आंध्रप्रदेश केंद्रीय विश्वविद्यालय
# CENTRAL UNIVERSITY OF ANDHRA PRADESH
## Ananthapuramu

**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)

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## CONTENTS

# 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.

## 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 (3) | DSE 1 (4)/ DSE 2 (4)/ DSE 3 (4)/ MOOCs | — | — | IDE 1 (3) Online | — | DSC 2 (1) DSC 4 (1) | 23 |
| II | DSC 5 (4) DSC 6 (3) DSC 7 (3) DSC 8 (3) | DSE 4 (4)/ DSE 5 (4)/ DSE 6 (4)/ MOOCs | — | CCC 1: Introduction to R programming (4) | IDE 2 (3) Online | — | DSC 6 (1) DSC 7 (1) DSC 8 (1) | 27 |
| III | DSC 9 (3) DSC 10 (4) DSC 11 (4) | DSE 7 (4)/ DSE 8 (4)/ DSE 9 (4)/ MOOCs | — | CCC 2: Building Mathematical Ability and Financial Literacy (4) | IDE 3 (3) Online | Internship (2) | DSC 9 (1) | 25 |
| IV | DSC 12 (2) | — | Dissertation (16) | — | — | — | DSC 12 (2) | 20 |
| **Total** | **40** | **12** | **16** | **8** | **9** | **2** | **8** | **95** |
| **Percentage** | **37.90** | **12.63** | **16.84** | **8.42** | **9.47** | **2.11** | **12.63** | **100** |

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

## 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 | 1 | 0 |
| 2. | MCS202 | CC: Qualitative methods for social sciences | 4 | 3 | 0 | 1 |
| 3. | MCS203 | CC: Data harvesting for social science research | 4 | 3 | 0 | 1 |
| 4. | MCS204 | CC: Econometrics – Theory and Applications | 4 | 3 | 0 | 1 |
| 5. | **DSE: Any one of the following/MOOCs** | | 4 | 3 | 0 | 1 |
| | MCS211 | Introduction to Python programming | | | | |
| | 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** |

| 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** | **6** | **30** |

**\*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**: Practicals/Project

### 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 40%.

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 40%.

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. Out of the remaining 10 marks, 5 marks are awarded for assignments, class presentations and class participation of the students and the remaining 5 marks are awarded for punctuality, and attendance of the student.

**Marks for the Attendance will be considered as follows:**

| S.NO | ATTENDANCE % | MARKS |
|------|--------------|-------|
| 1 | 95% or more | 5 |
| 2 | 90-94% | 4 |
| 3 | 85-89% | 3 |
| 4 | 80-84% | 2 |
| 5 | 75-79% | 1 |

8. A student should pass separately in both CIA and the ESE, i.e., a student should secure 16 (40% of 40) out of 40 marks for theory and 24 (40% of 60) out of 60 marks for lab components in the CIA. Therefore, a student should secure 24 (40 % of 60) out of 60 marks for theory and 16 (40% 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.

# Syllabus

# SEMESTER – I

| Course code : MCS101<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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

- 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)

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

### Unit – III: Social Networks

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

## Unit – IV: Social Complexity

- 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

- 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<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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 analyze social science data
- Gain methodological knowledge in social science research

## Course Outline

### Unit – I: Introduction to Social Science Research

- 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

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

### Unit – III: Descriptive statistics

- 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

- 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.

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

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

| Course code : MCS103<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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:**
**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:**
**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:**
**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:**
**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.

| | |
|---|---|
| Course code : MCS104<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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**

- 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**

- 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**

- 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**

- 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.

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

**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**

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**

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**

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

**Unit -IV**

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<br>Core/ Elective : Elective<br>No. of Credits : 4 | Course title<br>**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**

- 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**

- 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**

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

**Unit 4: Practical Applications of GIS and Future Trends**
- 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

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

## 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

- 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

- 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

- 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)**

- 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

## SEMESTER – II

| Course code : MCS201<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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**

- Multi-disciplinary nature of Demography, its linkage with other social science disciplines. Basic demographic concepts. Components of population change. Demographic transition
- Measures of age and sex structure: Defining age and sex, sex ratio, sex ratio at birth, Classification of age group and their importance;
- Measures of age structure: Percent distribution, Median age, age-sex pyramid, dependency ratio and potential support ratio.
- Factors affecting age and sex structure, Importance of age-sex structure in Demography. Socioeconomic implications of age and sex structure

**Unit – II: Gender and Health**

- Concept of gender, Gender stratification in traditional and modern societies, Gender and Sustainable Development Goals (SDGs). Gender budgeting.

- Concept of health, Measures of health status: Prevalence ratio, Incidence rates, Age-specific and Cause-specific Prevalence ratios, and Incidence rates.
- Health and Nutrition issues of adolescent of boys and girls , abuse and maltreatment.

