit – I: Introduction to Social Science Research **15 hours**

- What is research in social sciences?
- Role of theory and numbers
- Types of social research
- Types of data – primary data and secondary data
- Attributes (categorical variables) and variables, discrete variables, continuous variables

Unit – II: Organization, and representation of quantitative data **15 hours**

- Frequency distributions - what is frequency? Frequency and non-frequency data.
- Proportions and percentages
- Pie chart
- Bar graph
- Histograms
- Line graph

Unit – III: Descriptive statistics **15 hours**

- Measures of central tendency – Meaning of central tendency. Mean, median and mode. Calculating mean, median and mode from non-frequency and frequency data.

Relation between mean, median and mode. Relative advantages and disadvantages of using mean, median or mode

- Measures of dispersion – What is dispersion? Absolute measures of dispersion – range, variance, standard deviation, inter-quartile range. Relative measures of dispersion – coefficient of variation.

Unit – IV: Correlation and Regression **15 hours**

- Bi-variate data, relationship between two variables, linear and non-linear relationships

Correlation

- Scatter diagram
- Correlation coefficient
- Computing correlation coefficient
- Pearson's correlation coefficient

Regression

- Linear regression
- Regression line
- Logistic regression

Suggested Readings

Chava Frankfort-Nachmias, and Anna Leon-Guerrero. (2018). Social statistics for a diverse society. Eighth edition. Sage publications

Coolidge, F. L (2006), Statistics: A Gentle Introduction, Sage Publications. Los Angeles.

Freedman, David, Pisani, Robert and Purves Roger (2009), Statistics, Fourth edition, Viva Books Private Limited

Lawrence Neuman, W.(2014). Social Reserch Methods: Quantitative and Qualitative approaches. Seventh edition. Pearson publications.

Stephen Gorard (2003), Quantitative Methods in Social Science, Continuum Books

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Course code : MCS103 Core/ Elective : Core No. of Credits : 4	Course title **Macroeconomic theory**

Course Objectives:

- Build the theoretical understanding of Macroeconomics theories.
- Develop analytical skills in understanding Indian Macroeconomic policy.

Course Learning Outcomes:

• Understand the implication of the trend of change of macroeconomic variables like income, employment, and prices on an economy.

Course Outline

Unit-I **15 Hours**

National Income Accounting: Accounting structure, key concepts in accounting, circular flow of income, computational problems - Expenditure approach, income approach and value added approach for measurement, input-output tables.

Unit-II **15 Hours**

Theories of Consumption: The Psychological Law of Consumption - Kuznets's Consumption Puzzle - Fisher's Inter-temporal Choice Model - Permanent Income Hypothesis - Life Cycle Hypothesis.

Unit-III **15 Hours**

Theories of Investment, Demand and Supply of Money: The Neoclassical Theory of Investment - Capital Theory and Theory of the Firm - Finance and the Cost of Capital - The Accelerator Theory of Investment - The Stock Market and Tobin's Q Theory; Baumol Inventory Theory of Money, Quantity Theory of Money, High Powered Money, Money Multiplier.

Unit-IV **15 Hours**

Neoclassical and Keynesian Macroeconomic Models: Fiscal and Monetary Policy in IS-LM Model, Relative Efficacy, Aggregate Supply and Aggregate Demand, Open Economy Models.

Suggested Readings:

Blanchard, O., and S. Fischer, *Lectures on Macroeconomics*. Cambridge, MA: MIT Press, 1989. Mankiw, N. Gregory, *Principals of Macroeconomics*. Cengage Learning, 7th Edition 2014. Samuelson, P. A and Nordhaus. W. D, *Macroeconomics*, McGraw Hill, 2012.

References:

Brian Snowdon and Howard R.Vane, *Modern Macroeconomics: It's Origins, Development and Current State*. Edward Elgar, UK, 2005.

D'souza Errol, *Macroeconomics*. Person Publication, New Delhi, 2008.

David Romer, *Advanced Macroeconomics*. 4th Edition, McGraw-Hill Irwin, 2012.

Dornbuschet. al, *Macroeconomics*. 10th Edition, Tata McGrawHill, New Delhi, 2008.

Obstfeld,M., and K.Rogoff, *Foundations of International Macroeconomics*. Cambridge, MA: MIT Press, 1996. R.T.Froyen, *Macroeconomics, Theory and policies*, Prentice Hall, 2008.

Scarth, W. *Macroeconomics: An Introduction to Advanced Methods*, Titles on Demand, 2010.

Taylor, Lance, *Reconstructing Macroeconomics - Structuralist Proposals and Critiques of the Mainstream*,

Harvard University Press, Cambridge, Massachusetts, 2004.

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Course code : MCS104 Core/ Elective : Core No. of Credits : 4	Course title **Behavioral theories in social sciences**

Course Objectives

- To provide comprehensive understating on the interdisciplinary nature of social sciences with various concepts and theories

Learning Outcomes

- Develop an understanding on the theories in interdisciplinary subjects
- Gain insights on the various aspects of behavioral theories in social sciences

Course Outline

Unit – I: Introduction to Sociological concepts 13 hours

- Concepts and Perspectives in sociology: The Family: Sociological Significance of the Family, Types and functions of Family, Nuclear and joint families.
- Marriage: Different forms of marriage, changing patterns of marriage/mate selection in India.
- Kinship: Features of kinship systems in India, regional variations.
- Social stratification: Social Class and Caste, Principles of Class and Caste.
- Sociological Perspectives: Functional perspective, Conflict perspective, Symbolic-interactionist perspective, Feminist perspective

Unit – II: Sociological theories 17 hours

- What is sociological theory and how we navigate sociological theory?
- Karl Marx – Alienated labour, Marx's theoretical orientation
- Emile Durkheim – Social fact, Mechanical and Organic Solidarity, Division of labour
- Max Weber – Spirit of capitalism; Class, Status, Party
- Pierre Bourdieu- Social space and symbolic power, Habitus, Forms of Capital, Theory of Practice
- Structuration theory - Anthony Giddens
- The Network Society - Manuel Castells

Unit – III: Social Psychology: Perspectives and Theories 15 hours

- What is social psychology, evolution of social psychology
- Social psychological concepts: Social Cognition: how we think about social world, stages in information processing; Social perception, Attitudes, Prejudice and

