PS133: Special Topics in Quantitative Methods: Applied Computational Tools and Techniques for Causal Research

Alex Stephenson

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Class Information

Instructor: Alex Stephenson

Instructor Email: alexander [_] stephenson [at] berkeley [dot] edu

Course Site: bCourses

Class Room: Lewis Hall 9

Class Hours: MWF 1000-1100

Course Description

This course will focus on the practical application of research methods for political science. In this course, we will take on two major tasks:

1. How can we implement standard research designs found in political science research? The research aims of scholars are varied, but all research requires a strong research design. This class will examine several topics in research design and causal inference, emphasizing how to implement these techniques in practice.

2. How can we communicate our results so that others can reproduce what we have done? Successful research programs rely on the ability of others to scrutinize claims. This course will cover methods to explain our results to others in a transparent manner and strategies for visualizing research results.

By the end of the course, students will feel comfortable with the foundational tools of causal inference. They will also learn how to code these techniques in their research.

Objectives

By the end of this course, students should be able to meet the following conceptual objectives:

- Describe the essential elements of and primary threats to causal inference and identify how these threats could change the conclusion of a research project.

- Demonstrate the ability to evaluate the credibility of a modern empirical paper's research design.

- Demonstrate competence in writing code to replicate core research designs.

This course heavily makes use of R to implement all of the topics that we discuss. That said, this is not a computer science or data science course. We recognize that not everyone has the same programming background or familiarity with R. The course is designed to be as self-contained as possible. The use of code is to solidify our understanding of conceptual topics. That means if you have never programmed before, we will teach you what you need to be successful in this course. We hope that this class will make you excited to further expand your skills on your own or through future coursework.

Each conceptual topic in class will be paired with computational implementation by students. By the end of the semester, students will be able to meet the following computational objectives:

- Demonstrate familiarity working with common data structures (such as a data frame or a matrix) in R.

- Demonstrate the capability to implement different research designs using simulated and actual data in R.

- Demonstrate understanding of typical data wrangling workflows in R for research projects.

Grading

Grades in this course are earned by **demonstrating evidence of skill on the main concepts in the course** and showing appropriate engagement throughout the semester. Students demonstrate evidence of skill by completing the assignments outlined here at a reasonably high level of quality.

Your instructor has long been flummoxed by the fact that learning comes through mistakes, but most course grading systems do not allow for errors. Your instructor has also observed that such a state of affairs means that students often avoid challenging themselves because doing so usually results in a lower grade than playing it safe.

To that end, evaluation in this course is likely different from other courses you have had at Berkeley. In our class, **there are no points** on any items. Instead, we will evaluate the work you turn in against rubric standards made clear for each assignment. If work meets the standard, that work gets full credit. If work does not meet the standard, the student will receive clear feedback from the instructors and, unless specified otherwise, the chance to reflect on that feedback, revise your work, and then resubmit the assignment for re-grading.

We assume, and frankly hope, that students make mistakes because only through making mistakes, reflecting on those mistakes, and then correcting them do we learn. We learn new skills, retain that information, and transfer what we know to new domains through deliberate effort. Therefore, **students can make mistakes without penalty** as long as they eventually demonstrate evidence of the evaluated skill.

Assignments in this course as marked as follows:

Assignment	Marks
Weekly Practice	EMRN
Problem Sets	EMRN
Check-ins	P/NP

The criteria for each mark are explained in Evaluation Schemes. If any of this changes during the course, I will do it to favor students.

The following table determines students' final grades for the course. Grades are given for the highest grade level for which *all* the requirements in a row of the table have been met or exceeded. In other words, to earn a grade, a student needs to meet *all* the requirements in the row for that grade.

Grade	Weekly Practice	Problem Sets	Check-ins (P)
A	10 + with at least 7 E	5 ($\geq 3E$)	13
B	9 with at least 5 E	4	10
C	8	3	7
D	5	2	5

A grade of F is given if *none* of the rows have been fully completed.