- Major risk factors: alcoholism, tobacco and drug consumption, accidents. Health seeking behavior among men and women.
- Gender responsive policy making and planning of health and development programs Household environment and its differential impact on men and women's life: household headship and role in decision making.

## Unit – III:  Family Dynamics

- Nuptiality  - Basic concepts: Crude Marriage Rate (CMR), General Marriage Rate (GMR), Age-Specific Marriage Rate (ASMR), Total Marriage Rate (TMR), Singulate Mean Age at Marriage (SMAM). Indices of Nuptiality (Coale's Indices).
  Nuptiality analysis using data and Marriage Squeeze: Concepts and Implications
  Analysis of Household and family statistics: changes in household's demographic and economic composition (Jacob & segel)

- Ageing: concepts and measures of population ageing;
- Population ageing trends, patterns and determinants in India; state variations; future scenario of population ageing in India and states
- Social Status and Roles of Elderly, Family Structure, Intergenerational relations, Kinship and family support, Social Security; Social network- Frameworks (Berkman and others) and measurement.
- Living Arrangements of Elderly, Old Age Homes, Social Networks, and Contribution of elderly: "Feminization" of Ageing, Dependency, Gender Dimensions and Discrimination, Widows, Elder abuse, Social and legal Vulnerability
- Generational analysis

## Unit – IV: Migration and Urban development

- Concept of mobility and migration, sources and quality of data, types of migration, census definition of migrants, limitations
- Patterns of Internal migration in India; Determinants of internal migration: Causes of migration at the place of origin and at the place of destination;
- Patterns of international migration: Historical and recent trends; causes and consequences of international migration
- Direct estimation of lifetime and inter-censal migration rates from census data;
- Indirect measures of net internal migration: Vital Statistics Method, National Growth Rate Method and Census and Life Table Survival Ratio methods, and Introduction to Migration surveys.
- Definitions and concepts of urban areas & urbanization; Evolution of urban settlements;
- Urban policies and programmes; Smart Cities Mission; HRIDAY, AMRUT, PURA, RURBAN mission;

- Challenges in urban development: Slums, and Congestion, air pollution, solid waste management; SDGs and Sustainable cities; GIS in urban planning.

**Suggested Readings**

Bhende, A. (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

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

Basu, Alaka M. (1992). Culture, The Status of Women and Demographic Behaviour, OxfordUniversity, New York

Dyson, Tim and Mick Moore. (1983). "On Kinship structure, female autonomy, and demographic behaviour in India", Population and Development Review vol. 9(1), pp. 35- 60.

United Nation. (2001). Population, Gender and Development: A Concise Report. UN, Economicand Social Affairs (Dept. of), New York

World Health Organization. (1998). Gender and Health. Technical paper WHO/ FRH/WHD/98. (Website: www.who.int)

Chakraborti, Rajagopal Dhar. (2004). The Greying of India: Population Ageing in the Context of Asia, SAGE Publications Private Limited, New Delhi.

UNFPA. (2001). Population Ageing and Development: Social, Health and Gender Issues, United Nations, Malta.

UNFPA. (2011). Report on the status of elderly in select states of India, UNFPA, India

World Health Organization. (2015). WHO Report on Ageing and Health, WHO,Geneva.

Chaudhuri, J. R. (2001). An Introduction to Development and Regional Planning, Orient Longman, Hyderbad

Mishra, R.P. (1992). Regional planning: Concepts, Techniques, Policies and Case studies, Concept Publishing Co., New Delhi

UNEP and others. (2007). Livable Cities: The benefits of environmental planning, The CitiesAlliance, Washington. http://www.citiesalliance.org/idex.html

| Course code : MCS202<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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

Using existing literature, Approaches to qualitative research; theories underlying qualitative research; Text as data in qualitative research.

### Unit – II : Designing Qualitative Research

The qualitative research process: how and why to design; difference between quantitative and qualitative research designs; research guidelines; Displaying the conceptual framework

### Unit – III : Data collection and Interview Techniques

Mail method, interviews through telephone, internet and computers, face-to-face interviews or personal, self-administered and interview administered questionnaire, Quantitative vs. qualitative data collection, Principles and guideline for interview, language

### Unit – IV : Qualitative Methods of data collection

In-depth interviews, key informant interview, observation (participatory and non-participatory), focus group discussion, content analysis, social mapping, social networking, free listing, mechanical devices (camera, tape recorder), mystery client technique, vignettes method.

## Suggested Readings

Hennink, M., Hutter, I. and Baily, A.(2011). *Qualitative Research Methods*. Sage Publications, London.
Flick, Uwe (2014). An Introduction to Qualitative Research, SAGE, New Delhi.
Creswell, J. (2012). Research Design: Qualitative, Quantitative, and Mixed methods approaches (4th ed.) Thousand Oaks, CA: Sage

| Course code : MCS203<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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

- 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

- Introduction to Census of India, National Sample Survey (NSS); data structure, data extraction. Major NSS rounds in understanding 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

- 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

- 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<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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:**
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:**
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:**
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:**
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, $6^{th}$ Edition, 2008. Johnston J. and DiNardo, J, Econometric Methods.McGraw-Hill, $4^{th}$ Edition, 1997.

