SYLLABUS: BAVARIAN GRADUATE PROGRAM IN ECONOMICS
Advanced Econometrics: August 19, 20, 23-27, 2021

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Introduction: This is a course in advanced econometrics offered by BGPE. For this session, the course will take place virtually via Zoom.

Goal: The course covers estimation of linear and nonlinear econometric models. The estimation methods include ordinary least squares, generalized least squares, maximum likelihood estimation, and quasi-maximum likelihood estimation. We will also treat methods when some variables are endogenous, including basic instrumental variables and extensions to nonlinear models. The focus will be on applications to cross-sectional data and panel data but will include some linear analysis for time series data.

Background: I assume a working knowledge of probability and statistics – including manipulations involving conditional expectations and the basic limit theorems, such as the law of large numbers and the central limit theorem. Underlying the statistical properties are matrix algebra and multivariable calculus, including how these are combined with probability. I will not emphasize derivations but some of the material is easier to follow if you have facility with matrix algebra. Part of the course material includes a summary of matrix algebra that underlies derivations of some estimators and their statistical properties.

Thursday, August 19

12:30-13:00 Welcome

Daily Schedule:

13:00-14:30 First Session (Lecture)
14:30-14:45 Break
14:45-16:15 Second Session (Lecture)
16:15-16:30 Break
16:30-18:00 Third Session (Question/Answer and Lab)

Course Outline

The slides for the course are grouped into what I think are natural topics rather than what we will necessarily cover during a particular lecture session. Consequently, the material for some slides may spill over into a lecture later in the same day. However, material will not spill over into later days: each day we will start fresh on the listed topics. This structure will allow us to stay on track to finish the fundamental material in the course.

Day 1

Regression with Cross-Sectional Data
- Algebraic, Finite Sample, and Asymptotic Properties of OLS
- Functional Form
- Multicollinearity and Selection of Regressors
- Weighted Least Squares

Day 2

Regression with Time Series Data
- Stationarity, Weak Dependence
- Trends and Seasonality
- Robust Standard Errors
- GLS for Serial Correlation

OLS with Pooled Cross Sections
- Difference-in-Differences

Day 3

Instrumental Variables with Cross-Sectional Data
- Asymptotic Properties of Two Stage Least Squares
- Testing Endogeneity and Overidentification
- Weak Instruments
- Heterogeneous Treatment Effects and LATE

Day 4

Linear Panel Data Models with Exogenous Explanatory Variables
- Pooled OLS, Random Effects, Fixed Effects, First Differencing
- Comparison of Estimators
- Testing Key Assumptions

Heterogeneous Trend Models and Heterogeneous Slopes

Day 5

Linear Panel Data Models with Endogenous Explanatory Variables
- RE and FE 2SLS
- Specification Tests
- First Differencing Methods

Estimation under Sequential Exogeneity

Unbalanced Panels

Day 6

Maximum Likelihood Estimation
  Quasi-MLE
  Bootstrapping
Binary and Fractional Response Models
Exponential Models Nonnegative Outcomes: Poisson Regression
Endogenous Explanatory Variables
  Control Function Methods

Day 7

Joint MLE and Pooled MLE with Panel Data
  Robust Inference
  Bootstrapping with Panel Data
Binary and Fractional Response Models with Panel Data
Models for Nonnegative Responses
Models with Unobserved Heterogeneity and Endogeneity

Course Material

I will make available lecture notes, slides, problem sets, and Stata data sets. The "lecture notes" in some cases are merely expanded versions of the slides. I include the material in the interests of continuity as you study the notes on your own.

Textbooks

For the first two days of the course I will be drawing on material from a variety of sources, including my own (unpublished) lecture notes. Greene and Hayashi contain the material on OLS and GLS, presented at an advanced level. The treatment in Wooldridge (2019, Appendix E) is terse but has several of the important derivations.

For panel data and nonlinear models I will rely mainly on Wooldridge (2010). The other texts have nice treatments of many of the topics. Cameron and Trivedi is an especially good reference for bootstrapping.

A.C. Cameron and P.K. Trivedi, *Microeconometrics: Methods and Applications*, Cambridge University Press, 2005.

W.H. Greene, *Econometric Analysis*, Prentice Hall, 8th edition, 2018.

J.W. Wooldridge, *Introductory Econometrics: A Modern Approach*, Cengage, 7th edition, 2019.

J.M. Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, MIT Press, 2nd edition, 2010.