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BA Economics Honours | Semester V | Calicut University

Big Data Analysis in Economics

Course Code: ECO5FS112 • Module 4

Module IV: Machine Learning Methods

Modern applied econometrics synthesizes classical causal inference with predictive machine learning algorithms, expanding the analytical toolkit for high-dimensional economic data.

Unit 13, 14, 15 & 16: Supervised Learning: Regression, Classification, and Trees

- **Linear and Logistic Regression in Machine Learning:** Regularized regression models designed for high-dimensional datasets ($p > n$):
  - *Ridge Regression (L_2 Penalty):* Shrinks coefficients toward zero to handle severe multicollinearity.
  - *Lasso Regression (L_1 Penalty):* Performs automatic feature selection by driving non-essential coefficients exactly to zero.
  - *Logistic Regression:* Classifies binary outcomes (e.g., loan default prediction, poverty status classification).
- **Time Series Forecasting:** ARIMA models, Vector Autoregressions (VAR), Generalized Autoregressive Conditional Heteroskedasticity (GARCH), and Recurrent Neural Networks (LSTM) for macroeconomic forecasting.
- **Tree-Based Algorithms:**
  - *Classification and Regression Trees (CART):* Non-parametric recursive binary partitioning of feature space.
  - *Random Forests:* Ensemble learning technique combining hundreds of de-correlated decision trees via *bagging* (bootstrap aggregation), significantly reducing variance and preventing overfitting.

Unit 17, 18 & 19: Deep Learning, Text Mining, and Analytics with R

- **Neural Networks and Deep Learning:** Multi-layer perceptrons, Convolutional Neural Networks (CNN) for satellite imagery analysis (estimating agricultural yields and local infrastructure density), and deep sequence models.
- **Natural Language Processing (NLP) in Economics:**
  - *Sentiment Analysis:* Extracting economic sentiment from central bank speeches (e.g., RBI monetary policy statements) and financial news headlines.
  - *Latent Dirichlet Allocation (LDA):* Unsupervised probabilistic topic modeling to classify parliamentary debates, policy documents, and corporate annual reports.
  - *Economic Policy Uncertainty (EPU) Index:* Quantifying newspaper text frequency matching economic policy uncertainty keywords (Baker, Bloom, and Davis).
- **Big Data Analytics with R:** Utilizing key packages: `tidyverse`, `data.table`, `caret`, `randomForest`, `glmnet`, `tidytext`, and `rvest` for high-performance economic computing.

Advanced Theoretical Formulations and Empirical Frameworks (Analytical Division 1)

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historical evaluations to rigorously assess the validity of core assumptions and their real-world outcomes across developing and advanced economies.

Empirical Methodology, Identification Strategies, and Econometric Estimation

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Consider the structural estimation of policy impacts across decentralized economic agents. When evaluating macroeconomic interventions or microeconomic regulatory changes, parameters estimated from observational datasets must account for expectations formation and structural parameter stability in accordance with the Lucas Critique. Consequently, contemporary applied economics bridges micro-foundations with aggregate macroeconomic phenomena through dynamic stochastic general equilibrium (DSGE) modeling and micro-econometric panel estimations.

Comparative Institutional Analysis, Market Failures, and Policy Governance

Economic outcomes are fundamentally mediated by institutional architectures, legal property rights regimes, and regulatory governance. In emerging market economies such as India, market imperfections—including asymmetric information, transaction costs, infrastructural bottlenecks, and credit constraints—often necessitate nuanced policy interventions that differ substantially from textbook laissez-faire predictions.

Analytical Dimension	Orthodox / Classical Perspective	Heterodox / Institutional Framework	Empirical Policy Manifestations in India
Market Efficiency	Markets clear instantaneously; price mechanism allocates resources optimally without systemic friction.	Markets are prone to structural failures, information asymmetry, and coordination coordination failures.	Targeted regulatory oversight, public investment in infrastructure, and social safety nets.
Behavioral Motivation	Hyper-rational agents maximizing expected utility with complete cognitive computational capacity.	Bounded rationality, behavioral heuristics, loss aversion, and institutional anchoring effects.	Choice architecture, behavioral nudges (NITI Aayog initiatives), and consumer financial protection mandates.
State Intervention	State role restricted to core public goods, contract enforcement, and national defense (minimalist state).	State acts as developmental catalyst, risk-absorber of last resort, and promoter of equitable distribution.	Strategic industrial policy (PLI schemes), counter-cyclical fiscal intervention, and universal public services.
Distributional Equity	Factor rewards reflect marginal productivity; distribution is secondary to allocative efficiency.	Power asymmetries, bargaining power, and historical wealth accumulation shape distribution.	Progressive fiscal transfers, land reforms, and affirmative human capital investments.
Technological Progress	Exogenous technological shocks arriving randomly	Endogenous technological innovation driven by R&D, human capital, and	National Innovation Foundation, Startup India, and public digital

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	(Solow neoclassical growth model).	intellectual property institutions.	infrastructure (India Stack / UPI).

Comprehensive Empirical Analysis: The Kerala Model and Sub-National Development

In the context of the Indian economy and sub-national development paradigms, the Kerala Model of Development provides a seminal empirical case study illustrating the complex trade-offs between social development and economic growth. Characterized by high physical quality of life indicators—including near-universal adult literacy, high life expectancy, and low infant mortality rates comparable to advanced Western economies—achieved despite historically modest per capita state domestic product, Kerala demonstrates the transformative power of public social expenditure, agrarian land reforms, and decentralized local governance (Panchayati Raj institutions).

However, contemporary economic analysis also highlights structural challenges confronting this development paradigm: high educated unemployment, fiscal constraints stemming from escalating public debt servicing and pension obligations, and heavy reliance on external remittance inflows from migrant workers in the Persian Gulf. Sustaining this high-welfare equilibrium necessitates transitioning toward a knowledge-driven economy, incentivizing high-tech manufacturing, and mobilizing sustainable sub-national fiscal resources.

Policy Synthesis and Analytical Evaluation

Policy formulation in dynamic economic environments must therefore synthesize foundational deductive reasoning with robust inductive empirical inquiry. Economists must continuously evaluate the balance between market incentives and regulatory governance, ensuring that institutional frameworks promote both productive efficiency and distributive social justice.

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Technological Progress	Exogenous technological shocks arriving randomly (Solow neoclassical growth model).	Endogenous technological innovation driven by R&D, human capital, and intellectual property institutions.	National Innovation Foundation, Startup India, and public digital infrastructure (India Stack / UPI).

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