Introduction to Econometrics

2nd Edition

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Introduction to Econometrics

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Preface

The first edition of the book was published in 2023 for undergraduate students studying Economics Honours. The book follows the updated syllabus outlined in the National Education Policy (NEP) 2020. The objective of writing the book is to introduce students to the fundamental theory of Econometrics, including linear regression, estimation, and data problems. The prerequisites for the course are statistics, calculus, and basic mathematical procedures.

In the second edition, new examples and exercise problems have been added to each chapter. Illustrative examples drawn from past question papers of competitive examinations have been included, enhancing the book's usefulness for students preparing for entrance tests and civil service candidates.

The straightforward approach and inclusion of an extensive range of illustrative examples make the new edition more useful. *Basic Econometrics* by Damodar N. Gujarati, *Introduction to Econometrics* by G.S. Maddala, and *Econometric Analysis* by William H. Greene have been consulted to write this book.

The objective of the second edition is to discuss econometric tools and techniques used in data analysis that the Economics Honours undergraduate students in the Economics discipline require to advance in their careers. Companies across different industries need a large pool of experts in the field of econometrics and data analysis to build products and to solve business problems. Besides its wide range of applications in academic research, knowledge of econometrics increases job opportunities to a great extent.

Chapter 1 addresses the fundamental concepts of econometrics and its applications across various fields.

Chapter 2 outlines the techniques for estimating simple linear regression analysis and three-variable multiple linear regression models.

Chapter 3 examines the properties of regression estimators and dummy variable regression.

Chapter 4 focuses on hypothesis testing in regression analysis and Analysis of Variance. In the second edition, there is a new discussion of the F-test for the restricted linear least squares regression model.

Chapter 5 details the three data problems—multicollinearity, heteroscedasticity, and autocorrelation—and suggests solutions for each of these data problems.

Chapter 6 tackles the issues of model specification, discussing the challenges associated with mis-specifications of regression models and the statistical tests used to identify incorrect model specifications. In this edition, discussions of the Breusch-Godfrey test of autocorrelation and the Park test of heteroscedasticity are included.

Appendix A1 applies the cross-sectional data analysis using STATA and RStudio Econometric packages. It contains the commands in STATA and RStudio with examples.

Appendix A2 is an addition to the existing book in the current edition. The time series analysis and panel data analysis are discussed in this section, with the STATA commands for time series and panel data analysis.

I express my gratitude to my parents, teachers, friends, and colleagues who have encouraged me to write this book.

Dr. Jhumur Sengupta

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Syllabus

UNIVERSITY OF DELHI

Delhi School of Economics

Department of Economics

Semester IV - 2025

I Linear Regression Model
- (*i*) *OLS* method of Estimation and Properties of Estimators
- (*ii*) Measures of Fit
- (*iii*) Testing of Hypotheses, Prediction
- (*iv*) Introduction to econometric software and practical application using econometric software (*GRETL*/EViews/ R/STATA/EXCEL, *etc*.)

II Multiple Regression Model
- (*i*) *OLS* method of Estimation and Properties of *OLS* Estimators
- (*ii*) Testing of Hypotheses
- (*iii*) Measures of Fit
- (*iv*) Practical Application using Econometric Software (*GRETL* / EViews / *R* / STATA / EXCEL, *etc*.)

III Functional Forms and Qualitative Independent Variables
- (*i*) Non-linear Models and Transformations of Variables
- (*ii*) Dummy Variables
- (*iii*) Practical Application using Econometric Software (*GRETL*/EViews/ *R* / STATA / EXCEL, *etc*.)

IV Violations of Classical Assumptions
- (*i*) Consequences, Detection, and Remedies: Multicollinearity, Heteroscedasticity, Serial Correlation
- (*ii*) Practical Application Using Econometric Software (*GRETL* / EViews / *R* / STATA / EXCEL, *etc*.)

V Specification Bias
- (*i*) Model Selection Criteria
- (*ii*) Types of Specification Errors, Omitted Variable Bias
- (*iii*) Inclusion of Irrelevant Variables
- (*iv*) Incorrect Functional Form, Errors of Measurement
- (*v*) Practical Application Using Econometric Software (*GRETL* / EViews / *R* / STATA / EXCEL, *etc*.)