Plus/Minus grades within grade bands will be assigned at the instructor's discretion based on how close a student is to the next highest grade level. For students concerned about this at the outset of the semester, the best way to get the next half grade up is to show up and put forth a good-faith effort. Students that make other students' experiences better will be rewarded.
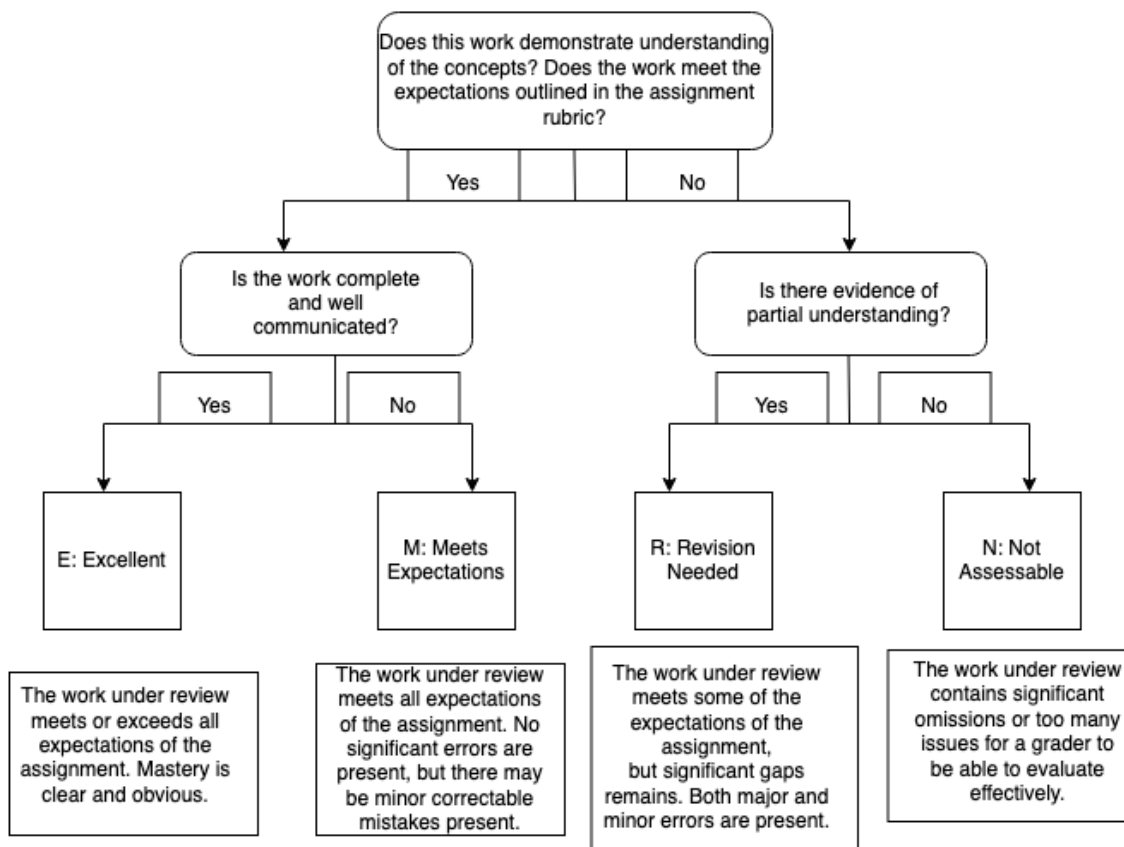
Work Revision Policy

The revision must be turned back in with seven days of receiving an initial grade for all work revision eligible assignments. Work revisions will be specific to the assignment. This includes the number of total resubmits allowed. In general, P/NP assignments will require students to submit a self-assessment with corrected solutions and explanations for each problem that they missed. In general, EMRN work will require the same self-assessment as before and that the student solve a new but similar type of problem that the student missed. For section assignments, the same holds true, except that students can choose to submit individually or as a team.

