1 Overview

This course covers basic statistical methods for inferring the causal impact of public policy initiatives on social outcomes. As randomized experiments are rare in the world of policy, empirical policy analysis has turned to natural experiments and quasi-experimental studies. We will start by introducing a general framework to understand causality and endogeneity. This framework is based on the analogy of a random experiment. We will then move on to understand and use the econometric methods frequently encountered in quasi experimental econometric studies: regression discontinuity methods, difference in differences and instrumental variables. The policy analysis/research examples for each method will be tailored to student policy interests. We will generally review education/crime/healthcare/labor policy examples, but students interested in other policies will be given the chance to use datasets and do readings specific to their policy interests. For each method, we will spend some time understanding the econometric theory and inherent assumptions. There will also be extensive work applying these methods to real-world datasets using the statistical software Stata.

2 Course objectives

Upon completion of the course, students should be able to:
1. Identify the main threats to validity in econometric research studies.
2. Evaluate the assumptions of common econometric models and estimation methods.
3. Explain the underlying econometric theory behind regression discontinuity methods, difference in differences and instrumental variables methods.
4. Develop competence accessing common data sources used in econometric studies.
5. Apply a range of econometric methods for causal inference with observational data.
6. Formulate a research design, indicating the research question, data sources, methods and estimation strategy.
7. Critique policy analysis studies using common econometric models and estimation methods.

3 Prerequisite

Applied Econometrics I (94-834) or similar econometrics background.
4 Grading

<table>
<thead>
<tr>
<th>Requirement</th>
<th>% of Grade</th>
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<tbody>
<tr>
<td>1. Homework</td>
<td>45%</td>
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<tr>
<td>2. Quiz during review session on April 10</td>
<td>15%</td>
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<td>3. Final exam</td>
<td>35%</td>
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<td>4. Class participation</td>
<td>5%</td>
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5 Textbook, software

- We will be using the required textbook from Applied Econometrics I: Stock and Watson, Introduction to Econometrics, 3rd Edition. Additional materials and readings will be distributed, depending on students’ policy interests.

- Recommended software: Stata. This program is available in the virtual lab and on the computers in HBH 239. We will provide instruction and support only for Stata, but you are free to use any other software that can perform the required analyses for the homework. If you are interested in purchasing Stata for your own computer, see: http://www.heinz.cmu.edu/computing-services/software/index.aspx The course website is on Blackboard.

6 Schedule

Week 1

- **Lecture 1** Monday March 16. Potential outcomes framework. Omitted variable bias. Causal effects and idealized experiments

- **Lecture 2** Wednesday March 18 Regression analysis of randomized experiments

  Reading for the week (will also feature in Homework 2): Alan B. Krueger, Experimental Estimates of Education Production Functions, The Quarterly Journal of Economics, May 1999

  **Recitation 1.** Friday March 20. Intro to Stata. Regression analysis of randomized experiments in Stata.

Week 2

- **Lecture 3** Monday March 23 Potential problems with running experiments. Threats to validity

  **Homework 1 (short) due Monday March 23rd**

  Reading for the week: Shadish, Cook and Campbell: Chapters 1-3 (selections), on Blackboard

- **Lecture 4** Wednesday March 25. Data: sources and types. Review of panel data regression

  **Homework 2 (Regression analysis of experiments - Stata) due Friday March 27th**

  Recitation 2. Friday March 27. Review of panel data regression in Stata.

Week 3

1. **Lecture 5** Monday March 30 Quasi-experiments.

   Readings TBA, depending on student policy interests
2. **Lecture 6** Wednesday April 1 Before-after and difference-in-differences estimation


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**Week 4**

1. **Lecture 7** Monday April 6 Difference-in-differences estimation. Examples

   **Homework 3 (Difference in differences reading questions or mini project due)**

2. **Lecture 8** Wednesday April 8 Review. Measurement error, proxy variables, simultaneity bias.

   **Homework 4 (Difference in differences in Stata) due Friday April 10th**

   Recitation 4. Friday April 10. Quiz, closed book/notes, covering material up to and including Monday April 6

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**Week 5**

- **Lecture 9** Monday April 13 Instrumental variables estimation: model and assumptions. Examples

  Readings TBA, depending on student policy interests

- **Lecture 10** Wednesday April 15 Instrumental variables estimation: sampling distribution of the 2SLS estimator

  Recitation 5. Friday April 17 Instrumental variable estimation in Stata

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**Week 6**

- **Lecture 11** Monday April 20 Instrumental variables estimation: instrument validity. Examples

  **Homework 5 (Instrumental variables reading or mini project) due Monday April 20**

- **Lecture 12** Wednesday April 22 Regression discontinuity designs: theory and examples

  Readings TBA, depending on student policy interests

- **Friday Homework 6 (Instrumental variables in Stata) due Friday April 24**

  Recitation 6, Friday April 24 Regression discontinuity estimation in Stata

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**Week 7**

- **Lecture 13** Monday April 27 Regression discontinuity designs: examples

  **Homework 6 (Regression discontinuity reading or mini project due) due Monday April 27**

- **Lecture 14** Wednesday April 29 Matching estimators (if time). Review.

  Recitation 7, Friday May 1. Review for final exam

**Monday May 4th** **Homework 7 (Regression discontinuity in Stata) due Monday May 4th**

**Final exam, during finals week**
7 Course Policies

- **Class presence and participation** points are given to encourage your active class participation. You will be rewarded with a perfect score as long as you frequently come to class and actively contribute to the class discussion during recitations and lectures.

- **Use of technology in the classroom**: Research on learning shows that unexpected noises and movement divert people’s attention, which means you are affecting everyone’s learning experience if your cell phone, pager, laptop, etc., makes noise or is visually distracting. For this reason, I ask you to turn off your mobile devices and close your laptops during class. Lectures will be geared on getting you to understand fundamental concepts. Lecture notes will be made available and you will focus on implementing lecture material in Stata during recitations, therefore you will lose little by not having laptops.

- **Late homework policy**: If for some substantial reason you cannot turn in your homework on the due date you should contact me prior to the due date. You will only be eligible for 85% of the total points if the homework is one day late, 70% if the homework is two days late. No homeworks will be accepted two days after the due date.

- **Exams**: Exams are closed book. Answers on exams must reflect your work alone. Cheating on exams will at a minimum result in a zero exam score, and may result in termination of your enrollment at CMU. All suspected incidents will be recorded with Heinz College administration at the same time the student is notified.

- **Homework**: Discussion among individual students about assignments is permitted and encouraged. However, the completed assignment must be your own work. The derivations, estimation results, and descriptions cannot be copied from another person or any other source. While the final answers to mathematically based homework problems are often very specific, the exact details of how a derivation or calculation is completed will vary from student to student. The same applies to the presentation and interpretation of statistical results. Submissions where these details are identical or nearly identical, either among students or with another source, will be regarded as cheating. The minimum sanction for copying or other forms of cheating on a homework assignment is the loss of credit equal to two assignments, and sanctions may range up to the termination of your enrollment at CMU. All suspected incidents will be recorded with Heinz College administration at the same time the student is notified.