UNIVERSITY OF CALCUTTA

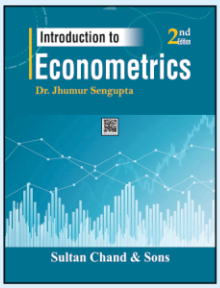
B.A. / B.Sc Economics (Honours)

Semester V

1. Nature and Scope of Econometrics
   - (*i*) Distinction between Economic Model and Econometric model
   - (*ii*) Concept of stochastic relation, Role of random disturbance in econometric model
   - (*iii*) Application of Econometrics in different branches of social science
2. Classical Linear Regression Model

   Simple linear regression model (*SLRM*) and multiple linear regression (*MLRM*) with two regressors
   - (*i*) The classical assumptions (basic interpretation); Concepts of population regression function and sample regression function, *SLRM* and *MLRM*.
   - (*ii*) Estimation of *SLRM* and *MLRM* (with two regressors only) by method of ordinary least squares.
   - (*iii*) Properties of the Least Squares Estimators in *SLRM*- Gauss-Markov theorem.
   - (*iv*) Testing of hypotheses in *SLRM* and *MLRM* – Single Test and Joint Test
   - (*v*) Goodness of fit (in terms of R^2, adjusted R^2 and F-statistic), Analysis of Variance (*ANOVA*).
   - (*vi*) Economic Interpretation of Regression results – Statistical signifcance and economic im-portance.
   - (*vii*) Simple correlation, partial correlation and multiple correlation (Degnition, and interpre-tation in the context of *SLRM* and *MLRM*).
3. Qualitative (Dummy) Independent Variables
   - (*i*) Intercept dummy and Slope dummy (only interpretation of the model).
   - (*ii*) Forecasting – Ex-post forecast and Ex-ante forecast, forecast error (only for two variable model).
4. Violations of Classical Assumptions
   - (*i*) Multicollinearity – Consequences, Detection (Variance Inflationary Factor) and Remedies.
   - (*ii*) Heteroscedasticity – Consequences, Detection (Lagrange Multiplier test) and Remedies.
   - (*iii*) Autocorrelation - Consequences, Detection (Durbin-Watson test) and Remedies.

About the Book



The first edition of Introduction to Econometrics was published in 2023. In the second edition, more problems have been added to the examples and exercises in each chapter. A new appendix explaining how to use STATA software for time series and panel data analysis has been included. The clear and straightforward approach to calculations and derivations addressing the fundamental theories and applications of Econometrics remains unchanged, making it ideal for beginners. The second edition continues to avoid the use of matrix algebra or calculus, as these methods can sometimes make the theory and empirical applications more complex for beginners.

Salient Features

- In the second edition, the coverage of topics, including regression models (simple and multiple), parameter estimation techniques, properties of estimators, hypothesis testing, and model specification remains the same as before.
- Additional examples with more illustrations and exercise problems.
- In the chapters, examples, and exercise problems are taken from competitive examinations such as the Indian Statistical Service (ISS), UPSC, GATE, and UGC NET Examination.
- The addition of the second Appendix containing time series and panel data analysis using STATA.
- More detailed discussion of the applications of the computer packages STATA and RStudio is provided in the two appendices.

About the Author

Dr. Jhumur Sengupta is affiliated with Dinabandhu Andrews College in Calcutta, India, as an Assistant Professor of Economics. She has over twenty years of teaching experience in Econometrics and Quantitative Economics. Her previous roles include Assistant Professor at the International School of Business in Calcutta, Jaypee Business School in Noida, South City College in Calcutta, and Kirorimal College under Delhi University. She obtained her M.A. and M.Phil. degrees in Economics from Jawaharlal Nehru University in New Delhi and completed her Ph.D. at the University of Calcutta. Her research interests include mathematical economics, Econometrics, Empirical Economics, and Political Economy. She has published numerous research papers based on empirical studies in various peer-reviewed journals with national and international recognition. She is passionate about conducting research in Empirical and Quantitative Economics.

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