

## GRADUATE CAUSAL INFERENCE AND RESEARCH DESIGN: SYLLABUS

Course code: Economics 5v98-02

Term: Spring 2015

Location: Cashion 408

Time: 2:00 - 3:15pm

Website: [http://business.baylor.edu/scott\\_cunningham/Causal\\_inference.html](http://business.baylor.edu/scott_cunningham/Causal_inference.html)

Instructor: Prof. Scott Cunningham  
Department of Economics  
Baylor University

Text: 254-537-2239

Email: [scunning@gmail.com](mailto:scunning@gmail.com)

Office: Hankamer 365

Office hours: Tuesday/Thursday 8:30-10:00am, or by appointment

### COURSE DESCRIPTION

This class introduces students to the modern theory of “causal inference” which can be traced back to the randomized experimental framework developed by Ronald Fisher, the “potential outcomes” model by Donald Rubin, and the causal graphical models developed by Judea Pearl. Confusion between correlation and causation can be costly, regardless of whether it is an individual, a firm or a public agency making the error.

The class is a very hands-on course. Students will learn to write programs in the econometrics software package, STATA, in addition to learn the numerous research designs economists and statisticians have developed to estimate causal inference when experiments are not feasible. Students will also develop an understanding of the mathematics of causal inference embedded in directed acyclical graphical models. We will cover matching estimation, linear and nonlinear regression models, panel methods, differences-in-differences, synthetic control, instrumental variables and regression discontinuity. The majority of the class will focus on selection bias and treatment assignment.

### COURSE OBJECTIVES

The primary objective of this course is for students to understand the difficulty in inferring causality in social scientific research. Complementary course objectives consist of:

- achieving competency in identifying causal effects using directed acyclical graphical models;
- implementing a variety of econometric tools and research strategies for causal inference;
- developing programming skills (in the statistical software package Stata)

### COURSE OUTCOMES

Course objectives are measures via the course assignments which assess acquired substantive knowledge and analytical ability via written work. See below under “Coursework, Grades, and Grading Policies”.

### CREDIT

Students will be evaluated based on two midterm, four homework assignments, four replications, and a research paper.

## TEXTBOOKS

The required texts are:

Morgan, Stephen L. and Christopher Winship. 2014. Counterfactuals and Causal Inference: Methods and Principles for Social Research. Cambridge University Press.

You can purchase it online here:

<http://www.amazon.com/gp/product/1107694167/>

and:

Angrist, Joshua and Jorn-Steffen Pischke, 2008. Mostly Harmless Econometrics: An Empiricist's Companion Princeton University Press, 1st edition.

You can purchase it online here:

<http://www.amazon.com/Mostly-Harmless-Econometrics-Empiricists-Companion/dp/0691120358>

All other readings are available online, either through a link to an electronic journal or through library e-reserve. Links will be distributed to students via the instructor's course website as the semester progresses. Some of the readings are technical pieces from economics journals. The degree to which a student needs to be familiar with the details of a paper will be clear from the emphasis given to the paper in lecture.

## COURSEWORK, GRADES, AND GRADING POLICIES

Graduate credit is weighted equally across midterm 1, midterm 2, replication projects and an original research project:

- Midterm 1 (20%)
- Midterm 2 (20%)
- Problem sets and replications (40%)
- Research Project (20%)
  - Step 1: Email me the paper topic (5 points) – **February 5th**
  - Step 2: Outline the research question and research design (5 points) – **February 19th**
  - Step 3: Obtaining data set, summary statistics table, figures and a regression (5 points) – **March 5th**
  - Step 4: Rough draft of paper (5 points) – **April 30**
  - Project: Final draft of paper (out of 80 to 100 points) – **May 7th**

## EXAMS (40%)

The exams may cover any material from the assigned readings in the text, as well as any additional material that I cover in lecture, including any articles I cover in class. Students will be excused from the midterm exams only for valid medical or family emergencies. These excuses must be identified before the midterm and students must produce signed evidence verifying the reason why they cannot attend. If it is missed for a valid reason, weight will be reassigned from the other exams; otherwise, zero credit will be given.

The first exam is scheduled for **March 5**. The final exam is **TBA**. The final exam will cover material from the entire semester. No makeup final exams will be allowed. If you will not be available during this time, please enroll in another course.

Students may ask that an exam be re-graded if they feel that a mistake has been made, by giving me a request in writing explaining their reasoning. The entire exam will be regraded and, after re-reading the exam, the grade may rise or fall. Of course, if a simple mistake has been made in adding up points, students should bring this to my attention and the grade will be changed.

## REPLICATIONS (40%)

You will be required to replicate 3-4 papers over the course of the semester. You will be given minimal to moderate guidance so I strongly encourage that you work in groups. In some cases, I have not personally replicated the paper and in other cases I have several times. This is a very hands-on course, and students will be required to learn STATA, an econometric package available for purchase. A student version is available through STATA Gradplan for \$69, or students can use the version installed in the computer labs. Please contact Stata directly at the following url if you are interested in purchasing your own copy.

- <http://www.stata.com/order/new/edu/gradplans/campus-gradplan/>

I will be hosting weekly **voluntary** Stata labs wherein I will teach you the basics of Stata. Attendance is purely voluntary. Stata Corp. has a list of excellent web-based tutorials for learning how to use Stata:

- <http://www.stata.com/links/resources1.html>

## RESEARCH PROJECTS (20%)

In addition to the midterm and replication, students are required to produce an original work showcasing the application of these methods to a social science or policy question. There are five dates associated with this assignment: email me a paper topic (2/5/15), outline a research question, with DAGs and a research design (2/19/15), Obtaining a dataset, producing summary statistics in a table, and at least one regression (3/5/15), a rough draft of the paper (4/30/15) and the final draft (5/7/15).

The final draft is out of 100 points. But for each of the intermediate steps that you complete, I will subtract 5 points from the total. So if you do all four intermediate steps, that's 20 points subtracted from the total and your final grade would be out of 80 points only.

## CLASS PARTICIPATION

If you miss more than 7 classes, Baylor policy requires that I fail you. In addition to being physically present, I expect students to come to class mentally prepared.

## ACADEMIC HONESTY

All students must be familiar with and abide by Baylor's Code of Academic Conduct, which is available online at <http://www.baylor.edu/honorcode/index.php?id=44060>. I take matters of academic honesty very seriously. A student who commits academic dishonesty disrespects the hard work of his classmates. Any student found cheating, plagiarizing, or colluding during the course will be referred to the Associate Dean. If you fall behind in your coursework and even feel tempted to be dishonest, please see me first so that we find a way for you to turn in your work late (but with some penalty). That said, students are encouraged to study together and to collaborate on homework, although each student must write up her own homework.

## TENTATIVE SCHEDULE AND TOPICS

The following is a rough outline of the topics we will cover in class:

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- Statistics review, linear regression, conditional expectation function
- Potential outcomes model, directed acyclic graphical modeling
- Selection on observables: back-door criterion
- Selection on observables: regression, stratification, propensity score matching, covariate matching
- Selection on observables: ordinary least squares

- Selection on observables: regression discontinuity design
- Selection on unobservables: panel methods, differences-in-differences, triple differences, synthetic control
- Selection on unobservables: instrumental variables, heterogenous treatment effects, LATE
- Selection on unobservables: partial identification, bounded estimates of ATE, Manski
- Selection on unobservables: front-door criterion, mechanisms
- Other topics (remainder)