Introduction to Causal Inference with Quantitative Methods

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Bachelor Seminar

Summer Semester, 2026

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Class Room: Bergheimer Str. 58, Room 02.034

Office Hours: via Calendly (see below)
Class Hours: Tuesdays, 16:15-17:45

Description

This seminar introduces causal inference for social science research: how to formulate causal questions and how to evaluate whether a quantitative design can support a causal claim. We start from the counterfactual logic of causality (treatments, outcomes, units, and the causal effect of interest) and then build a practical toolbox of research designs that are widely used across the social sciences.

After establishing the basic logic, the seminar covers key identification strategies and the assumptions behind them. Topics include randomized experiments (including noncompliance, attrition, and spillovers), regression adjustment and matching/weighting approaches under selection on observables, panel-data models and fixed effects, difference-in-differences designs for policy evaluation, and synthetic control methods for settings with one or a few treated units and rich pre-treatment time series. The seminar concludes with regression discontinuity and instrumental variables. Throughout, we focus on diagnosis rather than formulas: Which assumption is doing the heavy lifting? What threats to inference are most plausible in a given application? Which checks are informative (e.g., balance checks, pre-trend/event-study plots, placebo analyses, and sensitivity to design choices)?

The last three sessions are reserved for student presentations. Each participant develops a research question, proposes a causal design, and discusses likely limitations and diagnostic strategies.

Learning Objectives

By the end of the seminar, students will be able to:

1. Formulate causal research questions and define the estimand (treatment, outcome, units, population).

2. Explain the counterfactual logic of causal inference and distinguish causal from descriptive claims.
3. Identify key threats to causal inference (e.g., confounding, selection, post-treatment bias, spillovers).
4. Choose and justify appropriate causal designs (experiments, matching/controls, panel FE, DiD, synthetic control, RD, IV).
5. State the main identifying assumptions and propose basic diagnostic/robustness checks.
6. Critically evaluate published studies and present a research design proposal with limitations.

Course Requirements

No prior quantitative coursework is required; all necessary concepts are introduced in class. Prior experience with statistics or regression is helpful but not required. Software use (e.g., R or Stata) is optional and will be chosen in consultation with the class; the primary goal is conceptual mastery of causal reasoning and research design. The seminar is primarily designed for Political Science students, but it is also open to interested students from Economics and Sociology.

Weekly attendance is mandatory. If you cannot attend, please email me before the respective session. In addition, active participation includes reading the assigned texts, engaging with in-class discussions, asking questions, contributing to debates, and providing constructive peer feedback.

Reading the texts is imperative for the success of the seminar; without having read the readings, the seminar will be very difficult to follow, and over time, the material will become overwhelming.

2 credit points	**2 + 6 credit points**
• Active participation in class • Reading the literature • Doing (group) exercises • **In-class presentation (see below)**	• Active participation in class • Reading the literature • Doing (group) exercises • **In-class presentation (see below)** • **Term paper: 5,000 words**

Office Hours

Office hours are by appointment. Please use Calendly via this link to register for office hours: https://calendly.com/endre-borbath/office-hour.

We can meet on site in room 03.033 (Bergheimer Str. 58, 69115 Heidelberg) or online via the following Zoom link: https://eu02web.zoom-x.de/my/eborbath. If the appointment is scheduled as a face-to-face meeting on campus but you would prefer to meet online, please send me an email in addition to registering via the Calendly interface.

Online Learning

I provide the course literature in advance via Moodle (https://moodle.uni-heidelberg.de/) and also use the platform for general course information. Please contact me with any questions regarding the course literature, technical problems with Moodle, or other organizational issues.

Presentations

Every student receiving credit points for the seminar must present in class. In the presentation, each student is required to **develop a research question and propose a causal research design** using the approaches discussed in the seminar. **You do not need to conduct the empirical analysis itself**. Instead, the presentation focuses on (i) the logic of the design, (ii) the key identifying assumptions, and (iii) likely limitations and diagnostic/ robustness strategies.

In addition, **each student is required to discuss the presentation of one of their peers**.

