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BA Sociology Honours | Semester V | Calicut University

Statistics for Sociology

Course Code: SOC5FS112(1) • Module 4

Module 4: Measures of Correlation, Regression, and Hypothesis Testing

Course: SOC5FS112(1) – Statistics for Sociology • **University of Calicut (CUFYUGP 2024)**

1. Curricular Orientation & Advanced Theoretical Foundations

Module 4 ("Measures of Correlation, Regression, and Hypothesis Testing") within *Statistics for Sociology* provides advanced fifth-semester undergraduate scholars with comprehensive theoretical literacy, analytical rigor, and specialized empirical insight. At this senior stage of the undergraduate honours curriculum under CUFYUGP 2024 regulations, sociology engages directly with complex macroscopic institutional formations, critical subaltern critiques, advanced quantitative-qualitative methodologies, and pressing contemporary policy dilemmas.

Sociological enquiry at the advanced level requires mastering the nuanced interplay between theoretical paradigms and lived empirical realities. By critically examining measures of correlation, regression, and hypothesis testing, students develop the capacity to dissect structural power relations, evaluate state policies, interrogate ideological representations, and appreciate the unique historical dynamics governing social change in India and Keralam.

Core Epistemological Focus of Module 4

Advanced Analytical Questions: What are the structural and institutional mechanisms through which measures of correlation, regression, and hypothesis testing operates in modern societies? How do classical and contemporary theoretical paradigms account for contradictions, social inequalities, and transformative struggles within this arena? What distinctive insights emerge when examining these phenomena through the socio-historical and developmental lens of India and Keralam?

Statistical Calculation Reference: Bivariate Association & Hypothesis Testing

Sociologists investigate relationships between social variables (such as education and income, or caste status and occupational mobility) using parametric and non-parametric correlation, regression modeling, and contingency chi-square tests.

Karl Pearson Correlation Coefficient

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

Where: r = Pearson product-moment correlation coefficient ($-1 \le r \le +1$), X and Y = Paired quantitative social variables, and N = Total number of paired observations.

Spearman Rank Correlation

$$\rho = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

Where: ρ = Spearman rank correlation coefficient, d = Difference between paired ordinal ranks (R_x - R_y), and n = Number of paired subjects.

Linear Regression Equation

$$Y = a + bX \quad \text{where} \quad b = \frac{N \sum XY - (\sum X)(\sum Y)}{N \sum X^2 - (\sum X)^2}$$

Where: Y = Dependent social variable, X = Independent explanatory variable, a = Y-intercept, and b = Regression slope coefficient.

Chi-Square Test Statistic

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where: χ^2 = Chi-square test statistic, O = Observed empirical cell frequency, and E = Expected theoretical frequency under the null hypothesis of independence. Degrees of freedom: *df = (r - 1)(c - 1)*.

2. Comprehensive Analysis of Concept of Bivariate Association: Linear vs. Non-Linear, Positive vs. Negative Correlation

The scholarly investigation of **Concept of Bivariate Association: Linear vs. Non-Linear, Positive vs. Negative Correlation** represents a core analytical domain within this course. In advanced sociological scholarship, this theme embodies foundational conceptual debates, institutional structures, and empirical challenges that shape contemporary social reality. Scholars have examined this topic from competing theoretical traditions, ranging from classical structural formulations to critical neo-Marxist, feminist, subaltern, and post-modern paradigms.

Analyzing concept of bivariate association: linear vs. non-linear, positive vs. negative correlation requires unbundling its complex internal components and historical trajectories. Sociologists demonstrate that institutional practices, social identities, and normative systems are never natural givens; they are socially produced, politically negotiated, and contested over time. The analyst must rigorously evaluate the reciprocal interactions between structural constraints and individual or group agency.

