Design & Analysis of Quasi-Experiments for Causal Inference
ED PSYCH 963-001 – Fall 2025

Lecture	Tues/Thur 1:00 – 2:15 pm
Room	Educational Sciences 218
Credits	3 credits[1]
Instruction	Face-to-face

Instructor	Dr. James E. Pustejovsky (pronounced "PUHS-tea-UV-ski" or "Pusto" for short)
Pronouns	he/him/his
Office	1082C Educational Sciences
Phone	(608) 262-0842
Email	pustejovsky@wisc.edu
Office hours	TBD

Course Description

In many fields, randomized experiments are often considered the gold standard approach for learning about the causal effects of an intervention, program, or policy. However, randomized experiments are not always feasible or ethical. Furthermore, the increasing availability of large-scale observational datasets presents opportunities to investigate causal effects outside of the realm of designed experiments. This course surveys contemporary research design strategies for investigating questions about causal effects, focusing on the theory and application of quasi-experimental methods that can, under some conditions, provide strong warrants for drawing causal inferences. The focus of the course is on causal description of point-in-time interventions ("Is this intervention effective?") rather than causal explanation ("*Why* is this intervention effective?" or "What factors caused an observed change?").

The course begins with an introduction to the potential outcomes framework for expressing causal quantities, followed by an examination of (idealized) simple and block randomized experiments as prototypes for learning about causal effects. The remainder of the course covers theory and data-analysis strategies for drawing causal inferences from four quasi-experimental designs: non-equivalent control group designs (using techniques such as matching and propensity score weighting), difference-in-differences and interrupted time series designs,

[1] This class meets for two, 75-minute class periods each week over the Spring semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc) for about 3 hours out of the classroom for every class period.

instrumental variables approaches, and regression discontinuity designs. For each design, we will consider (i) the core strategy for identifying a causal effect, (ii) corresponding statistical approaches for estimating the effect, and (iii) strategies and design elements for strengthening the design. Further, advanced topics will be covered based on student interest.

Pre-requisites

- Prior training in regression analysis (such as ED PSYCH 763)
- Prior training in design and analysis of experiments (such as ED PSYCH 762)
- Experience with writing scripts/programming with at least one software platform for data management and analysis (e.g., R, SAS, Stata). You should be very comfortable doing the following in your preferred language:
    - Find a subset of a dataset (e.g., in a dataset containing the color preferences of elementary school students, find all rows corresponding to 4th grade students whose favorite color is purple).
    - Calculate summary statistics for subsets of observations (e.g., calculate the proportion of students in each grade whose favorite color is purple; calculate the mean and standard deviation of student heights by grade level).
    - Calculate new variables and add them to a dataset (e.g., create a new variable called "pinkpurple" that is equal to 1 if a student likes pink or purple and equal to 0 if the student does not like pink or purple).
    - Calculate t-tests for comparing two groups on a continuous variable.
    - Compute and interpret the output of linear regression models and logistic regression models, including models with interaction terms.

Course Learning Outcomes

After completing this course, students should be able to:

- Translate research questions into the framework of the potential outcomes model and specify causal quantities to be estimated.
- Articulate and assess the assumptions behind different strategies for estimating treatment effects and drawing causal inferences.
- Understand the conditions under which different causal inference strategies work well.
- Conduct, interpret, and defend a statistical analysis of observational data.
- Critically review published research that uses a quasi-experimental design.

Readings

- Hernán & Robins (2020). *Causal Inference: What If*. Boca Raton: Chapman & Hall/CRC. Available at https://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/
- Additional readings posted on Canvas.

Additional Recommended Resources

- Imbens & Rubin (2015). *Causal Inference in Statistics, Social, and Biomedical Sciences*. Cambridge University Press.
- Gerber & Green (2012). *Field Experiments: Design, Analysis, and Interpretation*. W. W. Norton.
- Pearl, Glymour, & Jewell (2016). *Causal Inference in Statistics: A Primer*. United Kingdom: John Wiley & Sons Ltd.
- Barrett, D'Agostino-McGowan, & Gerke (2023). *Causal Inference in R*. Available at https://www.r-causal.org/
- Cunningham (2019). *Causal Inference: The Mixtape*. Available at https://www.scunning.com/mixtape.html

Computing

In-class software demonstrations will use the R environment for statistical computing. In principle, you are welcome to complete the problem sets and exam using your choice of software. However, I am unable to provide examples, debugging help, or technical support for any software not demonstrated in class.

There are many freely available resources for learning R. Here are some:

- R: https://www.r-project.org/
- RStudio: https://www.rstudio.com/
- On-campus R Trainings:
    - https://sscc.wisc.edu/sscc_jsp/training/
    - https://www.library.wisc.edu/steenbock/2024/08/13/learn-how-to-analyze-data-using-python-and-or-r-programming-languages/
- A short online-introduction: https://pubs.wsb.wisc.edu/academics/analytics-using-r-2019
- YaRrr! The Pirate's Guide to R: https://bookdown.org/ndphillips/YaRrr/
- Princeton R tutorials: https://exploringr.princeton.edu/self-learning-resources-for-r/
- D-Lab R training: https://github.com/dlab-berkeley/R-for-Data-Science
- A guide to programming style in R: https://jef.works/R-style-guide/
- A quick introduction to using RStudio: https://cran.r-project.org/doc/contrib/Torfs+Brauer-Short-R-Intro.pdf

Evaluation

- Data analysis exercises (60%). Students will complete problem sets involving analysis of real or simulated data. The exercises will involve implementing different analytic methods and interpreting the results.
- Study presentation (15%). See below.
- Course project (25%). See below.

A tentative rubric for assignment of final grades is listed below. ***The instructor reserves the right to modify this rubric.*** Square brackets correspond to ≤ or ≥; rounded parentheses to < or >.

