POLS 6001: Quantitative Analysis

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Course Description

This course is an introduction to quantitative analysis, statistics, and programming for political science. This course will prepare you to consume and produce data-driven, large-N, empirical social science research. Regardless of the style of research you plan on doing, it is imperative that you develop the skills necessary to understand papers in top peer-reviewed journals and the talks you'll see while a graduate student. This course will primarily focus on political science and public policy, however the topics covered in this course will be applicable to any social science (economics, public administration, etc.). This course is a pre-requisite to the second course in the sequence which I *highly* recommend to everyone.

Because of the breadth of material covered in this course, it will move quickly. The structure will combine an introduction to core statistical concepts combined with practical programming in the programming language R. There will be almost-weekly problem sets that will be a mix of building on the statistical principals covered in lectures and readings, simulations of them using R, and practical exercises with real world data (government data, surveys, replication data, etc.), also in R. R is the required programming language for all assignments and exams. Understanding at an intuitive level how data is structured – and how it needs to be structured for analysis – and the tools to wrangle it is the second objective this semester.

At the end of this semester, you should have a fundamental understanding of sample inference, probability, randomization, experiments, and linear regression with OLS. You will also come away with some foundational intuition behind causal inference in observational and experimental settings – which we will build on in the second semester. You will also have a working and highly practical knowledge of R. A fundamental goal of this course is to provide you with "data science" skills that are applicable outside of academia and in high demand within academia. You will also be able to consume and understand a substantial amount of the research published in top journals, including the built-in assumptions, their limitations, and how to interpret their

models and results. The ultimate goal from POLS 6001 is to give you the tools to rigorously think through your own research questions, including what data may be needed, how to work with that data, research design, causal inferences, and producing models and figures similar to those you see in published papers.

Required Materials

Note: additional readings will be assigned throughout the semester but they will be available for free online.

- Imai, Kosuke. *Quantitative social science: an introduction*. Princeton University Press, 2018. *(QSS from here on)*
- Angrist, Joshua D., and Jörn-Steffen Pischke. *Mastering 'metrics: The path from cause to effect*. Princeton University Press, 2014.
- Bailey, Michael. *Real Stats: Using Econometrics for Political Science and Public Policy*. Oxford University Press, 2021. (2nd Edition).
  - **Note:** All books are available at the library on course reserves.
- *The Effect*, Nick Huntington-Klein. Available at: https://www.theeffectbook.net/index.html
- *Modern Dive*, Chester Ismay and Albert Y. Kim. Available at https://moderndive.com/index.html
  - These two free books will cover more computational approaches to the substantive topics. They're free and great resources.
- RStudio (free software)
- A personal laptop

Recommended Books

If I assign any readings from these they will be emailed as PDFs. All are excellent references and will help you learn more about the topics we cover in this course.

- Gelman, Andrew, Jennifer Hill, and Aki Vehtari. *Regression and other stories*. Cambridge University Press, 2020.
- Aronow, Peter M., and Benjamin T. Miller. *Foundations of agnostic statistics*. Cambridge University Press, 2019.
- Angrist, Joshua D., and Jörn-Steffen Pischke. *Mostly harmless econometrics*. Princeton University Press, 2008.
- Moore, Will H., and David A. Siegel. *A mathematics course for political and social research*. Princeton University Press, 2013.

- Wickham, Hadley, and Garrett Grolemund. *R for data science: import, tidy, transform, visualize, and model data*. O'Reilly Media, Inc., 2016.
- Gailmard, Sean. *Statistical modeling and inference for social science*. Cambridge University Press, 2014.
- Healy, Kieran. *Data visualization: a practical introduction*. Princeton University Press, 2018.
- Cunningham, Scott. *Causal Inference: The Mixtape*. Yale University Press, 2021.

