ED 944
Advanced Economic and Econometric Applications to Education Research I
Prof. Scott Imberman
Fall 2014

Synopsis: The goal of this course is to provide students who plan to conduct research in education policy with practical understanding of econometric techniques often used in this research and the methodologies’ relationship with causal inference. Through lectures, problem solving, and readings of seminal papers that utilize the techniques, by the end of the course students will understand when each strategy is appropriate, the benefits and drawbacks of each strategy, the theoretical underpinnings behind each methodology and how to implement the methods in practice using statistical software. Thus upon completion students should be capable of thoroughly reading and criticizing research papers using econometric techniques in applications and to apply such techniques to their own research.

Meetings: This course will be held Mondays and Wednesdays from 12:40PM to 2:00PM. In Wells A306.

Office Hours: Mondays 4:30pm to 6:30pm or by appointment.

Requirements:

(1) Problem Sets: The key to understanding applied econometrics is regular conduct of statistical software. Thus students will be assigned bi-weekly problem sets that combine theoretical questions about interpretation and application of techniques with actual implementation using statistical software. The software used in this course will be Stata which you must use for all assignments as I will provide partial credit both on the code and output produced. Stata is available on all MSU computer labs, though it is recommended that you purchase your own copy. Students may purchase a 6 month license of Stata/IC for $69 at http://www.stata.com/order/new/edu/gradplans/student-pricing/. Please use Stata/IC. Stata/SE or Stata/MP. Small Stata will not be sufficient for this course. You may work in groups of at most 3 students, but each student must provide their own submission. Problem sets will be worth 40% of your grade.

(2) Replication Study: Students will be required to conduct a replication analysis of a paper in education policy chosen by the instructor that uses an econometric technique learned in class. This will be worth 30% of your grade.
Final Exam: At the end of the course there will be a take-home final exam that includes theoretical and practical questions along with some econometric analyses students are to conduct using statistical software. The final exam will be worth 30% of your grade.

Readings:
Required: There are two primary required textbooks for this course. The first is “Econometric Analysis of Cross Section and Panel Data” by Jeffrey Wooldridge (ISBN 978-0262232586). This textbook is a graduate level econometrics textbook and a number of the problems for the problem sets will come from this text. The second required text is “Methods Matter” by Richard Murnane and John Willett (ISBN 978-0199753864).

Other Useful Resources: “Mostly Harmless Econometrics” by Joshua Angrist and Joris Pishke (ISBN 978-0691120355) is a very valuable resource that covers many of the topics we will discuss in class in more detail. If you did not take econometrics or advanced statistics as an undergraduate, it is recommended that you also purchase Wooldridge’s undergraduate text “Introductory Econometrics: A Modern Approach” (ISBN 978-1111531041) as an additional reference. Another useful resource for basic statistical techniques is “Statistical Methods for the Social Sciences” by Alan Agresti and Barbara Finlay (ISBN 978-0130272959). Finally, remarkably, I find Wikipedia to be a useful resource for statistics so if you are not clear on something that would be a good first place to look for additional help.

Papers: Finally, I will assign a series of papers in economics of education that utilize the various techniques we use. We will discuss these papers in class and critically assess their findings, the appropriateness of their econometric techniques, and the implications of these studies for policy. All papers will be provided on D2L.

Course Outline: This outline is preliminary and subject to change. Note that the Wooldridge readings can be quite technical with a lot more in there than you need for this course. Thus, it’s recommended that you read the Wooldridge assignments after the relevant lecture and essentially use the text as a secondary reference to the lectures. All papers and Murnane & Willett readings should be done before the class where the material will be covered.

**NOTE THAT THE SYLLABUS IS PRELIMINARY AND READINGS AND TOPICS COVERED MAY CHANGE**
1. **Introduction**

Why is it important to use econometrics in education policy?
What is causal inference?

Readings:  
Murnane & Willett, Chapters 1 – 3  
Wooldridge, Chapter 1  

2. **Mathematics and Statistics Background/Review**

Basic linear algebra.  
Calculus: derivatives.  
Probability.  
Commonly used probability distributions.  
Conditional expectations.  
Z and t statistics.

Readings:  
Wooldridge, Chapters 2.1 – 2.3

3. **Ordinary Least Squares Regression**

What is linear regression?  
Intuition behind minimizing the sum of squared residuals.  
Concepts of consistency, bias and efficiency.  
When is OLS causal?  
Homoskedasticity and heteroskedasticity.  
Using proxy variables as a method of causal inference.

Readings  
Wooldridge, Chapters 4.1 – 4.3.1  

4. **Randomized Controlled Trials (Experiments)**

Why conduct experiments?  
The Rubin causal model.  
Treatment effects.  
Problems with experiments.
Balancing tests, ex-ante and ex-post balance.
Statistical power and sample size; power analyses.
Attrition.

Readings: Murnane and Willett, Chapters 4 – 6
Wooldridge, Chapters 21.1 – 21.3.1


5. **Panel Data Methods**

Cross-section, longitudinal and panel data.
Unobserved random-effects.
Unobserved fixed-effects.
Strict exogeneity assumption.
Use of school and student fixed-effects.
Whether to use fixed effects or lagged achievement to account for student factors.

Readings: Wooldridge, Ch. 10


6. **Natural Experiments, Difference-in-Differences and Triple Differences Techniques**

What are “natural experiments?”
Non-parametric difference-in-differences.
Regression techniques for difference-in-differences and triple differences.
Benefits of identifying off of trends.
Cluster-robust standard errors.
Parallel trends assumption.
Assumption of no concurrent changes in unobservables.
Policy endogeneity.

Readings: Murmane and Willett, Ch. 8
           Wooldridge, Chs. 6.5, 20.3


7. **Instrumental Variables**

What is an “instrument?”
When to use instrumental variables.
Instrument power and validity.
Making the argument for validity.
Two-stage least squares.
Direct tests for power and the pitfalls of weak instruments.
Indirect tests for validity.
Average treatment effects vs. local average treatment effects.
Lotteries as instruments.

Readings: Wooldridge, Chapters 5.1 – 5.2, 21.4
           Murnane & Willett, Chapters 10, 11


8. **Regression Discontinuity**

RD as a localized experiment.
Local average treatment effect from RD.
Parametric and non-parametric methods.
Strict and fuzzy RD.
Bandwidth choice.
Tests for manipulation.

Readings:  Wooldridge, Ch. 21.5

Murnane & Willett, Ch. 9


9. **Propensity Score Matching**

Selection on observables vs. selection on unobservables.
What can matching do and not do?
The common support problem.
Bootstrap standard errors.

Readings:  Wooldridge, Chapters 21.3.3 – 21.3.5

Murnane & Willett, Chapter 12

Black, Dan A., and Jeffrey A. Smith. "How robust is the evidence on the effects of college quality? Evidence from matching."

10. **Application: Teacher Value-Added Models**
