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Office hours: MW 1 – 2 pm

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Lecture: Monday 8 – 9.50 pm  
Lab: TBA

## **Advanced Econometrics I**

– GECO 6281 –

### **Course Description**

This course covers a variety of advanced techniques of econometric analysis, and it is centered around Generalized Method of Moments (GMM) and Maximum Likelihood Estimation as organizing principles. After an in-depth introduction to probability theory, the single equation OLS estimator, its asymptotic properties, and shortcomings will be treated. Using the notion of the Instrumental Variables Estimation, the Generalized Method of Moments will be introduced. Furthermore, after an introduction to Maximum Likelihood Estimation, a variety of applications such as discrete response models will be discussed. Finally, we will discuss several topics in time-series and panel econometrics. The software used in this course will be Octave and Mathematica.

### **Grading**

Grading will be based on the midterm in-class exam (35%) and the final in-class exam (45%). By working out and handing in all exercise sets one can earn the remaining 20%.

### **Course Prerequisites**

GECO 6189 or equivalent. This assumes that students have a basic knowledge in basic probability theory, linear algebra and multivariate calculus, as well as a basic understanding of computer programming.

## **Course Outline**

### **I. The Geometry of Least Squares**

### **II. Probability Theory**

- Continuous and discrete random variables, probability distributions
- Expected Value: properties, law of total expectations

### **III. Least Squares Estimation**

- Gauss-Markov Conditions.
- Derivation and Statistical Properties of OLS estimator
- Hypothesis testing in linear regression models, confidence intervals
- Advanced topics on Least Squares Estimation, Generalized Least Squares

### **IV. Instrumental Variables Estimation**

- Introduction
- Instrumental Variables Estimation Techniques: IV and 2SLS estimators

### **V. Generalized Method of Moments Estimation**

- Introduction
- Asymptotic properties, computational issues
- Hypothesis testing

### **VI. Maximum Likelihood Estimation**

- Review of the basic theorems underlying MLE
- Standard Errors. Variance/Covariance Matrix of the MLE Estimator
- MLE Asymptotics
- Post-Estimation: Likelihood Ratio test, Lagrange Multipliers Test, Wald Tests

### **VII. Estimation of Discrete and Limited Variables**

- Introduction
- Binary choice models: Probit and Tobit
- Models for more than two discrete responses

## VIII. Multivariate Models

- Introduction
- SUR, Three-Stage-Least Squares and FIML estimation

## IX. Stationary Time Series Analysis

- Introduction
- Autoregressive and Moving Average processes
- Statistical Properties, ACF and PACF functions, conditions for stationarity
- Estimation of AR, MA and ARMA processes
- Dynamic Models
- Non-stationary processes: Unit root testing and cointegration

## X. Panel Data Econometrics

- Introduction
- Estimation methods: Pooled Regression, Fixed and Random Effects estimation
- Statistical inference, hypothesis testing

## Course Textbooks

Davidson, R. & MacKinnon, J. D. (2003), *Econometric Theory and Methods*, Oxford University Press.

Greene, W. (2007), *Econometric Analysis*, 6th ed, Prentice Hall.

Hayashi, F. (2000), *Econometrics*, Princeton University Press, Princeton.

Rudd, O. (2000), *An Introduction to Classical Econometric Theory*, Oxford University Press, Oxford, UK.

Wooldridge, J. M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, MA.