Discrimination; Social influence changing others behavior: conformity, compliance, obedience and power of the situation

- Helping and Altruism, Aggression: social learning theory of aggression, violence against women
- Groups and Individuals; Culture and self: Nisbett; Markus and Kitayama's work; The Milgram Experiments**;** Zimbardo's Stanford Prison Experiment, Bystander Effect: Seminal Studies in the Bystander Effect

Unit – IV: Basic concepts and perspectives in Economics Sociology 15 hours

- Concepts: Value, property, money, labour, rationality
- Forms of exchange: Reciprocity and gift; Exchange and money
- Perspectives: Functionalist, Marxist, and feminist; Formalism and Substantivism
- Social inequality: Affluence and poverty, Economics of inequality in global society, Economic disparity in India
- Gender and economy: emotional labour, gender and exclusion

Suggested Readings

Neil J. Smelser, and Richard Swedberg (Eds). 2005. The Handbook of Economic Sociology. Princeton University Press.

M.F. Guillen et al. 2002. *The new Economic Sociology*. Russel Sage Foundation.

Frank Dobbin. 2004. *The New Economic Sociology: A Reader.* Princeton University Press.

Hann, Chris. and Keith Hart. 2011. *Economic Anthropology*. Cambridge, UK: Polity Press

Carrier, James G. 2022. *Handbook of Economic Anthropology*. Edward Elgar Publishing.

Barbara Harriss-White. 2005. *India's market Society: Three essays in political economy*. Three Essays Press.

Thomas Piketty. 2015. *Economics of inequality*. Harvard University Press.

Real-Work economic Review- Special issue on Thomas Piketty's *Capital in the Twenty-First Century.*

Abhijit Banerjee and Esther Duflo. 2011. *Poor Economics: Rethinking poverty and the ways to end it*. Penguin.

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Course code : MCS111 Core/ Elective : Elective No. of Credits : 4	Course title **Introduction to Artificial Intelligence**

Course Objectives:

- To learn the differences between optimal reasoning vs human like reasoning.
- To understand basic principles of AI towards problem solving, inference perception, knowledge representation and learning.
- To understand the notions of state space representation, heuristic search, time and space complexities.
- To understand the applications of AI namely Intelligent Agents, Game Play, Expert Systems, Machine Learning and NLP.

Learning Outcomes:

- Able to demonstrate knowledge of building blocks of AI as presented in terms of Intelligent Agents.
- Attain the capability to represent various real-life problem domains using logic-based techniques and use this to perform inference and planning.

Course Outline:

Unit-I **15 Hours**

Introduction: What is AI? Foundations of AI, History of AI, Agents and Environments, the nature of the Environment, Problem Solving Agents, Problem Formulation, Search Strategies.

Unit -II **15 Hours**

Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order Logic, Inference in First-order logic, forward and Backward Chaining

Unit - III **15 Hour**

Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees, Why Learning Works, Learning in Neural and Belief networks.

Unit -IV **15 Hours**

Practical Natural Language Processing: Practical applications, Efficient parsing, scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis

Suggested Readings:

Stuart Russell, Peter Norvig, ―*Artificial Intelligence: A Modern Approach*‖,2nd Edition, Pearson Education, 2007.

B. Yagna Narayana, ―*Artificial Neural Networks*‖, PHI, 2005.

E. Rich and K. Knight, ―*Artificial Intelligence*‖, 3rd Edition, TMH, 2017.Dan W. Patterson, ―*Artificial Intelligence and Expert Systems*, PHI, 2015.

References:

Giarrantana, Riley, ―*Expert Systems: Principles and Programming*‖, 4th Edition,Course Technology Inc, 2004.

Ivan Bratka, ―*PROLOG Programming for Artificial Intelligence*‖, PearsonEducation, 3rd Edition, 2012.

Course code : MCS111 Core/ Elective : Elective No. of Credits : 4	Course title **Fundamentals of Geographic Information System (GIS)**

Objective: The objective of this course is to provide students with a foundational understanding of Geographic Information Systems (GIS), including their definitions, applications, components, and the development of GIS technology. Students will learn about geographic data types, data input, storage, editing, and the various methods of spatial analysis and GIS output presentation.

Learning Outcomes: By the end of this course, students will be able to:

- Define GIS and describe its applications, components, and elements, including the development of GIS technology.
- Equipping students with essential skills and knowledge for leveraging GIS in various applications.
- Explain the nature of geographic data, differentiate between spatial and attribute data, and understand vector and raster data models, along with data input devices and methods for storage and manipulation of GIS databases.
- Perform neighbourhood and proximity analyses, use buffer and overlay analyses, and effectively present GIS outputs.

Course Outline:

Unit 1: Introduction to GIS **15 Hours**

- Definition and Applications:
- Components and Elements of GIS:
- Development of GIS Technology:
- Geographic Objects and Maps:
- Coordinate Systems and Map Projections:

Unit 2: GIS Data Input, Storage, and Editing **15 Hours**

- Nature of Geographic Data:
- Vector and Raster Data Models:
- Data Input Devices and Methods:
- Storage and Manipulation of GIS Databases:

Unit 3: GIS Spatial Analysis **15 Hours**

- Spatial Analysis Techniques:
- Overlay Analysis:
- Presentation of GIS Outputs:

Unit 4: Practical Applications of GIS and Future Trends **15 Hours**

- GIS Project Development:
- Emerging Trends and Technologies in GIS:
- Ethical and Legal Considerations:

References:

Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). Geographic Information Systems and Science (4th ed.). Wiley.
Bolstad, P. (2016). GIS Fundamentals: A First Text on Geographic Information Systems (5th ed.). Eider Press.
DeMers, M. N. (2008). Fundamentals of Geographic Information Systems (4th ed.). Wiley.
Chang, K. (2019). Introduction to Geographic Information Systems (9th ed.). McGraw-Hill.
ESRI. (n.d.). ArcGIS Online Resources. Retrieved from https://www.esri.com/en-us/arcgis/about-arcgis/overview

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Course code : MCS111 Core/ Elective : Elective No. of Credits : 4	Course title **Understanding Social Realities**

Course Objectives

- To familiarize students with social realities, along with basic concepts
- To enhance their understanding on contemporary issues

Learning Outcomes

- Able to identify and explain basic sociological concepts and social realities
- Critically analyse contemporary social issues

