

PSCI 7095-001: Advanced Political Data Analysis (Data II)

University of Colorado Boulder

Spring 2023

Time: Monday, 4:00-6:30
Location: KTCH 1B31

Instructor: Dr. Andrew Q. Philips
Office: KTCH 131
Email: andrew.philips@colorado.edu
Office hours: Monday, 2:30-4:00 or by appointment

COURSE DESCRIPTION: Quantitative analysis is an important component of nearly all political science research. This course is designed to introduce you to many of the fundamental tools used for data analysis. We will review and build on what you have learned in Data I. The start of this course focuses on understanding the approach of ordinary least squares (OLS). We will start by reviewing some topics you may already know, then move onto OLS estimation. Then we will cover violations of OLS assumptions, as well as various approaches to addressing such violations.

While it is crucial for political scientists to master OLS, in reality most research involves using alternative modeling techniques, many of which were developed for use in situations where OLS is inappropriate. Therefore, in the second half in the course, we cover a variety of alternative extensions and issues such as dichotomous dependent variables, endogeneity, more recent modeling strategies for causal inference, as well as spatial and temporal dependence. In addition, we will spend a lot of time discussing how to present and interpret regression results, as well as substantive and statistical significance.

By the end of this course you should be able to:

- Understand what is going on “under the hood” of OLS and other models
- Interpret regression results
- Diagnose and address violations of the regression assumptions
- Have a variety of models to add to your “toolkit”
- Apply what you have learned to your research.

PREREQUISITES: This is a graduate level course; students should have a background in introductory regression (i.e., Data I). We will be working in matrix algebra notation throughout much of the course, although prior experience with this is not necessary.

SOFTWARE: We will use R for most of this course. Although familiarity with R is not necessary, it is a plus. Those unfamiliar with this program may want to purchase or borrow the suggested textbooks that cover working with R, although there are copious amounts of information available for free online. Please download both R (<https://cran.r-project.org/>) and RStudio (<https://www.rstudio.com/>) before the first class session. We will probably also use some Stata, although it is not necessary to purchase it for this course. Although there will not be a substantial amount of writing, students are encouraged to write up any assignments using \LaTeX .

GRADES: Course grades will be based on the following. Participation and homework assignments make up 40% of the final grade. About halfway through the semester, a take-home mid-term exam

will be given that is worth 30% of the final grade. At the end of the semester, there will be a take-home final exam worth 30% of the final grade. There are no opportunities for extra credit.

Participation and Homework	40%
Midterm Exam	30%
Final Exam	30%

The following scale will be used to turn numerical grades into letter ones. Note that I will round up a letter should your grade fall on the number (but on or above 0.5) between two letters (e.g., 89.5 up to 90 rounds up to an A-).

Grade Scale

A	95-100
A-	90-94
B+	87-89
B	84-86
B-	80-83
C+	77-79
C	74-76
C-	70-73
D+	67-69
D	64-66
D-	60-63
F	0-59

PARTICIPATION: Participation is an integral component of graduate courses. Students are expected to come to every class *having already read the assigned readings for that day*, and should be prepared to discuss them. Graduate-level courses only are successful when all students participate actively in the discussion.

HOMEWORK: Throughout the semester, there will be various homework assignments. Some of these will be group assignments, others on your own. Most will involve some form of data analysis and interpretation/presentation of regression results. We will discuss more specifics on homework in class.

MIDTERM EXAM: About halfway through the semester there will be a midterm exam. This will be a take-home exam.

FINAL EXAM: At the end of the semester, there will be a comprehensive final exam. The final exam will be take-home and open book. You may consult textbooks, articles, and your notes for this exam, *but not others* (this will be considered a form of cheating).

ATTENDANCE AND LATE POLICY: Attendance is a key component of succeeding in graduate school. I provide slides for each class, but we will have a much more comprehensive discussion than what appears on the slide. Attendance is mandatory. If you have to miss a class, you should let me know in advance so that we can make arrangements.

Assignments are due on the day listed in the syllabus. Late assignments will not be accepted.

REQUIRED TEXTS: The following text is required for the course. Any additional readings will be made available to you on the first day of class or as needed. This text is advanced, but will be a helpful reference after the semester is over.

- Hansen, Bruce E. *Econometrics*. 2022. Princeton University Press.
- Cunningham, Scott. *Causal inference: The mixtape*. Yale University Press.

Note that it is expected to read the week's required readings before coming to class.

RECOMMENDED TEXTS: The following texts are not required, but may be helpful to some. In the schedule below there are additional texts in the "suggested readings".

- Gujarati, Damodar N. and Dawn C. Porter. *Essentials of econometrics*. 2009. 4th edition. McGraw-Hill Education. A good introductory econometrics text.
- Angrist, Joshua D. and Jorn-Steffen Pischke. *Mostly harmless econometrics: An empiricist's companion*. 2009. Princeton University Press. A quite accessible introduction to causal inference and various other topics.
- Wooldridge, Jeffrey M. *Econometric analysis of cross section and panel data*. 2010. 2nd edition. MIT Press. A Greene-level text that focuses on cross-sectional and cross-sectional time series data.
- Greene, William H. *Econometric analysis*. 2017. 8th edition. Pearson.
- Kennedy, Peter. *A guide to econometrics*. 2008. 6th edition. Wiley-Blackwell. A popular introductory econometrics text.
- Philips, Andrew Q. 2019. "L^AT_EX: A brief introduction".

