Advanced Econometrics I

Peking University HSBC Business School

Instructor: SungBin Sohn

Class: Mondays and Thursdays 1030am-1220pm in 229 (for Session E)
Mondays and Thursdays 330pm-520pm in 229 (for Session F1)

Office Hours: Tuesdays 10-11am and 1-2pm or by appointment at 748

Email: sungbin.sohn@phbs.pku.edu.cn

Teaching Assistant: TBA

Course Description:

This is a graduate level course in econometrics. Econometrics is statistical analysis of economic and financial data. It is widely applied to estimate economic relationship, test economic theory and evaluate government and business policies. It has also been applied to management, marketing, sociology, etc. This course helps students use and understand regression analysis, introduces widely used econometric models, and explores underlying economic and intuition.

The course begins with brief reviews of probability distributions and limit theorems. Then, it studies the classical linear regression model (CLRM) focusing on the least squares estimator. The course further studies the cases in which main assumptions in the CLRM are violated. Some special topics (e.g., qualitative variable, instrumental variable, specification error, etc.) will also be studied. If time permits, other estimation methods such as the maximum likelihood and the generalized method of moments could be covered. The course emphasis is rather theoretical than empirical.

Textbook and Prerequisites:

There is no designated textbook for the course, but the following book could be useful (you are not required to read it):

Jeffrey Wooldridge (2012), *Introductory Econometrics: A Modern Approach*, Cengage Learning

You are assumed to have already taken Mathematics (GEN500) and to be familiar with the linear algebra and calculus.

Requirements and Grading:

Requirements for the course include attending lectures, several problem sets, a midterm exam and a final exam. Since the course is cumulative in the sense that each lecture builds on previous ones, full attendance is required. I take roll several times randomly throughout the module. Each time you're absent, your course score will be deducted by 1 point unless you obtain my pre-approval. As for problem sets, you are encouraged to work in groups. However, you must turn in an individual solution. Plagiarism is strictly punished. Late submission is unacceptable and will not be graded. Some problem sets may contain computational exercises. Specifically, the grading of the course can be broken down to the following:

Class attendance and homework	30%
Midterm exam	30%
Final exam	40%

Email policies:

I strongly encourage you to ask questions during lectures and office hours. If you have special needs to reach me outside the lectures or office hours, however, you may email me. I will try to respond to your email in two business days. If you don't get my response within two business days, please send me a reminder email. When you email me, please prefix the subject header [AE] in order to make your email too conspicuous to miss it.

Course Outline and References:

The schedule of topics could be updated as the course evolves.

1. **Brief review of probability theories (Appendix B)**
   - 1.1. Basic concepts
   - 1.2. Distributions (Normal, Chi-squared (χ^2), *t* & *F*)

2. **Limit theorems (Appendix C3)**
   - 2.1. Convergence
   - 2.2. Law of large number (LLN)
   - 2.3. Central limit theorem (CLT)
   - 2.4. Slutsky's theorem
   - 2.5. Delta method

3. **Classical linear regression model: Simple regression (Ch. 2)**
   - 3.1. Standard assumptions of classical linear regression model
   - 3.2. Least squares estimator (LSE)
   - 3.3. Properties of OLS estimator
   - 3.4. Estimator of σ^2

4. **Classical linear regression model: Multiple regression (Ch. 3, 4)**
   - 4.1. Standard assumptions of classical linear regression model
   - 4.2. Least squares estimator (LSE)
   - 4.3. Properties of OLS estimator
   - 4.4. Gauss-Markov theorem
   - 4.5. Estimator of σ^2
   - 4.6. Distribution of β & σ^2
   - 4.7. Wald test
   - 4.8. Goodness of fit
   - 4.9. Confidence interval of β
   - 4.10. Prediction interval of *y*

(Midterm Exam)

5. **Departure from assumptions in classical linear regression model**
   - 5.1. Heteroskedasticity (Ch. 8)
     - 5.1.1. Introduction
     - 5.1.2. Generalized least squares (GLS) estimator
     - 5.1.3. Feasible generalized least squares (FGLS) estimator
   - 5.2. Serial correlation (Ch. 12)
     - 5.2.1. Introduction
     - 5.2.2. Estimation
     - 5.2.3. Heteroskedasticity-Autocorrelation consistent (HAC) estimator
   - 5.3. Multicollinearity (Ch. 3.4)
   - 5.4. Non-normal error term (Ch. 5)
     - 5.4.1. Large sample properties of OLS estimators
     - 5.4.2. Large sample properties of *t*-statistic and *F*-statistic

6 Special topics

- 6.1. Qualitative (dummy) variable (Ch. 7, 17.1)
  - 6.1.1. Dummy independent variable
  - 6.1.2. Dummy dependent variable
- 6.2. Specification error (Ch. 3.3, 3.4)
  - 6.2.1. Inclusion of irrelevant variables
  - 6.2.2. Exclusion of relevant variables (omitted variable)
- 6.3. Measurement error (Ch. 9.4)
  - 6.3.1. Measurement error in a dependent variable
  - 6.3.2. Measurement error in independent variables
- 6.4. Instrumental Variable (Ch. 15)
  - 6.4.1. Endogeneity problem
  - 6.4.2. Estimation: Just-identified case
  - 6.4.3. Estimation: Over-identified case
- 6.5. Panel data (Ch. 13.3, 13.4, 14.1)
  - 6.5.1. Unobserved heterogeneity: Fixed effect (FE) model
  - 6.5.2. Difference-in-differences estimation
  - 6.5.3. Seemingly unrelated regressions (SUR)

7. Other estimation methods (optional)

- 7.1. Maximum likelihood estimator (MLE)
  - 7.1.1. Likelihood function and MLE
  - 7.1.2. Some statistics about likelihood function
  - 7.1.3. Properties of MLE
- 7.2. Generalized method of moments estimator (GMME)
  - 7.2.1. Method of moments
  - 7.2.2. Generalized method of moments
  - 7.2.3. Properties of GMME

(Final Exam)

Rescheduled classes:

The class on September 8 (Monday) is rescheduled on September 10 (Wednesday). Class time and location remain the same.

Exam schedule:

Midterm exam:	September 29 (Monday)
Final exam:	November 10 (Monday) or 11 (Tuesday)