

# SOSC4000K: Experiments and Quasi-Experiments in the Social Sciences

Division of Social Science  
Hong Kong University of Science and Technology  
Spring 2022

## Instructor Information

Primary Instructor

David Hendry

Email: [hendry@ust.hk](mailto:hendry@ust.hk)

Office: Room 3346

Office Hours: Tuesdays and Thursdays, 12:00 - 13:00,  
or by appointment

Teaching Assistant

Chi Ho (Stephen) Choy

Email: [choyho@ust.hk](mailto:choyho@ust.hk)

Office: Room 3005

## Overview

This course explores the statistical methods used for causal inference in the social sciences. Working within the potential outcomes framework, we discuss how the logic of inference for randomized experiments is the same as for non-randomized (observational) studies under certain additional assumptions. Though randomized experiments serve as the gold standard for causal inference, we note how it may sometimes be reasonable to treat non-experimental data as if it had been drawn from an experiment. Usually, this involves some knowledge about how the natural world produced the data through a quasi-random process. Research designs and methods covered include randomized experiments, matching, instrumental variables, difference-in-differences, synthetic control, and regression discontinuity designs. In turn, we discuss how all of these methods require a unique set of assumptions to allow us to make valid causal inferences. Throughout the course we will draw examples from across the social sciences to illustrate the vast range of applications of these methods. Furthermore, the course will include computing sessions during which students are taught how to implement the techniques using modern statistical software.

## Meeting Time and Place

Tuesdays and Thursdays, 10:30am - 11:50am

Room 4402, Main Academic Building, Lifts 17-18

## Intended Learning Outcomes

At the end of the course, students should be able to:

1. Understand the history and development of the experimental method across the social sciences.
2. Understand the history and development of quasi-experimental research designs across the social sciences.

3. Understand the history and development of the potential outcomes framework.
4. Identify and understand the major identification assumptions and data structures required for credible causal inference in modern applied social science statistics.
5. Conduct and interpret statistical analyses of data from social science research designs using experimental and quasi-experimental designs.
6. Apply their knowledge of how to conduct and interpret statistical analyses to original social science problems.

## Grading

### 10% Fundamentals Problem Set

Students will complete one homework assignment consisting of questions about the potential outcomes framework. Responding to these questions will involve some basic mathematics, understanding of philosophical issues regarding causality in the potential outcomes framework, and interpretation of statistical results. Students are encouraged to use any class notes and books or supplemental materials that they find useful, and to work with other students in the class. However, each student must submit an individual assignment. Though cooperation and use of notes and books is encouraged, students must put answers into their own words and plagiarism will not be tolerated. [ILOs 1, 2, 3, and 4]

- Distributed on February 22 after class, due at midnight on March 1

### 10% Group Presentation in Experiment Workshop

We will hold a two-day workshop during the semester focused on applied social science journal articles that use experimental methods. On the first day of the workshop, students will give group presentations focused on a summary and critique of an article chosen by the group in consultation with the instructor. Group sizes will be determined based on course enrollment. A detailed description of the assignment will be provided in class and on Canvas. [ILOs 4 and 5]

- Presentations will occur during class on March 10

### 50% Computing Problem Sets

Throughout the semester, students will complete a series of structured problem sets primarily focused on performing statistical analysis using R and providing appropriate written interpretation of statistical results. For each problem set, students will be provided with a dataset and a series of tasks to perform. Examples of similar analyses will be covered during the lectures. Students are encouraged to use any class notes and books or supplemental materials that they find useful, and to work with other students in the class. However, each student must submit an individual assignment. Though cooperation and use of notes and books is encouraged, students must put answers into their own words and plagiarism will not be tolerated. When calculating final grades on Computing Problem Sets, the lowest score will be dropped. [ILOs 4, 5, and 6]

- Computing Problem Set 1: Experiments
  - \* Distributed on March 1 after class, due at midnight on March 8

- Computing Problem Set 2: Instrumental Variables
  - \* Distributed on March 8 after class, due at midnight on March 15
- Computing Problem Set 3: Matching and Weighting
  - \* Distributed on March 29 after class, due at midnight on April 7
- Computing Problem Set 4: Regression Discontinuity Designs
  - \* Distributed on April 12 after class, due at midnight on April 26
- Computing Problem Set 5: Difference in Differences
  - \* Distributed on April 26 after class, due at midnight on May 3

## 20% Final Paper

In a paper of about 4000 words, students will conduct an original data analysis on a topic of their choosing and write up the results in the style of a research note journal article. Student topics should be chosen in consultation with the instructor. A detailed description of the assignment will be provided in class and on Canvas. [ILOs 4, 5, and 6]

- Topics should be finalized in consultation with the instructor by April 21
- Papers are due by midnight on May 25

## 10% Attendance

After the Add/Drop period, attendance will count toward students' final grade. Students can miss two class sessions for any reason without penalty. Any additional absences will be penalized unless they are valid excuses backed up by documentation.

