PL208 Statistical Analysis for Political Science

Details

Instructor: Bogdan G. Popescu
Hours: MW 10:00-11:15AM
Total Hours of Contact: 2:30 per week
Room: F.1.5-Frohring Campus, First Floor, Room 5

Credits: 3
Prerequisites: None
Office Hours: TBA

Course Description

This is an applied course on statistical methods commonly used in social science research (including political science and sociology) and provides the necessary foundation to conduct your analysis. Students will learn how to use a widely-used statistical package in data analytics - R and prepare HTML Quarto documents. More generally, students will learn how to read statistics, use statistical tests, and draw conclusions based on them. Students will also learn to carry out statistical tests using statistical packages and interpret results based on their analyses. About 50% of the class will be dedicated to coding.

Summary of Course Content

The course will convene twice a week. There will be lectures covering statistical concepts applied to political science and practical lab sessions where students will use statistical software to conduct the tests. There will be assignments that have to be completed every week. The grades will be 30% midterm, 30% final exam, and 35% weekly assignments, and 5% how much you help your colleagues during the assignments.

Learning Outcomes

Upon successful completion of this course the students will be able to:

- Use statistical core terminology accurately.
- Organize data using both numerical and graphical methods.
- Use measures of central tendency and variability to summarize a data set.
- Carry out tests of hypothesis about population parameters.

Assessment methods

- Five problem sets: 35% of the final grade (7% each)

- Mid term exam: 30% of the final grade
- Final exam: 30% of the final grade

You will be graded on five problem sets during the semester (35% of your grade), the extent to which you help your colleagues for the problem sets (5%) and two exams (each 30% of your grade).

Problem Sets

1.**Initial Individual Submission**: This component contributes 50% of the overall grade for the problem set. When you first complete the problem set independently and submit it to the instructor, your grade for this component will be calculated based on the quality of your independent work. This grade will be weighted at 50% of the total assignment grade.

2.**Final Submission After Group Consultation**: This component also contributes 50% of the overall grade for the problem sets. After discussing the problem set with your group members and documenting the correct answers, you will submit this revised version individually. Note: no group submission is permitted. Each one of you has to submit the second attempt of the assignment individually. Your grade for this component will be based on the quality of your final submission after group consultation. This grade will also be weighted at 50% of the total assignment grade.

3.**Colleague Evaluation**: Your colleagues will assess how much you contributed to helping them with the problem sets at the end of the semester. This evaluation is separate from the individual and group submissions. It measures your ability to assist your fellow students. While the specific weight assigned to this evaluation is not mentioned in the text, it is likely that this evaluation will influence your final grade for the problem sets. The text mentions that "part of the grade for the problem set will also be how much you help your colleagues." This component will count towards your final grade at the end (5%).

Mid term and Final exam

There will also be an in-class midterm and a final exam consisting of specific questions and problems. Each is worth 30%.

Attendance Requirements

Students are required to attend classes following the University's policies. Students with more than two unexcused absences are assumed to have withdrawn from the course. Students with a justified reason not to attend class have to send me an email explaining why they cannot attend ahead of class and need to submit a form to the Dean's Office.

Examination policy

A major exam (midterm or final) cannot be made up without the permission of the Dean's Office. The Dean's Office will grant such permission only when the absence was caused by a serious impediment, such as a documented illness, hospitalization or death in the immediate family (in which you must attend the funeral) or other situations of similar gravity. Absences due to other meaningful conflicts, such as job interviews, family celebrations, travel difficulties, student misunderstandings or personal convenience, will not be excused. Students who will be absent from a major exam must notify the Dean's Office prior to that exam. Absences from class due to the observance of a religious holiday will normally be excused. Individual students who will have to miss class to observe a religious holiday should notify the instructor by the end of the Add/Drop period to make prior arrangements for making up any work that will be missed.

Grade Description of Academic Work

- A (95-100)
- B (85-94)
- C (75-84)
- D (65-74)
- F (65 and below)

Academic Honesty

As stated in the university catalog, any student who commits an act of academic dishonesty will receive a failing grade on the work in which the dishonesty occurred. In addition, acts of academic dishonesty, irrespective of the weight of the assignment, may result in the student receiving a failing grade in the course. Instances of academic dishonesty will be reported to the Dean of Academic Affairs. A student who is reported twice for academic dishonesty is subject to summary dismissal from the University. In such a case, the Academic Council will then make a recommendation to the President, who will make the final decision

Students with Learning or Other Disabilities

John Cabot University does not discriminate on the basis of disability or handicap. Students with approved accommodations must inform their professors at the beginning of the term. Please see the website for the complete policy

Recommended Books

Aronow, Peter and Miller, Benjamin, 2019. Foundations of Agnostic Statistics. Cambridge University Press.

Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press.https://mixtape.scunning.com.

Ismay, Chester, and Albert Y. Kim. 2019. *Statistical Inference via Data Science: A ModernDive into R and the Tidyverse.* Chapman and Hall / CRC. https://moderndive.com/.

Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/.

Llaudet, Elena and Imai, Kosuke. 2023 "Data Analysis for Social Science." Princeton: Oxford University Press.

Warne, Russel T. 2018. "Statistics for the Social Sciences. A General Linear Model Approach." London: Cambridge University Press.

Optional Books

Bauer, Paul C. and Dennis Cohen. 2023. *Applied Causal Analysis (with R)* https://bookdown.org/paul/applied-causal-analysis/.

Keyes, David, R for the Rest of Us: 2025. *A Statistics-Free Introduction* https://book.rfortherestofus.com. No Stach Press

Lovelace, Robin, Nowosad, Jakub, and Jannes Muenchow. 2021. *Geocomputation with R.* https://bookdown.org/robinlovelace/geocompr/.

Mieno, Tara. 2023. *R as GIS for Economists.* https://tmieno2.github.io/R-as-GIS-for-Economists/.

Week 1

Class 1: Overview of Statistics
09/01/2025 - Mon - Lecture

- What are variables?
- Measuring variables
- Population versus sample

Class 2: Operations and Objects in R
09/03/2025 - Wed - Lab | Video

- Intro to R and R Studio
- Data management in R

Reading

Llaudet, Elena and Imai, Kosuke. 2023. Data Analysis for Social Science. Princeton University Press. Chapter: Introduction

Week 2

Class 1: Levels of Data
09/08/2025 - Mon - Lecture

- Conceptual operationalization and validity
- Types of data: nominal, ordinal, interval, ratio

Class 2: Levels of Data
09/10/2025 - Wed - Lab | | Video - NO CLASS

- Reading datasets in R
- Working with lists, numbers, strings, dataframes
- Subsetting

Reading

Llaudet, Elena and Imai, Kosuke. 2023. Data Analysis for Social Science. Princeton University Press. Chapter: Introduction
Llaudet, Elena and Imai, Kosuke. 2023. Data Analysis for Social Science. Princeton University Press. Chapter: Estimating Causal Effects with Randomized Experiments

Week 3

Class 1: Descriptive Statistics
09/15/2025 - Mon - Lecture - NO CLASS

- Frequency tables and histograms

- Measures of central tendency: mean, mode, median, standard deviation
- Sigma Notation

Class 2: Descriptive Statistics
09/17/2025 - Wed - Lab | Video

- Measures of central tendency: mean, mode, median, standard deviation
- Data cleaning and data merges
- Data visualization: scatterplots

Reading

Llaudet, Elena and Imai, Kosuke. 2023. Data Analysis for Social Science. Princeton University Press. Chapter: Inferring Population Characteristics via Survey Research

Assignment 1

Week 4

Class 1: Probability - I
09/22/2025 - Mon - Lecture

- Probability distributions
- Joint probabilities
- Theoretical vs. empirical probability

Class 2: Probability - I
09/24/2025 - Wed - Lab

- Data cleaning and data merges
- Data visualization: barplots and lineplot

Reading

Aronow, Peter and Miller, Benjamin, 2019. Foundations of Agnostic Statistics. Cambridge University Press. Chapter 1: Probability Theory
Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 2: Probability and Regression Review

Week 5

Class 1: Probability - II
09/29/2025 - Mon - Lecture

- Probability Mass Functions (PMFs)
- Probability Distribution Functions (PDFs)
- Cumulative Distribution Functions (CDFs)

Class 2: Probability - II
10/01/2025 - Wed - Lab

- Probability distributions: standard normal distributions, generating random samples, cumulative distribution functions, probability density functions.

Reading

Aronow, Peter and Miller, Benjamin, 2019. Foundations of Agnostic Statistics. Cambridge University Press. Chapter 1: Probability Theory
Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 2: Probability and Regression Review

Assignment 2

Week 6

Class 1: Statistical Significance testing and Z-Tests
10/06/2025 - Mon - Lecture

- Null hypotheses
- One vs.two-tailed tests
- Type 1 and Type 2 errors

Class 2: Hypothesis Testing
10/08/2025 - Wed - Lab

- Hypothesis testing: z-tests

Reading

Llaudet, Elena and Imai, Kosuke. 2023. Data Analysis for Social Science. Princeton University Press. Chapter: Quantifying uncertainty