TENTATIVE SCHEDULE: Note that this schedule is subject to change. We will spend as long as we need to on a topic.

No Class January 16 (MLK Day)

Topic 1: Course Introduction, Regression Assumptions, Introduction to Matrix Algebra and R

Required Readings:

- Hansen, Appendix A (skim)

Suggested Readings:

- Phillips, Nathan. 2018. *YaRrr! The Pirate's Guide to R*. <https://bookdown.org/ndphillips/YaRrr/>.
- Burns, Patrick. 2011. *The R Inferno*. Available at: <http://www.burns-stat.com/documents/books/the-r-inferno/>.
- Philips, Andrew Q. 2019. "R: A brief introduction."

Topic 2: Under the Hood: OLS

Required Readings:

- None

Topic 3: Under the Hood: OLS (continued)

Required Readings:

- Hansen, Ch. 2.14-2.28, 3

Topic 4: OLS in Practice

Required Readings:

- Hansen, Ch. 4 (up to 4.13), 4.15-4.21, 5-5.11, 7-7.6, 7.11-7.14 (optional: skim ch 6)

Topic 5: OLS in Practice (Continued)

Required Readings:

- Hansen, Ch 5.12 on, 7.16-7.18, 9
- Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. "Understanding interaction models: Improving empirical analyses." *Political Analysis* 14(1): 63-82.
- Berry, William D., Matt Golder, and Daniel Milton. 2012. "Improving tests of theories positing interaction." *Journal of Politics* 74(3): 653-671.
- Hainmueller, Jens, Jonathan Mummolo and Yiqing Xu. 2019. "How much should we trust estimates from multiplicative interaction models? Simple tools to improve empirical practice." *Political Analysis* 27:163-192.

Suggested Readings:

- Franzese, Robert, and Cindy Kam. 2009. *Modeling and interpreting interactive hypotheses in regression analysis*. University of Michigan Press.

Topic 6: Generalized Least Squares

Required Readings:

- Hansen, Ch. 4.13-4.14, 4.21 on
- Mansournia, Mohammad Ali, Maryam Nazemipour, Ashley I. Naimi, Gary S. Collins, and Michael J. Campbell. 2021. "Reflection on modern methods: demystifying robust standard errors for epidemiologists." *International Journal of Epidemiology* 50(1): 346-351.

Suggested Readings:

- Abadie, A., Athey, S., Imbens, G.W. and Wooldridge, J.M., 2022. "When should you adjust standard errors for clustering?" *The Quarterly Journal of Economics*, 138(1): 1-35.
- Imbens, G.W. and Kolesar, M., 2016. "Robust standard errors in small samples: Some practical advice." *Review of Economics and Statistics*, 98(4): 701-712.
- White, Halbert. 1980. "A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity." *Econometrica: Journal of the Econometric Society*: 817-838.

Topic 7: Binary Dependent Variables

Required Readings:

- Hansen Ch. 25
- Berry, William D., Jacqueline HR DeMeritt, and Justin Esarey. 2010. "Testing for interaction in binary logit and probit models: Is a product term essential?" *American Journal of Political Science* 54(1):248-266.

Topic 8: Endogeneity and Instrumental Variables

MID-TERM EXAM handed out [take home]

Required Readings:

- Hansen Ch. 12

- Cunningham Ch. 7

Suggested Readings:

- Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. "The colonial origins of comparative development: An empirical investigation." *American Economic Review* 91(5):1369-1401.

Topic 9: Causality and Causal Inference I

Required Readings:

- Hansen Ch. 2.3-2.32
- Cunningham Ch. 3 and 4
- Pearce, Neil and Debbie A. Lawlor. 2016. "Causal inference—so much more than statistics." *International Journal of Epidemiology*: 1895-1903.

Suggested Readings:

- Angrist, Joshua D. and Jorn-Steffen Pischke. 2009. *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press. Chapters 1 and 2.
- Keele, Luke. 2015. "The statistics of causal inference: A view from political methodology." *Political Analysis*: 23:313-335.

No Class March 27 (Spring Break)

Topic 10: Causality and Causal Inference II

Required Readings:

- Cunningham Ch. 5, 6 and 9
- Hansen Ch. 18
- Keele, Luke, Randolph T. Stevenson and Felix Elwert. 2020. "The causal interpretation of estimated associations in regression models." *Political Science Research and Methods* 8: 1-13.
- Matthay, Ellicott C., Erin Hagan, Laura M. Gottlieb, May Lynn Tan, David Vlahov, Nancy E. Adler, M. and Maria Glymour. 2020. "Alternative causal inference methods in population health research: Evaluating tradeoffs and triangulating evidence." *SSM-Population Health* 10: 100526.

