

# Advanced Statistical Applications: Poli 271/CSS 205

## Course Information

<b>Course Description</b>	This course covers statistical models for inference in the social sciences. In the first half of the course, we will focus on generalized linear models. We will cover the basic statistical principles underlying these models as well as how to estimate them via maximum likelihood. In the second half of the course, we will focus on predictive models for classification. We will cover non-parametric models, regularization, cross-validation, and dimensionality reduction. The ultimate goal of this course is to provide students with an understanding of statistical models that will allow them to conduct cutting-edge empirical research in their own fields of substantive interest.
<b>Instructor</b>	Molly Roberts, Office Hours 2-2:50PM Tuesdays
<b>IA/TA</b>	Kevin Flannagan, Office Hours Thursdays 2-3pm in SSB 448

## Course Learning Outcomes

Upon completion of this course, students will be able to:

1. Describe the difference between predictive, descriptive, and causal questions in the social sciences. Explain how statistical models are used differently in each setting.
2. Write down the data generating process for generalized linear models including linear regression, logistic regression, count models, and duration models.
3. Derive the likelihood for these models and use statistical software to find the maximum likelihood estimates for their coefficients. Explain the properties of MLEs.
4. Produce a final project that replicates an existing study that implements one of the models discussed in class. Produce a quantity of interest from the author's analysis that the author did not produce in the study that adds to interpretation of the results.

## Course Format

This course will be held in a hybrid format. Instead of attending a three hour class each week, students will watch about one hour worth of video lecture. In-person class will be held from 12-2PM on Tuesday and will focus on reviewing concepts from the video and applying them to data. From 2-3PM, Professor Roberts will hold optional extra practice/office hours to answer additional questions.

### **In-Person\* Lecture:**

Tuesday, 12-2PM

**Asynchronous (Online) Course Elements:**

Videos, readings, quizzes, problem sets, and other resources available at: UC San Diego’s Learning Management System: <https://canvas.ucsd.edu>.

Login: UC San Diego Active Directory credentials

**A Typical Week in This Course**

**Wednesday-Monday:**

- Watch 1-3 short recorded lecture segments and complete readings. These lectures will introduce the foundational concepts in the course that will help you complete the weekly assignments, prepare you for the midterm, and final project.
- Complete assigned readings

**Tuesday:**

- Problem sets due before class, at 12PM.
- In-person class, 12-2PM, with the exception of week 7, which will be from 12-3PM. In the in-person class, students will apply concepts from the lecture videos in hands-on code examples. Students will code with the professor. Students receive participation points for attending class.
- Optional Extra Practice/Office Hours 2-3PM, immediately following class on Tuesdays.

**Overall Course Expectations**

What you can do to support your success in the course:	What I will do to support your success in the course:
Read the syllabus and stay current with course information	Be prepared and bring my enthusiasm for teaching to each session
Keep up with readings and assignments, as each one builds on the previous one.	Respond to emails within one working day, and provide timely feedback on assignments / submissions.
Contribute to the learning environment with <a href="#">fairness, cooperation, and professionalism</a>	Establish a learning environment with fairness, cooperation and professionalism, and will take action if these principles are violated.
Treat your classmates, instructional assistants and myself <a href="#">honestly and ethically</a>	Treat you honestly and ethically, and will address any concerns you might have
Commit to excel with integrity <sup>1</sup> . Have the	Uphold integrity standards and create an

courage to act in ways that are honest, fair, responsible, respectful & trustworthy.	atmosphere that fosters active learning, creativity, critical thinking, and honest collaboration.
Manage your time, so you can stay on track with the course and complete tasks on time	Only assign work that is vital to the course, and will work to meet the standard credit hour allotment for the course.
Communicate with me if you determine that a deadline cannot be met due to extenuating circumstances	Consider requests for adjustments and will make reasonable exceptions available to all students when approved

1. Please read UC San Diego’s [Policy on Integrity of Scholarship](#) and take the [integrity pledge!](#)

## Readings

Readings will be posted and some made available on the course website on Canvas.

## Course Software

We will use R (<http://www.r-project.org>) to introduce the computational tools within the course.

