Causal Inference for the Social Sciences I

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Instructional Team

Instructor

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Instructor

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Teaching Assistants (TAs)

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Course outline

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Part 1: The randomized experimental ideal

- Introduction to potential outcomes and random assignment
- Estimation and inference in fully controlled randomized experiments

Part 2: Imperfectly controlled randomized experiments

- Noncompliance: When subjects don't comply with experiment's treatment
- Attrition: When subjects don't report their outcomes

Part 3: Observational studies (when subjects self-select into treatment)

- Matching and assessments of "covariate balance"
- Depending on interest, other designs we may cover include regression discontinuity, difference-in-differences, interrupted time series, synthetic control, etc.

1. ## Part 4: Sensitivity analysis

- How would inferences change should crucial assumptions be false?

Course outline

- Part 1 of the course is very conceptual, covering essential topics in statistics but from a new randomization- or design-based perspective
    - ⋆ This part of the course is often the most challenging
- Parts 2 - 4 emphasize computation in `R`
    - Especially `R`'s `optmatch` package

Course Goals

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- We'll study methods including:
    1. Randomization-based analysis for experiments
    2. Instrumental variables & principal stratification
    3. Propensity scores and matching
    4. Omitted variable sensitivity analysis
- By the end of this course, students should be ...
    1. Able to apply the foundations of causal inference to unpack and make sense of their own and others' research projects
    2. Understand a suite of valuable designs: when they could be used, when not, and their pluses and minuses
    3. Implement their own designs and analysis with data in `R`

Audience and Prerequisites

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- The typical student is an applied scientist who plans to use causal inference in their research
- Exposure to `R` is helpful, but not necessary
- Familiarity with statistical concepts is assumed: random variables, expectations, distribution functions, etc ...
    - Familiarity with regression, maximum likelihood, etc is less important

Textbooks and assignments

Audience and Prerequisites

- Primary textbook: Rosenbaum (2017)
    - Supplementary textbooks: Rosenbaum (2002, 2010); Imbens and Rubin (2015); Gerber and Green (2012)
- Three homework assignments
    - Mix of conceptual questions and applied questions with data analysis using `R`

References

Gerber, A. S. and D. P. Green (2012). *Field Experiments: Design, Analysis, and Interpretation*. New York, NY: W.W. Norton.

Imbens, G. W. and D. B. Rubin (2015). *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. New York, NY: Cambridge University Press.

Rosenbaum, P. R. (2002). *Observational Studies* (2nd ed.). New York, NY: Springer.

Rosenbaum, P. R. (2010). *Design of Observational Studies*. New York, NY: Springer.

Rosenbaum, P. R. (2017). *Observation and Experiment: An Introduction to Causal Inference*. Cambridge, MA: Harvard University Press.