

POLISCI 9590A - Intro to Quantitative Methods

Fall 2023

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Course Description

The objective of this course is to provide graduate students with the necessary statistical tools to make inferences about politics. We will cover fundamentals of probability theory, estimation, hypothesis testing and data visualization. These topics will be discussed with an eye on applications to research questions in all subfields of political science. Leaving this course, students will also be able to acquire, format, analyze, and visualize various types of data using the statistical programming language R.

We will hold two meetings a week. The first one will be dedicated primarily to the theoretical content of the class. The second meeting will be a laboratory during which we will mobilize theoretical concepts using real data. Students are required to attend all classes during the semester. Evaluations will consist of problems sets and exams.

Software Requirements

This course will be taught using R, a free object-oriented statistical programming language. We will also use RStudio, an interface which makes working with R substantially easier. You should download the latest version of R (<http://cran.r-project.org/>) and the latest version of RStudio (<https://www.rstudio.com/>) before our first laboratory. Please note that you will also need to bring a scientific calculator to class every week.

Students are expected to have a basic familiarity with computation. While no background in statistics, political science, or computer science is required, students are expected to be generally familiar with contemporary computing environments (e.g. know how to use a computer, identify paths to files, download new software, etc.) and have a willingness to learn a wide variety of data science tools.

You will receive an invitation to a **Slack channel** at the beginning of the semester. Feel free to share all your problem set-related, substantive or technical questions in the appropriate Slack channel (i.e. not via private messages). Note that questions must be written in such a way as

to not give away answers to the problem sets. Students are encouraged to answer each other's questions.

Evaluations

Evaluations will consist of problems sets (50% of total grade) and exams (50% of total grade). Please note that your final grade in this class might be curved.

Week	Date	Evaluation	Percent
3	25/09/2023	Problem Set 1	12.5%
5	11/10/2023	Problem Set 2	12.5%
7	25/10/2023	Midterm Exam	25%
10	13/11/2023	Problem Set 3	12.5%
12	27/11/2023	Problem Set 4	12.5%
13	06/12/2023	Final Exam	25%

1. Problem Sets (12.5% each)

You will complete 4 problem sets over the course of this class, each worth 12.5% of your final grade. Some of them will be difficult or ask you to expand on what we discussed in class. Please note that these challenges are inherent to learning computational social science, and while we will work to minimize them, we cannot eliminate them.

Problem sets should be submitted **at the beginning of class** on their due date. The problem set hand-out must be submitted in-person (i.e. pen and paper format). The script used to solve the programming problems should be submitted via OWL. Specific instructions will be included on the problem sets. Not submitting your work in the appropriate PDF format will result in a 0.5 points penalty.

You might find it helpful to form study groups to work on the problem sets with your peers. However, **each student must submit their own write-up**, and I strongly recommend that you attempt the problems on your own before getting together with your study group. This is the best way to prepare for exams. One key point: do not share calculations, code, or answers in any fashion. You may discuss the problem sets conceptually, but the write-up must be 100% your own. It is also not allowed to use artificial intelligence softwares to answer the problem set questions. Please note that you must write on your copy the name of all other students you collaborated with. Infringing upon **any** of these rules will result in a 0 **for the entire problem set** and may lead to disciplinary action.

2. Exams (25% each)

There will be a midterm and a final exam, each worth 25% of your final grade. Both the theoretical content and the practical programming content of the class will be evaluated during these

exams. Most of the questions will be variations or expansions of the material covered in the problem sets. We will hold a review session on the course preceding each of the exams to discuss any questions you may have on the material.

Exams will be held in class. You will have access to your notes and computer for the programming part of the exam, and to a hand-written page with notes for the theory part of the exam (one-sided for the midterm, double-sided for the final). For the programming part of the exam, your script should be compiled as a PDF and uploaded on OWL by the end of the evaluation. Not submitting your work in the appropriate PDF format will result in a 0.5 points penalty. Accessing Google, personal notes and class material will be allowed for the programming questions, but any form of real-time communication (Slack, Discord, email, SMS, etc.) or use of artificial intelligence softwares is prohibited and will result in disciplinary action. Please note that exams cannot be written early under any circumstances.

Class Material

1. Slides, Lab Material, Problem Sets Material

Presentation slides, lab material and material for the problem sets will be made available on OWL. RMarkdown write-ups for our laboratories will be uploaded on the following web page: <https://www.evelynbrie.com/teaching#/polisci-9590a/>.

