

**SYLLABUS: BAVARIAN GRADUATE PROGRAM IN ECONOMICS**  
**Advanced Econometrics: February 17-22, 2019**

Jeffrey M. Wooldridge  
Michigan State University

**Goal:** This course covers estimation of linear and nonlinear econometric models. The estimation methods include ordinary least squares, generalized least squares, nonlinear least squares, maximum likelihood estimation, quasi-maximum likelihood estimation, and quantile regression. 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 section data and panel data but will include some linear analysis for time series data.

**Background:** I will 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. It is important to have facility with matrix algebra, including how matrix algebra is used with probability and statistics.

**Sunday, February 17**

19:00 Welcome Meeting/Dinner

**Monday-Thursday Daily Schedule:**

8:00-9:00 Breakfast  
9:00-10:30 First Session (Lecture)  
10:30-11:00 Coffee Break  
11:00-12:30 Second Session (Lecture)  
12:30-14:00 Lunch  
14:00-16:00 Third Session (Lecture/Problem Set)  
16:00-16:30 Coffee Break  
16:30-18:00 Fourth Session (Problem Set)  
18:00-19:00 Free Time  
19:00 Dinner

**Friday Schedule:**

8:00-9:00 Breakfast  
9:00-10:30 First Session (Lecture)  
10:30-11:00 Coffee Break  
11:00-12:30 Second Session (Lecture)  
12:30-14:00 Lunch  
14:00-15:00 Third Session (Lecture)

## 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

- Ordinary Least Squares: Algebraic, Finite Sample, and Asymptotic Properties; Applications to Cross Section and Time Series Data
- Generalized Least Squares and Feasible GLS: Applications to Cross Section and Time Series

### Day 2

- Instrumental Variables and Two Stage Least Squares: Asymptotic Properties; Testing Endogeneity and Overidentification; Weak Instruments; Applications to Cross Section and Time Series Data
- Generalized Method of Moments: Asymptotic Properties; Optimal Weight Matrix; Optimal Instruments
- Nonlinear Models with Endogenous Explanatory Variables

### Day 3

- Linear Panel Data Models: Estimation and Inference Using Pooled OLS, Random Effects, Fixed Effects, First Differencing; Robust Inference; Comparison of Estimators and Testing Key Assumptions.
- Linear Panel Data Models: Instrumental Variables Methods
- Unbalanced Panels

### Day 4

- Nonlinear Estimation: Basics of M-estimation; Nonlinear Least Squares; Maximum Likelihood Estimation; Quasi-MLE
- Pooled MLE for Panel Data
- Limited Dependent Variable Models: Logit and Probit (Binary and Fractional Responses); Count Data Models
- Endogenous Explanatory Variables

### Day 5

- Nonlinear Estimation with Panel Data; Joint MLE and Pooled MLE; Correlated Random Effects Approaches to Unobserved Heterogeneity; Robust Inference for Pooled MLE and quasi-MLE
- Bootstrapping with Panel Data
- Common Nonlinear Panel Data Models
- Dynamic Models
- 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 (2016, 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, 8<sup>th</sup> edition, 2018.

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

J.W. Wooldridge, *Introductory Econometrics: A Modern Approach*, Southwestern, 6<sup>th</sup> edition, 2016.

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