90-906: Introduction to Econometric Theory

Professor Edson Severnini
Carnegie Mellon University
Fall 2018, Heinz College
MW, 1:30-2:50pm, HBH 1007

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HBH 2212
412-268-2329
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Email Policy and Office Hours
Please email me only if my answer is expected to be a few words or sentences, and include “PhD Econometrics I - Fall 2018” on the subject. I will get back to you within 24 hours on weekdays, and 48 hours on weekends. That said, I prefer talking to you in person during my office hours, which will be held on Tuesdays, 9:30-10:50am. The TA’s office hours will be posted on Canvas. You may also ask questions in the TA’s recitations, which you are required to attend.

Course Description
Empirical research is most valuable when it uses data to answer specific causal questions, as if in a randomized clinical trial. In the absence of a real experiment, we look for well-controlled comparisons and/or natural quasi-experiments. Some research designs are more convincing than others, but the econometric methods behind them are almost always fairly simple. This course provides an introduction to the most important items in an applied econometrician’s toolkit: (i) analysis of randomized controlled trials; (ii) regression models designed to control for variables that may mask the causal effects of interest; (iii) difference-in-differences-type strategies that use repeated observations to control for unobserved omitted factors; and (iv) instrumental variables and regression discontinuity methods for the analysis of real and natural experiments. In this course, emphasis will be given to conceptual issues and statistical techniques that turn up in the applied research we read and do. Many empirical examples will illustrate these ideas and techniques.

Prerequisite
90-905: Statistical Theory for Social and Policy Research (or equivalent; taken concomitantly)
The main prerequisite for this course is basic training in probability and statistics. Students should be comfortable with the elementary tools of statistical inference, such as standard errors and t-statistics. Familiarity with fundamental probability concepts such as mathematical expectation, and with principles of linear algebra such as vector and matrix operations, is also helpful, but extraordinary mathematical sophistication is not required.

Course Objectives
Upon successful completion of this course, you should be able to:
1. Understand the key theoretical and practical elements of regression analysis.
2. Use the core methods in today’s econometric toolkit in empirical analysis – e.g., linear regression for statistical control, instrumental variable methods for the analysis of real and natural experiments, and difference-and-difference methods that exploit policy changes.
Student Audience
Within the Heinz College, 90-906 is appropriate for first-year PhD students plus first and second year Masters students who desire and are prepared for a rigorous course in econometrics as a base for more advanced research methodology. Outside the Heinz school, 90-906 may be of interest to graduate students in Engineering and Public Policy, Social and Decision Science, Software Engineering, Psychology, GSIA, Philosophy, Applied History, or Architecture who need background in econometrics targeted toward social and policy research.

Course Web Page
I plan to post slides, readings, homework, and announcements on Canvas: http://www.cmu.edu/canvas/

Textbooks
The main textbooks for this course (and your professional life) are Mostly Harmless Econometrics: An Empiricist’s Companion, by Joshua D. Angrist and Jörn-Stepfen Pischke, and Econometrics, by Bruce E. Hansen (available online at https://www.ssc.wisc.edu/~bhansen/econometrics/Econometrics.pdf). These books cover the most important items in an applied econometrician’s toolkit. Lectures will also draw from three additional references: Econometric Analysis (7th Ed.), by William H. Greene, Econometric Analysis of Cross Section and Panel Data (2nd Ed.), by Jeffrey M Wooldridge, and the chapter “Endogeneity in Empirical Corporate Finance”, by Michael R. Roberts and Toni M. Whited, in the Handbook of the Economics of Finance Volume 2, 2012, edited by George Constantinides, Milton Harris, and Rene Stulz.

In case you are not familiar with the software to be used in the course – STATA –, you should acquire another book that provides detailed instructions on how to work with the software as well as the econometric theory behind the commands. The book is Microeconometrics Using Stata (Revised Edition), by A. Colin Cameron and Pravin K. Trivedi.

Grading Scheme
Students are expected to attend and actively participate in class, complete assignments (readings, homework problems, paper replications, etc.), and take examinations. Students are also expected to attend recitations, and office hours as needed. There will be approximately bi-weekly assignments, including paper replications, and two exams.

The final grade will be determined by a formula chosen by each student subject to the following constraints:

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<tr>
<th>Grade Components</th>
<th>Range</th>
<th>Default</th>
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<tbody>
<tr>
<td>Class participation</td>
<td>5-10%</td>
<td>5%</td>
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<tr>
<td>Assignments</td>
<td>30-40%</td>
<td>35%</td>
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<tr>
<td>Exam 1</td>
<td>25-35%</td>
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<td>Exam 2</td>
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<td>Total</td>
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The total of the percentages allocated by the student must total 100%. This allocation is intended to provide flexibility in the way a student demonstrates mastery of the course material. If no choice is made, grading will be by the default weights.

**Regrade Policy**
If you feel that a regrade request is justified, please write down the reasons on a separate page, print it and staple it to the front of your exam/assignment, and bring it to me or the TA in class. If you like to use your old exams/assignments to study for the next exam, make a copy for yourself before handing them in. Deadline for regrades is *one week* after the return of the exams/assignments, unless a different date is announced in class. Late requests will not be considered.

If there was an arithmetic error in adding up points on your exam/assignment, let us know right away, and we will record the correct grade. This doesn't constitute a regrade request. Just write a brief note on the cover sheet and give the exam/assignment to me or the TA.

**Cheating & Plagiarism**
Students are expected to honor the letter and the spirit of the Carnegie Mellon University Policy on Cheating and Plagiarism. All activities cited in that policy will be treated as cheating in this course. Students are expected to familiarize themselves with this policy. Students are also encouraged to review the Carnegie Mellon University Academic Disciplinary Actions Overview for Graduate Students, which details penalties and sanctions, as well as students’ rights. I will take a zero-tolerance policy on cheating and plagiarism and will consult with Departmental leadership on appropriate action for all instances of cheating and plagiarism. As the aforementioned policies indicate, penalties can include course failure, suspension, and dismissal from the program.

> -- Carnegie Mellon University Policy on Cheating and Plagiarism
> http://www.cmu.edu/policies/documents/Cheating.html
> -- Carnegie Mellon University Academic Disciplinary Actions Overview for Graduate Students
> http://www.cmu.edu/policies/documents/GradDisc.html

**Personal Accommodations**
Students with disabilities: If you wish to request an accommodation due to a documented disability, please inform me and contact Disability Resources as soon as possible. They can be reached at access@andrew.cmu.edu or (412) 268-2013.

**Thoughts for the Semester**
Your graduate-school experience might prove to be mostly enjoyable and carefree, but it is likely to entail stress as well. The University Provost provides the following thoughts for students. They seem very sensible to us:

*Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.*
All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services is here to help: call 412-268-2922 and visit their website at [http://www.cmu.edu/counseling/](http://www.cmu.edu/counseling/). Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

**TOPICS TO BE COVERED IN THE COURSE**

1. **Regression Analysis – Cross Section and Panel Data (5 weeks)**

   **Examples:**


   Optional additional readings:

2. Instrumental Variables (2 weeks)

Examples:


Optional additional reading:


3. Randomized Controlled Trial (1 week)

Examples:


Optional additional readings:


**4. Difference in Differences (3 weeks)**

*Examples:*


Optional additional readings:


5. Regression Discontinuity Design (3 weeks)

**Examples:**


Optional additional readings:


