

Econometric Methods for Causal Inference (EPI 268)

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Office hours: By appointment

Class time: Wednesdays, 9:30 – 12:00pm

Class location: Mission Hall, Room 1407

Units: 2 or 3

Course description

Epidemiologists and clinical researchers are increasingly seeking to estimate the causal effects of health-related policies, programs, and interventions. Economists have long had similar interests, and have developed and refined methods to estimate causal relationships. Examples include difference-in-differences, instrumental variables, and regression discontinuity. This course introduces a set of econometric tools and research designs in the context of health-related questions. The course topics are especially useful for evaluating natural experiments—situations in which comparable groups of people are exposed or not exposed to conditions determined by “nature” (not by a researcher), as occurs with a government policy or a disease outbreak.

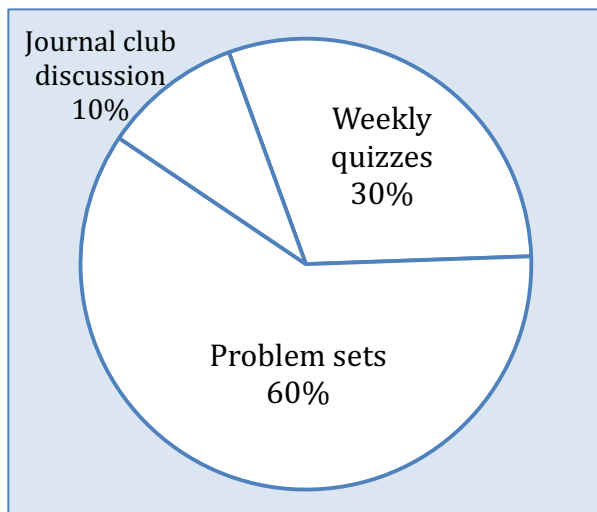
Prerequisites: Biostat 200, Biostat 208, EPI 203, or equivalent experience. Experience with Stata.

Objectives

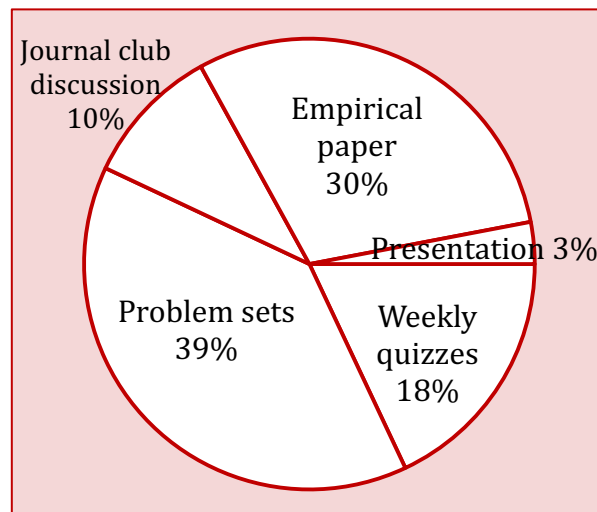
- Identify opportunities for rigorous evaluation of natural experiments
- Enumerate the (oft unstated) assumptions involved in interpreting research that aims to draw causal inferences
- Implement the research techniques covered in class

Requirements

2 Units



3 Units



Weekly Quizzes

Quizzes will be completed online, typically due seven days after each class. Late quizzes will not be graded except in extraordinary circumstances. The main purpose of the quizzes is to ensure that you have completed and understood the content of the assigned readings and in-class lecture for that week. You may *not* work on the quizzes with others.

Problem Sets

There are three problem sets, each due at the beginning of class on the due date. Late assignments will not be graded except in extraordinary circumstances. Assignments may be handwritten or typed, but must be legible. You can work with others, but each student must turn in their own assignment, and must acknowledge intellectual contributions of anyone who has assisted them.

Journal Club Discussion

Each student will be responsible for facilitating class discussion about one assigned reading. The student will be graded on his/her ability to stimulate discussion about the strengths and limitations of the paper, with focus on the paper's strategy for identifying causal effects, analytic framework, and presentation of results. The discussion leader should schedule a meeting with the instructor prior to class, in order to review the article and key points for discussion. During all journal club sessions, each student is expected to have read the article before class and to participate during the discussion.

Original Empirical Paper (3-unit option only)

The paper will be based on a topic of your choice, using data of your choice, and should apply a technique covered in this class. You are encouraged to discuss your paper with others, but as always you must acknowledge any intellectual contributions made by others. See the Moodle course page for more detailed guidelines. Extra class sessions will be offered to help students in the 3-unit option to develop an empirical paper. A one-page proposal for the paper is due by email on February 13. The final paper is due by email on March 20.

Presentation of Empirical Paper (3-unit option only)

Students who elect the 3-unit option will give a 20-minute presentation about their empirical paper during class on March 13. The presentations will include a brief study motivation, review of the methods, and (preliminary) findings. The presentations offer an opportunity for the presenter to receive feedback on the study design and interpretation of the findings.

Readings

Each week you will be assigned one or more textbook chapters or a summary article and an empirical paper that applies the method under study. You are encouraged to complete these readings *prior* to class on the day they are listed.

Required Textbook

- [Abbreviated MM below] Joshua Angrist and Jörn-Steffen Pischke (2015). Mastering 'Metrics: The Path from Cause to Effect. Princeton University Press.