Course Outline

Unit – I: Social construction of reality 12 hours

- Construction of reality; phenomena of social reality; everyday social reality; language and social reality; objective reality of society;
- Legitimation and social reality; Legitimation and Social Reality; Socialisation and Legitimation;
- Social Reality and The Symbolic Universe; Maintaining Social Reality and Language

Unit – II : Approaches to Understanding Social Reality 15 hours

- Comte's Ideas on the nature of sociology; observation in social sciences logical understanding of social reality;
- Empirical approach: what is empirical research?;
- Concept of cultural realitivism; ethical and normal view points in social research;
- Comparative approach: relationship with common sense, elements of comparative approach
- Feminist approach: Features, feminist methods and feminist discourse in India

Unit – III: Social Inequality 17 hours

- Notion of social inequality; nature of caste-inequalities in India; Caste as the Invention of Colonial Modernity or a Legacy of Brahmanical Traditions
- Nature of Class-Inequality in India
- Interrelation of Caste and Class Hierarchies; Social-Inequalities, Development and Participatory Politics
- Identity politics in India: Caste, religion, language; Meaning and significance of religious politics, evolution of religious politics

Unit – IV: Society and Information, Communication and Technology (ICT) 16 hours

- ICT concept and components; E-governance concept and significance
- ICT roles and applications: role of ICT in Administration, rural development, education and training; e-commerce
- E-seva: ICT project in Self-Help in Andhra Pradesh
- ICT implementation in governance: Issues and challenges

Suggested Readings

Berger, Peter, and Thomas Luckmann. (1967). "The Social Construction of Reality". New York : Doublesay

Annual Report, 2004-05, Department of Information Technology, Government of India.

Bhatnagar, Subhash and Robert Schware. (2000). Information and Communication Technology in Development-Cases from India, Sage, New Delhi

Gupta, MP, Prabhat, Kumar, and Jaijit, Bhattacharya. (2004). "Government Online Opportunities and Challenges", Tata McGraw-Hill Publishing Company Ltd., New Delhi

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SEMESTER – II

Course code : MCS201 Core/ Elective : Core No. of Credits : 4	Course title **Computational Demography**

Course Objectives

- To develop deep understanding on the foundational concepts and measures of computational demography
- To explore the intersection of gender, health, family dynamics, migration and urban development issues

Learning Outcomes

- Demonstrate understanding of basic concepts, and components of demography
- Able to explain and analyse family structure dynamics, challenges of migration and urban development in India

Course Outline

Unit – I: Basics of Demography **14 Hours**

Basic concepts of demography, Components of population change, Demography and its linkage with other social science disciplines. Demographic transition theory

Data Sources for Demography: Census of India, Sample Registration System, Surveys

Basic measures: Rate, Ratio, Proportions

Measures of age and sex structure: Defining age and sex, sex ratio, sex ratio at birth, age-sex population pyramid, Median age, dependency ratio and potential support ratio.

Importance of age-sex structure in Demography, Factors affecting age and sex structure, Socioeconomic implications of age and sex structure

Computing age-sex pyramid for India and states using Census Data

Unit – II: Fertility **14 Hours**

Definition and Concepts of fertility: Fecundity and Fertility, Sterility, Family size, Birth order, Parity, Natural fertility

Basic measures of fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rates (ASFR), Total Fertility Rate (TFR), Gross Reproduction Rate (GRR)

Sources of Data for computing fertility: Vital registration or Civil Registration System, National Periodic Census, Sample Fertility Surveys

Computing CBR, GFR, ASFR, TFR, GRR, Socio-cultural factors affecting fertility; Computing levels and trends of fertility in India.

Unit – III: Mortality **16 Hours**

Basic concepts of mortality; Measures of mortality – Crude Death Rate (CDR), Age-Specific Death Rates (ASDR), Infant Mortality Rate (IMR), Neonatal Mortality Rate (NMR), Cause-specific death rates, and ratios;
Sources of data for computing mortality – Sample Registration System (SRS), National Surveys
Concept of Life table, types, structure and functions;
Computing sex and age patterns of mortality for India and states, and computing rural-urban differentials in mortality;

Unit – IV: Migration **16 Hours**

Basic concepts: Mobility, Commuting, and Migration; life-time migration, net and gross migration, streams of migration
Sources of data for migration analysis: Census of India, Surveys – National Sample Survey, Kerala Migration Survey, Tamil Nadu Migration Survey, Odisha Migration Survey
Measures of migration: Direct and Indirect
Direct measures: Place of birth, duration of residence, place of last residence
Indirect measures: Vital statistics method, National growth rate method, Survival ratio methods - Census survival ratio method, Life table survival ratio method
Determinants of internal migration: Causes of migration at the place of origin and at the place of destination
Consequences of internal migration
Computing levels of migration, as well as age-sex patterns of migration for India, and States

Suggested Readings

Bhende, A., and Kanitkar, T. (1996). Principles of Population Studies (Seventh Edition), Himalaya Publishing House, Bombay.

Jacob S. Siegel and David A. Swanson. (2004). The Methods and Materials of Demography, Second Edition, Elsevier Science, USA

Rajan, S.I., and Bhagat.R.B. (2023). Researching Internal Migration. Routledge Taylor and Francis Group, London.

Ram, F. and Pathak, K.B. (2017). Techniques of demographic analysis. Himalaya Publishing House, Mumbai.

Srinivasan, K. (2011). Training Manual on Demographic Techniques. UNFPA, and Census of India.

United Nations. (1974). Methods of Measuring Internal Migration, Manual VI, UN, New York.

Course code : MCS202 Core/ Elective : Core No. of Credits : 4	Course title **Qualitative methods for social sciences**

Course Objectives

- To comprehend students with knowledge of qualitative data collection methods

Learning Outcomes

- Understand different interview techniques and methods of data collection
- Able to design checklist and guidelines for qualitative data collection

Course Outline

Unit – I : Introduction **13 Hours**

Introduction to Qualitative Research; Approaches to Qualitative research; Text as data in qualitative research; Verstehen and understanding; Comparing Quantitative and Qualitative research; the emic and etic perspectives;

Unit – II : Designing Qualitative Research **16 Hours**

Basic designs in qualitative research – Ethnography, Grounded theory, Case studies, comparative studies, retrospective studies, longitudinal studies; Research questions; Incorporating literature and theory; Conceptual framework; Sampling in qualitative research, participant and site selection.