The presentation should be **no longer than 10 minutes**. **You are required to email me your slides a week before the presentation, by Monday noon**. This allows the discussants to prepare feedback. The presentations will also be uploaded to Moodle and made available to all students in the class.

A successful presentation has 4-6 slides, with the following structure:

1. **Research question and motivation:** What is the research question? What is the main theoretical expectation? What is the treatment and outcome? What is the unit of analysis and the target population? (1-2 slides)
2. **Proposed causal design:** Which identification strategy do you propose (e.g., experiment, matching/controls, panel FE, DiD, synthetic control, RD, IV)? What data would be needed and how would the key concepts be operationalized? (1-2 slides)
3. **Assumptions, limitations, and diagnostics:** What assumption(s) identify the effect? What are the main threats to inference in your setting (e.g., confounding, selection, interference, violations of parallel trends, manipulation around a cutoff, weak instruments)? Which diagnostic checks or robustness exercises would you use to probe these concerns (e.g., balance tests, pre-trend/event-study plots, placebo tests, sensitivity to donor pool/specification, manipulation checks, first-stage strength)? (1-2 slides)
4. **What can and cannot be concluded:** If the assumptions hold, what would the design allow you to learn? What would remain uncertain even with good implementation? (1 slide)

Following this structure helps ensure the presentation is concise and covers all essential elements. You may include descriptive figures or simple illustrative plots if helpful, but **the presentation is not expected to report estimated effects or regression results**.

As a discussant, you are required to critically evaluate the strengths and weaknesses of the proposed design, suggest ideas for refinement and further development, and ask at least one question. Discussants do not need slides and are expected to talk for 2-3 minutes.

Term Paper

The term paper should be 5,000 words (BA), including references and footnotes. The deadline is the end of the summer term, **30th September, 2026**. The paper is the final product of the seminar and should demonstrate your ability to apply the concepts and tools discussed in

class. **You are strongly encouraged to write the paper on the same topic as your presentation (or a closely related extension).**

You can choose between two formats:

1. **Empirical term paper (design implemented):** You formulate a clear research question and address it with **original empirical analysis**. The paper must **state a causal estimand** (i.e., specify the treatment, outcome, unit of analysis, and target population, and clearly describe the causal effect of interest) and **implement a plausible research design** discussed in the seminar. The empirical analysis should include (i) descriptive evidence on the phenomenon under study and (ii) an inferential component (e.g., regression adjustment, matching/weighting, panel fixed effects, difference-in-differences, synthetic control, regression discontinuity, or instrumental variables, as appropriate). Results should be presented and interpreted in relation to the research question and theoretical expectations.

2. **Research proposal (design not implemented):** You formulate a clear research question and develop a theoretical proposition or a set of hypotheses based on a **critical review of a relevant strand of literature**. In addition to the seminar readings, the proposal should engage with **further literature** and go beyond summarizing existing studies by using the debate to motivate an original argument or set of hypotheses. The proposal must **state a causal estimand** and **specify an appropriate research design** to study the argument/hypotheses. This includes a brief discussion of methodology (quantitative, qualitative, or mixed methods), operationalization, potential data sources, and a clear discussion of the **key identifying assumptions, anticipated threats to inference, and diagnostic/robustness strategies**. No empirical analysis is required for this format.

Important: In both formats, you do not need to deliver a definitive causal estimate. However, you must make clear **what causal effect you aim to learn about**, **which assumptions would be required** for your design to identify it, and **which limitations remain**. The topic of the paper should relate to the fields of political sociology, policy analysis, or micro-/macro-economics.

Formatting

Please format the term paper according to the following guidelines:

- **Title page:** include the paper title, course name, semester, your name, student ID, department/institution, and email address.
- **Font & spacing:** use a 12-point serif font (e.g., Times, Palatino) with 1.5-line spacing; footnotes in 10-point font, single spacing.
- **Margins & layout:** all margins should be at least 2.5 cm.
- **Page numbers:** number all pages (except the title page) consecutively, placed at the bottom center or bottom right.
- **Structure:** include a table of contents with section and subsection titles and page numbers. Use meaningful headings (avoid merely Section 1, 2, 3). You do not need to number the sections or subsections.
- **Abstract:** all papers must include an abstract of no more than 250 words. See my recommendation on writing a suitable abstract below.