Evaluation Schemes

There are two grading schemes in this class.

EMRN

All assignments with EMRN grading have individual rubrics for acceptable work. EMRN grading follows the flowchart below.

Does this work demonstrate understanding of the concepts? Does the work meet the expectations outlined in the assignment rubric?

- Yes → **Is the work complete and well communicated?**
  - Yes → **E: Excellent** — The work under review meets or exceeds all expectations of the assignment. Mastery is clear and obvious.
  - No → **M: Meets Expectations** — The work under review meets all expectations of the assignment. No significant errors are present, but there may be minor correctable mistakes present.
- No → **Is there evidence of partial understanding?**
  - Yes → **R: Revision Needed** — The work under review meets some of the expectations of the assignment, but significant gaps remains. Both major and minor errors are present.
  - No → **N: Not Assessable** — The work under review contains significant omissions or too many issues for a grader to be able to evaluate effectively.

EMRN assignments are not eligible for revision if the work demonstrates clearly insufficient effort or if the work misses a deadline. Students are welcome to clarify with the instructor what clearly insufficient effort looks like if they are unsure.

P/NP

A Passing grade (P) is given if the work is turned in by its deadline and if each part of the assignment has a response and the responses are correct. A No Pass (NP) is given if some part of the assignment is incorrect. P/NP assignments are not eligible for revision if the work demonstrates clearly insufficient effort or if the work misses a deadline. Students are welcome to clarify with the instructor what clearly insufficient effort looks like if they are unsure.

Course Policies

Attendance

While conceptually possible to do well in this course without attending a single meeting, it is highly improbable. Students should plan to attend all classes and participate actively in each class meeting to get the most out of the course. Attendance will be noted but not graded. Students with an excessive number of absences will struggle to get a good grade in this class.

Religious Observances

This fall has a large number of religious holidays. If you plan to observe a religious holiday, even if it is not typically one in the course schedule, please see me as soon as possible.

Deadlines

As stated policy: Deadlines are strictly enforced absent a University exception. We will not accept late work in part because of the revision policy stated above.

As subtext: students have many legitimate exceptions for completing an assignment on time that may not be a University exception. Suppose a student believes they qualify for an exemption on an assignment. In that case, it is the student's responsibility to reach out to the instructor ASAP (preferably far before the deadline) to discuss. Exemptions in this regard are granted on a case-by-case basis.

Academic Success

My goal for this class is to help each student get the grade they want to earn in this class. I firmly believe that all students are capable of high achievement, but I will respect each student's choice in the level of effort they choose to exert in my class. If there is something that a student needs to succeed, please let me know in a format that feels comfortable to you.

Email Policy

I will endeavor to answer all emails within 72 hours. If I have not responded to an email in that interval, please send me a follow-up email. If your query is answered in this syllabus, my reply will simply direct you to the syllabus.

Students often send email communication that is overly formal or unnecessarily informal. In the spirit of unsolicited advice for communicating with your instructors, when in doubt, use the email template below:

Dear *Professor X/How the person you're emailing you instructs you to begin salutations*,

Insert line recognizing our common existence if you so choose

One sentence specifying what class you're in and section if relevant. Insert your specific question here. Insert a sentence indicating what resources you've consulted if the question is administrative.

Insert a sentence letting me know what action you'd like me to take.

Some form of salutation. Best and/or Thanks tend to be the norm. Insert your name as you'd prefer to be called.

An example of this template in action:

Dear Professor X,

I hope this email finds you well.

I'm in PSXXX Section 1. Would you be willing to write me a letter of recommendation for a scholarship opportunity on campus? I consulted the syllabus and did not see if you had a specific policy about letters of rec.

Could you please let me know if you are willing to do so, and if so, what information I will need to provide.

