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Introduction

Econometrics is an academic discipline that aims at bridging economics and data through statistical analysis. Modern economic studies are inseparable from econometric analysis for evaluating existing economic theories, discovering new theories or exploring empirical evidence. In this course, we will introduce basic concepts, principles and methods of econometrics in specifying, estimating and testing empirical models. Our discussions will be mainly established in the context of linear regressions. We will also introduce the first-order asymptotic method which is essential for statistical inference, and discuss constrained estimation methods. In this course, students may learn basic econometric principles and methods for their future empirical or econometric research, and may also learn programming skills in **R** via doing computer homework.

Lectures

1. Introduction

2. Linear regression

   - Conditional moments, Law of iterated expectations, conditional expectation function, best prediction, linear regression, dummy variables, best linear predictor, partition of regressors, omitted variable bias, linear projection, causal effect.

3. Least square estimation

   - Ordinary least square (OLS) estimator, computational properties, algebraic properties, projection & orthogonal projection matrices, R^2, residual regression, Frisch-Waugh-Lovell theorem, leave-one-out OLS estimator.

4. Classical linear regression I

- First & second moments of the OLS estimator, Gauss-Markov theorem, heteroskedasticity, generalized least squares (GLS) estimator, covariance matrix and its estimation, goodness-of-fit measures.

5. Classical linear regression II

    - Properties of normality, Gaussian maximum likelihood estimator (MLE), distribution of the OLS estimator, confidence interval, t statistic, F statistic, information matrix equality, Crámer-Rao lower bound.

 - **Midterm exam. 11/11**

6. Large sample theory I

    - Limits, concepts of convergence, law of large numbers, central limit theorem, continuous mapping theorem, delta method, stochastic order.

7. Large sample theory II

    - Consistency of the OLS estimator, asymptotic normality of the OLS estimator, asymptotic covariance matrix and its estimation, parameter transformation, asymptotic standard error, t statistic, Wald statistic, asymptotic confidence interval.

8. Constrained estimation

    - Constrained least squares, exclusion restriction, Hausman equality, minimum distance, efficient minimum distance, nonlinear constraints, inequality restrictions.

 - **Final exam. 1/6**

Requirement

Regular class attendance is a basic requirement. **Mathematical statistics** and **matrix algebra** are required as background knowledge of this course. Computer homework needs to be done using **R** (`https://www.r-project.org/`).

Textbook

Textbook
Hansen, B. E. (**2021**), *Econometrics*, (`https://www.ssc.wisc.edu/~bhansen/econometrics/Econometrics.pdf`)

- Free, complete, up-to-date, real-time updating

- 1st version: 2000

- This version: August 18, 2021

- # of pages: 1043 (Indeed, it can serve as a complete econometrics textbook for three semesters.)

- In this semester, we will discuss the topics introduced in Chapters 2-8 of this book. Most, but not all, materials of these chapters will be discussed.

Supplementary Books

1. Hansen, B. E. (2021), *Probability and Statistics for Economists*, (`https://www.ssc.wisc.edu/~bhansen/probability/Probability.pdf`)

2. White, H. (2001), *Asymptotic Theory for Econometricians*, Academic Press.

Grade

- Midterm (40%), Final (40%), **Homework** (20%).

- Welcome to contact me for econometrics but NOT for grade.

Office Hours

- Before and **after** the classes

- By appointment

- Asks for TA's help

Teaching Assistant

- Homework

- Help

- Communication