- **Sections:** the paper should consist of an *Introduction*, *Main Body*, and *Conclusion*. Use subsections as needed, but avoid over-fragmentation. Format headings as follows: level 1 14-point bold; level 2 12-point bold; level 3 12-point italic. Do not use more than three levels.
- **Figures and tables:** all figures and tables must have a number, a title, and a note. Each should be self-explanatory. If you use color, ensure that it remains distinguishable when printed in black and white.
- **Citations & footnotes:** mark all non-original arguments or borrowed ideas with citations, ideally using the Chicago citation style. I recommend using a reference manager such as Zotero (see below).
- **Bibliography / References:** at the end, list all sources cited in alphabetical order. Do not include works not cited in the text.
- **Appendices:** appendices (if needed) do not count toward the main text length; label them clearly (Appendix A, Appendix B, etc.).
- **Declaration of originality:** include a short statement (on the title page or at the end) confirming that you have written the paper independently and used only the stated sources.

Academic Writing and Reading

On Writing Research Papers

Minkoff, Scott L. 2012. "A Guide to Developing and Writing Research Papers in Political Science," https://kevinlyles.digital.uic.edu/wp-content/uploads/2021/08/minkoff_researchpaper_guide_v4.pdf.

On Writing a Good Abstract

Gilardi, Fabrizio. 2021. "Good Abstracts: A Template," https://fabriziogilardi.org/media/files/good-abstracts.pdf.

Templates for Writing

Graff, Gerald, and Cathy Birkenstein. 2018. *They Say, I Say: The Moves That Matter in Academic Writing*. Fourth edition. New York: W. W. Norton. ISBN: 0-393-63167-2. https://tinyurl.com/bdec4eex.

General Tips for Writing

Catherine de Vries' Substack: Respect the Marble (https://catherineeunicedevries.substack.com)

On Reading Efficiently

Pacheco-Vega, Raul. 2020. "Reading Strategies," http://www.raulpacheco.org/resources/reading-strategies.

Note: Raul Pacheco-Vega's blog is a valuable resource for academic writing in general!

Software Recommendations

I use Google Scholar and Zotero (both freely available) for literature search. For note-taking, I use Obsidian (also freely available). I recommend that you learn how to use these software tools (or their alternatives), as the investment pays off later during your studies. YouTube has many tutorial videos, and I am also happy to help if you have questions.

Academic Integrity and Mental Health

Plagiarism

Students must comply with the university policy on academic integrity found at https://www.ub.uni-heidelberg.de/en/service/detecting-plagiarism. In addition, please also familiarize yourself with the Study Guide https://www.uni-heidelberg.de/politikwissenschaften/master_recht.html. Not knowing the rules is no excuse for plagiarism!

Use of AI

If you use AI (ChatGPT, Claude, etc.) to write your term paper, you are required to be transparent about it. More specifically, list the prompts and answers in a separate appendix at the end of the term paper. This appendix does not count towards the word count.
You do not need to list the use of AI for grammar corrections (e.g., DeepL Write, Grammarly, etc.). You are also allowed to use AI for coding, data analysis, and programming, but remember to critically evaluate AI-generated content and use it as a supportive tool rather than as a primary author.
Please remember always to respect the rules of academic integrity and honesty! Plagiarism will be handled according to university policy.

Mental Health

Many students feel overwhelmed by the tasks and responsibilities during their studies, especially if they are new to Germany and Heidelberg. This is normal! If you feel that you are not able to cope alone, please consider approaching the psychosocial counselling service offered free of charge by the student services at https://www.uni-heidelberg.de/en/study/advisory-services/psychosocial-counselling-for-students-pcs. If you are having difficulties, e.g., with the term paper, please do not hesitate to approach me.

Schedule and Readings

Block I: Foundations of Causal Thinking

Session 1, 14.04.2026 - Introducing the Seminar

- Getting to know each other
- Introduction to the syllabus
- Clarifying expectations

Session 2, 21.04.2026 - Causal Questions and "Effects"

- What exactly is the "effect" you want to learn about?
- What would count as a convincing answer, and what would still be ambiguous even with good data?