Course Objectives

1. Gain an understanding of how to think through and answer research questions in political science.
2. Gain an intuitive understanding of data and how to work with it.
3. Become familiar with R and learn how to look for solutions to common problems.
4. Learn principles behind research design and causal inference.
5. Learn fundamentals of statistics, sampling, and research in observational settings.
6. Grasp the intuition and statistics behind Ordinary Least Squares (OLS).
7. Learn the tools to consume and produce basic social science research.

Expectations

In this course you will be expected to:

1. Complete 9 problem sets;
2. Complete an in-class midterm;
3. Complete a group research design project;
4. Complete a take-home final exam.

Pre-requisites

There are no specific pre-requisites for this course beyond a basic understanding of high-school level algebra. The course will cover all of the needed math and programming in order to get up to speed. However, I *highly* recommend checking out the recommended reading section. I also recommend, if it's been a while, brushing up on basic algebra and calculus concepts (limits, derivatives, integrals, etc.). This will make your life easier with the readings.

This course *will* be a pre-requisite for the next course in the sequence taught in the Spring.

Course Structure

Class Structure

The typical class session will involve lectures on statistical principals combined with demonstrations using R. Time permitting, there will be in-class group exercises using R.

Assessments

One in-class midterm exam and one take-home final exam. Additionally, there will be problem sets spread throughout the semester. These will be graded on a check-minus / check / check-plus basis largely determined by effort. The two that receive the lowest grade will be dropped. All problem sets and the group project **must** be completed in LaTeX or RMarkdown. Any hand-written assignments or assignments completed in word processing software will lose 10 points. I highly recommend https://www.overleaf.com/. I will be covering how to do this, but it's ultimately up to you to learn this very important tool.

You **will** be allowed to work in groups on the problem sets. **However**, each person must turn in their own problem set and their own code! These problem sets are meant to take time to do as the only way to become better at the skills learned in this course will be through practice.

Grading Policy

- **30%** of your grade is the midterm exam.
- **30%** of your grade is the final exam.
- **20%** of your grade are the problem sets (with the two lowest dropped).
- **20%** of your grade is participation in class.
  - Participation includes showing up to class and, completing the readings, and being an overall good citizen in the course.

Note: I reserve the right to curve any and all grades.

Course Policies

- **Questions & inquiries:** Students should reach out to me at any time with questions, concerns, or inquiries. During the week, I strive to respond to all student emails within 24 hours. On the weekend, I shoot for 48 hours. If you do not hear back from me within those time-frames, do not hesitate to email again. I cannot promise to respond after business hours (5pm or later), though occasionally I will.
- **Late assignment policy:** Assignments cannot be turned in late unless otherwise agreed to by the student and instructor.
- **Academic code of conduct:** All students will be expected to abide by the University of Utah's Student Code. No cheating, plagiarism, or other serious offenses will be tolerated. This includes the use of proper citation in ALL papers completed for the class. Violation will result in disciplinary action. Please speak to me if you have any questions.
- **Disability services:** The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 801-581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability Services.
- **University safety statement:** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit http://safeu.utah.edu.
- **Addressing sexual misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).
- **Wellness statement:** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness: www.wellness.utah.edu; 801-581-7776.

University Sanctioned Language on Vaccinations

Please read this section carefully as this course will be taught in person.

University leadership has urged all faculty, students, and staff to **model the vaccination, testing, and masking behaviors** we want to see in our campus community.

These include:

- Vaccination
- Masking indoors
- If unvaccinated, getting weekly asymptomatic coronavirus testing

Vaccination

- **Get a COVID-19 vaccination** if you have not already done so. Vaccination is proving highly effective in preventing severe COVID-19 symptoms, hospitalization and death from coronavirus. Vaccination is the single best way to stop this COVID resurgence in its tracks.
- Many in the campus community already have gotten vaccinated:
- More than 80% of U. employees
- Over 70% of U. students
- Visit `http://mychart.med.utah.edu/`, `http://alert.utah.edu/covid/vaccine`, or `http://vaccines.gov/` to schedule your vaccination.

