

# Using and Abusing Statistics

How to Identify and Make Credible Causal Claims in the Social Sciences

Bermond Scoggins

## Course Summary and Objectives

*Using and Abusing Statistics* is a causal inference course that introduces students to the wonders and complexities of causality in the social sciences. Building on students' foundational understanding of quantitative methods and statistics, the course encompasses more sophisticated research designs using experimental and observational data aimed at uncovering cause and effect. While these designs are ubiquitous in the top economics, political science, and psychology journals, making causal claims are difficult and they often contain a range of weaknesses or flaws. Identifying the strengths and weaknesses of different research designs and statistical arguments are essential for both the improvement of scientific knowledge and good decision-making in government and business.

The course begins with a brief overview of experimental designs, drawing on prominent field experiments in economics and survey experiments in political science, and will introduce students to the process of computationally reproducing a paper's results using its data and code. Using the R programming language, special emphasis will be placed on students understanding researcher decisions by reproducing published work themselves. Alongside this, core concepts necessary for evaluating statistical work are covered – p-values, the difference between statistical and scientific significance, meta-analysis, sample size justification using power analysis, p-hacking/data manipulation, and data fabrication. The remainder of the course will be spent analysing and reproducing different causal inference designs where the randomisation of a treatment is impossible or unethical. These include regression discontinuity design, difference-in-differences, and instrumental variables. By the conclusion of the course, all students will be equipped with the tools to scrutinise important empirical claims published in the top journals.

## Prerequisites

Taking PLS210 Research Design and PLS211 Quantitative Methods will provide useful background knowledge. While I assume a basic acquaintance with descriptive statistics and regression, these fundamentals alongside other basic statistical concepts and the R programming language environment will be covered in the first few weeks of the semester.

## Course Assessments

1. Weekly reading notes (20%)
  - 10 weekly reading notes (2% each) containing brief summaries of the readings and raising questions about technical details or implications of the methods.
  - Discussed in-class and shared with all students.
2. Reproducing code and annotating decisions in R with RStudio (30%)
  - Three annotated R Notebooks discussing a paper's code step-by-step.
  - Includes a discussion of substantive research question (estimand) and methods (estimator). The notebook will visualise data, discuss data quality, and substantive interpretation of results – do the results align with those of the original author(s)?
3. Critical Review Paper and Presentation (50%)
  - Justification of research paper (10%)
  - Critical review paper (10%)
  - Presentation (30%)

## Grading Scale

- A: 95-100
- A-: 90-94
- B+: 85-89
- B: 80-84
- B-: 75-79
- C+: 70-74
- C: 65-69
- C-: 60-64

- D: 55-59
- D-: 50-54
- F: 0-49

## Main Resources

The following books, which are fully available online, will be frequently used in this course:

- Lakens, Daniel. *Improving Your Statistical Inferences*. 2022.
- Cunningham, Scott. *Causal Inference: The Mixtape*. Yale University Press, 2021.
- Huntington-Klein, Nick. *The Effect: An Introduction to Research Design and Causality*. Chapman and Hall/CRC, 2021.

All other readings can be found on Moodle.

# Course Outline

## Week 1: The Difficulty of Making Causal Claims in the Social Sciences

Content: Introducing/reviewing R and RStudio, GitHub, RMarkdown, and contemporary issues in quantitative social science (the Replication Crisis).

- Huntington-Klein: Chapters 1–4
- Open Science Collaboration (2015)
- Toshkov (2016): Chapter 6

## Week 2: The Causal Inference Toolbox

Content: A review of hypothesis testing, p-values, and linear regression/ANOVA. A quick overview of the different causal inference tools.

- Huntington-Klein: Chapter 5–6
- Lakens: Chapter 1

Supplementary material with data you can reproduce yourself:

- Imai (2018): Sections 4.2–4.3

## Week 3: Cause and Effect with Experiments I

Content: Reproducing a survey experiment from political science in R.