2. Readings

Mandatory readings are the following:

- Aronow, P. & Miller, B. *Foundations of Agnostic Statistics*. 2019. Cambridge University Press (openly available via the link provided on OWL)
- Imai, K. *Quantitative Social Science: An Introduction*. 2018. Princeton University Press (available at the UWO bookstore)

Some additional readings included in the course schedule will be uploaded on the course's OWL site. A plethora of additional high-quality material relative to programming with R is freely available online, among others here:

- Wickham H. & Grolemund G. *R for Data Science*. 2017. O'Reilly. Available here: <https://r4ds.had.co.nz/>

I also recommend consulting the following book, which discusses how to conduct empirical research in political science using R:

- Berdahl R. *Explorations: Conducting Empirical Research in Canadian Political Science, 4th Edition*. 2021. Oxford University Press. Available here: https://learninglink.oup.com/access/berdahl4e-student-resources#tag_lab-manual

Late Problem Sets and Grading

All students will be granted one 24-hour automatic problem set extension during the semester, no questions asked. You do not need to inform us in advance when using your extension, as we will be keeping track of submission times. Beyond that, late problem sets will be penalized by 10 percentage points for each 24 hours that they are late, until the answer key is posted on OWL, after which your grade will be 0. The material in this course is cumulative, so lateness on a specific assignment will have negative effects on your ability to learn the material.

If you are unable to come to class when a problem set is due, your scanned problem set and your script can be submitted via OWL. If illness prevents you from turning in assignments on time, the illness must be documented according to Western's Policy on Accommodation for Illness (available [here](#)). Requests for a problem necessitating a leave of absence should be made directly to the School of Graduate and Postdoctoral Studies.

Office Hours and Tutorials

I will hold office hours to address any follow-up questions, to suggest further readings, to discuss assignments and to cover any other topics relevant to the class. These office hours are held in-person at Social Science Centre 7233 or via Zoom on Monday from 15:00 to 17:00 (please make an appointment here: https://calendly.com/e_brie).

The teaching assistant will also hold office hours and tutorials at the time indicated on the first page of this syllabus. Attending tutorials is not mandatory, but is highly encouraged.

Medical and Compassionate Extensions

If illness prevents you from coming to class or from turning in assignments on time, the illness must be documented according to Western's Policy on Accommodation for Illness (available [here](#)). To obtain any accommodation in the context of this class, you must email appropriate documentation to the Academic Counselling office at arts@uwo.ca. All requests for medical or compassionate extensions must go through academic counseling only. The Accommodation request is emailed to professors shortly after, and it is the student's responsibility to follow up with professors and make the appropriate arrangements if approved. If you miss a make-up exam with an accommodation, it will be replaced with a significant research assignment based on all the material and readings covered during the semester.

Duration of Extensions

If it is approved by student counselling, your extension will be for exactly how many days they approve. For example, if the problem set due date was the 22nd, and your accommodation is from the 22nd to 24th, you will get a 3-day extension (22, 23, 24) meaning your problem set is then due by 1:30 pm on the 25th. You must submit your problem set through OWL by 1:30 pm

on the new due date. After that it will be counted as late and the late penalty will start to apply.

If the accommodation dates given by counselling start a day or two after the problem set due date, your extension is still only for the number of days between their start and end dates. For example, if the problem set is due on the 22nd, and your accommodation is from the 24th to 25th, you will receive a 2-day extension only (24, 25) from the original due date, making it due on the 24th. Applying for an accommodation on a Friday and not hearing back from counselling until the Monday will not give you extra days.

Flexibility with Assignment Deadlines

Students who have the “flexibility with assignment deadlines” accommodation from Accessible Education do NOT need to email me. You must contact academic counselling to have an extension approved and it will be for a maximum of 3 days. Longer extensions will not be granted. Therefore, if the problem set due date was the 22nd, and you receive the 3 day “flexibility with assignment deadlines” accommodation, your problem set is then due by 1:30 pm on the 25th. Having the “flexibility with assignment deadlines” accommodation does not apply to the date you write the exams.

Re-Writing Assignments and Ignoring Unsubmitted Work

You are not allowed to re-write any exam or problem set once they have been handed in for marking, unless due to exceptional circumstances as assessed by the Dean’s office. In the event that you do not submit some evaluations, you **may not** have your mark reweighted as to ignore your unsubmitted work unless you have written permission from the Academic Counsellor in your Faculty.

Statement on Academic Offences

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence and the penalties a Graduate Chair can impose [here](#).

Computer-marked tests and exams may be subject to submission for similarity review by softwares that will check for unusual coincidences in answer patterns. All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com.

Schedule and learning goals

The learning goals below should be viewed as the key concepts you should grasp after each class. Please note that this schedule is tentative and subject to change.