Unit – III : Qualitative Data collection Methods **18 Hours**

In-depth interviews – what is in-depth interview and when to use? ; developing interview guidelines: semi-standardized, problem-centric; conducting interview: skills of the interviewer; strengths and limitations
Focused Group Discussions – overview, role of moderator, note-taker, steps in moderating focus group, effective focused-group notes, focus group checklists, strengths and limitations; Observation – what is observation, and when to use?; types of observation – participant and non-participant; preparation and conduct of observation – gaining access to field; field notes, field dairy, social mapping
Visual methodologies - Photographs, Film / Video, illustrations

Unit – IV : Ethical issues in Qualitative Research **13 hours**

Need for Ethics in research; ethics committee; ethical issues in qualitative research design, data collection, and data analysis

Suggested Readings

Flick, Uwe (2014). An Introduction to Qualitative Research, SAGE, New Delhi.

Hennink, M., Hutter, I. and Baily, A.(2011). Qualitative Research Methods. Sage Publications, London.

Mack, N., Woodsong, C., MacQueen, K.M., Guest, G., and Namey, E. (2005). Qualitative Research Methods: A Data Collector's Field Guide. Family Health International, USA.

Saldana, J. (2011). Fundamentals of Qualitative Research. Oxford University Press, New York.

Course code : MCS203 Core/ Elective : Core No. of Credits : 4	Course title **Data harvesting for social science research**

Course Objectives

To equip students with knowledge and skills needed to collect, organize, and manage large-scale data for social science research

Learning Outcomes

- Identify various data sources for social science research
- Able to apply data harvesting strategies to real-world social science problems, integrate digital tools and techniques, while ensuring data quality, ethical consideration, and adherence to research protocols

Course Outline

Unit – I : Introduction to Social Science Data sources **15 hours**

- What is Data?, Difference between data and information; Sources of data: primary and secondary;
- Importance and relevance of data in social science research

Unit – II : Censuses and Surveys **18 hours**

- Introduction to Census of India, National Sample Survey (NSS); data structure, data extraction. Major NSS rounds to understand social science research.
- Discussion on large-scale surveys: India Human Development Survey (IHDS), National Family Health Survey (NFHS), District Level Household Survey (DLHS)

Unit – III : Understanding Web Scraping and Privacy **18 hours**

- Why harvest data? Advantages and Drawbacks of data harvesting;
- Introduction to social media data;
- Privacy issues with social media – Facebook data-sharing scandal; Pegasus spyware scandal; Whatsapp privacy policy update;

Unit – IV: Data privacy initiatives **9 hours**

- Personal Data protection bill; Digital Personal Data Protection Act 2023

Suggested Readings

Freedman, J. (2020). Privacy, Data harvesting and You. Rosen publishing group, New York
González-Bailón, S. (2017). Decoding the Social World: Data Science and the Unintended Consequences of Communication. MIT press.
Salganik, M. J. (2018). Bit by Bit: Social Research in the Digital Age. Princeton University Press.

Course code : MCS204 Core/ Elective : Core No. of Credits : 4	Course title **Econometrics theory and application**

Course Objective:

The aim of this course is to:

Introduce the basic econometrics tools.

Understand the methods of econometric analysis and their application in empirical research.

Course Learning Outcomes:

By the end of the course, students will be able to;

Learn classical linear regression model, statistical inference in regression model, problems in regression and uses of dummy variables and estimation with independent and limited dependent dummy variables.

Use econometric models for economic research.

Course Outline:

Unit-I **15 Hours**

The Linear Regression Models: Bi-variate and multi-variate linear regression models, CLRM assumptions, Ordinary Least Squares estimation, Properties of OLS and the Gauss- Markov theorem; Hypothesis testing, goodness of fit; matrix approach to linear regression models.

Unit-II **15 Hours**

Functional Forms of Regression Models: Choice of functional forms-Log-linear, Double log and lin-Log models, Reciprocal and polynomial models, Choice of functional form, Interpreting coefficients in different functional forms and applications, Specification error and tests for specification error.

Unit-III **15 Hours**

Relaxation of CLRM Assumptions and Problems in Regression: Violation of CLRM assumptions and its consequences, detection and remedial measures of multicollinearity, heteroskedasticity and autocorrelation.

Unit-IV **15 Hours**

Maximum Likelihood Estimation: Introduction to binary and limited dependent variable, Limitation of the linear probability model(LPM), Method of maximum likelihood estimation and its properties (including consistency), Probit and Logit models, Multinomial models.

Suggested Readings:

Greene, William H, Econometric Analysis. Prentice Hall, 6th Edition, 2008. Gujarati, D and Porter, Basic Econometrics, McGraw Hill/Irwin, 5th Edition, 2009.

References:

Greene, William H, Econometric Analysis, Prentice Hall, 6th Edition, 2008. Johnston J. and DiNardo, J, Econometric Methods.McGraw-Hill, 4th Edition, 1997.

Ramanathan, Ramu, Introductory Econometrics with Applications, Thomson Asia Pvt Ltd., Singapore, 5th Edition 2002. Stock, James H., and Mark W. Watson, Introduction to Econometrics, Addison-Wesley Series in Economics, 2nd Edition, 2006. Wooldridge, J., Introductory Econometrics: A Modern Approach. Nelson Education, 2015.

G. S. Maddala, Introduction to Econometrics. Wiley Publishers, 4th Edition, Indian Edition, 2009.

Christopher Dougherty, Introduction to Econometrics. OUP, 3rd Edition, Indian Edition, 2007.

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Course Code : MCS211 Course Type : Elective No. of Credits : 4	Course Title **Data Analytics with Python**

Course Objective:

The aim of this course is to;

- Grasp Python programming fundamentals and data preprocessing.
- Utilize Python for data visualization and exploratory analysis.
- Analyze economic data with Python for hypothesis testing and statistical interpretation.
- Assess Python-based machine learning models and their performance.
- Develop Python-based time series models and apply basic machine learning for decision-making.

Course Learning Outcomes:

- Students will be able to handle big datasets and undertake statistical and econometric analysis.

