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Introduction

Econometrics II is an advanced course based on Econometrics I. It covers several important topics in econometrics. These topics are essential not only for theoretical analyses but also for empirical studies.

In Econometrics I, we have discussed basic principles of model specification, estimation and inference methods in the context of linear regressions. In particular, we have discussed

- how to express the relationship between a dependent variable y and a set of regressors X using a linear regression (which is indeed the baseline setting of parametric econometric models)?
- how to define a sensible parameter of the linear regression for identification (the true parameter when the regression is correctly specified vs. the pseudo-true parameter when the regression is misspecified)?
- how to estimate the parameter using real data based on the least squares (LS) method?
- how to establish the computational properties (the orthogonal condition) and the statistical properties (the unbiasedness, the BLUE, the normality, the t test and the F test) of the LS estimator (under the assumption of conditional normality)?
- how to relax the conditional normality assumption using the asymptotic approach?
- how to establish a simple law of large numbers using the concept of convergence in probability for random samples?
- how to establish a simple central limit theorem using the concept of convergence in distribution for random samples?

- how to establish the asymptotic inference methods for the LS estimator and its transformation based on the law of large numbers, the central limit theorem, the continuous mapping theorem and the delta method?

In Econometrics II, we plan to introduce a more complete framework of econometric analysis by introducing constrained estimation methods and discussing a number of important econometric topics, including hypotheses testing, model selection, endogeneity and instrumental-variable (IV) estimation, and the generalized method of moments (GMM). We also plan to introduce basic types and properties of time-series data and the linear time-series models for stationary processes. In this course, students may learn important econometric methods and basic principles of time-series analysis for their future empirical or econometric research, and may also enhance their programming skills in R via doing computer homework.

Lectures

1. Introduction
2. Constrained estimation (Ch.8 of Hansen's (2022) textbook)
    - Constrained least squares, exclusion restriction, Hausman equality, Minimum distance (MD) estimator, asymptotic distribution of the MD, asymptotically efficient MD estimator, misspecification and local misspecification.
3. Hypothesis testing (Ch.9)
    - Hypotheses, type I error, type II error, significance, p-value, asymptotic χ^2 tests, Wald test, criterion-based test, minimum-distance test, Hausman test, score test, testing consistency, asymptotic local power.
4. Model selection (Ch.28)
    - Weighted mean squared errors criterion, Akaike's information criterion, Bayesian information criterion, Mallows' C_p, cross validation, model selection consistency, asymptotic optimality.

- **Midterm exam. 4/16**

5. Endogeneity and IVs (Ch.12)
    - Endogenous regressors, identification, two-stage LS (2SLS) and properties, generated regressors, control function, endogeneity tests, overidentification test, weak IVs.
6. GMM (Ch.13)

- Moment equation models, method of moments, overidentified moment equations, GMM estimator, efficient GMM, overidentification test, conditional moment equation models.

7. Time series data (Ch.14)
   - Stationarity, convergent series, ergodicity, martingale difference, mixing, linear projection, white noise, Wold decomposition, lag operator, unit root.
8. Univariate time-series models (Ch.14)
   - Moving average (MA) processes, autoregressive (AR) processes, ARMA processes, ARIMA processes, time trend, time-series regressions, estimation, asymptotics.

- **Final exam. 6/11**

Requirements

- **Do not contact me for your grade.**
- **Regular class attendance.**
- **Mathematical statistics** and **elementary matrix algebra** are prerequisites.
- All computer homework must be completed using **R**. (`https://www.r-project.org/`)

Textbook

- Hansen, B. E. (2022), *Econometrics*, Princeton University Press.

Supplementary Readings

- Hansen, B. E. (2022), *Probability and Statistics for Economists*, Princeton University Press.
- White, H. (2001), *Asymptotic Theory for Econometricians*, Academic Press.

Grade

- Homework (20%)
- Midterm (40%)
- Final (40%)

Office Hours

- Before and after the classes
- By appointment