University of California, Davis
Agricultural and Resource Economics
ARE 106: Econometric Theory and Applications
Summer Session II, 2018 (8/6 - 9/12)

Instructor:	Pierce Donovan	donovan@ucdavis.edu
Class:	Wellman 119	MTW 2:10 - 3:50 pm
Office Hours:	SSH 2136	TW 11:00 am - 12:00 pm
		R 9:00 am - 10:00 am
TA:	Bret Stevens	bdstevens@ucdavis.edu
Discussion:	Bainer 1132	R 2:10 - 3:50, 4:10 - 5:50 pm
Office Hours:	SSH 2136	M 11:00 am - 1:00 pm

Course Description

In this course, you will learn how to conduct basic empirical work in economics. To build an understanding of proper *research design*, we will explore common methods in modern econometrics through example. The course focuses on regression analysis, a tool that allows us to control for confounding factors embedded in real-world data and isolate causal effects. In my mind, there is no course more valuable in the Managerial Economics major. I aim to provide an exciting take on an interesting field while supplying you with the tools to become successful analysts.

Good econometric work is different from other data sciences because it involves *clear, causal thinking*. Many of the questions worth asking require careful and creative analysis in order to uncover the effect of interest. Do smaller class sizes promote better student performance? Can city air quality be improved by implementing driving restrictions? How does increased police presence affect crime rates? During this course you will begin to understand how to answer questions like these in a convincing manner.

Prerequisites (a healthy attitude)

ARE 100A and STA 103. The latter lays the mathematical foundation for this course, and some of the material will be extensively used here. Success in this course will in no small part be due to your mastery of the concepts learned in STA 103.

This course covers a lot of material in 6 weeks. Do not expect to understand everything immediately. I recommend reviewing your notes and the textbook daily. Come to office hours, often. Sometimes it will help to see the material from another point of view.[†] This course is rewarding only if you are willing to put in the effort.

[†]Google is very useful here. Wikipedia is a great starting point for reviewing the math and statistics in the course. StackExchange provides some invaluable discussion on some of the harder concepts.

Communication

Please come see me when you *start* to find things challenging. If you are having difficulties with the course, then I should be seeing you in office hours.[†] I also want to extend support for anyone wanting to go beyond the course material. I will be accessible by email as well, although I strongly prefer communicating in-person. I do not plan on answering emails late at night or on Sundays.

If you have any problems with this course or any other matters that may affect your work in this course, or you simply need someone to talk to, please contact me.

Course Website

I'll be using Canvas to upload any resources we will be using throughout the course. Readings, homework, code, and grades will be found here. I will not be uploading my notes online.

Readings

Most of our instruction will be inspired by the following book (*A&P*):

> *Mastering Metrics: The Path From Cause to Effect*, Princeton University Press, 2014
> - Joshua D. Angrist and Jörn-Steffen Pischke

The book is required for the course. You will be expected to have read the appropriate sections *before* the relevant lectures. The best way to follow along in the class is to have read the readings in advance. From time to time I will also assign journal article readings for certain lectures or homework assignments. For the reading schedule, see the course outline.

Homework

There will be five homework assignments, each due before lecture on Monday. Homework will be graded by the following Thursday. I will have each homework up at least a week in advance on Canvas. Assignments will be submitted online, via Gradescope. I encourage you to work together, although you may only *submit* each assignment in groups of two. Late homework will be accepted for 24 hours, with a 20% penalty.

The earlier assignments will be more pen-and-paper, as you will initially be [re-]building a background in probability and statistics. We will quickly move on to studying a subset of regression analysis, estimation by *Ordinary Least Squares*. Later assignments will be more empirical. These will involve reviewing past economic work by others or doing some of your own analysis. You will be learning how to use `STATA`, a powerful program for statistical analysis, in order to facilitate this work. Of course, my office hours will be available to answer coding questions as well.

[†] Bret is also an important resource. Between the two of us, we have plenty of opportunities for face-to-face help.

Examinations

Our exams will be in **100 Hunt**. The midterms will run from 2:00pm-3:30pm. The final will run from 2:00pm-4:00pm. You will not need a scantron or a calculator. Be sure to bring scratch paper if you write with a pen. Check the course outline for the relevant dates.

My exams are designed to evaluate how well you keep up with the assigned material and serve to summarize and re-emphasize important points. In preparation for each exam, I will be uploading additional problems with each homework assignment. You will find that the exams are highly correlated with the class notes and homework.

Everything is cumulative - by nature. The later topics in the course will require everything preceding. That being said, the midterms will roughly cover the 1^{st} and 2^{nd} thirds of the course, respectively. The final will cover a little bit of everything, with more focus on the later topics.

I do not plan to give make-up points, nor will there be any make-up exams. Regarding midterms, a legitimate excuse will result in an exam being removed from the computation your grade. Of course, if you have a learning disability or a physical disability that requires accommodation, please let me know as soon as possible.

Discussion

Bret's discussion sections are meant to (1) provide an opportunity for you to ask questions about anything you did not understand during lecture,[†] (2) facilitate discussion about applied econometric problems, and (3) help you build an understanding of `STATA`.

Part of discussion sections will be for evaluating econometric work. Through discussing the work of others', you will begin to understand how you might start answering questions about things that interest *you*.

Rather than watching Bret code, `STATA` is best learned by doing. Bret will provide the building blocks of `STATA` code, and you will participate in group exercises that apply code to data.