Course Outline:

Unit-I: **[25 Hours]**

Introduction to Python programming: Introduction to python: Overview of python and its data analysis libraries (NumPy, pandas, Matplotlib, Seaborn); Data preprocessing and cleaning: Importing data into python; Handling missing data: imputation techniques; Dealing with outliers and anomalies; data transformation, data integration and manipulation.

Unit-II: **[22 Hours]**

Data Visualization and Exploratory Data Analysis: Descriptive statistics: Histograms, box plots, scatter plots; Correlation analysis, Data visualization; Hypothesis testing: t-tests, chi-square tests, ANOVA, etc.; Confidence intervals and p-values; Non-parametric tests; Interpreting statistical results.

Unit-III: **[25 Hours]**

Model Development in Python: Linear regression: simple and multiple regression; Logistic regression for classification; Decision trees and random forests; Model evaluation metrics: R-squared, MAE, RMSE, accuracy, precision, recall, etc.; Model assumptions and diagnostics; Model evaluation using visualization; Overfitting, Underfitting and Model Selection; Prediction and decision making.

Unit-IV: **[18 Hours]**

Time Series Analysis Using Python: Time series components: trend, seasonality, noise; Decomposition techniques; Time series modelling; Time series forecasting methods: moving average, ARIMA, exponential smoothing; Brief introduction to machine learning using python.

Suggested Readings:

McKinney, W. *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython.*, O'Reilly Media, Inc., 2012.
Swaroop, C. H. *A Byte of Python. Python Tutorial*, 2003.
Ken Black, *Business Statistics for Contemporary Decision Making*. "John Wiley & Sons, Inc", 6th Editing.

References:

Anderson Sweeney Williams, *Statistics for Business and Economics*. Cengage Learning, 2011.
David W. Hosmer, Stanley Lemeshow, *Applied Logistic Regression* (Wiley Series in probability and statistics)."Wiley-Interscience Publication", 2000.
Douglas C. Montgomery, George C. Runger, *Applied Statistics & Probability for Engineering*. Wiley & Sons, Inc, 2002.
Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*. Cengage Learning, 2011.
Jiawei Han and Micheline Kamber, *Data Mining: Concepts and Techniques*, 2006.
Leonard Kaufman, Peter J. Rousseeuw, *Finding Groups in Data: An Introduction to Cluster Analysis*. Wiley & Sons, 1990.
Sarah Stewart, *Python Programming - Python Programming for Beginners*, Platinum Press LLC, 2019.

Course code : MCS211 Core/ Elective : Elective No. of Credits : 4	Course title **Machine Learning**

Course Objectives:

- To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IoT nodes.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Learning Outcomes:

- After completion of the course student will be able to:
- Extract features that can be used for a particular machine learning approach in various IoT applications.
- Compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
- Mathematically analyse various machine learning approaches and paradigms.

Course Outline

Unit-I **15 Hours**

Supervised Learning (Regression/Classification): Basic methods: Distance- Based methods, Nearest-Neighbours, Decision Trees, Naive Bayes, Linear Models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi- class/Structured Outputs, Ranking

Unit-II **15 Hours**

Unsupervised Learning: Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion,Generative Models (mixture models and latent factor models)

Unit-III **15 Hours**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Unit-IV **15 Hours**

Sparse Modelling and Estimation, Modelling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Suggested Readings

- Kevin Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, —*The Elements of Statistical Learning*, Springer, 2009.

Course code : MCS213 Core/ Elective : Compulsory No. of Credits : 4	Course title **Introduction to R Programming**

Course Objectives:

- This course introduces R, which is a popular statistical programming language. The course covers data reading and its manipulation using R, which is widely used for data analysis internationally.
- The course also covers different control structures and design of user-defined functions. Loading, installing, and building packages are covered.

Learning Outcomes: After completion of the course students will be able to do:

- Develop an R script and execute it
- Install, load and deploy the required packages, and build new packages for sharing and reusability
- Extract data from different sources using API and use it for data analysis
- Visualize and summarize the data
- Design application with database connectivity for data analysis

Course Outline

Unit I **15 Hours**

Introduction: R interpreter, Introduction to major R data structures like vectors, Matrices, arrays, list and data frames, Control Structures, vectorized if and multiple Selections, functions.

Unit II **15 Hours**

Installing, loading and using packages: Read/write data from/in files, extracting data from web-sites, clean data, transform data by sorting, adding/removing new/existing Columns, centring, scaling and normalizing the data values, converting types of Values, using string in-built functions.

Unit III **15 Hours**

Statistical analysis of data for summarizing and understanding data, Visualizing data Using scatter plot, line plot, bar chart, histogram, and box plot.

Unit IV **15 Hours**

Designing GUI: Building interactive application and connecting it with database. Building Packages.

Suggested Readings:

Cotton, R., Learning R: a step-by-step function guide to data analysis. 1stedition. O'Reilly Media Inc

Gareth James et.al., An Introduction to Statistical Learning: with Applications in R (Springer Texts in Statistics), (7th Edition), Springer, 2017

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SEMESTER – III

Course code : MCS301 Core/ Elective : Core No. of Credits : 4	Course title **Causal inferences for Social sciences**

Course Objectives

To provide comprehensive understanding on statistical models commonly used in causal analysis of social data

Learning Outcomes

- Critically evaluate and select appropriate statistical models for analysing causal relationship in social science research
- Able to apply statistical models to conduct causal analysis

Course Outline

Unit – I: Multiple Regression 15 hours

- Multiple regression with two predictor variables, Multiple regression with three or more predictor variables, Dummy variables to represent categorical variables;
- Multicollinearity; interaction, nonlinearities, Goodness of fit: Standard error of the estimate, coefficient of determination, R^2, Multiple correlation coefficient, R, Partial correlation coefficient;
- Statistical inference: hypothesis testing, confidence intervals, p values for a single regression coefficient, testing the difference between two regression coefficients

Unit – II: Multiple Classification Analysis 15 hours

- Basic Multiple Classification Analysis (MCA) table: Unadjusted values, and adjusted values;
- MCA with quantitative control variables;
- Expressing results from Ordinary Multiple regression in an MCA format;
- Presenting MCA results graphically.

Unit – III : Path Analysis 15 hours

- Path diagrams and path coefficients, path models with more than one exogeneous variable; path models with control variables,
- Path models with standardized variables: standardized variables and standardized path coefficients, standardized and unstandardized coefficients.

