

Elements of Econometrics

Lecturer: Oleg O. Zamkov

Class teachers: Oleg O. Zamkov, Vladimir I. Tcherniak

Course description

The Elements of Econometrics is a two semesters course for the 3-rd year ICEF students. This is an introductory Econometrics course for the students specialized in Economics. Statistics course is a pre-requisite, as well as Economics, Mathematics and Computers courses. The course is taught in English and finally examined by the University of London external programme.

The stress in the course is done on the essence of statements, methods and approaches of econometric analysis. The conclusions and proofs of basic formulas and models are given which allows to the students to understand the principles of econometric theory development. The main accent is done on economic interpretations and applications of considered econometric models. The course is mostly oriented at cross-sections econometrics; some topics of time series and panel data econometrics are also taught in the course.

Teaching objectives

The students should get the basic knowledge and skills of econometric analysis. They should be able to apply it to the investigation of economic relationships and processes, and also understand the econometric methods, approaches, ideas, results and conclusions met in the majority of economic books and articles. In the course the students should study traditional econometric methods developed mostly for the work with cross-sections data. At the same time the students should understand essential differences between the time series and cross sections data and those specific econometric problems met in the work with these types of data, as well as with panel data. The students should get the skills of construction and development of simple and multiple regression models, get acquainted with some non-linear models and special methods of econometric analysis and estimation, understanding the area of their application in economics. The considered methods and models should be mastered practically on real economic data bases with modern econometric software.

Teaching methods

The following methods and forms of study are used in the course:

- lectures

- classes (half of the classes is devoted to theoretical and applied analysis, and another half is conducted in the computer room and is devoted to practical applications of the econometric methods studied in the course)
- home assignments for each topic consisting of theoretical and applied parts
- teachers' consultations
- self-study, which can be conducted with the course materials and in a computer room, making home assignments using Excel and Econometric Views, work with economic data bases, with ICEF, UoL, LSE and other course materials through the Internet and ICEF information system.

Grade determination

The students sit two mid-term written exams in November and in April, first semester written exam in January, and University of London external exam in May. November and January exams include multiple choice and free response parts. April and May exams are free response (open questions) exams. The first semester grade is determined as follows: January exam grade gives 50% of the grade, November exam — 30%, and 20% is given for home assignments. In the final course grade the University of London exam grade gives 40%, the first semester grade gives 30%, and 30% is given for the second semester (20% — for April exam and 10% for home assignments).

Main reading

The Third edition of textbook “Introduction to Econometrics” by Christopher Dougherty is the main textbook for the course. Its Russian translation can be also used. The University of London Study Guide, Examination papers and Examiners' Report are also widely used in the course. Another (supplementary) recommended textbook is “Basic Econometrics” by D.N.Gujarati containing some extra course information, derivations, tests, proofs and applications. The book by O. Zamkov and ICEF teaching materials (7–8) are also used in the course. The books by Greene, Verbeek and Kennedy are recommended as supplementary reading: the first contains deeper presentation of course materials, the others — useful explanations and comments.

1. Dougherty, Christopher. Introduction to Econometrics. Oxford University Press, 2006 (3rd edition) (CD). Перевод на русский язык: Доугерти К. Введение в эконометрику. Изд.3. М., ИНФРА-М, 2009.
2. Dougherty, Christopher. Elements of econometrics. Study Guide. University of London, 2009.

