Overview and Class Goals. Time series (TS) data – also called longitudinal data – and time series cross-sectional (TSCS) data – also called panel data – are widely used in the social sciences. In some cases, TS and TSCS data are the ideal format for exploring change over time within several units, which might be individuals, organizations, regions, or other entities observed over time. In other cases, panel data are used to either expand the number of observations, to gain leverage over unobservables, or both. Finally, time series and panel data provide opportunities for causal inference often unavailable in strictly cross-sectional datasets. As useful as these data structures are, they typically derive from data generating processes that violate the usual assumptions of linear regression, requiring a variety of specialized techniques for valid inference. Appropriate methods vary subtly by the nature of the time series or panel dataset and the goals of inference and require training to choose correctly and deploy well.
Learning Goals. This course provides a survey of regression models for time series and time series cross-sectional data and associated analytic techniques. In particular, we focus on methods used in political science and allied fields (including sociology, public health, business, education, and public policy) to study continuous outcomes at the level of organizations or political units, and sometimes individuals (especially in settings where individual growth or development can be neglected). Students will learn how to explore their data to choose appropriate models, and how to understand those models once estimated. In particular, our emphasis lies in modeling dynamics and panel structures with continuous outcomes, as well as on interpretation and fitting of models. (Other courses cover the modeling of panel data with discrete outcomes.) Specific topics vary and may include trends and seasonality, ARIMA models, lagged dependent variables, distributed lags, cointegration and error correction models, fixed and random effects, panel heteroskedasticity, missing data imputation, and causal inference using panel data, including recent developments in difference-in-difference methodology.

Prerequisites. No specific courses are required; however, students should have a solid grounding in linear regression, as provided, for example, by courses in Political Science (POLS 501 and POLS 503), Sociology (SOC 504 and SOC 506), or Statistics (STAT/CSSS 504). Familiarity with (or a willingness to quickly learn) matrix notation for regression models is essential, as is basic proficiency in the R statistical language. Students may use alternative packages when they are able to comprehensively achieve class goals using those packages, but in-class support will be provided only for R.

Course Requirements. Course evaluation will be based on problem sets (60% of course grade based on three over the term, due by Canvas submission by the start of class on assigned days), a student poster presentation in class (5% of course grade), and a research paper (35% of course grade; due Tuesday, 4 June 2024 at noon as in PDF format to cado1ph@uw.edu). Students are strongly encouraged to collaborate in groups of two or three on the paper, which should apply methods studied in the course (or with instructor approval, related methods of similar sophistication) to a student-chosen time series or panel dataset. Pure methodology papers in time series and/or panel data analysis are also acceptable. Further rules and suggestions for the research paper are provided on the course website.
Office Hours. Christopher Adolph: By appointment via Zoom. Ramses Llobet: By appointment via Zoom.


Use of Generative Text and Images Prohibited. Students are prohibited from using generative text or generative images — so called-artificial intelligence tools such as ChatGPT or DALL·E — to assist in completing any course assignments. Students should not use chatbots based on large language models to complete class assignments because of the fundamental challenges these tools have in generating accurate statements (“hallucination”) and the intrinsic inability of these tools to properly attribute sources of information. Moreover, a strong ethical and legal case can be made against the use of either generative text or images in academic work due to the unauthorized use of copyrighted materials to train the models underlying these tools. Regardless of the merits of these tools, reliance on them in an instructional environment deprives students of the opportunity to hone the research, writing, and coding skills required to evaluate or refine their outputs. Even if there is a case for using chatbots or AI art in some contexts, doing so in this course contradicts its core pedagogical aims.

Students may not use chatbots or so-called AI art to produce, in whole or in part, either rough or final drafts of computer code, figures, assignment write-ups, presentations, or papers: use of chatbots to assist in any of these tasks will be considered cheating and/or academic fraud. If you are uncertain whether use of a specific resource violates this rule, ask your instructor before using it.