Suggested Readings:

- Hansen Ch. 21
- De Chaisemartin, Clement, and Xavier d'Haultfoeuille. 2020. "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects." *American Economic Review* 110 (9): 2964-2966.
- Motolinia, Lucia. 2021. "Electoral accountability and particularistic legislation: Evidence from an electoral reform in Mexico" *American Political Science Review* 115(1): 97-113.
- Kaur, Komal Preet and Andrew Q. Philips. 2022. "A moveable benefit? Spillover effects of quotas on women's numerical representation." *Political Research Quarterly*: 1-17.

Topic 11: Time Series

Required Readings:

- Hansen Ch. 14 (skim, and skim Ch. 15-16 if you're feeling adventurous)
- DeBoef, Suzanna, and Luke Keele. 2008. "Taking time seriously." *American Journal of Political Science* 52(1): 184-200.
- Philips, Andrew Q. 2018. "Have your cake and eat it too? Cointegration and dynamic inference from autoregressive distributed lag models." *American Journal of Political Science*. 62(1): 230-244.

Suggested Readings:

- Keele, Luke, and Nathan J. Kelly. 2006. "Dynamic models for dynamic theories: The ins and outs of lagged dependent variables." *Political Analysis* 14(2): 186-205.

Topic 12: Spatial Statistics

Required Readings:

- Beck, Nathaniel, Kristian Skrede Gleditsch, and Kyle Beardsley. 2006. "Space is more than geography: Using spatial econometrics in the study of political economy." *International Studies Quarterly* 50(1): 27-44.
- Whitten, Guy D., Laron K. Williams and Cameron Wimpy. 2021. "Interpretation: The final spatial frontier." *Political Science Research and Methods* 9(1): 140-156.
- Wimpy, Cameron, Guy D. Whitten and Laron K. Williams. 2021. "X marks the spot: Unlocking the treasure of spatial-X models." *Journal of Politics* 83(2): 1-18.

Suggested Readings:

- Franzese, Robert J., and Jude C. Hays. 2007. "Spatial-econometric models of cross-sectional interdependence in political science panel and time-series-cross-section data." *Political Analysis* 15(2): 140-164.
- Plumper, Thomas and Eric Neumayer. 2010. "Model specification in the analysis of spatial dependence." *European Journal of Political Research* 49: 418-442.

Topic 13: Machine Learning

Required Readings:

- Hansen Ch. 29
- Hindman, Matthew. 2015. "Building better models: Prediction, replication, and machine learning in the social sciences" *The Annals of the American Academy of Political and Social Science* 659(1):48-62.
- Montgomery, Jacob M., and Santiago Olivella. 2018. "Tree-based models for political science data." *American Journal of Political Science* 62(3): 729-744.

Suggested Readings:

- Grimmer, Justin. 2015. "We are all social scientists now: How big data, machine learning, and causal inference work together" *PS*: 80-83.
- James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. 2013. (JWHT 2013) "An introduction to statistical learning: With applications in R." Springer Series in Statistics. 1st edition. ISBN: 978-1461471370
- Funk, Kendall D., Hannah L. Paul and Andrew Q. Philips. 2021. "Point break: Using machine learning to uncover a critical mass in women's representation." *Political Science Research and Methods* 1-19.

Topic 14: Panel data

Required Readings:

- Hansen, Ch. 17
- Philips, Andrew Q. n.d. *Pooled Data Analysis for the Social Sciences*. Chapter 2.
- Zhu, Ling. 2012. "Panel Data Analysis in Public Administration: Substantive and Statistical Considerations." *Journal of Public Administration Research and Theory* 23:395-428.
- Clark, Tom S., and Linzer, Drew A., 2015. "Should I use fixed or random effects?" *Political Science Research and Methods* 3(2):399-408.

Suggested Readings:

- Beck, Neil and Jonathan Katz. 2011. "Modeling Dynamics in Time-Series-Cross-Section Political Economy Data." *Annual Review of Political Science*: 331-352.

- Beck, N. 2001. "Time-series-cross-section data: What have we learned in the past few years?" *Annual Review of Political Science* 4(1):271-293.
- Croissant, Y and G Millo. 2008. "Panel Data Econometrics in R: The plm Package." *Journal of Statistical Software*, 27(2). URL: <http://www.jstatsoft.org/v27/i02/>

Final Exam: TBA (take-home)

SYLLABUS CHANGES

I reserve the right to make changes to the syllabus during the course of the semester as needed and will make the most updated copy available to you and announce said changes during class.

Last updated: January 10, 2023

UNIVERSITY-MANDATED STATEMENTS

Classroom behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

Requirements for COVID-19

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the "Accommodation for Disabilities" statement on this syllabus.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracingcolorado.edu). If you are going to miss class you must contact either the instructor and/or the TAs

Accommodation for disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

Preferred student names and pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution (honorcolorado.edu); 303-492-5550). Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website.

Sexual misconduct, discrimination, harassment and/or related retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureportcolorado.edu. Information about university policies, reporting options, and support resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution options. To learn more about reporting and support options for a variety of concerns, visit [Don't Ignore It](#).

Religious holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, I will try to accommodate your requests, but you must contact me early in the semester.

See the [campus policy regarding religious observances](#) for full details.