3. Gujarati D.N. Basic Econometrics. McGraw-Hill, 4-е издание, 2003 (Gu).

Additional reading

1. Магнус Я.Р., Катышев П.К., Пересецкий А.А. Эконометрика. Начальный курс. Изд. 7. М., Дело, 2005 (МКР).
2. Econometric Views 5.1 User's Guide. Quantitative Micro Software, LLC.
3. Greene W.H. Econometric Analysis. Prentice Hall int. 5th ed., 2003, и предшествующие издания (Gr).
4. Kennedy P. A Guide to Econometrics. MIT Press, 5th edition, 2003, and и предшествующие издания (K).
5. Verbeek, M. A Guide to Modern Econometrics. Wiley, 2008. Перевод на русский язык: М.Вербик, Путеводитель по современной эконометрике. М., «Научная Книга», 2008.
6. J.M.Woodridge. Introductory Econometrics. A modern approach. 2nd ed. Thompson South-Western, 2003 (W).
7. Замков О.О. Введение в эконометрику: лекции по курсу. I-4, 2004. На русском и английском языке.

Internet resources and databases

1. <http://econ.lse.ac.uk/ie/> (I-1)
2. <http://www.oup.com/uk/orc/bin/9780199280964/> (I-2)
3. <http://highered.mcgraw-hill.com/sites/0072335424/> (I-3)
4. http://www.londonexternal.ac.uk/current_students/programme_resources/lse/index.shtml (I-4).
5. <http://www.worthpublishers.com/mankiw> (I-5)
6. <http://www.gks.ru> (I-6)
7. <http://www.cbr.ru> (I-7)
8. <http://mief.hse.ru> (I-8)
9. <http://crow.academy.ru/econometrics> (I-9)

Software and databases

The main software used in the course is Econometric Views (version 5.1 and later ones). Spreadsheet Excel is also used in the course.

For making class and home assignments the following data bases are used:

- data prepared by Chr.Dougherty at the LSE (data for estimation of earnings functions based on NSLY survey at the USA; annual data on demand, disposable income and relative prices for aggregated goods and services in the USA, for 1959–2003 — the data is available at I–1);
- Monthly data for main macroeconomic indicators for Russia, 1992–2009 (I–6, I–7);
- Annual data for estimated GNP, labour and capital in USSR economy for 1928–1987.

Course outline

1. Introduction to Econometrics

Statistical Investigation of Economic Variables' Relationships. Relationships in the economy: examples, problems of estimation and analysis (demand functions, earnings functions, economic growth models). Economic data: cross sections, time series, panel data.

Main statistical concepts and facts used in the course.

Data bases. Software. Course materials presentation.

Review (CD), L.1 (OZ)

2. Simple Linear Regression Model (SLR) with Non-stochastic Explanatory Variables. OLS estimation

Simple Linear Regression Model: definitions and notation. SLR Model Estimation using Ordinary Least Squares (OLS). Expressions for the OLS estimators of slope coefficient and intercept: derivation and interpretation.

Assumptions of the SLR models and the properties of OLS estimators. Gauss-Markov theorem (formulation). Standard deviations and standard errors of regression coefficients: derivation and interpretation.

Statistical significance of OLS estimators: hypotheses testing using t-tests. Derivation and interpretation of confidence intervals. The general quality of regression: determination coefficient R^2 . F -statistics and F -tests. Relationship of R^2 with correlation coefficients.

SLR model without intercept. OLS-estimation, properties and applications.

Ch. 1, Ch. 2 (CD), Ch. 3, Ch. 6 (6.1, Appendix 6A.1) (Gu), L.2 (OZ)

3. Multiple Linear Regression Model (MLR): two explanatory variables and k explanatory variables

Derivation and properties of OLS-estimators of MLR with two explanatory variables. Determination coefficient R^2 . Adjusted R^2 . Testing hypotheses using t - and F -statistics.

OLS-estimation of the model with k explanatory variables in vector-matrix form. Properties of coefficients' estimators. F -test for groups of variables.

Multicollinearity. Its consequences, detection and remedial measures.

Estimation of production functions in volumes and growth rates' forms as multiple regression models.

Ch. 3 (CD), L.2,4 (O3), Ch. 3 (MKP)

4. Variables Transformations in Regression Analysis

Linearisation of non-linear functions and their estimation using Ordinary Least Squares. Disturbance term specification. Interpretation of linear, logarithmic and semi-logarithmic relationships. Estimation of functions with constant elasticity and exponential time trends.