A	[90, 100]	C	[65, 70)
A/B	[85, 90)	C/D	[60, 65)
B	[75, 85)	D	[50, 60)
B/C	[70, 75)	F	[0, 50)

Problem sets

- Students will complete problem sets involving analysis of real or simulated data. The exercises will typically involve implementing different analytic methods and interpreting the results. Some exercises will involve reading and interpreting published studies.
- Problem sets will be submitted and graded through Canvas.

Study presentation

- Working individually or in pairs, students will give an oral presentation on a published study that uses the methods we are studying. The presentation should accomplish the following:
    - Summarize the context, methods, and main findings of the study,
    - Make connections to concepts discussed in the course, and
    - Provide a critical perspective on the strengths and limitations of the study's design and findings.
- Presentations will be scheduled in advance, with most presentations occurring towards the end of the semester.
- Students should submit their slide decks through Canvas after giving their oral presentation.

Course project

There are three options for the course project:

Option 1: Find a published study that uses one or more of the techniques discussed in the course to evaluate the causal effects of a program, policy, or intervention and for which the raw data is available (either a study that does secondary data analysis of a publically available dataset, or a study where the authors have made the raw data available through an archive or repository). Replicate the main analysis of the paper. Re-analyze the data using at least one alternative method. Critically assess the findings of the study.

Option 2: Conduct an observational study using one of the causal inference methods discussed in the course. Submit a paper presenting the results of the study and covering: the research question, data, empirical strategy, results, and conclusions. The data-analysis code should be submitted as an appendix. You are free to choose any topic you like, as long as you have a clear research question that concerns the causal effect of some intervention, treatment, policy, or event on some outcome, result, or performance.

Option 3: Pick a policy topic and critically evaluate the empirical evidence about a particular program or set of programs, covering at least three relevant studies. Write a report in which you: 1) discuss and carefully define the causal questions relevant to assessment of the program(s); 2) discuss and carefully define the questions that the studies attempt to answer; 3) describe and discuss the appropriateness of the study designs; 4) describe the results; 5) assess the state of knowledge about your policy topic based on your chosen studies; and 6) identify knowledge gaps.

Attendance

Students are responsible for all of the material presented during class meetings. Students are expected to attend in-person class meetings. Screen recordings may also be available through the Canvas page for accommodation purposes only.

Respectful Learning Environment

Courses in Educational Psychology are venues for the free, open, and respectful exchange of ideas. Class members are expected to respect others and to contribute to a healthy learning environment in all course activities. Concerns in this regard should be brought to the attention of the course instructor.

Diversity & Inclusion Statement

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming

and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

The School of Education recognizes that our desire to be an anti-racist, unbiased, and inclusive academic community is ongoing and involves shared commitment, responsibility, action, and accountability. We believe that diversity, equity, inclusion, and inclusive excellence, the four essential pillars of our approach to generating positive and lasting change, build upon our scholarship and the School's reputation as a leading educational institution. Read the full statement for values and commitments supporting the School's efforts.

Academic Integrity Statement

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison. Students are expected to maintain absolute integrity and a high standard of individual honor in scholastic work. Assignments and projects must be completed with the utmost honesty, which includes acknowledging the contributions of other sources to your scholastic efforts; avoiding plagiarism; and completing assignments independently unless expressly authorized otherwise. ***Homework assignments or projects containing any plagiarized material will not be accepted.*** Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of academic misconduct, which may result in disciplinary action. Examples of disciplinary action include, but are not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion.

Accommodations for Students with Disabilities Statement

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: McBurney Disability Resource Center)

Privacy of Student Information & Digital Tools: Teaching & Learning Analytics & Proctoring Statement

The privacy and security of faculty, staff and students' personal information is a top priority for UW-Madison. The university carefully reviews and vets all campus-supported digital tools used to support teaching and learning, to help support success through learning analytics, and to enable proctoring capabilities. UW-Madison takes necessary steps to ensure that the providers of

such tools prioritize proper handling of sensitive data in alignment with FERPA, industry standards and best practices.

Under the Family Educational Rights and Privacy Act (FERPA which protects the privacy of student education records), student consent is not required for the university to share with school officials those student education records necessary for carrying out those university functions in which they have legitimate educationl interest. 34 CFR 99.31(a)(1)(i)(B). FERPA specifically allows universities to designate vendors such as digital tool providers as school officials, and accordingly to share with them personally identifiable information from student education records if they perform appropriate services for the university and are subject to all applicable requirements governing the use, disclosure and protection of student data.

Privacy of Student Records & the Use of Audio Recorded Lectures

See information about privacy of student records and the usage of audio-recorded lectures.

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

Course Evaluations

Students will be provided with an opportunity to evaluate this course and your learning experience. Student participation is an integral component of this course, and your confidential feedback is important to me. I strongly encourage you to participate in the course evaluation.

UW-Madison now uses an online course evaluation survey tool, AEFIS. In most instances, you will receive an official email two weeks prior to the end of the semester when your course evaluation is available. You will receive a link to log into the course evaluation with your NetID where you can complete the evaluation and submit it, anonymously.

Quarantine or Isolation Due to Communicable Disease

Student should continually monitor themselves for symptoms of COVID-19 and other resperatory illnesses and get tested if they have symptoms or have been in close contact with someone who is ill. Student should reach out to instructors as soon as possible if they become ill or need to isolate or quarantine, in order to make alternate plans for how to proceed with the course. Students are strongly encouraged to communicate with their Instructor concerning their illness and the anticipated extent of their absence from the course (either in-person or remote).

The instructor will work with the student to provide alternative ways to complete the course work.

Academic Calendar & Religious Observances

See: https://secfac.wisc.edu/academic-calendar/#religious-observances