- Simonovits, McCoy, and Littvay (2022)

## Week 4: Cause and Effect with Experiments II

Content: Reproducing a field experiment from economics in R.

- Thornton (2008)

## Week 5: Evaluating Scientific Claims I

*What is important in a paper?*

Content: Visualising data, effect sizes, statistical versus scientific significance.

- Lakens: Chapters 5, 6, 13
- “The Mind of a Con Man” in *New York Magazine* 2013.

## **Week 6: Evaluating Scientific Claims II**

### *Power and uncertainty*

Content: Power analysis, confidence intervals, meta-analysis.

- Lakens: Chapters 2, 7, 8, 11
- Klein et al. (2018)

## **Week 7: Cause and Effect with Observational Data**

### *What do we do when an experiment is impossible or unethical?*

Content: Overview of panel data, regression discontinuity designs, difference-in-differences, synthetic controls, and instrumental variables.

- Cunningham, Chapter 4

## **Week 8: Regression Discontinuity I**

Content: Introducing regression discontinuity.

- Huntington-Klein: Chapter 20
- Cunningham: Chapter 6

## **Week 9: Regression Discontinuity II**

Content: Reproducing a RDD study on drunk driving.

- Hansen (2015)

## **Week 10: Difference-in-Differences I**

Content: Introducing DiD. Consultation week.

- Huntington-Klein: Chapter 18

Supplementary material:

- Coleman (2020)
- Coleman's GitHub: <https://github.com/tscoleman/SnowCholera>

## **Week 11: Difference-in-Differences II**

Content: Reviewing a DiD study on organ donation policy.

- Kessler and Roth (2014)

## **Week 12: Instrumental Variables**

Content: Introducing instrumental variables.

- Huntington-Klein: Chapter 19

## **Week 13: Catch-up and Summary**

Content: Review week and catch-up.

## **Week 14: Research Credibility and Open Science Practices**

Content: Summarising problems of causal inference, poor computational reproducibility, and open data and code. Additional catch-up and Q&A.

## **Plagiarism and Absences**

I expect zero plagiarism and cheating in this class (it is your responsibility to know and abide by the Student Code of Conduct for Nazarbayev University). Everyone should use references and in-text citations where appropriate (everywhere). Preferred citation style is the Chicago in-text.

According to the NU policy, a missing class without a valid medical excuse results in an ‘F’ grade. Students must submit a good medical note to SHSS within three business days of missing any class.

## Article References

- Coleman, Thomas. 2020. “John Snow, Cholera, and South London Reconsidered.” *SSRN Electron. J.*
- Hansen, Benjamin. 2015. “Punishment and Deterrence: Evidence from Drunk Driving.” *American Economic Review* 105 (4): 1581–1617.
- Imai, Kosuke. 2018. *Quantitative Social Science: An Introduction*. Princeton University Press.
- Kessler, Judd B, and Alvin E Roth. 2014. “Getting More Organs for Transplantation.” *American Economic Review* 104 (5): 425–30.
- Klein, Richard A, Michelangelo Vianello, Fred Hasselman, Byron G Adams, Reginald B Adams, Sinan Alper, Mark Aveyard, et al. 2018. “Many Labs 2: Investigating Variation in Replicability Across Samples and Settings.” *Advances in Methods and Practices in Psychological Science* 1 (4): 443–90.
- Open Science Collaboration. 2015. “Estimating the Reproducibility of Psychological Science.” *Science* 349 (6251).
- Simonovits, Gabor, Jennifer McCoy, and Levente Littvay. 2022. “Democratic Hypocrisy and Out-Group Threat: Explaining Citizen Support for Democratic Erosion.” *J. Polit.*, January.
- Thornton, Rebecca L. 2008. “The Demand for, and Impact of, Learning HIV Status.” *American Economic Review* 98 (5): 1829–63. <https://doi.org/10.1257/aer.98.5.1829>.
- Toshkov, Dimitar. 2016. *Research Design in Political Science*. Bloomsbury Publishing.