2.1. Theoretical Traditions and Scholarly Frameworks

The intellectual literature concerning concept of bivariate association: linear vs. non-linear, positive vs. negative correlation features diverse theoretical arguments. Positivist and functionalist approaches analyze how social patterns contribute to systemic equilibrium, institutional continuity, and normative integration. In stark contrast, conflict, critical, and subaltern approaches demonstrate how institutional arrangements embody structural inequalities, class exploitation, caste hegemony, and patriarchal dominance.

Contemporary sociological theory moves beyond static structuralism by embracing dynamic models of practice, discourse, and performativity. Scholars utilize structuration theory, field-habitus models, and intersectional matrices to examine how individuals navigate institutional rules, mobilize cultural resources, and contest entrenched asymmetries in everyday life.

Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Concept of Bivariate Ass
Structural Functionalism	Systemic equilibrium, institutional roles, social integration	Institutions exist to fulfill vital functional needs of the social organism	Examines the functional contributions of concept of bivariate association: linear vs. non-linear, positive vs. negative correlation to social order.
Conflict & Critical Perspective	Power monopolies, class hegemony, resource exploitation	Social patterns reflect material interests and dominance of ruling groups	Unmasks how concept of bivariate association: linear vs. non-linear, positive vs. negative correlation reproduces structural oppression and privilege.
Interpretative & Post-Modern	Discursive formations, symbolic meaning, performativity	Reality is socially constructed through language, symbols, and gaze	Analyzes how actors construct, negotiate, and perform concept of bivariate association: linear vs. non-linear, positive vs. negative correlation.
Subaltern & Post-Colonial	Subaltern standpoints, anti-caste critique, decolonization	Eurocentric models obscure subaltern lived realities and colonial violence	Reinterprets concept of bivariate association: linear vs. non-linear, positive vs. negative correlation from the perspectives of Dalits, Adivasis, and women.

2.2. Institutional Operations and Empirical Manifestations

In lived empirical reality, concept of bivariate association: linear vs. non-linear, positive vs. negative correlation functions across diverse institutional spheres—including family arrangements, state bureaucracies, corporate markets, community associations, and digital communication networks. These institutional sites reveal how abstract cultural ideologies and macroeconomic imperatives are translated into concrete social expectations and differential access to resources.

Within the Indian socio-cultural matrix, traditional structures frequently articulate with modern bureaucratic, market, and technological forces. Rather than experiencing simple unilinear modernization, Indian society exhibits complex configurations where traditional caste hierarchies, kinship networks, and religious identities fuse with modern democratic politics, neoliberal capitalism, and consumer culture.

Sociological Insight: Empirical Dimensions in India & Keralam

Within the empirical setting of Keralam and greater India, **Concept of Bivariate Association: Linear vs. Non-Linear, Positive vs. Negative Correlation** manifests unique dynamics. The state's celebrated history of subaltern social reform (Kerala Navodhanam), radical land reforms dismantling the feudal Janmi system, universal public education, expansive welfare safety nets, and heavy reliance on transnational migration and Gulf remittances provides a distinctive sociological laboratory for observing social change, institutional democratization, and second-generation development challenges.

2.3. Critical Methodological and Epistemological Issues

Investigating concept of bivariate association: linear vs. non-linear, positive vs. negative correlation requires methodological reflexivity. Sociologists must examine the epistemological assumptions underlying quantitative indicators, survey enumeration, and qualitative ethnographic observations.

Furthermore, an intersectional analytical framework is indispensable. The intersecting vectors of caste identity, socioeconomic class, gender roles, regional location, and generational status must be simultaneously evaluated to comprehend the diverse lived realities of social actors in contemporary society.

3. Comprehensive Analysis of Karl Pearson's Product-Moment Correlation Coefficient (r): Formula, Assumptions, Calculation, and Sociological Interpretation

The scholarly investigation of **Karl Pearson's Product-Moment Correlation Coefficient (r): Formula, Assumptions, Calculation, and Sociological Interpretation** represents a core analytical domain within this course. In advanced sociological scholarship, this theme embodies foundational conceptual debates, institutional structures, and empirical challenges that shape contemporary social reality. Scholars have examined this topic from competing theoretical traditions, ranging from classical structural formulations to critical neo-Marxist, feminist, subaltern, and post-modern paradigms.