Penalty for Cheating or Academic Fraud. Any student caught cheating or plagiarizing by the instructor on any assignment will receive a grade of X for the course and will be reported to the Dean’s office in the College of Arts and Sciences.

Notice Required by State Law. Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW’s policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request).
Other relevant university policies. See this website:
https://registrar.washington.edu/staffandfaculty/syllabi-guidelines

Course textbooks

Required (sharing encouraged; some selections provided)


Main course text on time series; highly readable and comprehensive coverage of the most relevant methods for social science applications, with a political science focus.


Secondary text on time series; straightforward general introduction focused on implementation of common methods in R.


Excellent general introduction to linear regression and hierarchical modeling, of which panel data models are a specialized subset of approaches; good for code and intuition, especially on simulation methods.


Classic modern text covering linear regression and panel data models from an econometric perspective.
Optional books for further study


Required and optional articles


Course outline

This outline of topics is a guideline and may be altered to meet course needs. In particular, the pace of the course may vary to make sure we are moving as fast as possible conditional on everyone understanding the material. Students should come to class having read the material for the next topic to be covered. Optional material is marked “(opt.)”.

Part I: Review of Fundamentals

Week 1  ·  25–27 March  ·  Course Introduction / Review of Linear Regression & Simulation

Resources:  Review POLS/CSSS 510 lectures on MLE, simulation
            Woolridge, Ch. 4, review on linear regression
            King, Tomz, and Wittenberg, 2000
            Math review (opt.): www.csss.washington.edu/MathCamp/Review/
            Zuur Ch 1–6 (opt.; for R beginners)
            Handout on matrix algebra (opt.)

Part II: Analysis of Time Series Data

Week 2  ·  1–3 April  ·  Basic Concepts for Time Series: Trends, Lags, and Cycles

Readings:  Box–Steffensmeier et al, Ch. 1, 2.
            Cowpertwait & Metcalf, Ch. 1.1, 1.4, 1.6, 2.1–2.5.

Week 3  ·  8–10 April  ·  Modeling Stationary Time Series

Readings:  Box–Steffensmeier et al, Ch. 3.
            Cowpertwait & Metcalf, Ch. 4, 5.1–5.4, 5.9–5.11, 6.

Optional:  Box–Steffensmeier et al, Ch. 4.

Week 4  ·  15–17 April  ·  Modeling Nonstationary Time Series

Readings:  Box–Steffensmeier et al, Ch. 5, 6.
            Cowpertwait & Metcalf, Ch. 7.

Optional:  Pfaff, Ch. 4.
Part III: Analysis of Panel Data

**Week 5** · 22–24 April · Basic Concepts for Panel Data

*Readings:* Gelman and Hill, Ch. 11, 12, 13.
Woolridge, Ch. 10.1–10.4.

**Week 6** · 29 April–1 May · Panel Data Models with Many Time Periods

Woolridge, Ch. 10.5–10.7.

**Week 7** · 6–8 May · Panel Data Models with Few Time Periods

*Readings:* Roodman 2009 (skip code examples)

Part IV: Advanced Topics

**Week 9** · 20–22 May · Special Topics – TBD

We will consider one or more advanced topics, to be chosen with class input. Possible topics include synthetic controls methods for differences-in-differences models, missing data imputation, and linkages between this course and event history analysis. Additional readings will be provided.

**Problem Set 3 Due Monday 20 May via Canvas**
Part V: Student Poster Presentations

**Week 9–10 · 22–29 May · Student Poster Presentations**

Students will prepare and present a poster on their research projects in progress; this yields valuable feedback prior to final write-ups. Requirements and suggestions for poster construction will be discussed in class. Presentation dates will be assigned to minimize discrepancy with student preferences. Early presentations are assumed to be less complete and evaluated accordingly. Students unable to present on certain days due to schedule conflicts should inform the instructor.

**FINAL PAPER DUE TUESDAY 4 JUNE AT NOON BY EMAIL AS PDF**