Unit – IV : Logit Regression, and Multinomial Logit Regression **15 hours**

- Logistic function, Odds and logit of P, Logistic regression coefficients; odds ratios; effect on the odds when the predictor variable is categorical with more than two categories;
- statistical inference, goodness of fit; fitting logit regression model;
- Limitations of logit regression model;
- Basic form of multinomial logit model; Interpretation of coefficients;
- statistical inference, goodness of fit; presentation of results in a Multiple Classification Analysis format; Multinomial models with interactions and nonlinearities.

Suggested Readings

Andrews, F., J. Morgan, and J. Sonquist (1969), *Multiple Classification Analysis*. Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan

Kendall, M. G. and C. A. O'Muircheartaigh (1977), *Path Analysis and Model Building*. World Fertility Survey Technical Bulletin No. 2. The Hague: International Statistical Institute

Retherford, R.D. and Minja, K.C. (1993). “Statistical models for causal analysis”. John Wiley and sons publications

Course code : MCS302 Core/ Elective : Core No. of Credits : 4	Course title **Social and Ethical Issues of Big Data and AI**

Course Objectives

- To provide a comprehensive understanding of the foundational social and ethical issues of big data and artificial intelligence
- To critically examine the societal, professional implications of privacy, security, and bias in Big Data and AI technologies

Learning Outcomes

- Apply ethical theories to understand big data and AI
- Demonstrate understanding on internet, security, privacy and algorithmic bias in big data and AI

Course Outline

Unit – I: Introduction to Social and Ethical issues of Big Data **15 Hours**

Big data limitations: An overview; Data and Reality, Discrimination and Personalisation, Correlation and Causation, concerns and challenges of AI

Unit – II: Ethical Foundations **15 Hours**

Introduction to research ethics, unethical medical and social research, ethical computational social science, digital exit strategy,
Professional society codes of ethics: contemporary ethical issues from tech companies

Unit – III: Internet, Privacy, and Security **15 Hours**

Internet background, and implications for privacy and security; privacy; security, causes and types of breaches

Unit – IV: Algorithmic Bias **15 Hours**

Perspectives on Algorithmic bias; algorithmic bias related to gender; facial recognition; The future of work and AI

Suggested Readings

Luciano, Floridi. (2015). “The ethics of information”. Oxford University Press.

Nissenbaum, Helen. (2009). “Privacy in context: Technology, Policy, and the Integrity of social life”. Stanford University Press.

Course code : MCS303 Core/ Elective : Core No. of Credits : 4	Course title **Introduction to Public Policy**

Course Objectives:

- To familiarize with the theoretical foundations of public policy.
- To understand the nature of specific public policies in India.
- To examine the impact of public policy on society, economy and the environment.

Learning Outcomes:

- Develop skills on policy content and of policy communication.
- Evaluate the effectiveness and efficiency of existing public policies using appropriate methods.
- Equip with critical thinking and analytical skills for evaluating public policies.

Course Outline

Unit-I : Fundamentals of Public Policy **15 Hours**

- Public Policy: Evolution, Nature and Scope
- Policy Science: Emergence and Significance
- Theories: Group, Elite, Institutional, Systems, Rational, Incremental, Process and Public Choice

Unit-II: Policy Typologies **15 Hours**

- Liberal Vs Conservative; Substantive Vs Procedural
- Distributive, Redistributive and Regulatory
- Material Vs Symbolic; Public Vs Private

Unit-III : Public Policy Process **15 Hours**

- Public Policy Cycle: Agenda Setting, Formulation, Legitimation, Implementation and Evaluation
- Policymaking Styles/Levels: Bottom-Up and Top-Down
- Models of Public Policy Analysis

Unit-IV: Public Policy Environment **15 Hours**

- Context: Political, Economic, Social and Cultural
- Actors: Executive, Legislature, Judiciary, Bureaucracy, Citizens, Political Parties, Pressure Groups, Media and International Actors and Regimes
- Selected Public Policies in India: Education, New Economic Policy, Reservation Policy and Environment

Suggested Readings:

Peters, B. G. (2021). Advanced introduction to public policy. Edward Elgar Publishing.
Dunn, W. N. (2017). Public policy analysis (6th ed.). Routledge

References:

Bardach, E. (2012). A practical guide for policy analysis: The eightfold path to more effective problem-solving (4th ed.). CQ Press.
Cairney, P. (2016). The politics of policy-making. Oxford University Press.
Dye, T. R. (2017). Understanding public policy (15th ed.). Pearson.

Howlett, M., Ramesh, M., & Perl, A. (2020). Studying public policy: Policy cycles and policy subsystems (5th ed.). Oxford University Press.
Peters, B. G., & Pierre, J. (2014). Handbook of public policy. SAGE Publications. Sabatier, P. A., & Weible, C. M. (Eds.). (2014). Theories of the policy process (3rd ed.). Westview Press.

Weimer, D. L., & Vining, A. R. (2017). Policy analysis: Concepts and practice (6th ed.). Routledge.

Course code : MCS311 Core/ Elective : Elective No. of Credits : 4	Course title **Data Analytics with R**

Course Objective:

Students will learn R. Programming language, data analytics, data visualisation and statistical model for data analytics.

Course Learning Outcomes:

On completion of the course, students can be able to:
Analyze data by using R Programme.
Handle big datasets to generate valid inferences.

Course Outline:

Unit-I **15 Hours**

A. Introduction to R programming: Overview of R programming, Environment setup with R Studio, R commands, variables and data types, control structures, R packages; **B. Reading and getting data into R (External Data):** Using csv files, xml files, web data, json files, databases, excel files; Data transformation, data integration and manipulation; Working with R charts and graphs.

Unit-II **15 Hours**

Statistical Analysis in using R: Descriptive statistics: mean, median, mode, variance, etc.; Correlation analysis and heatmaps; Univariate and bivariate analysis; Probability Theory; Hypothesis testing: t-tests, chi-square tests, ANOVA, etc.; Confidence intervals and p-values; Non-parametric tests; Interpreting statistical results.