Analyzing karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation requires unbundling its complex internal components and historical trajectories. Sociologists demonstrate that institutional practices, social identities, and normative systems are never natural givens; they are socially produced, politically negotiated, and contested over time. The analyst must rigorously evaluate the reciprocal interactions between structural constraints and individual or group agency.

3.1. Theoretical Traditions and Scholarly Frameworks

The intellectual literature concerning karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation features diverse theoretical arguments. Positivist and functionalist approaches analyze how social patterns contribute to systemic equilibrium, institutional continuity, and normative integration. In stark contrast, conflict, critical, and subaltern approaches demonstrate how institutional arrangements embody structural inequalities, class exploitation, caste hegemony, and patriarchal dominance.

Contemporary sociological theory moves beyond static structuralism by embracing dynamic models of practice, discourse, and performativity. Scholars utilize structuration theory, field-habitus models, and intersectional matrices to examine how individuals navigate institutional rules, mobilize cultural resources, and contest entrenched asymmetries in everyday life.

Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Karl Pearson's Product-M
Structural Functionalism	Systemic equilibrium, institutional roles, social integration	Institutions exist to fulfill vital functional needs of the social organism	Examines the functional contributions of karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation to social order.
Conflict & Critical Perspective	Power monopolies, class hegemony, resource exploitation	Social patterns reflect material interests and dominance of ruling groups	Unmasks how karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation reproduces structural oppression and privilege.
Interpretative & Post-Modern	Discursive formations, symbolic meaning, performativity	Reality is socially constructed through language, symbols, and gaze	Analyzes how actors construct, negotiate, and perform karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation.
Subaltern & Post-Colonial	Subaltern standpoints, anti-caste critique, decolonization	Eurocentric models obscure subaltern lived realities and colonial violence	Reinterprets karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation from the perspectives of Dalits, Adivasis, and women.

3.2. Institutional Operations and Empirical Manifestations

In lived empirical reality, karl pearson's product-moment correlation coefficient (r): formula, assumptions, calculation, and sociological interpretation functions across diverse institutional spheres—including family arrangements, state bureaucracies, corporate markets, community associations, and digital communication networks. These institutional sites reveal how abstract cultural ideologies and macroeconomic imperatives are translated into concrete social expectations and differential access to resources.

Within the Indian socio-cultural matrix, traditional structures frequently articulate with modern bureaucratic, market, and technological forces. Rather than experiencing simple unilinear modernization, Indian society exhibits complex configurations where traditional caste hierarchies, kinship networks, and religious identities fuse with modern democratic politics, neoliberal capitalism, and consumer culture.

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4. Comprehensive Analysis of Spearman's Rank Correlation Coefficient (rho): Formula for Tied and Non-Tied Ranks

The scholarly investigation of **Spearman's Rank Correlation Coefficient (rho): Formula for Tied and Non-Tied Ranks** represents a core analytical domain within this course. In advanced sociological scholarship, this theme embodies foundational conceptual debates, institutional structures, and empirical challenges that shape contemporary social reality. Scholars have examined this topic from competing theoretical traditions, ranging from classical structural formulations to critical neo-Marxist, feminist, subaltern, and post-modern paradigms.

Analyzing spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks requires unbundling its complex internal components and historical trajectories. Sociologists demonstrate that institutional practices, social identities, and normative systems are never natural givens; they are socially produced, politically negotiated, and contested over time. The analyst must rigorously evaluate the reciprocal interactions between structural constraints and individual or group agency.

4.1. Theoretical Traditions and Scholarly Frameworks

The intellectual literature concerning spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks features diverse theoretical arguments. Positivist and functionalist approaches analyze how social patterns contribute to systemic equilibrium, institutional continuity, and normative integration. In stark contrast, conflict, critical, and subaltern approaches demonstrate how institutional arrangements embody structural inequalities, class exploitation, caste hegemony, and patriarchal dominance.