Thanks,

[Your name]

Office Hours

Office hours are a chance for students to engage one-on-one or in smaller groups with the professor or GSI. Students can use this time to clarify class materials, ask questions about challenging parts of the course or inquire about future opportunities such as graduate schools, jobs, or internships. While not causal, your instructor has observed a strong positive correlation between students who regularly attend office hours and academic success. To get the most out of office hours, consult the link here.

Academic Integrity

Students are expected to know and abide by the University's policies on Academic Integrity. Should a student be uncertain about this policy, consult university resources. Any cases of documented plagiarism will result in a failing grade for the course.

Academic Accomodations

We are committed to creating a learning environment that meets the needs of all students. Students who have or think they may have a disability can work with the Disabled Students' Program (DSP) to request an official accommodation. DSP (dsp.berkeley.edu) is the campus office responsible for authorizing disability-related accommodations. DSP's on-campus office is located at 260 César Chávez Student Center.

Please see me as soon as possible for all other accommodation questions.

Berkeley offers additional student resources for students needing additional support. See the links below:

Basic Needs Center (Food and Housing): http://basicneeds.berkeley.edu/

Counseling and Psychological Services: https://uhs.berkeley.edu/counselingD

Student Technology Equity Program: https://technology.berkeley.edu/STEP

Course Schedule

Below is a living schedule. We will not cover more than what is listed, but we may cover much less if the material is too fast-paced.

Part 1: Foundations

Week 1: Research Design

Week 2: Potential Outcomes and Estimands

No class on Monday, September 6

Week 3: Why Randomize/Statistical Review

Week 4: Regression

Week 5: Regression

Part 2: Experiments

Week 6: Ideal Experiments

No section on September 29. No class on October 1

Week 7: Field experiments

Week 8: Dealing with Noncompliance

Part 3: Observational Studies

Week 9: Selection on Observables

Week 10: Fixed Effects

Week 11: What is a "Natural" Experiment

Week 12: Regression Discontinuity Designs

Week 13: Instrumental Variables

Week 14: Difference in Differences

No class on November 25.

Likely Readings

Week 1: Research Design

Lundberg, Ian, Rebecca Johnson, and Brandon M Stewart. 2021. "What Is Your Estimand? Defining the Target Quantity Connects Statistical Evidence to Theory." American Sociological Review: 34. https://doi.org/10.1177/00031224211004187

Week 2: Potential Outcomes and Estimands

Testa, Paul. 2021. "10 Types of Treatment Effect You Should Know About." EGAP. https://egap.org/resource/10-types-of-treatment-effect-you-should-know-about/ (August 8, 2021).

Week 3: Why Randomize/Statistical Review

Cunningham, Scott. 2021. Causal Inference: The Mixtape Chapter 2. New Haven: Yale University Press. https://mixtape.scunning.com/probability-and-regression.html

Week 4: Regression

Morgan, Stephen L., and Christopher Winship. 2014. Counterfactuals and Causal Inference: Methods and Principles for Social Research Chapter 6. 2nd ed. Cambridge: Cambridge University Press. http://ebooks.cambridge.org/ref/id/CBO9781107587991 (September 8, 2020).

Week 5: Regression

Wilfahrt, Martha. 2018. "Precolonial Legacies and Institutional Congruence in Public Goods Delivery: Evidence from Decentralized West Africa." World Politics 70(2): 239–74. https://www.cambridge.org/core/journals/world-politics/article/abs/precolonial-legacies-and-institutional-congruence-in-public-goods-delivery/5BA3EFBDEB0981B965801B9C1DA31D64

Week 6: Field Experiments

Kalla, Joshua L., and David E. Broockman. 2020. "Reducing Exclusionary Attitudes through Interpersonal Conversation: Evidence from Three Field Experiments." American Political Science Review 114(2): 410–25. https://www.cambridge.org/core/journals/american-political-science-review/article/abs/reducing-exclusionary-attitudes-through-interpersonal-conversation-evidence-from-three-field-experiments/4AA5B97806A4CAFBAB0651F5DAD8F223

