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## Design & Analysis of Quasi-Experiments for Causal Inference ED PSYCH 963-001 – Fall 2021

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*Lecture*            Tues/Thur 1:00 – 2:15 pm  
*Room*                Grainger Hall 2170  
*Credits*             3 credits<sup>1</sup>  
*Instruction*        Face-to-face

*Instructor*        Dr. James E. Pustejovsky (pronounced “PUHS-tea-UV-ski” or “Pusto” for short)  
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*Office hours*      TBD

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### 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?”).

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: instrumental variables approaches, regression discontinuity designs, difference-in-differences and interrupted time series designs, and non-equivalent control group designs (using

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<sup>1</sup> 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.

techniques such as matching and propensity score weighting). 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).

### **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.
- 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/>
- TryR code school: <http://tryr.codeschool.com>
- YaRrr! The Pirate's Guide to R: <http://nathanieldphillips.com/theiratesguidetor/>
- Princeton R tutorials: <http://data.princeton.edu/R/>
- D-Lab R training: <https://github.com/dlab-berkeley/R-for-Data-Science>

## Evaluation

- Data analysis exercises (70%). Students will complete problem sets involving analysis of real or simulated data. The exercises will involve implementing different analytic methods and interpreting the results.
- Course project (30%). 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  $\leq$  or  $\geq$ ; rounded parentheses to  $<$  or  $>$ .

A	[90, 100]	C+	[74, 77)
A-	[87, 90)	C	[70, 74)
B+	[84, 87)	C-	[67, 70)
B	[80, 84)	D	[60, 67)
B-	[77, 80)	F	[0, 60)

## 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 meta-analyses.
- Problem sets will be submitted and graded through Canvas.

## 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; and 5) assess the state of knowledge about your policy topic based on your chosen studies and identify knowledge gaps.

### Attendance

Students are responsible for all of the material presented during class meetings. Attendance is not required.

### 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 educational 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.

## **Students' Rules, Rights & Responsibilities**

During the global COVID-19 pandemic, we must prioritize our collective health and safety to keep ourselves, our campus, and our community safe. As a university community, we must work together to prevent the spread of the virus and to promote the collective health and welfare of our campus and surrounding community.

## **UW-Madison Badger Pledge**

### **Campus Guidance on the use of Face Coverings**

Face coverings must be correctly worn on campus at all times and in all places (both outside and inside), except by students in their assigned residence hall rooms; by employees when alone in a private, unshared lab or office; when traveling alone in a private vehicle; and when exercising outside in a way that maintains 6 feet of distance from other people.

Students with disabilities or medical conditions who are unable to wear a face covering should contact the [McBurney Disability Resource Center](#) or their Access Consultant if they are already affiliated. Students requesting an accommodation unrelated to disability or medical condition, should contact the Dean of Students Office.

Students who choose not to wear a face covering may not attend in-person classes, unless they are approved for an accommodation or exemption. All other students not wearing a face covering will be asked to put one on or leave the classroom. Students who refuse to wear face coverings appropriately or adhere to other stated requirements will be reported to the [Office of Student Conduct and Community Standards](#) and will not be allowed to return to the classroom until they agree to comply with the face covering policy. An instructor may cancel or suspend a course in-person meeting if a person is in the classroom without an approved face covering in position over their nose and mouth and refuses to immediately comply.

## **Quarantine or Isolation Due to COVID-19**

Student should continually monitor themselves for COVID-19 symptoms and get tested for the virus if they have symptoms or have been in close contact with someone with COVID-19. 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.

## **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.

## **Academic Calendar & Religious Observances**

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