## Readings

Required readings should be completed prior to the date they are listed on the schedule. All readings will be provided through Canvas. There is no text that is perfect for this course, and therefore there is no text that students are required to purchase. However, the following books are *highly* recommended, particularly if students wish to dive deeper into the topics covered in this course or pursue them in their own research.

- Angrist, Joshua D., and Jörn-Steffen Pischke. 2015. *Mastering 'Metrics: The Path from Cause to Effect*. Princeton: Princeton University Press.
- Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton: Princeton University Press.
- Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments: Design, Analysis, and Interpretation*. New York: W.W. Norton & Co.
- Imbens, Guido W., and Donald R. Rubin. 2015. *Causal Inference for Statistics, Social, and Biomedical Sciences*. Cambridge: Cambridge University Press.
- Morgan, Stephen L., and Christopher Winship. 2007. *Counterfactuals and Causal Inference: Methods and Principles for Social Research*. Cambridge: Cambridge University Press.
- Rosenbaum, Paul R. 2010. *Design of Observational Studies*. New York: Springer.

- Shadish, William R., Thomas D. Cook, and Donald T. Campbell. 2002. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. New York: Houghton and Mifflin.

## Schedule

Schedule is subject to change with advanced notice from the instructor. If any changes are made to the schedule or readings, said changes will be announced in class and an updated version of the syllabus posted to Canvas.

### Tuesday, February 8

- Topic: History of experimental research; development and evolution of the experimental method in various social science disciplines; introduction and overview of quasi-experiments
- Required Readings:
  - Druckman, James N., Donald P. Green, James H. Kuklinski, and Arthur Lupia. 2011. “Experimentation in Political Science.” In Druckman, Green, Kuklinski, and Lupia, eds., *Cambridge Handbook of Experimental Political Science*. Cambridge: Cambridge University Press, pp. 3–14.
  - Jackson, Michelle, and D.R. Cox. 2013. “The Principles of Experimental Design and Their Application in Sociology.” *Annual Review of Sociology* 39: 27–49.
  - Angrist, Joshua D., and Jörn-Steffen Pischke. 2010. “The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics.” *Journal of Economic Perspectives* 24(2): 3–30.

### Thursday, February 10

- Topic: Introduction to the Potential Outcomes Framework
- Required Readings:
  - Holland, Paul W. 1986. “Statistics and Causal Inference.” *Journal of the American Statistical Association* 81: 945-970.
  - Freedman, David A. 1991. “Statistical Models and Shoe Leather.” *Sociological Methodology* 2: 291-313.
- Recommended Readings:
  - Splawa-Neyman, Jerzy, [Dabrowska, D. M., and T.P. Speed]. 1923 [1990]. “On the Application of Probability Theory to Agricultural Experiments. Essay on Principles. Section 9.” *Statistical Science* 5: 465-472.
  - Rubin, Donald B. 1990. “Comment: Neyman (1923) and Causal Inference in Experiments and Observational Studies.” *Statistical Science* 5: 472-480.
  - Morgan, Stephen L. and Christopher Winship. 2007. *Counterfactuals and Causal Inference*. Cambridge University Press. Chapter 1: 1-24.