## Assignments, Projects, and Grading

### Summary of Grade Criteria

Assignment	Weight	Due Date
Participation x 10	20%	
Problem Sets x 5	30%	Tuesdays, 12PM
Midterm x 1	25%	February 28, 12PM (CSS Comprehensive Exam)
Final Project x 1	25%	Due Tuesday, March 19, 12PM

### Grading Scale

<b>A</b> = 93-100%	<b>B+</b> = 88-89.9%	<b>C+</b> = 78-79.9%	<b>D</b> = 60-69% <b>F</b> = 59%-below
<b>A-</b> = 90-92.9%	<b>B</b> = 83-87.9%	<b>C</b> = 73-77.9%	

**B-** =80-  
82.9%

**C-** =70-  
72.9%

### **Grading Procedure and Feedback**

Students will be graded on an absolute scale over the course of the quarter. At the end of the quarter, the average of the top 5 scores in the class will become 100%, which will either keep all grades the same or move them up. The lowest quiz score will be dropped for each student.

### **Attendance and Participation**

Students will receive attendance and participation points by  
Attending and participating in weekly lectures and discussions.

## **Instructional Team: Who Are My Instructors?**

### Instructor



*Professor Roberts*

### **Margaret Roberts**

Professor

Political Science and HDSI

Margaretroberts.net

Office Hours: Tuesday 2-3PM

## Resources for Support and Learning

<p><b>Learning and Academic Support</b></p>	
<p><b><u><a href="#">Ask a Librarian: Library Support</a></u></b>  <i>Chat or make an appointment with a librarian to focus on your research needs</i></p> <p><b><u><a href="#">Course Reserves, Connecting from Off-Campus and Research Support</a></u></b>  <i>Find supplemental course materials</i></p> <p><b><u><a href="#">First Gen Student Success Coaching Program</a></u></b>  <i>Peer mentor program that provides students with information, resources, and support in meeting their goals</i></p> <p><b><u><a href="#">Office of Academic Support &amp; Instructional Services (OASIS)</a></u></b>  <i>Intellectual and personal development support</i></p>	<p><b><u><a href="#">Writing Hub Services in the Teaching + Learning Commons</a></u></b>  <i>One-on-one online writing tutoring and workshops on key writing topics</i></p> <p><b><u><a href="#">Supplemental Instruction</a></u></b>  <i>Peer-assisted study sessions through the Academic Achievement Hub to improve success in historically challenging courses</i></p> <p><b><u><a href="#">Tutoring – Content</a></u></b>  <i>Drop-in and online tutoring through the Academic Achievement Hub</i></p> <p><b><u><a href="#">Tutoring – Learning Strategies</a></u></b>  <i>Address learning challenges with a metacognitive approach</i></p>
<p><b>Support for Well-being and Inclusion</b></p>	
<p><b><u><a href="#">Basic Needs at UCSD</a></u></b>  <i>Any student who has difficulty accessing sufficient food to eat every day, or who lacks a safe and stable place to live is encouraged to contact:</i>  <a href="mailto:foodpantry@ucsd.edu">foodpantry@ucsd.edu</a>   <a href="mailto:basicneeds@ucsd.edu">basicneeds@ucsd.edu</a>   (858) 246-2632</p> <p><b><u><a href="#">Counseling and Psychological Services</a></u></b>  <i>Confidential counseling and consultations for psychiatric service and mental health programming</i></p>	<p><b><u><a href="#">Community and Resource Centers Office of Equity, Diversity, and Inclusion</a></u></b>  <i>As part of the <a href="#">Office of Equity, Diversity, and Inclusion</a> the campus community centers provide programs and resources for students and contribute toward the evolution of a socially just campus (858).822-.3542   <a href="mailto:diversity@ucsd.edu">diversity@ucsd.edu</a></i></p> <p><b><u><a href="#">Get Involved</a></u></b>  <i>Student organizations, clubs, service opportunities, and many other ways to connect with others on campus</i></p> <p><b><u><a href="#">Undocumented Student Services</a></u></b></p>

<p><b><u>Triton Concern Line</u></b>          Report students of concern: (858) 246-1111</p> <p><b><u>Office for Students with Disabilities (OSD)</u></b>          Supports students with disabilities and accessibility across campus</p>	<p><i>Programs and services are designed to help students overcome obstacles that arise from their immigration status and support them through personal and academic excellence</i></p>
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## Campus and Course Policies

### Course Policies

#### Health and Well-Being Statement

Throughout your time at UC San Diego, you may experience a range of issues that can negatively impact your learning. These may include physical illness, housing or food insecurity, strained relationships, loss of motivation, depression, anxiety, high levels of stress, alcohol and drug problems, feeling down, interpersonal or sexual violence, or grief.

