POLISCI 9590A - Intro to Quantitative Methods

Fall 2022

Instructor: Evelyne Brie

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Office: Social Science Centre 7233

Office Hours:

Monday 15:00 - 17:00 (SSC 7233)

Tuesday 14:00 - 16:00 (SSC 7328)

Teaching Assistant:

Alvaro J. Pereira (aperei65@uwo.ca)

Classes:

Monday 9:30 - 11:00

Wednesday 11:30 - 13:00

Social Science Centre 7236

Tutorials:

Thursday 16:00 - 17:00

Social Science Centre 7236

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.

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 question 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 (60% of total grade) and exams (40% of total grade). Please note that your final grade in this class might be curved.

Week	Date	Evaluation	Percent
3	26/09/2022	Problem Set 1	15%
5	12/10/2022	Problem Set 2	15%
7	26/10/2022	Midterm Exam	20%
10	14/11/2022	Problem Set 3	15%
12	28/11/2022	Problem Set 4	15%
13	07/12/2022	Final Exam	20%

1. Problem Sets (15% each)

You will complete 4 problem sets over the course of this class, each worth 15% 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.

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 yourself for the exams. One key point: do not share code in any fashion. You may discuss the problem sets conceptually, but the coding must be 100% your own.

2. Exams (20% each)

There will be a midterm and a final exam, each worth 20% 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 one-sided hand-written page with notes for the theory part of the exam.

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.evelynebrie.com/teaching/polisci-9590a/**.

2. Readings

Mandatory readings are the following:

- Aronow, P. & Miller, B. *Foundations of Agnostic Statistics*. 2019. Cambridge University Press

- Imai, K. *Quantitative Social Science: An Introduction*. 2018. Princeton University Press

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 at their request during the semester, no questions asked. Beyond that, late problem sets will be penalized by 10 percentage points for each 24 hours that they are late. 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 (Alvaro J. Pereira - email: aperei65@uwo.ca) will also hold office hours every Tuesday from 14:00 to 16:00 in SSC 7328 (without appointment). He will also give tutorials every Thursday from 16:00 to 17:00 in SSC 7236. Attending tutorials is not mandatory, but is highly encouraged.

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 12th

- Theory: Causality and Inference, Types of Variables, Data Generating Process

    – King, Keohane and Verba. *Designing Social Inquiry*. 1994 (Chapter 3)

Wednesday, September 14th

- Lab: Inputting and Manipulating Data, Submitting Assignments using *knitr*

    – Imai: Chapter 1 (P. 1 - 29)

—————————————— *Week 2: Probability Theory I* ——————————————

Monday, September 19th

- 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 21th

- Lab: Sampling with/without Replacement, "Birthday Problem"

  – Imai: Section 6.1 (P. 242 - 252)

—————————————— *Week 3: Probability Theory II* ——————————————

Monday, September 26th

- Theory: Random Variables and Probability Distributions

  – Aronow and Miller: Section 1.2 (P. 15 - 21)

- Submit Problem Set 1 (15%)

Wednesday, September 28th

- 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 3rd

- Theory: *I.I.D.*, Estimators, Bias, Central Limit Theorem

  – Aronow and Miller: Section 3.1 to 3.2.4 (P. 91 - 109)

Wednesday, October 5th

- 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 10th

- Thanksgiving Holiday

Wednesday, October 12th

- 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)

- <mark>Submit Problem Set 2 (15%)</mark>

--------------------- *Week 6: Hypothesis Testing* ---------------------

Monday, October 17th

- 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 19th

- 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 24th

- Review Session

Wednesday, October 26th

- <mark>Midterm Exam (20%)</mark>

Week 8: Fall Break

--------------------- *Week 9: Linear Models I* ---------------------

Monday, November 7th

- 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 9th

- Lab: Bivariate Regression Models

    - Imai: Section 4.2 (P. 139 - 160)

_____ *Week 10: Linear Models II* _____

Monday, November 14th

- Theory: Mechanics of OLS (Basic Matrix Algebra)

    - Aronow and Miller: Section 4.1.3 (P. 147 - 151)

- <mark>Submit Problem Set 3 (15%)</mark>

Wednesday, November 16th

- 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 21st

- Theory: Nominal Data, Ordinal Data

    - Hahn and Godley. *An Introduction to Statistics for Canadian Social Scientists*. 2017 (Chapters 12 and 13)

Wednesday, November 23rd

- 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 28th

- 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*.

- <mark>Submit Problem Set 4 (15%)</mark>

Wednesday, November 30th

- 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 5th

- Review Session

Wednesday, December 7th

- Final Exam (20%)