Required:

Huntington-Klein, Nick. 2026a. "Research Questions." In *The Effect: An Introduction to Research Design and Causality*, 9–18. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

———. 2026b. "Treatment Effects." In *The Effect: An Introduction to Research Design and Causality*, 143–160. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Recommended:

Cunningham, Scott. 2021. "Introduction." In *Causal Inference: The Mixtape*, 1–15. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Session 3, 28.04.2026 - What Can Go Wrong? Bias and Bad Controls

- If we "control for X" in a regression, when does that reduce bias, and when can it create bias?
- How can we tell whether a variable is a confounder, a mediator, or a collider?

Required:

Huntington-Klein, Nick. 2026. "Causal Diagrams." In *The Effect: An Introduction to Research Design and Causality*, 87–100. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cinelli, Carlos, Andrew Forney, and Judea Pearl. 2024. "A Crash Course in Good and Bad Controls." *Sociological Methods & Research* 53 (3): 1071–1104. https://doi.org/10.1177/00491241221099552.

Recommended:

Cunningham, Scott. 2021. "Directed Acyclic Graphs." In *Causal Inference: The Mixtape*, 96–118. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Session 4, 05.05.2026 - Experiments: The Benchmark Design

- Why does random assignment solve the causal inference problem (in principle), and what would we estimate in an ideal experiment?
- In real experiments, what are the main things that can still go wrong, and how would we notice?

Required:

Huntington-Klein, Nick. 2026. "Identification." In *The Effect: An Introduction to Research Design and Causality*, 67–85. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Angrist, Joshua D., and Jörn-Steffen Pischke. 2015. "Randomized Trials." In *Mastering Metrics: The Path from Cause to Effect*, 1–33. Princeton, NJ; Oxford: Princeton Univers. Press. ISBN: 978-0-691-15284-4.

Recommended:

Cunningham, Scott. 2021. "Potential Outcomes Causal Model." In *Causal Inference: The Mixtape*, 119–174. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Block II: Comparing Like with Like

Session 5, 12.05.2026 - Regression and Controls: Making Groups Comparable

- What does regression adjustment assume about selection into treatment, and when is that assumption plausible?
- How should we interpret an adjusted regression coefficient as an "effect", and what evidence would make that interpretation more credible?

Required:

Huntington-Klein, Nick. 2026. "Regression *(only selected sections)*." In *The Effect: An Introduction to Research Design and Causality*, 179–205. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Angrist, Joshua D., and Jörn-Steffen Pischke. 2015. "Regression *(only the section: A Tale of Two Colleges)*." In *Mastering Metrics: The Path from Cause to Effect*, 47–55. Princeton, NJ; Oxford: Princeton Univers. Press. ISBN: 978-0-691-15284-4.

Recommended:

Huntington-Klein, Nick. 2026. "Regression *(the rest of the chapter)*." In *The Effect: An Introduction to Research Design and Causality*, 206–268. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Session 6, 19.05.2026 - Matching and Weighting: Making Groups Comparable

- What does it mean to make treated and control units "comparable," and how do matching try to achieve that?
- How do we diagnose whether the approach worked, and what can still go wrong even with good balance?

Required:

Huntington-Klein, Nick. 2026. "Matching *(only selected sections)*." In *The Effect: An Introduction to Research Design and Causality*, 269–285. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cunningham, Scott. 2021. "Matching and Subclassification." In *Causal Inference: The Mixtape*, 175–191. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Recommended:

Huntington-Klein, Nick. 2026. "Matching *(the rest of the chapter)*." In *The Effect: An Introduction to Research Design and Causality*, 286–328. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Block III: Change Over Time

Session 7, 26.05.2026 - Panel Data: Comparing Units to Themselves

- What do we gain by observing the same units repeatedly over time, and what does "comparing units to themselves" actually mean?
- Which kinds of confounding problems do fixed effects help with, and which problems remain?