Week 7

Class 1: T-Tests and Correlations
10/13/2025 - Mon - Lecture

- Pearson correlation coefficient
- Visualizing correlations
- Correlation vs. causation

Class 2: T-Tests, Choropleth Maps, and Correlations
10/15/2025 - Wed - Lab

- T-Tests

- Visualizing differences: boxplots
- Choropleth maps
- Correlations

Reading

Aronow, Peter and Miller, Benjamin, 2019. Foundations of Agnostic Statistics. Cambridge University Press. Chapter 2: Summarizing Distributions

Week 8

Class 1: Bivariate Regression
10/20/2025 - Mon - Lecture | Video

- Regression line
- Coefficients
- Standard errors
- Goodness of fit

Class 2: Bivariate Regression
10/22/2025 - Wed - Lab

- Running bivariate regressions in R
- Interpreting results
- Making tables
- Coefficient plots
- Predicted values and Residuals

Reading

Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 4: Regression
Llaudet, Elena and Imai, Kosuke. 2023. Data Analysis for Social Science. Princeton University Press. Chapter: Predicting Outcomes Using Linear Regression

Assignment 3

Week 9

Class 1: Bivariate and Multivariate Regressions
10/27/2025 - Mon - Lecture | Video

- Assumptions of OLS
- Regression with a Binary Independent Variable
- Counterfactuals
- Multivariate regressions
- Interaction Effects
- Gauss-Markov Assumptions

Class 2: Quarto Essentials
10/29/2025 - Lab | Video

- Quarto Essentials Reporting
- Quarto preambles, Table of Contents, and Sections
- Latex Equations, tables, and figures
- How to Make Slides in Quarto

Reading

Ismay, Chester, and Albert Y. Kim. 2019. Statistical Inference via Data Science: A ModernDive into R and the Tidyverse. Chapman and Hall / CRC. Chapter 6
Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/. Chapter 13
Quarto Guide

Week 10

Class 1: Theories of Change
11/03/2025 - Mon - Lecture | Video

- Causal Diagrams - DAGs
- Confounders, Colliders, Mediators
- The Fundamental Problem of Causal Inference
- Selection Bias
- Randomization and RCTs

Reading

Aronow, Peter and Miller, Benjamin, 2019. Foundations of Agnostic Statistics. Cambridge University Press. Chapter 7: Causal Inference
Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 3: Directed Acyclic Graphs

Class 2: RCT Data
11/05/2025 - Wed - Lab

- Analysis of RCT Data
- Mapping Rasters and Shapefiles
- Interactive Maps with leaflet
- Summary Statistics
- Covariate Balance
- Plotting Average Treatment Effects

Reading

Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 4: Potential Outcomes Causal Model

Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/. Chapter 13

Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/. Chapter 5

Assignment 4

Week 11

Class 1: Midterm Revision
11/10/2025 - Mon - Lecture

Class 2: MIDTERM
11/12/2025 - Wed

Week 12

Class 1: Threats to Validity
11/17/2025 - Mon - Lecture

- Construct Validity
- Statistical Conclusion Validity
- Internal and External Validity
- Matching

Class 2: DAGs
11/19/2025 - Wed - Lab

- DAGs (Directed acyclic graphs)
- Nearest Neighbor Matching based on Mahalanobis Distance
- Matching based on Inverse Probability Weights

Reading

Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 3: Directed Acyclic Graphs.

Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter 4: Matching and Subclassification. Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/. Chapter 6, Chapter 7, Chapter 8

Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/. Chapter 14

Week 13

Class 1: Differences in Differences
11/24/2025 - Mon - Lecture

- Quasi-Natural Experiments
- Indicators and Interactions
- Differences-in-Differences
- Assumptions

Class 2: Differences in Differences
11/26/2025 - Wed - Lab

- Analysis of Differences-in-Differences
- Event-Study Analyses

Reading

Huntington-Klein, Nick. 2021. The Effect: An Introduction to Research Design and Causality. Boca Raton, Florida: Chapman and Hall / CRC. https://theeffectbook.net/. Chapter 18
Cunningham, Scott.2021. Causal Inference: The Mixtape. Yale University Press. Chapter: Differences-in-Differences

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Week 14

Class 1: Data Visualization 1
12/01/2025 - Mon - Lab

- ggplot2 Basics
- Simple Geoms vs. Complex Geoms
- Layers

Class 2: Data Visualization 2
12/03/2025 - Wed - Lab

- Colors
- Shapes
- Transparency

Class 3: Data Visualization 3
12/03/2025 - Wed - Lab

- Facets
- Coordinates
- Annotations
- Themes

Supplementary Tutorials

Revision for Final Exam