Comparison of the quality of regression relationships: linear and semi-logarithmic functions. Zarembka scaling.

Ch. 4 (CD), Ch. 6 (6.5-6.7) (Gu), L.4 (O3)

5. Dummy Variables

Dummy variables in linear regression models. Reference category and dummy variables' trap. Types of dummy variables: intercept and slope dummies. Interaction dummies. Multiple sets of dummies. Chow test.

Dummy variables in economic models: earnings functions, production functions. Dummy variables in seasonal adjustment.

Ch. 5 (CD), Ch. 9 (Gu)

6. Linear Regression Model Specification

Consequences of Incorrect Specification. Omitting significant explanatory variable. Including unnecessary explanatory variable in the model. Monte-Carlo method in econometric analysis: general principles, areas of application and examples. Proxy Variables.

Testing of linear constraints on parameters of MLR. F -test and t -tests. Role and examples of linear constraints in economic models.

Lagged Variables in economic models.

SLR model assumptions' violation. General principles of consequences' analysis, detection and correction. Generalised Least Squares (GLS).

Ch. 6 (CD), Ch. 13 (13.3-13.4) (Gu)

7. Heteroscedasticity

Concept, consequences and detection of heteroscedasticity. Goldfeld-Quandt, White, Spearman, Glejzer tests. Model Correction. Weighted Least Squares

(WLS) method as a special case of GLS. White's heteroscedasticity-corrected standard errors.

Reasons and examples of heteroscedasticity in economic models.

Ch. 7 (CD), Ch. 11 (Gu)

8. Stochastic Explanatory Variables

Stochastic explanatory variables in LR models. Model assumptions. Properties of OLS-estimators and test statistics of stochastic explanatory variables' coefficients. Measurement errors. Milton Friedman's critique on consumption function estimation. Instrumental variables. Using instrumental variables in M.Friedman's consumption model and in other economic models.

Ch. 8 (CD), Ch. 13 (13.5–13.6) (Gu)

9. Simultaneous Equations Models

Concept of simultaneous equations model. Exogenous and endogenous variables. Predetermined variables.

The simultaneous equations bias. Inconsistency of OLS estimators. Structural and reduced forms of the model. Model of demand and supply and simple Keynesian equilibrium model as simultaneous equations models.

Identification problem. Rules of identification.

Testing exogeneity: Durbin-Wu-Hausman (DWH) test.

Methods of estimation. Indirect Least Squares (ILS). Instrumental Variables. Two-Stages Least Squares (TSLS). Examples of simultaneous equations models estimation in Economic Analysis.

Ch. 9 (CD), Ch. 18–20 (Gu), L.6 (O3)

10. Maximum Likelihood Estimation

The idea of maximum likelihood estimation (ML). SLR and MLR Models Estimation using ML. ML Estimators' properties. Test statistics (z -statistics, pseudo- R^2 , LR -statistic) and statistical tests.

Ch. 10 (10.6) (CD), Ch. 4 (4.4, Appendix 4A) (Gu)

11. Binary Choice Models, Limited Dependent Variable Models

Linear probability model: problems of estimation. Logit-analysis. Probit-analysis. Using Maximum Likelihood for logit and probit models' estimation.

Censored samples. Direct and truncated estimation. Tobit-model. Sample selection bias. Heckman two-step procedure.

Ch. 10 (CD), Ch. 15 (Gu)

12. Modelling with Time Series Data. Dynamic Processes Models. Forecasting

Time series data regressions: Model assumptions. Properties of OLS estimators. Distributed lag models: geometrically distributed lags, polynomial lags. Koyck transformation and estimation of geometrical lag's parameters.

Autoregressive Distributed Lag (ADL) model. Common factor test.

Partial adjustment. Adaptive expectations. Cagan hyperinflation model estimation. M. Friedman's permanent income model: problems of estimation and analysis.

