The goal of this course is for students to learn a set of statistical tools and research designs that are useful in conducting high-quality empirical research on topics in applied microeconomics and related fields. Since most applied economic research examines questions with direct policy implications, this course will focus on methods for estimating causal effects. This course differs from many other econometrics courses in that it is oriented towards applied practitioners rather than future econometricians. It therefore emphasizes research design (relative to statistical technique) and applications (relative to theoretical proofs), though it covers some of each.

Prerequisites

PPHA42000 (Applied Econometrics I) is the prerequisite for this course. Students should be familiar with graduate school level probability and statistics, matrix algebra, and the classical linear regression model at the level of PPHA420. In the Economics department, the equivalent level of preparation would be the 1st year Ph.D. econometrics coursework.

In general, I do not recommend taking this course if you have not taken PPHA420 or a Ph.D. level econometrics coursework.

This course is a core course for Ph.D. students and MACRM students at Harris School. Those who are not in the Harris Ph.D. program, the MACRM program, or the economics Ph.D. program need permission from the instructor to take the course.
No electric device policy:

I ask you not to use electric devices, including laptops, phones, and smart pads in class. Please seek permission from the instructor if you need to use an electric device for a special reason (e.g. a medical reason).

Assignments and Grading

I will assign 4 problem sets during the course. I highly encourage you to work as a group up to 4 students. You can work as a group, but each student must submit his/her problem set individually.

To make our TA’s life easier, I also ask everyone to type answers (except for math equations if you prefer handwriting, but please write very clearly otherwise the TA may not be able to grade your math equations).

Problem sets are due in class as specified in the schedule below. Late problem sets will incur a penalty of 50% of the total points per day except for medical reasons (with a doctor’s official note submitted to instructor) and family emergencies (contact instructor).

There will also a final exam (in-class, closed book, one-page cheat sheet). There will be no make-up exams.

Grades will be based on performance on problem sets (40%), final exam (50%), and class participation (10%).

Statistical Software

You may use any software that you wish, but solutions for problem sets will be handed out in Stata. Demonstrations during lectures will also be conducted in Stata.
# Course Schedule (subject to change)

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/26</td>
<td>Causality</td>
<td></td>
</tr>
<tr>
<td>3/28</td>
<td>Randomized Controlled Trials</td>
<td></td>
</tr>
<tr>
<td>4/2</td>
<td>Randomized Controlled Trials</td>
<td></td>
</tr>
<tr>
<td>4/4</td>
<td>Regression Discontinuity Design</td>
<td></td>
</tr>
<tr>
<td>4/9</td>
<td>Regression Discontinuity Design</td>
<td></td>
</tr>
<tr>
<td>4/11</td>
<td>Advanced Topics in IV, LATE, MTE</td>
<td></td>
</tr>
<tr>
<td>4/16</td>
<td>Advanced Topics in IV, LATE, MTE</td>
<td>Problem Set #1 due</td>
</tr>
<tr>
<td>4/18</td>
<td>Selection on Observables and Lalonde’s Critique</td>
<td></td>
</tr>
<tr>
<td>4/23</td>
<td>Matching</td>
<td></td>
</tr>
<tr>
<td>4/25</td>
<td>Matching</td>
<td></td>
</tr>
<tr>
<td>4/30</td>
<td>DID, Fixed Effects, Synthetic Controls</td>
<td></td>
</tr>
<tr>
<td>5/2</td>
<td>DID, Fixed Effects, Synthetic Controls</td>
<td>Problem Set #2 due</td>
</tr>
<tr>
<td>5/7</td>
<td>Clustering and Bootstrapping Standard Errors</td>
<td></td>
</tr>
<tr>
<td>5/9</td>
<td>Introduction to Maximum Likelihood Estimation</td>
<td></td>
</tr>
<tr>
<td>5/14</td>
<td>Limited dependent variables</td>
<td></td>
</tr>
<tr>
<td>5/16</td>
<td>Discrete Choice Methods with Individual Data</td>
<td>Problem Set #3 due</td>
</tr>
<tr>
<td>5/21</td>
<td>Introduction to GMM</td>
<td></td>
</tr>
<tr>
<td>5/23</td>
<td>BLP: Discrete Choice with Aggregated Data</td>
<td></td>
</tr>
<tr>
<td>5/28</td>
<td><strong>Memorial day – No class</strong></td>
<td></td>
</tr>
<tr>
<td>5/30</td>
<td>Numerical Optimization Methods</td>
<td>Problem Set #4 due</td>
</tr>
<tr>
<td>TBA</td>
<td><strong>Final exam (3 hours)</strong></td>
<td></td>
</tr>
</tbody>
</table>
Textbooks and Notes

The main materials for this course will be my lecture slides, two textbooks: 1) the econometrics notes at NBER econometrics courses written by Imbens and Wooldridge [WNE] and 2) the econometrics textbook by Cameron and Trivedi [CT], and several academic papers listed below.

In addition, Angrist and Pischke [AP] provide intuitive, practical, and less mathematical explanations for some topics. Wooldridge [JW] is at the same level of WNE and CT. For each topic, I reference chapters from these sources.

For discrete choice methods with individual data, the best textbook is Kenneth Train [KT]. We use its relevant chapters later in the course.

- [WNE] Imbens, Guido and Jeffrey Wooldridge (2007). What’s New In Econometrics, NBER Summer Course.


References to each topic

Econometrics is hard, but I personally found that repeated learning is very helpful. For this reason, please do required readings before you come to class. Ask your questions in class. Then, read the relevant chapters and papers again after class. This process helps you to master the knowledge.

** The main textbook-style materials for each topic (required readings)
* Other references that I use for the topic
# Further readings for the topic, including more theoretical materials

1. Causality

** WNE Lecture 1, Section 2.

** AP Chapters 1 - 2.

# CT Chapter 2.


2. RCT

** Sections 1,2,4,5,6 in:


3. Regression Discontinuity Designs


** WNE Lecture 3.

CT Chapter 25.6.

* AP Chapter 6.


4. Advanced Topics in Instrumental Variables

A. The IV Estimator

** CT Chapter 4.8.

** AP Chapter 4.1 - 4.3.

JW Chapter 5.


B. Heterogeneous Treatment Effects

** CT Chapter 25.7.** AP Chapter 4.4 - 4.5.

** WNE Lecture 5.

JW

Chapter18.4.


C. 2SLS and Weak Instruments

** CT Chapter 4.9.

** AP Chapter 4.6.

* WNE Lecture 13.


D. Marginal Treatment Effects (MTE)


5. Selection on Observables, Lalonde’s Critique, Matching, Propensity Score Matching


** CT Chapter 25.

** AP Chapter 3.

** WNE Lecture 1.


5. DID, Fixed Effects, Synthetic Controls

** WNE Lecture 10.

** CT Chapter 25.

** AP Chapter 5.


6. Clustering and Bootstrapping Standard Errors

** CT Chapter 24.5.
** AP Chapter 8.2.


** CT Chapter 11.


7. Maximum likelihood Estimation

A. Introduction to Maximum likelihood Estimation

** CT Chapters 5.1 - 5.3, 5.6, 5.7

JW Chapter 13.

B. Limited Dependent Variables Models

** CT Chapters 14.1 - 14.5., 16

JW Chapter 15, 16.


C. Multinomial Discrete Choice (Discrete Choice with Individual Data)

** CT Chapter 15.

** WNE Lecture 11.
8. Generalized Method of Moments

** CT Chapter 6.

** WNE Lecture 15.


9. Numerical Optimization Methods

** CT Chapter 10

** KT Chapter 8