## Tuesday, February 15

- Topic: Internal and External Validity
- Required Readings:
  - Shadish, William R., Thomas D. Cook, and Donald T. Campbell. 2002. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*. New York: Houghton, Mifflin, and Co. [pp. 53-63, 83-93]

## Thursday, February 17

- Topic: Ethical Considerations in Social Science Experiments
- Required Readings:
  - Humphreys, Macartan. 2015. “Reflections on the Ethics of Social Experimentation.” *Journal of Globalization and Development* 6(1): 87–112.
  - Teele, Dawn. 2014. “Reflections on the Ethics of Field Experiments.” In Teele, ed., *Field Experiments and their Critics: Essays on the Uses and Abuses of Experimentation in the Social Sciences*. New Haven: Yale University Press, pp. 115–140.
- **Note: Last day of Add/Drop period**

## Tuesday, February 22

- Topic: Placing Experiments in the Potential Outcomes Framework
- Required Readings:
  - Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments: Design, Analysis, and Interpretation*. New York: W.W. Norton & Co. [Chapters 1 and 2]
  - Rosenbaum, Paul. 2009. *Design of Observational Studies*. New York: Springer. [Chapters 2.1-2.3.2: pp. 21-35]
- Recommended Readings:
  - Fisher, Ronald A. 1935. *Design of Experiments*. New York: Hafner. [Chapters 1-2]
- Assessment:
  - **Attendance will be recorded starting today**
  - Distributed at the end of class: Fundamentals Problem Set

## Thursday, February 24

- Topic: Extending Experiments
- Required Readings:
  - Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments: Design, Analysis, and Interpretation*. New York: W.W. Norton & Co. [pp. 71-85; 253-273; 289-312]
- Recommended Readings:
  - Boruch, Robert, Henry May, Herbert Turner, Julia Lavenberg, Anthony Petrosino, Dorothy De Moya, Jeremy Grimshaw, and Ellen Foley. 2004. “Estimating the Effects of Interventions That Are Deployed in Many Places: Place-Randomized Trials.” *American Behavioral Scientist* 47(5): 608-633.

- Collins, Linda M., John J. Dziak, Kari C. Kugler, and Jessica B. Trail. 2014. “Factorial Experiments: Efficient Tools for Evaluation of Intervention Components.” *American Journal of Preventive Medicine* 47(4): 498-504.
- Imai, Kosuke, and Marc Ratkovic. 2013. “Estimating Treatment Effect Heterogeneity in Randomized Program Evaluation.” *Annals of Applied Statistics* 7(1): 443-470.
- Na, Chongmin, Thomas A. Loughran, and Raymond Paternoster. 2015. “On the Importance of Treatment Effect Heterogeneity in Experimentally-Evaluated Criminal Justice Interventions.” *Journal of Quantitative Criminology* 31: 289-310.

## Tuesday, March 1

- Topic: Statistical Analysis of Experiments
- Required Readings:
  - None
- Assessment:
  - Due by midnight: Fundamentals Problem Set
  - Distributed at the end of class: Computing Problem Set 1: Experiments

## Thursday, March 3

- Topic: Instrumental Variables Analysis
- Required Readings:
  - Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist’s Companion*. Princeton: Princeton University Press. [Chapter 4.1-4.4.4]
  - Angrist, Joshua D., Guido W. Imbens, and Donald B. Rubin. 1996. “Identification of Causal Effects Using Instrumental Variables.” *Journal of the American Statistical Association* 9: 444-455.
- Recommended Readings:
  - Angrist, Joshua D. 2006. “Instrumental Variables Methods in Experimental Criminological Research: What, Why and How.” *Journal of Experimental Criminology* 2: 23-44.
  - Angrist, Joshua D., and Alan B. Krueger. 2001. “Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments.” *Journal of Economic Perspectives* 15(4): 69-85.
  - Gerber, Alan S., and Donald P. Green. 2012. *Field Experiments: Design, Analysis, and Interpretation*. New York: W.W. Norton & Co. [pp. 173-192]
  - Morgan, Stephen L., and Christopher Winship. 2014. *Counterfactuals and Causal Effect: Methods and Principles for Social Research* 2nd ed. Cambridge: Cambridge University Press. [Chapter 9]

## Tuesday, March 8

- Topic: Statistical Analysis Within the Instrumental Variables Framework
- Required Readings:
  - None
- Assessment:
  - **Due by midnight: Computing Problem Set 1: Experiments**
  - Distributed at the end of class: Computing Problem Set 2: Instrumental Variables

## Thursday, March 10

- Topic: Experiments Workshop Day 1
- Required Readings:
  - No additional readings beyond your group's presentation article
- Assessment:
  - **In class: Group presentation of experimental article**

## Tuesday, March 15

- Topic: Experiments Workshop Day 2
- Required Readings:
  - TBD
- Assessment:
  - **Due by midnight: Computing Problem Set 2: Instrumental Variables**

## Thursday, March 17

- Topic: Matching and Weighting I
- Required Readings:
  - Rosenbaum, Paul. 2009. *Design of Observational Studies*. New York: Springer. [Chapter 7, pp. 153-162]
  - Cochran, W.G. 1968. "The Effectiveness of Adjustment by Subclassification in Removing Bias in Observational Studies." *Biometrics* 24: 295-313.