Forecasts and prediction. Confidence intervals. Salkever's method. Stability tests. Chow test of predictive failure. Forecasts' quality indicators. Their coefficients.

Causality in Economics: Granger test.

Ch. 11, Ch. 12 (12.6-12.8) (CD), Главы 17, 22 (Gu), L.5 (O3)

13. Autocorrelated disturbance term

Signs and consequences of disturbance term's autocorrelation in LR model. Durbin-Watson d-test for first order autocorrelation. Breusch-Godfrey (BG) test of higher-order autocorrelation. Autocorrelated disturbance term and model misspecification. Model correction: Autoregressive transformation. Cochrane-Orcutt (CO) procedure and non-linear estimation. Autoregressive transformation and transformed' model estimation as a special case of GLS. Prais-Winsten correction. AR, MA, ARMA models.

Autocorrelated disturbance term in a model with lagged dependent variable as one of the explanatory variables. Durbin h -statistic and test.

Autoregressive Conditional Heteroscedasticity (ARCH) model.

Ch. 12 (12.1-12.5, CD), Ch. 12 (Gu), L.3 (O3)

14. Time Series Econometrics: Nonstationary Time Series

Stationary and nonstationary time series. Definitions and examples of stationary and nonstationary time series. Random walk. Drifts and trends. Consequences of nonstationarity. Spurious regressions. Detection of nonstationarity. Correlograms. Unit root tests. Cointegration. Fitting models with nonstationary time series. Detrending. Error-correction models.

Ch. 13 (CD), Ch. 21 (Gu)

15. Panel Data Models

Introduction to panel data and economic examples. Pooled regressions. Fixed effect regressions. Within-groups regression models. First differences regression models. Least squares dummy variables (LSDV) regression models. Random effect regressions. Fixed effects or random effects: Durbin-Wu-Hausman (DWH) test.

Ch. 14 (CD), Ch. 13 (MKP). Ch. 16 (Gu)

Distribution of hours

| # | Topic | Total hours | Contact hours | | Self study |
|----|------------------------------|----------------|---------------|----------|---------------|
| | | | Lectures | Seminars | |
| 1. | Introduction to Econometrics | 14 | 2 | 2 | 10 |

| # | Topic | Total hours | Contact hours | | Self study |
|--------|--|----------------|---------------|----------|---------------|
| | | | Lectures | Seminars | |
| 2. | Simple Linear Regression Model (SLR) with Non-stochastic Explanatory Variables. OLS estimation | 22 | 4 | 4 | 14 |
| 3. | Multiple Linear Regression Model (MLR): two explanatory variables and k explanatory variables | 30 | 8 | 8 | 14 |
| 4. | Variables Transformations in Regression Analysis | 18 | 4 | 4 | 10 |
| 5. | Dummy Variables | 18 | 4 | 4 | 10 |
| 6. | Linear Regression Model Specification | 22 | 4 | 4 | 14 |
| 7. | Heteroscedasticity | 22 | 4 | 4 | 14 |
| 8. | Stochastic Explanatory Variables | 18 | 2 | 2 | 14 |
| 9. | Simultaneous Equations Models | 24 | 6 | 6 | 12 |
| 10. | Maximum Likelihood Estimation | 14 | 2 | 2 | 10 |
| 11. | Binary Choice Models, Limited Dependent Variable Models | 26 | 6 | 6 | 14 |
| 12. | Modelling with Time Series Data. Dynamic Processes Models. Forecasting | 34 | 10 | 10 | 14 |
| 13. | Autocorrelated Disturbance Term | 22 | 4 | 4 | 14 |
| 14. | Time Series Econometrics: Nonstationary Time Series | 26 | 6 | 6 | 14 |
| 15. | Panel Data Models | 18 | 4 | 4 | 10 |
| Total: | | 324 | 68 | 68 | 188 |