Week 7: Survey Experiments

Mattes, Michaela, and Jessica L. P. Weeks. 2019. "Hawks, Doves, and Peace: An Experimental Approach." American Journal of Political Science 63(1): 53–66. https://onlinelibrary.wiley.com/doi/abs/10.1111/ajps.12392

Week 8: Spillovers and non-compliance

Banerjee, Abhijit, Arun G Chandrasekhar, Esther Duflo, and Matthew O Jackson. 2019. "Using Gossips to Spread Information: Theory and Evidence from Two Randomized Controlled Trials." The Review of Economic Studies 86(6): 2453–90. https://web.stanford.edu/~arungc/BCDJ_gossip.pdf

Gerber, Alan S., and Donald P. Green. 2011. "Field Experiments and Natural Experiments. Parts 5-6" The Oxford Handbook of Political Science. https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199604456.001.0001/oxfordhb-9780199604456-e-050 (August 8, 2021).

Bowers, Jake, Mark M. Fredrickson, and Costas Panagopoulos. 2013. "Reasoning about Interference Between Units: A General Framework." Political Analysis 21(1): 97–124. https://www.cambridge.org/core/journals/political-analysis/article/abs/reasoning-about-interference-between-units-a-general-framework/0E2410C1A5666EE5ACA4CBE29AFFFAE7

Week 9: Selection on Observables

Imai, Kosuke, and James Lo. 2021. "Robustness of Empirical Evidence for the Democratic Peace: A Nonparametric Sensitivity Analysis." International Organization 75(3): 901–19. https://imai.fas.harvard.edu/research/files/dempeace.pdf

Week 10: Fixed Effects

Kropko, Jonathan, and Robert Kubinec. 2020. "Interpretation and Identification of Within-Unit and Cross-Sectional Variation in Panel Data Models." PLOS ONE 15(4): e0231349. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0231349

Week 11: What is a "Natural" Experiment

Titiunik, Rocio. 2020. "Natural Experiments." arXiv:2002.00202 [econ, stat]. http://arxiv.org/abs/2002.00202 (February 16, 2020).

Sekhon, Jasjeet S., and Rocío Titiunik. 2012. "When Natural Experiments Are Neither Natural nor Experiments." American Political Science Review 106(1): 35–57. https://www.cambridge.org/core/journals/american-political-science-review/article/abs/when-natural-experiments-are-neither-natural-nor-experiments/E8A67829C2EEBC429CDD671B4C9313F9

Hyde, Susan D. 2007. "The Observer Effect in International Politics: Evidence from a Natural Experiment." World Politics 60(1): 37–63. https://www.cambridge.org/core/journals/world-politics/article/abs/observer-effect-in-international-politics-evidence-from-a-natural-experiment/B72409C4FB717F72CAB765024468511F

Week 12: Regression Discontinuity Designs

Cattaneo, Matias D., Nicolás Idrobo, and Rocío Titiunik. 2019. A Practical Introduction to Regression Discontinuity Designs: Foundations. 1st ed. Cambridge University Press. https://www.cambridge.org/core/product/identifier/9781108684606/type/element (December 11, 2019).

Week 13: Instrumental Variables

van der Windt, Peter. 2021. "10 Things to Know About the Local Average Treatment Effect." EGAP. https://egap.org/resource/10-things-to-know-about-the-local-average-treatment-effect/ (August 8, 2021).

Week 14: Difference in Differences

Wing, Coady, Kosali Simon, and Ricardo A. Bello-Gomez. 2018. "Designing Difference in Difference Studies: Best Practices for Public Health Policy Research." Annual Review of Public Health 39(1): 453–69. https://www.annualreviews.org/doi/10.1146/annurev-publhealth-040617-013507