Unit-III **15 Hours**

Econometric Modelling in R: Linear regression: simple and multiple regression; Logistic regression for classification; Decision trees and random forests; Model evaluation metrics: R-squared, MAE, RMSE, accuracy, precision, recall, etc.; Model assumptions and diagnostics; Overfitting, underfitting and model selection using caret and glmnet; Prediction and decision making.

Unit-IV: **15 Hours**

Time Series Analysis Using R: Time series components: trend, seasonality, noise; Decomposition techniques; Time series modelling in R; Time series forecasting methods: moving average, ARIMA, exponential smoothing; Brief introduction to machine learning using R using mlr and h2o.

Suggested Readings

An Introduction to R, Notes on R: *A Programming Environment for Data Analysis and Graphics*. W. N. Venables, D.M. Smith and the R Development Core Team.Version3.0.1 (2013-05-16). URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

Reference:

Dunlop et, al. *Statistics and Data Analysis: From Elementary to Intermediate*. Prentice Hall, 2000.
G Casella and R. L. Berger, *Statistical Inference*, Thomson Learning 2002.
Hastie, Trevor, et. al., *The elements of statistical learning*. Vol. 2.No. 1. New York: springer, 2009.
Jared P Lander, *R for Everyone: Advanced Analytics and Graphics*, Pearson Education, 2013
Joseph F Hair, William C Black et. Al., *"Multivariate Data Analysis"*, Pearson Education, 7th Edition, 2013. Mark Gardener, *"Beginning R - The Statistical Programming Language"*, John Wiley & Sons, Inc., 2012. Michael Berthold, David J. Hand, *Intelligent Data Analysis*, Springer, Latest Edition.

Montgomery, et. al...*Applied statistics and probability for Engineers*. John Wiley & Sons, 2010. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
W. N. Venables, D. M. Smith and the R Core Team, "*An Introduction to R.*" 2013.

Course code : MCS311 Core/ Elective : Elective No. of Credits : 4	Course title **Advanced Geospatial Analysis**

Objective: The course is designed to comprehensively understand advanced geospatial analysis techniques and their applications. Students will deepen their knowledge and proficiency using sophisticated geospatial tools and software through practical exercises and hands-on projects. The course aims to enhance students' spatial data modeling, analysis, and visualization skills, enabling them to tackle complex spatial problems effectively. Additionally, students will explore advanced applications of geospatial analysis in various fields such as environmental management, urban planning, disaster management, and health geography. By the end of the course, students will be equipped with the knowledge and skills necessary to apply advanced geospatial analysis techniques in real-world scenarios and make informed decisions based on spatial data analysis.

Course Outcomes: By the end of this course, students will be able to:

1. Apply advanced geospatial analysis techniques to complex geographic problems.
2. Utilize advanced geospatial tools and software with proficiency.
3. Conduct sophisticated spatial data modeling and analysis.
4. Create detailed and insightful spatial data visualizations.
5. Design and implement advanced geospatial projects across multiple disciplines.

Course Outline:

Unit 1: Advanced Spatial Data Analysis **15 Hours**

Spatial Data Types and Sources

- Advanced types of spatial data: 3D data, temporal data
- Data acquisition from various sources: satellite imagery, LiDAR, remote sensing

Data Preprocessing

- Data cleaning, transformation, and integration
- Handling large datasets and improving data quality Spatial Statistics
- Geostatistics: Kriging, variogram analysis
- Spatial autocorrelation and pattern analysis

Unit 2: Spatial Modeling and Simulation **15 Hours**

Spatial Models

- Types of spatial models: agent-based models, cellular automata
- Building and validating spatial models

Simulation Techniques

- Monte Carlo simulation
- Scenario-based modeling and analysis Applications

- Land use change modeling
- Environmental impact simulation

Unit 3: Advanced Geospatial Technologies **15 Hours**

Geographic Information Systems (GIS)

- Advanced GIS software and tools
- Customizing GIS applications with scripting languages (e.g., Python, R)

Remote Sensing

- Advanced remote sensing techniques
- Image processing and analysis
- Hyperspectral and multispectral data analysis

Global Positioning System (GPS) and Mobile GIS

- Advanced GPS applications
- Integration of mobile GIS in data collection and analysis

Unit 4: Spatial Data Visualization and Decision Support **15 Hours**

Data Visualization Techniques

- Advanced cartography and thematic mapping
- 3D visualization and virtual reality applications

Decision Support Systems

- Designing geospatial decision support systems (GDSS)
- Case studies of GDSS in various fields Presentation and Communication

- Effective communication of geospatial analysis results
- Developing interactive web maps and dashboards
- Applications and Case Studies (Environmental Management, Urban Planning, Disaster Management)

References

Smith, J. K., & Johnson, L. M. (2023). Advanced Spatial Data Analysis: Techniques and Applications. New York, NY: Springer.

Jones, R. W., & Brown, S. A. (Eds.). (2022). Spatial Modeling and Simulation in Geography: Concepts and Methods. London, UK: Routledge.

Garcia, M. H., & Wang, Y. (2021). Advanced Geospatial Technologies: Applications and Innovations. San Francisco, CA: Wiley.

Williams, P. D., & Davis, E. C. (2020). Spatial Data Visualization and Decision Support: Principles and Practices. Boston, MA: Pearson.

Course code : MCS311 Core/ Elective : Elective No. of Credits : 4	Course title **Qualitative data analysis using software**

Course Objectives

To comprehend students with working knowledge of qualitative data analysis using software

Learning Outcomes

- Able to code and visualize qualitative data
- Working knowledge of software used for qualitative data analysis

Course Outline

Unit – I : Fundamentals of Qualitative Data Analysis **13 Hours**

Approaches to textual data analysis; textual data preparation; Developing codes: definition of codes, Meaning of first cycle coding and second cycle coding with examples;
Within-case and cross-case analysis, variables versus cases.

Unit – II : Coding and analysis. **16 Hours**

Grounded theory analysis and coding; Thematic analysis and coding; Discourse analysis;

First cycle coding methods: Grammatical, Elemental, Affective coding methods; exploratory coding methods;
Second cycle coding methods: Transition from first to second cycle coding methods,
What is an analytic memo? ; Reflection and refraction; Coding and categorizing analytic memos,
From codes to patterns: Network display; Graphic display.