Mental Health Resources

- Rates of burnout, anxiety, depression, isolation, and loneliness have noticeably increased during the pandemic. If you need help, reach out for campus mental health resources, including counseling, trainings and other support.
- Consider participating in a Mental Health First Aid or other wellness-themed training provided by our Center for Student Wellness and sharing these opportunities with your peers, teaching assistants and department colleagues.

On a personal note: I highly recommend taking advantage of the mental health resources the university has to offer before you need them. Graduate school is difficult and stressful for a number of reasons. I am highly sympathetic and empathetic towards this. You should feel free to talk to me if you're struggling with your mental health.

Schedule and weekly learning goals

The schedule is tentative and subject to change. The readings listed for each week should be done *before* class.

Week 01, 08/23 - 08/27: Introduction and Tools of the Trade

- Required reading before class: https://r4ds.had.co.nz/index.html Chapters 1-7 (Introduction - Exploratory Data Analysis; Pay special attention to 5.6.1)
- Review R Orientation Workshop materials

Week 02, 08/30 - 09/03: Describing Relationships and Intro to Causality

- Problem Set 1 due
- https://r4ds.had.co.nz/index.html Chapters 9-21
- Chapters 1-2 in *The Effect Book* - https://www.theeffectbook.net/index.html
- QSS Chapter 2.1-2.4
- Mastering Metrics 1.1-1.2

Week 03, 09/06 - 09/10: No Class – Labor Day

Week 04, 09/13 - 09/17: Measurement, Statistical Relationships, Sampling

- Problem Set 2 due
- Rebekah Cummings from the library gives a presentation.
- QSS Chapter 3
- *Real Stats* Chapter 2
- Mastering Metrics Chapter 1 Appendix
- Chapter 3 in *The Effect Book*
- *Modern Dive* Chapters 2, 7.1-7.5 - https://moderndive.com/2-viz.html

Week 05, 09/20 - 09/24: More Sampling and Bivariate OLS

- Problem Set 3 due
- *Real Stats* Chapter 3
- QSS Chapter 4.1-4.2
- *Modern Dive* Chapter 5
- *The Effect Book* Chapter 4

Week 06, 09/27 - 10/01: More Linear Regression & Hypothesis Testing

- Problem Set 4 due
- *Mastering Metrics* 2.1-2.2
- QSS Chapter 4.3-4.4
- *Real Stats* Chapter 4
- *Modern Dive* Chapter 6, 9

Week 07, 10/04 - 10/08: Midterm & More OLS

- **NO Problem Set Due**
- In class midterm ($\sim$1 hour)
- *Real Stats* Chapter 5
- Mastering Metrics Chapter 2 Appendix
- *The Effect Book* Chapter 13

Week 08, 10/11 - 10/15: Fall Break

Week 09, 10/18 - 10/22: OLS Continued – Specifying Models, Bootstrap SEs

- The Effect Book, Ch. 13
- Real Stats, Ch. 6, 7.1-7.2

Week 10, 10/25 - 10/29: Selection on Observables Research Designs

- Problem Set 5 Due
- Causal Inference: The Mixtape Ch. 3 - https://mixtape.scunning.com/dag.html
- The Effect Book, Ch. 6
- Real Stats, Ch. 7.3-7.4

Week 11, 11/01 - 11/05: Time-Series Cross-Sectional (Panel) Data

- Problem Set 6 due
- Real Stats, Ch. 8.1-8.4
- The Effect Book, Ch. 16

Week 12, 11/08 - 11/12: Difference-in-Differences

- Problem Set 7 due
- Real Stats Ch. 8.5
- Mastering Metrics Ch. 5
- QSS Ch. 2.5

Week 13, 11/15 - 11/19: Instrumental Variables

- Problem Set 8 due
- Real Stats, Ch. 9 (Skip 9.5)
- The Effect Book, Ch. 19
- Mastering Metrics Ch. 3

Week 14, 11/22 - 11/26: No in-person class

- No problem set

Week 16, 11/29 - 12/03: Exam Review

Week 17, 12/06 - 12/10: Final exam due