## Tuesday, March 22

- Topic: Matching and Weighting II
- Required Readings:
  - Rosenbaum, Paul. 2009. *Design of Observational Studies*. New York: Springer. [Chapter 8.1-8.3, pp. 163-172 and Chapter 9, pp. 187-194]

- Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton: Princeton University Press. [Chapter 3.3.1-3.3.3, pp. 69-91]
- Dehejia, R. H. and S. Wahba. 1999. “Causal Effects in Non-Experimental Studies: Re-Evaluating the Evaluation of Training Programs.” *Journal of the American Statistical Association* 94: 1053-1062.

### Thursday, March 24

- Topic: Statistical Analysis Using Matching and Weighting I
- Required Readings:
  - None

### Tuesday, March 29

- Topic: Statistical Analysis Using Matching and Weighting II
- Required Readings:
  - None
- Assessment:
  - Distributed at the end of class: Computing Problem Set 3: Matching and Weighting

### Thursday, March 31

- Topic: Regression Discontinuity Designs I
- Required Readings:
  - Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton: Princeton University Press. [Chapter 6]
  - Lee, David S. 2008. “Randomized Experiments from Non-random Selection in U.S. House Elections. *Journal of Econometrics* 142(2): 675-697.

### Tuesday, April 5

- No class: Ching Ming Festival

### Thursday, April 7

- Topic: Regression Discontinuity Designs II
- Required Readings:
  - Pettersson-Lidbom, Per and Björn Tyrefors. 2009. “The Policy Consequences of Direct versus Representative Democracy: A Regression-Discontinuity Approach.” *Working Paper*. Available at: [http://www.ne.su.se/polopoly\\_fs/1.214891.1418657730!/menu/standard/file/directdem.pdf](http://www.ne.su.se/polopoly_fs/1.214891.1418657730!/menu/standard/file/directdem.pdf)
- Assessment:
  - **Due by midnight: Computing Problem Set 3: Matching and Weighting**

## Tuesday, April 12

- Topic: Statistical Analysis of Regression Discontinuity Designs
- Required Readings:
  - None
- Assessment:
  - Distributed at the end of class: Computing Problem Set 4: Regression Discontinuity Designs

## Thursday, April 14

- No class: midterm break

## Tuesday, April 19

- Topic: Difference in Differences I
- Required Readings:
  - Angrist, Joshua D., and Jörn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton: Princeton University Press. [Chapter 5, pp. 221-246]
  - Card, David and Alan B. Krueger. 1994. “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania.” *American Economic Review* 84: 772-793.
- Recommended Readings:
  - Card, David. 1990. “The Impact of the Mariel Boatlift on the Miami Labor Market.” *Industrial and Labor Relations Review* 43: 245-257.

## Thursday, April 21

- Topic: Difference in Differences II
- Required Readings:
  - TBD
- Assessment:
  - **Note: By this date, students should obtain approval from the instructor on final paper topics.**

## Tuesday, Apr 26

- Topic: Statistical Analysis of Difference in Differences
- Required Readings:
  - None
- Assessment:
  - **Due by midnight: Computing Problem Set 4: Regression Discontinuity Designs**
  - Distributed at the end of class: Computing Problem Set 5: Difference in Differences

## Thursday, Apr 28

- Topic: The Synthetic Control Method
- Required Readings:
  - Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2009. “Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California’s Tobacco Control Program.” *Journal of the American Statistical Association* 105(490): 493-505.
  - Abadie, Alberto and Javier Gardeazabal. 2003. “The Economic Costs of Conflict: A Case-Control Study for the Basque Country.” *American Economic Review* 93(1): 113-132.

## Tuesday, May 3

- Topic: Statistical Analysis of Synthetic Control Designs
- Required Readings:
  - None
- Assessment:
  - **Due by midnight: Computing Problem Set 5: Difference in Differences**

## Thursday, May 5

- Topic: Frontiers in Experimental and Quasi-Experimental Research in the Social Sciences
- Required Readings:
  - TBD

## Tuesday, May 10

- Topic: Course Overview and Wrap-Up
- Required Readings:
  - None