

**SYLLABUS: BAVARIAN GRADUATE PROGRAM IN ECONOMICS**  
**Advanced Econometrics: March 5-10, 2023**

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**Goal:** This course covers estimation and applications of linear and nonlinear econometric models with a focus on “microeconometrics.” The estimation methods include ordinary least squares, generalized least squares, maximum likelihood estimation, and quasi-maximum likelihood estimation. We will also cover methods when some variables are endogenous, particularly instrumental variables methods for linear and models with cross-sectional data. Linear panel data and nonlinear panel data models are covered in some detail. We will apply the methods to linear difference-in-differences with pooled cross sections and panel 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. Nevertheless, most of the presentation is based on understanding assumptions and applying the methods.

**Sunday, March 5, 2023**

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 Session)  
16:00-16:30 Coffee Break  
16:30-18:00 Fourth Session (Problem Session)  
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)  
12:30-13:30 Lunch  
13:30-14:30 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

- Regression with Cross-Sectional Data: Algebraic, Finite Sample, and Asymptotic Properties of OLS; Functional Form; Multicollinearity, Selection of Regressors; Weighted Least Squares
- OLS with Pooled Cross Sections; Difference-in-Differences Structures

### Day 2

- Instrumental Variables and Two Stage Least Squares with Cross-Sectional Data: Asymptotic Properties; Testing Endogeneity and Overidentification; Weak Instruments
- Generalized Method of Moments with Cross-Sectional Data
- Optimal Instruments
- Models Nonlinear in 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
- Difference-in-Differences with Panel Data

### Day 4

- Linear Panel Data Models with Endogenous Explanatory Variables; RE and FE 2SLS; Specification Tests; First Differencing Methods
- Estimation under Sequential Exogeneity
- Models with Lagged Dependent Variables
- Unbalanced Panels

### Day 5

- Maximum Likelihood Estimation and Quasi-MLE with Cross-Sectional Data
- Limited Dependent Variable Models: Logit and Probit for Binary and Fractional Responses; Exponential Models
- Joint MLE and Pooled MLE; Correlated Random Effects; Robust Inference for Pooled MLE and QMLE
- Common Nonlinear Panel Data Models

## **Final Exam**

The exam for the course is open book, open notes. I will provide several questions at least one week ahead of the exam, some of which will appear verbatim on the exam. Other exam questions will be variations on those distributed. You will have some choice of which questions to answer.

## **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, 8<sup>th</sup> edition, 2018.

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

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

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