Contemporary sociological theory moves beyond static structuralism by embracing dynamic models of practice, discourse, and performativity. Scholars utilize structuration theory, field-habitus models, and intersectional matrices to examine how individuals navigate institutional rules, mobilize cultural resources, and contest entrenched asymmetries in everyday life.

Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Spearman's Rank Correlat
Structural Functionalism	Systemic equilibrium, institutional roles, social integration	Institutions exist to fulfill vital functional needs of the social organism	Examines the functional contributions of spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks to social order.

Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Spearman's Rank Correlat
Conflict & Critical Perspective	Power monopolies, class hegemony, resource exploitation	Social patterns reflect material interests and dominance of ruling groups	Unmasks how spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks reproduces structural oppression and privilege.
Interpretative & Post-Modern	Discursive formations, symbolic meaning, performativity	Reality is socially constructed through language, symbols, and gaze	Analyzes how actors construct, negotiate, and perform spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks.
Subaltern & Post-Colonial	Subaltern standpoints, anti-caste critique, decolonization	Eurocentric models obscure subaltern lived realities and colonial violence	Reinterprets spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks from the perspectives of Dalits, Adivasis, and women.

4.2. Institutional Operations and Empirical Manifestations

In lived empirical reality, spearman's rank correlation coefficient (rho): formula for tied and non-tied ranks functions across diverse institutional spheres—including family arrangements, state bureaucracies, corporate markets, community associations, and digital communication networks. These institutional sites reveal how abstract cultural ideologies and macroeconomic imperatives are translated into concrete social expectations and differential access to resources.

Within the Indian socio-cultural matrix, traditional structures frequently articulate with modern bureaucratic, market, and technological forces. Rather than experiencing simple unilinear modernization, Indian society exhibits complex configurations where traditional caste hierarchies, kinship networks, and religious identities fuse with modern democratic politics, neoliberal capitalism, and consumer culture.

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Furthermore, an intersectional analytical framework is indispensable. The intersecting vectors of caste identity, socioeconomic class, gender roles, regional location, and generational status must be simultaneously evaluated to comprehend the diverse lived realities of social actors in contemporary society.

5. Comprehensive Analysis of Linear Regression Analysis: Principle of Ordinary Least Squares (OLS), Regression Equations of Y on X and X on Y

The scholarly investigation of **Linear Regression Analysis: Principle of Ordinary Least Squares (OLS), Regression Equations of Y on X and X on Y** represents a core analytical domain within this course. In advanced sociological scholarship, this theme embodies foundational conceptual debates, institutional structures, and empirical challenges that shape contemporary social reality. Scholars have examined this topic from competing theoretical traditions, ranging from classical structural formulations to critical neo-Marxist, feminist, subaltern, and post-modern paradigms.

Analyzing linear regression analysis: principle of ordinary least squares (ols), regression equations of y on x and x on y requires unbundling its complex internal components and historical trajectories. Sociologists demonstrate that institutional practices, social identities, and normative systems are never natural givens; they are socially produced, politically negotiated, and contested over time. The analyst must rigorously evaluate the reciprocal interactions between structural constraints and individual or group agency.

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Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Linear Regression Analys
Structural Functionalism	Systemic equilibrium, institutional roles, social integration	Institutions exist to fulfill vital functional needs of the social organism	Examines the functional contributions of linear regression analysis: principle of ordinary least squares (ols), regression equations of y on x and x on y to social order.
Conflict & Critical Perspective	Power monopolies, class hegemony, resource exploitation	Social patterns reflect material interests and dominance of ruling groups	Unmasks how linear regression analysis: principle of ordinary least squares (ols), regression equations of y on x and x on y reproduces structural oppression and privilege.
Interpretative & Post-Modern	Discursive formations, symbolic meaning, performativity	Reality is socially constructed through language, symbols, and gaze	Analyzes how actors construct, negotiate, and perform linear regression analysis: principle of ordinary least squares (ols), regression equations of y on x and x on y.

Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Linear Regression Analys
Subaltern & Post-Colonial	Subaltern standpoints, anti-caste critique, decolonization	Eurocentric models obscure subaltern lived realities and colonial violence	Reinterprets linear regression analysis: principle of ordinary least squares (ols), regression equations of y on x and x on y from the perspectives of Dalits, Adivasis, and women.

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6. Comprehensive Analysis of Chi-Square Test of Independence (chi^2): Test Statistic, Contingency Tables, Degrees of Freedom, and Null Hypothesis Significance Testing

The scholarly investigation of **Chi-Square Test of Independence (chi^2): Test Statistic, Contingency Tables, Degrees of Freedom, and Null Hypothesis Significance Testing** represents a core analytical domain within this course. In advanced sociological scholarship, this theme embodies

foundational conceptual debates, institutional structures, and empirical challenges that shape contemporary social reality. Scholars have examined this topic from competing theoretical traditions, ranging from classical structural formulations to critical neo-Marxist, feminist, subaltern, and post-modern paradigms.

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Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Chi-Square Test of Indep
Structural Functionalism	Systemic equilibrium, institutional roles, social integration	Institutions exist to fulfill vital functional needs of the social organism	Examines the functional contributions of chi-square test of independence (chi^2): test statistic, contingency tables, degrees of freedom, and null hypothesis significance testing to social order.
Conflict & Critical Perspective	Power monopolies, class hegemony, resource exploitation	Social patterns reflect material interests and dominance of ruling groups	Unmasks how chi-square test of independence (chi^2): test statistic, contingency tables, degrees of freedom, and null hypothesis significance testing reproduces structural oppression and privilege.
Interpretative & Post-Modern	Discursive formations, symbolic meaning, performativity	Reality is socially constructed through language, symbols, and gaze	Analyzes how actors construct, negotiate, and perform chi-square test of independence (chi^2): test statistic, contingency tables, degrees of freedom, and null hypothesis significance testing.
Subaltern & Post-Colonial	Subaltern standpoints, anti-caste critique, decolonization	Eurocentric models obscure subaltern lived realities and colonial violence	Reinterprets chi-square test of independence (chi^2): test statistic, contingency tables, degrees of freedom, and null hypothesis significance testing

Theoretical Paradigm	Primary Analytical Focus	Epistemological Assumptions	Application to Chi-Square Test of Indep
			from the perspectives of Dalits, Adivasis, and women.

6.2. Institutional Operations and Empirical Manifestations

In lived empirical reality, chi-square test of independence (chi^2): test statistic, contingency tables, degrees of freedom, and null hypothesis significance testing functions across diverse institutional spheres—including family arrangements, state bureaucracies, corporate markets, community associations, and digital communication networks. These institutional sites reveal how abstract cultural ideologies and macroeconomic imperatives are translated into concrete social expectations and differential access to resources.

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7. Comparative Analytical Matrix & Applied Case Analysis

To achieve comprehensive academic synthesis of Module 4, the multidimensional elements of this subject matter are systematically contrasted across distinct socio-historical paradigms in the comparative matrix below:

Comparative Parameter	Traditional / Pre-Modern Context	Modern Industrial & Colonial Period	Contemporary Globalized & Digital Era
Organizing Principle	Ascriptive status, ritual hierarchy, localized agrarian subsistence	Rational-legal bureaucracy, capital accumulation, urbanization	Networked information flows, flexible labor, global consumerism
Power & Hegemony	Feudal landlords, religious orthodoxy, traditional monarchies	Colonial administrative apparatus, modern state institutions, industrial elites	Transnational corporations, technocratic governance, algorithmic platforms
Subjectivity & Agency	Collective corporate identity rooted in lineage, caste, or village	Civic citizen identity, trade union solidarity, anti-colonial nationalism	Individualized, fluid, and reflexive identities shaped by media and consumption
Modes of Resistance	Peasant revolts, religious millenarianism, everyday non-compliance	Socio-religious reform movements, organized labor strikes, electoral politics	Decentralized digital networks, identity-based movements, environmental activism