Week 1: Introduction to Causal Inference

Monday, September 11th

- Theory: Causality and Inference, Types of Variables, Data Generating Process
 - King, Keohane and Verba. *Designing Social Inquiry*. 1994 (Chapter 3)

Wednesday, September 13th

- Lab: Inputting and Manipulating Data, Submitting Assignments using *knitr*
 - Imai: Chapter 1 (P. 1 - 29)

Week 2: Probability Theory I

Monday, September 18th

- Theory: Sample Space, Basic Properties, Permutations and Combinations
 - Spiegelhalter. *The Art of Statistics: Learning from Data*. 2019 (Chapter 8)
 - Aronow and Miller: Section 1.1 (P. 1 - 15)

Wednesday, September 20th

- Lab: Sampling with/without Replacement, "Birthday Problem"
 - Imai: Section 6.1 (P. 242 - 254)

Week 3: Probability Theory II

Monday, September 25th

- Theory: Random Variables and Probability Distributions
 - Aronow and Miller: Section 1.2 (P. 15 - 21)
- **Submit Problem Set 1 (12.5%)**

Wednesday, September 27th

- Lab: Sampling from Distributions, Law of Large Numbers
 - Imai: Section 6.3 and Section 6.4.1 (P. 277 - 302)

Week 4: Estimation and Inference

Monday, October 2nd

- Theory: *I.I.D.*, Estimators, Bias, Central Limit Theorem
 - Aronow and Miller: Section 3.1 to 3.2.4 (P. 91 - 109)

Wednesday, October 4th

- Lab: Measures of Center and Variance
 - Imai: Section 6.4.2, 7.1.1 and 7.1.2 (P. 302 - 305, P. 314 - 325)

Week 5: Data Visualization

Monday, October 9th

- Thanksgiving Holiday

Wednesday, October 11th

- Lab: Data Visualization using **ggplot**
 - Wickham. *ggplot2: Elegant Graphics for Data Analysis*. 2016: Chapter 2
 - Schwabish. *Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks*. 2021 (P. 13 - 53)
- **Submit Problem Set 2 (12.5%)**

Week 6: Hypothesis Testing

Monday, October 16th

- Theory: Accepting and Rejecting Hypotheses, P-Values
 - Aronow and Miller: Section 3.4.1 and 3.4.2 (P. 124 - 130)
 - Spiegelhalter and Masters. *Covid By Numbers: Making Sense of the Pandemic with Data*. 2021 (Chapter 5 and Chapter 6)

Wednesday, October 18th

- Lab: T-Tests, Visualizing the Rejection Region
 - Imai: Section 7.1.3 to 7.1.6 and Section 7.2 (P. 326 - 362)

Week 7: Review and Midterm Exam

Monday, October 23th

- Review Session

Wednesday, October 25th

- Midterm Exam (25%)

Week 8: Fall Break

Week 9: Linear Models I

Monday, November 6th

- Theory: Properties of OLS Estimators (B.L.U.E.)
 - Aronow and Miller: Section 4.1.1 and 4.1.2 (P. 143 - 145)
 - Look at tables and figures from the following paper: Fearon and Laitin. "Ethnicity, Insurgency, and Civil War". 2003. *American Political Science Review*.

Wednesday, November 8th

- Lab: Bivariate Regression Models
 - Imai: Section 4.2 (P. 139 - 160)

Week 10: Linear Models II

Monday, November 13th

- Theory: Mechanics of OLS (Basic Matrix Algebra)
 - Aronow and Miller: Section 4.1.3 (P. 147 - 151)
- Submit Problem Set 3 (12.5%)

Wednesday, November 15th

- Lab: Multivariate Regression Models
 - Bueno de Mesquita and Fowler. *Thinking Clearly with Data, A Guide to Quantitative Reasoning and Analysis* (P. 74-93)

Week 11: Nominal and Ordinal Data

Monday, November 20st

- Theory: Nominal Data, Ordinal Data
 - Hahn and Godley. *An Introduction to Statistics for Canadian Social Scientists*. 2017 (Chapters 12 and 13)

Wednesday, November 22nd

- Lab: Chi-Square and ANOVA
 - Shang, Y. *Making Sense of Data with R*. 2022. (Sections 8 and 9 - available here: <https://bookdown.org/yshang/book/>)

Week 12: Missing Data and Generalization

Monday, November 27th

- Theory: Regularity and Irregularity in Missing Data
 - Aronow and Miller: Section 6.1.1 to 6.1.3 (P. 207 - 217)
 - Skim the following article: Fowler and Hall. "Do Shark Attacks Influence Presidential Elections? Reassessing a Prominent Finding on Voter Competence". 2018. *The Journal of Politics*.
- Submit Problem Set 4 (12.5%)

Wednesday, November 29th

- Lab: Dealing with NAs in Datasets, Bootstrapping
 - Imai: Sections 3.1 and 3.2 (P. 78 - 80)

Week 13: Review and Final Exam

Monday, December 4th

- Review Session

Wednesday, December 6th

- Final Exam (25%)