Grading

The final grade composition is as follows:

35%	Analytic / Computational Homework (x5)
30%	Midterms (x2, 1.5 hours each, on 8/15 and 8/29)
25%	Final (2 hours, on 9/12)
10%	Attendance / Participation

[†]To ensure your questions are covered, I recommend emailing Bret in advance of section.

Conduct

These are just a few things to keep in mind:

- When asking for help outside of class, please be able to show how you have approached your problem. Simply asking for an answer is not a productive use of my time or yours. I hope to facilitate real learning, and that takes effort on everyone's part.
- I will not tolerate academic dishonesty. UC Davis Academic Senate policy requires instructors to report any suspected cheating, plagiarism, or other misconduct to Student Judicial Affairs.[†]
- You do **not** have permission to take pictures of my notes or take recordings during class. I expect and encourage you to write your own notes. You do **not** have permission to publish my course materials (online or otherwise). I do not want to see my work on Course Hero.
- Please be respectful to your classmates. Refrain from talking during class if it is not relevant to lecture or discussion. Cell phone or tablet use should not detract from your ability to follow along with class. Please leave laptops at home (except perhaps on days where we will use `STATA`). No activity on your part should undermine the efforts of other students.

UC Davis is a diverse community comprised of individuals having many perspectives and identities. In order to create an inclusive and intellectually vibrant community, we must understand and value individual differences and common ground. The UC Davis Principles of Community reflect the ideals I seek to uphold in this class.[††]

[†]Read the UC Davis Code of Academic Conduct, here.

[††]Read the UC Davis Principles of Community, here.

Course Outline

(8/6) Week 1: Randomized Trials

Lecture 1: Background Probability and Statistics (Monday)

A&P: Intro

Concepts: random variable, random sampling, probability distribution, parameter, estimator, law of large numbers, expectation, unbiasedness, variance, standard deviation, covariance

Lecture 2: Statistical Inference (Tuesday)

A&P: Chapter 1 Appendix

Article: NYT analysis of the Nike Vaporfly (link: NYT)

Concepts: sampling variance, standard error, the central limit theorem, t-statistics, confidence intervals, p-values, hypothesis testing and statistical significance

Lecture 3: Randomized Trials (Wednesday)

A&P: Chapter 1

Concepts: potential outcomes, counterfactuals, selection bias, random assignment, treatment and control groups, dummy variables, conditional expectation, average treatment effects

Discussion: Applications of Randomization (Thursday)

(8/13) Week 2: Regression

Lecture 4: Regression Anatomy (Monday)

Homework #1 due.

A&P: Chapter 2 Appendix

Concepts: curve-fitting, residuals, the least-squares estimator, Gauss-Markov assumptions

Lecture 5: Causal Thinking and Regression (Tuesday)

A&P: Chapter 2

Concepts: selection on observables, omitted variables bias, causal vs control variables

Exam 1: First Midterm (100 Hunt, 2:00pm-3:30pm) (Wednesday)

Discussion: Introduction to `STATA` (Thursday)

(8/20) Week 3: Forward Unto Regression

Lecture 6: "Real" Models (Monday)

Homework #2 due.
A&P: Chapter 2, Chapter 2 Appendix
Article: Speeding, Coordination, and the 55 MPH Limit (Lave, 1985)
Concepts: structural vs reduced-form modeling, internal/external validity

Lecture 7: Tougher Models (Tuesday)

A&P: Chapter 2, Chapter 2 Appendix
Concepts: data types, identifying variation, log models and percent changes, interaction variables and heterogeneous effects, polynomials and non-constant effects, fixed effects

Lecture 8: Instrumental Variables (Wednesday)

A&P: *Skim* Chapter 3
Concepts: "partialing out" procedure, instrument, proxy variable, two-stage least squares, exclusion and independence of an instrument

Discussion: Developing Research Questions (Thursday)

(8/27) Week 4: Regression Discontinuity Design

Lecture 9: RD One: Sharp (Monday)

Homework #3 due.
A&P: Chapter 4
Concepts: running variable, threshold, discontinuity, bandwidth, "local randomization," local linear regression, local treatment effect, quasi experiment

Lecture 10: R_2D Two: Fuzzy (Tuesday)

A&P: Chapter 4
Concepts: "ocular" econometrics, imperfect treatment, "fuzzy" RD

Exam 2: Second Midterm (100 Hunt, 2:00pm-3:30pm) (Wednesday)

No discussion on Thursday. (AKA 5-day weekend)

(9/3) Week 5: Differences-in-Differences

No lecture on Monday. (Labor Day)

Lecture 11: DD One: Theory (Tuesday)

Homework #4 due.
A&P: Chapter 5
Concepts: common (parallel) trends, interaction variables, time effects, clustered errors

Lecture 12: DD Two: Examples (Wednesday)

A&P: Chapter 5
Article: Racial Discrimination among NBA Referees (Price and Wolfers, 2010)
Article: Cool to be Smart or Smart to be Cool? Understanding Peer Pressure in Education (Bursztyn, Egorov, and Janzen, 2017)
Concepts: natural experiments, thoughtful research design

Discussion: Applications of RD and DD (Thursday)

(9/10) Week 6: Clean-up

Lecture 13: Maximum Likelihood Estimation and Logistic Regression (Monday)

Homework #5 due.
Concepts: maximum likelihood, categorical dependent variables, logistic function, odds, predicting probabilities

Lecture 14: Final Exam Review (Tuesday)

Concepts: Literally Everything.

Exam 3: Final Exam (100 Hunt, 2:00pm-4:00pm) (Wednesday)