Applied Sociological Case Study: Socio-Historical Transformations in Keralam

Empirical Context: Kerala's historical trajectory offers a celebrated case study for examining institutional transformation. From a rigid 19th-century caste feudal structure characterized by severe untouchability and unapproachability, the region transformed into one of the most egalitarian and politically conscious states in South Asia.

Analytical Evaluation: Applying the concepts of Module 4, students analyze how the confluence of subaltern reform mobilizations (Sree Narayana Guru, Ayyankali), missionary and state education, radical political unionism, the 1969 Land Reforms Act, and mass migration to the Persian Gulf fundamentally restructured traditional social hierarchies. However, contemporary sociologists also examine emerging contradictions: persistent gender asymmetries in the formal workforce, high elderly dependency ratios, youth out-migration, and ecological vulnerabilities.

8. Applied Policy Dimensions & Social Interventions

Sociological analysis provides vital diagnostics for informing progressive social policy, grassroots development programs, and community welfare initiatives. The theoretical principles analyzed in this module yield actionable insights across multiple applied arenas:

- **Evidence-Based Social Policy:** Formulating governmental welfare interventions that address the structural root causes of poverty, marginalization, and educational disparity rather than treating superficial symptoms.
- **Community-Driven Development:** Implementing participatory rural appraisal (PRA), social mapping, and stakeholder consultation to ensure grassroots decentralization and authentic democratic empowerment (as exemplified by Kerala's People's Plan Campaign).
- **Human Rights & Social Justice Advocacy:** Utilizing empirical sociological data to expose systemic discrimination, gender-based violence, caste atrocities, and environmental injustice before judicial bodies, legislative committees, and international human rights forums.
- **Organizational Development & Conflict Resolution:** Enhancing diversity management, ethical communication, and collaborative team functioning in public institutions, non-profit organizations, and social enterprises.

9. Pedagogical Synthesis & Examination Preparation

In concluding Module 4 ("Measures of Correlation, Regression, and Hypothesis Testing"), students should consolidate their command of the central theoretical paradigms, comparative taxonomies, and empirical debates examined. Mastering sociology requires developing the capacity to critically interrogate social structures, challenge commonsense assumptions, and evaluate institutional dynamics with analytical rigor.

Key Concept / Theorist	Foundational Sociological Definition	Analytical & Curricular Significance
Structural Inequality	Systematically unequal distribution of resources, power, and opportunities built into social institutions.	Demonstrates that disparities are structured outcomes of institutional arrangements rather than individual deficiencies.
Social Hegemony (Antonio Gramsci)	Dominance maintained through cultural leadership and moral consensus rather than physical force.	Explains how ruling groups win the spontaneous consent of subordinate classes through ideological institutions.
Cultural Capital (Pierre Bourdieu)	Accumulated cultural knowledge, linguistic skills, credentials, and dispositions conferring social power.	Illuminates how educational institutions reproduce class hierarchies under the guise of meritocracy.
Epistemological Reflexivity	The systematic practice of scrutinizing the researcher's own positionality, assumptions, and power relations.	Guarantees methodological integrity and ethical rigor in qualitative and quantitative social research.

Self-Assessment & Critical Examination Questions

1. Critically evaluate the theoretical debates and foundational concepts articulated in measures of correlation, regression, and hypothesis testing, contrasting functionalist and conflict approaches.
2. Examine how historical transformations, state interventions, and social movements in India and Keralam have reshaped institutional structures and power dynamics.
3. Discuss the methodological challenges and ethical responsibilities involved in empirical sociological inquiry into contemporary social problems.
4. Analyze the practical relevance of sociological insights in designing inclusive development policies and empowering marginalized communities.