Additional Textbooks

- Guido W. Imbens and Donald B. Rubin (2015). Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction. Cambridge University Press. (The most thorough and current statement of potential outcomes models for causal inference.)
- Joshua Angrist and Jörn-Steffen Pischke (2009). Mostly Harmless Econometrics. Princeton University Press. (The more mathematically advanced companion to Mastering 'Metrics.)
- Jeffrey M. Wooldridge (2013). Introductory Econometrics: A Modern Approach, 5th Edition. South-Western College Publishers. (A thorough, introductory treatment of a broad range of econometric applications.)
- Peter Kennedy (2008). A Guide to Econometrics, 8th Edition. Wiley-Blackwell. (Intuitive feel for econometric concepts, alongside more technical discussion.)
- A. Colin Cameron and Pravin Trivedi (2009). Microeconometrics Using Stata. Cambridge University Press. (A useful, though aging, primer on using Stata for econometrics; the book also has parallel content to the authors' textbook Microeconometrics.)
- Partha Deb, Edward C. Norton, Willard G. Manning (2017). Health Econometrics Using Stata. Stata Press. (Overview of a variety of econometric modeling approaches in Stata, including many not covered in this course, e.g., GLM, count models, and a mass at zero.)

Guidelines for Requesting Accommodations and Leave

If you wish to be evaluated for classroom accommodations due to a disability, medical condition, or pregnancy-related medical condition, please contact the Student Disability Services Office (sds.ucsf.edu) or HR Disability Management (hr.ucsf.edu) to review the process for requesting accommodations. If you have been approved for accommodations, please request a letter be sent to me detailing the accommodations. For parental- or pregnancy-related accommodations and leave, please contact your program director to develop a plan with respect to coursework.

Course Schedule

Jan 9: Causal Inference and Regression

Topics: course introduction, RCTs as gold standard, potential outcomes framework, conditional expectation function, regression notation, regression mechanics, interpreting coefficients and effect sizes

Required reading: MM, Intro, Ch. 1, 2

Further reading: Holland (1986); Imbens, Rubin (2015), Ch. 1-3; Rubin (1986)

Jan 16: Regression Adjustment and Nonparametric Regression

Topics: regression adjustment, omitted variable bias, nonparametric regression, introduction to Stata, Monte Carlo simulation (bias analysis)

Required reading: Freedman (1991); Baum (2011); Baum (2007)

Further reading: Arnold et al. (2011); Kennedy (2008), Ch. 2

Jan 23: **The Propensity Score and Matching Methods**

Topics: Estimating the propensity score, assessing overlap, propensity score regression, propensity score blocking, inverse probability weighting, alternative matching estimators

Journal club #1

Required reading: Stuart (2010); Prochaska et al. (2016)

Further reading: Gum et al. (2001); Hirano, Imbens (2001); Imbens (2015); King, Nielsen (2018)

Jan 30: **Difference-in-Differences I**

Topics: introduction to panel data, difference-in-differences analysis, DiD assumptions, clustering standard errors in DiD

Required reading: MM, Ch. 5.1; Rajaram et al. (2014)

Further reading: Bertrand, Duflo, Mullainathan (2004); Wherry, Miller (2016); Ryan, Burgess, Dimick (2015)

Feb 6: **Difference-in-Differences II**

Problem set #1 due

Topics: DiD analyses in Stata, triple differences estimator, case studies with synthetic controls

Journal club #2

Required reading: Joyce (2009); Rudolf et al. (2015)

Further reading: Abadie, Diamond, Hainmueller (2010); Basu et al. (2016); Gruber (1994)

Feb 13: **Fixed Effects**

Empirical paper proposal due

Topics: dummy variable version, first difference estimator, deviations from means estimator, fixed effects vs. random effects, specification tests

Journal club #3

Required reading: MM, Ch. 5.2; White et al. (2016)

Further reading: Allison (2009), Ch. 2; Colen, Ramey (2014); Currie, Thomas (1995); Cylus, Glymour, Avendano (2014); Frankenberg (1995); Wooldridge (2013), Ch. 13, 14

Feb 20: **Instrumental Variables**

Topics: IV intuition, IV assumptions, two-stage least squares, local average treatment effects, IV specification testing

Journal club #4

Required reading: MM, Ch. 3; Angrist (1990)

Further reading: Angrist, Imbens, Rubin (1996); Baiocchi, Cheng, Small (2014); Glymour, Tchechen Tchechen, Robins (2012); Harris, Remler (1998); McClellan, McNeil, Newhouse (1994); Pizer (2015)

Feb 27: **Regression Discontinuity Designs I**

Problem set #2 due

Topics: RD graphical intuition, forcing variable, sharp RD, sharp RD estimation

Required reading: MM, Ch. 4.1; Bor, Moscoe, Bärnighausen (2015); Hansen (2015)

Further reading: Green et al. (2009);

Mar 6: **Regression Discontinuity Designs II**

Topics: Fuzzy RD, fuzzy RD estimation, RD specification testing, RD in Stata

Journal club #5

Required reading: MM, Ch. 4.2; Lee, Lemieux (2010); Miller, Pinto, Vera-Hernandez (2013)

Further reading: Card, Dobkin, Maestas (2009); Imbens, Lemieux (2009)

Mar 13: **Student Presentations**

Mar 20: *Problem set #3 due*

Empirical paper due

References

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