Required:

Huntington-Klein, Nick. 2026. "Fixed Effects *(only selected sections)*." In *The Effect: An Introduction to Research Design and Causality*, 385–402. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cunningham, Scott. 2021. "Panel Data *(only selected sections)*." In *Causal Inference: The Mixtape*, 386–396. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Recommended:

Cunningham, Scott. 2021. "Panel Data *(the rest of the chapter)*." In *Causal Inference: The Mixtape*, 396–405. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Session 8, 02.06.2026 - Difference-in-Differences: Before/After with a Comparison Group

- What is the key idea of difference-in-differences, and what exactly is the "parallel trends" assumption?
- What evidence would make a DiD design more convincing, and what patterns would make you skeptical?

Required:

Huntington-Klein, Nick. 2026. "Difference-in-Differences *(only selected sections)*." In *The Effect: An Introduction to Research Design and Causality*, 439–453. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cunningham, Scott. 2021. "Difference- in-Differences *(only selected sections)*." In *Causal Inference: The Mixtape*, 406–415. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Recommended:

Huntington-Klein, Nick. 2026. "Difference-in-Differences *(the rest of the chapter)*." In *The Effect: An Introduction to Research Design and Causality*, 453–476. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Session 9, 09.06.2026 - Synthetic Control: Building a "Best Comparison"

- When you have only one (or a few) treated units, what would a "good comparison case", and how does synthetic control try to construct it?
- What makes a synthetic control analysis credible, and what should make you skeptical?

Required:

Huntington-Klein, Nick. 2026. "Synthetic Control." In *The Effect: An Introduction to Research Design and Causality*, 590–593. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cunningham, Scott. 2021. "Synthetic Control *(only selected sections)*." In *Causal Inference: The Mixtape*, 511–524. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Recommended:

Cunningham, Scott. 2021. "Synthetic Control *(the rest of the chapter)*." In *Causal Inference: The Mixtape*, 525–539. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller. 2015. "Comparative Politics and the Synthetic Control Method." *American Journal of Political Science* 59 (2): 495–510. https://doi.org/10.1111/ajps.12116.

Block IV: Quasi-Random Variation

Session 10, 16.06.2026 - Regression Discontinuity: Close to the Cutoff

- Why can comparing units just above vs just below a cutoff approximate random assignment?
- What are the main credibility checks in RD, and what would make you distrust an RD design?

Required:

Huntington-Klein, Nick. 2026. "Regression Discontinuity *(only selected sections)*." In *The Effect: An Introduction to Research Design and Causality*, 513–536. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cunningham, Scott. 2021. "Challenges to Identification *(in the chapter Regression Discontinuity)*." In *Causal Inference: The Mixtape*, 282–289. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Recommended:

Huntington-Klein, Nick. 2026. "Regression Discontinuity *(the rest of the chapter)*." In *The Effect: An Introduction to Research Design and Causality*, 536–563. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Session 11, 23.06.2026 - Instrumental Variables: Using External Shocks

- What problem is IV trying to solve, and what makes a variable a valid "instrument"?
- How can we evaluate an IV design in practice?

Required:

Huntington-Klein, Nick. 2026. "Instrumental Variables *(only selected sections)*." In *The Effect: An Introduction to Research Design and Causality*, 477–498. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Cunningham, Scott. 2021. "Instrumental Variables *(only selected sections)*." In *Causal Inference: The Mixtape*, 315–323. New Haven London: Yale University Press. ISBN: 978-0-300-25168-5.

Recommended:

Huntington-Klein, Nick. 2026. "Instrumental Variables *(the rest of the chapter)*." In *The Effect: An Introduction to Research Design and Causality*, 498–512. Boca Raton, Florida: Taylor & Francis. ISBN: 978-1-032-58022-7.

Block V: Student Presentations

Session 12, 30.06.2026 - In-class presentations

- Student presentations

Session 13, 07.07.2026 - In-class presentations

- Student presentations

Session 14, 14.07.2026 - In-class presentations

- Student presentations

Session 15, 21.07.2026 - Concluding Discussion and Feedback Session

- Feedback session on the content and organization of the seminar, with an open discussion on what you learned, liked, or found challenging.