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

G. S. Maddala, Introduction to Econometrics. Wiley Publishers, $4^{th}$ Edition, Indian Edition, 2009.

Christopher Dougherty, Introduction to Econometrics. OUP, $3^{rd}$ Edition, Indian Edition, 2007.

| Course code : MCS211<br>Core/ Elective : Elective<br>No. of Credits : 4 | Course title<br>**Introduction to Python Programming** |
|---|---|

**Course Objective**
To introduce the basic and advanced programming in Python

**Course Outcome:** On successful completion of this course, the students will be able to
- Demonstrate the programming skills in Python
- Apply the Python programming for data visualization, and analysis

**Unit I**
Introduction to Python: Basic Programming in Python: Python Basics, Flow Control, Functions, List, Dictionaries. Automating Tasks Using Python: Pattern Matching with Regular Expressions, Reading and Writing Files, Organizing Files, Debugging, error handling

**Unit II**
Strings & Lists: Concept - Escape Characters - String Special Operations - String Formatting Operator - Single Quotes - Double Quotes - Triple Quotes - Raw String - Unicode Strings - Built-in String Methods - List Type Built-in Methods - Special Features of Lists.

**Unit III**
Tuples, Dictionaries & Functions: Tuples - Tuple Operators and Built-in Functions - Special Features of Tuples - Dictionaries, Operators, Built-in Functions, Built-in Methods, Dictionary Keys - Functions - Calling Functions - Creating Functions - Formal Arguments - Positional Arguments - Default Arguments - Variable-Length Arguments.

**Unit IV**
The NumPy ndarray: a multidimensional array object, creating ndarrays, data types for ndarrays, arithmetic with numpy arrays, basic indexing and slicing, transposing arrays and swapping axes, universal functions: fast element-wise array functions, array-oriented programming with arrays, file input and output with arrays, pseudorandom number generation. introduction to pandas data structures, series, data frame, Web Scraping.

**Unit V**
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

**Suggested readings**
Lutz, M., "Learning Python: Powerful Object-Oriented Programming," O'Reilly Media, Inc. 5th Edition, 2013.
Jake vanderPlas (2017): Python Data Science Handbook – Essential Tools for Working with Data.O'Really Media
McKinney, W. *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython.*, O'Reilly Media, Inc., 2012.

| | |
|---|---|
| Course code : MCS211<br>Core/ Elective : Elective<br>No. of Credits : 4 | Course title<br>**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:** 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:** 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:** Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

**Unit-IV:** 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 StatisticalLearning*‖, Springer, 2009.
- Christopher Bishop, ―*Pattern Recognition and Machine Learning*‖, Springer, 2007.

| Course code : MCS213<br>Core/ Elective : Compulsory<br>No. of Credits : 4 | Course title<br>**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:** 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:** 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:** Statistical analysis of data for summarizing and understanding data, Visualizing data Using scatter plot, line plot, bar chart, histogram, and box plot.

**Unit IV:** 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

## SEMESTER – III

| Course code : MCS301<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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

- 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

- 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

- 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**

- 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<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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**

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

**Unit – II: Ethical Foundations**

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**

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

**Unit – IV: Algorithmic Bias**

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

**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**

- 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**

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

**Unit-III : Public Policy Process**

- 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**

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

**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**
**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**
**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**
**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:**
**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<br>Core/ Elective : Elective<br>No. of Credits : 4 | Course title<br>**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**

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**

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

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

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<br>Core/ Elective : Elective<br>No. of Credits : 4 | Course title<br>**Qualitative data analysis using software** |
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**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**

- Ethical issues in analysis: Informed consent, Privacy, confidentiality and anonymity, harm and risk;
- Data processing and preparation,
- 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 : An Introduction to codes and coding**

- First cycle coding methods:  Grammatical, Elemental, Affective coding methods; exploratory coding methods;
- Second cycle coding methods: Transition from first to second cycle coding methods,
- Grounded theory coding methods

**Unit – III : Writing Analytical Memos about Narrative and Visual Data**

- What is an analytic memo?
- Reflection and refraction,
- Coding and categorizing analytic memos, Designing network display,
- Analysing Visual data: documents, photographs, video-recorded action,

**Unit – IV: Qualitative data analysis using Software**

- 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<br>Core/ Elective : Compulsory<br>No. of Credits : 4 | Course title<br>**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**

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**

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

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

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<br>Core/ Elective : Core<br>No. of Credits : 4 | Course title<br>**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**

- 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**

- 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**

- 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**

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

**Unit – V: Introduction to Data Analysis using STATA**

- 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