Unit – III : Software in Qualitative Research **15 Hours**

Introduction to Computer Assisted Qualitative Data Analysis Software (CAQDAS)
Why and ways of using software and computers in qualitative research
How to choose Qualitative Data Analysis (QDA) software: ATLAS.ti, NVivo, Dedoose
Checklist for using QDA software

Unit – IV : Writing and Presenting Qualitative Research **16 Hours**

Styles of Qualitative Research Writing: Descriptive, Analytical, Interpretative, Critical.
Writing theses, dissertations; Hands-on experience with qualitative data analysis using software

Suggested Readings

Miles, M.B., Hberman, A.M., & Saldana, J. (2014). "*Qualitative data analysis: A methods sourcebook*" – 3rd edition, Sage publications, CA.
Saldana, J. (2016). "*The coding manual for qualitative researchers*". Sage publications, London.
Silverman, D. (2013). "*Doing Qualitative Research*", Sage publications, London.

Course code : MCS313 Core/ Elective : Compulsory No. of Credits : 4	Course title **Building Mathematical Ability and Financial Literacy**

Course Objectives:

- To familiarize with fundamental mathematical concepts including set theory, permutations and combinations.
- To understand the logical reasoning for efficient problem-solving, analysis of propositions and conditional statements.

Learning Outcomes:

- Analyzing financial instruments like stocks, shares, loans, insurance and income tax liabilities.
- Ability to compute measures of central tendency, dispersion, correlation and regression.

Course Outline

Unit-I: Mathematics **15 Hours**

1. Basic Set Theory

- Introduction to Sets
- Elements and Subsets
- Set Operations: Union, Intersection and Complement

2. Permutations and Combinations

- Fundamental Principles
- Permutation Formulas
- Combination Formulas

3. Mathematical Logic

- Propositions and Truth Values
- Logical Connectives
- Tautology and Contradiction
- Logical Equivalences
- Converse, Inverse and Contrapositive of Conditional Statements

Unit-II: Commercial Mathematics **15 Hours**

1. Cost Price, Selling Price, Profit and Loss
- Basic Concepts
- Calculation Methods

2. Simple and Compound Interest

- Simple Interest Calculations
- Compound Interest: Reducing Balance vs. Flat Rate

3. Financial Instruments

- Stocks and Shares
- Housing Loans
- Insurance
- Equated Monthly Instalments (EMIs)
- Income Tax Calculation

Unit-III: Statistics **15 Hours**

1. Sources and Types of Data
- Primary and Secondary Sources
- Types of Data

2. Graphical Representation of Data
- Charts, Graphs and Diagrams

3. Measures of Central Tendency and Dispersion

- Arithmetic Mean, Median and Mode
- Range, Variance, Standard Deviation and Coefficient of Variation

4. Bivariate Data

- Scatter Plot
- Pearson's Correlation Coefficient
- Simple Linear Regression

Unit-IV: Financial Literacy **15 Hours**

1. Money and Banking
- Functions and Measurement of Money
- Scheduled and Non-scheduled Banks

2. Central Banking and Monetary Policy Tools
- Functions of Central Banks
- Credit Creation
- Quantitative and Qualitative Methods of Credit Control

3. Role of Reserve Bank of India (RBI)

- Objectives and Limitations of Monetary Policy
- RBI's Functions and Policies in the Indian Economy

Suggested Readings:

J. Medhi Statistical methods (An Introductory text); Wiley Eastern Ltd. (latest edition)
Building Mathematical ability, foundation course, University of Delhi, S. Chand Publications

Lewis, M.K. and p. d., Monetary economics. Oxford University press, New York, 2000

References:

C Rangarajan: Indian economy: essays in money and finance, 1999

Brahmaiah, B. and P. Subbarao, Financial futures and options, Himalaya Publishing House, Mumbai,1998

SEMESTER – IV

Course code : MCS401 Core/ Elective : Core No. of Credits : 4	Course title **Survey Research Methods and Data analysis using software**

Course Objectives

Acquaint students with different methods in survey research and data analysis techniques using software

Learning Outcomes

- Understand survey research methods and software for data collection
- Develop skills to structure questionnaire and standards for large scale quantitative surveys
- Able to do advance statistical analysis using secondary data

Course Outline

Unit – I: Concept of sampling **10 hours**

- Concept of population and sample, sample survey verses census
- Sampling units, assumptions of sampling from finite population, sampling frame
- Selection and inclusion probabilities,
- Probability and non-probability sampling, and sampling design.

Unit – II: Types of sampling methods **12 hours**

- Probability sampling designs - Simple Random Sampling with and without replacement, Stratified Sampling, Systematic random sampling, Cluster Sampling; Nonprobability sampling designs – Quota sampling, Purposive sampling

- Sampling design of large-scale surveys National Family Health Survey; Longitudinal Ageing Study in India; Sample registration System; National Sample Survey Organization

Unit – III: Questionnaire Development for quantitative surveys 15 hours

- Types of Questionnaire/schedule, Checklist schedules, structure of questionnaire, roster, skipping non applicable questions, checks.
- Standardization of tools, Principles of constructing a questionnaire/ interview schedule
- Types of questions (knowledge, attitudinal, behavioral, practice), framing of questions (simple, delicate, personal matter), sequencing of questions. Updating/developing new questions

Unit – IV: Software for Data Collection in large scale surveys 10 hours

- Computer assisted personal interview (CAPI), process of data transfers, introduction to KoboToolbox. Web-designed questionnaires.

Unit – V: Introduction to Data Analysis using STATA 13 hours

- Creating database structure, data entry, specifying scales, validation of data entry, importing and exporting data

- Data visualization Histogram; boxplots; bar charts; line graphs; heat map; scatterplots; pie charts; customize plot axes, labels, add legends, and add colors

- Data manipulation Recoding; creating new variable; sorting; filtering and selection of specific data; merging files; generating simple frequencies; use of syntax editor

- Exploratory data analysis Computation of measures of central tendency and dispersion; computation of correlation coefficient; chi-square test for association between two categorical variables

Suggested Readings

Cochran, W.G. (1977). Sampling Technique, Third edition. New York: JohnWiley & Sons
Kish, L. (1995). Survey Sampling. New York: John Wiley and Sons, INC.
StataCorp. (2021). STATA user's guide, release 17. College Station, TX: StataCorp LLC

United Nations. (2005). Household Sample Surveys in Developing and Transition Countries. New York: United Nations