These concerns or stressful events may lead to diminished academic performance and affect your ability to participate in day-to-day activities. If there are issues related to coursework that are a source of particular stress or challenge, please speak with me, Professor Roberts, so that I am able to support you. UC San Diego provides a number of resources to all enrolled students, including:

- **Counseling and Psychological Services** (858-534-3755 | [caps.ucsd.edu](https://caps.ucsd.edu))
- **Student Health Services** (858-534-3300 | [studenthealth.ucsd.edu](https://studenthealth.ucsd.edu))
- **CARE at the Sexual Assault Resource Center** (858-534-5793 | [care.ucsd.edu](https://care.ucsd.edu))
- **The Hub Basic Needs Center** (858-246-2632 | [basicneeds.ucsd.edu](https://basicneeds.ucsd.edu))

We care about you at UC San Diego, and there is always help available.

#### Subject to Change Policy

While I will try to adhere to the course schedule as much as possible, I also want to adapt to your learning pace and style. Therefore, the syllabus and course plan may change in the quarter. I always welcome feedback from you about what is working and not working for your learning in the course.

## Campus Policies

Below are links to useful campus policies – principles of community, integrity, and code of conduct that are also policies within this course:

- [UC San Diego Principles of Community](#)
- [UC San Diego Policy on Integrity of Scholarship](#)
- [Religious Accommodation](#)
- [Nondiscrimination and Harassment](#)
- [UC San Diego Student Conduct Code](#)

## Course Schedule

Below is a tentative course schedule. Please refer to the Modules section on canvas for the most up to date schedule.

Week	Activities, Assessments, and Due dates
1	<p>Read:</p> <ul style="list-style-type: none"> <li>• <i>Unifying Political Methodology</i>, Section 1.2, pg 6-13</li> <li>• <i>Introduction to Statistical Learning</i>, Section 2.1.1, pg 15-20</li> </ul> <p>Lecture:</p> <ul style="list-style-type: none"> <li>• Introduction to the course</li> <li>• Statistical Learning</li> <li>• Linear Regression Reframed</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• Introduce yourself on the Canvas discussion board</li> </ul>
2	<p>Read:</p> <ul style="list-style-type: none"> <li>• <i>Quantitative Social Science, an Introduction</i> Chapter 6 Probability</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video: Basic Probability</b></li> </ul> <p>Lecture:</p> <ul style="list-style-type: none"> <li>• Review of R</li> <li>• Probability, using code</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• Work on problem set 1</li> </ul>
3	<p>Read:</p> <ul style="list-style-type: none"> <li>• Chapter 1, Ward and Ahlquist</li> <li>• Optional: Chapter 2, <i>Unifying Political Methodology</i></li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video 1:</b> Introduction to Maximum Likelihood</li> </ul>

	<p>Lecture:</p> <ul style="list-style-type: none"> <li>• Review of R</li> <li>• Maximum likelihood, using code</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• <b>Problem Set 1 due, Tuesday, January 23</b></li> </ul>
4	<p>Read:</p> <ul style="list-style-type: none"> <li>• Ahlquist and Ward, Chapter 2.1-2.2</li> <li>• Optional: <i>Unifying Political Methodology</i>, Chapter 4.1-4.6</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video 1:</b> Optimization</li> <li>• <b>Video 2:</b> Uncertainty</li> <li>• <b>Video 3:</b> Properties of MLE</li> </ul> <p>Lecture:</p> <ul style="list-style-type: none"> <li>• No Lecture</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• <b>Problem Set 2 due, Tuesday, January 30</b></li> </ul>
5	<p>Read:</p> <ul style="list-style-type: none"> <li>• Chapters 3 Ward and Ahlquist</li> <li>• Chapter 5.1-5.2 Ward and Ahlquist</li> <li>• Chapter 6 Ward and Ahlquist</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video 1:</b> Binary Dependent Variables</li> <li>• <b>Video 2:</b> Simulation</li> </ul> <p>Lecture:</p> <ul style="list-style-type: none"> <li>• Coding of Binary Dependent Variables and Simulation</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• <b>Problem Set 3 due, Tuesday, February 5</b></li> </ul>
6	<p>Read:</p> <ul style="list-style-type: none"> <li>• Chapters 7-8, and 10 Ward and Ahlquist</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video 1:</b> Count and Ordered Models</li> </ul> <p>Lecture:</p> <ul style="list-style-type: none"> <li>• Coding of Count and Ordered Models</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• <b>Problem Set 4 due, Tuesday, February 13</b></li> </ul>
7	<p>Read:</p> <ul style="list-style-type: none"> <li>• Review Readings</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>No lecture videos</b></li> </ul>



	<p><b>Lecture (**12PM-3PM**):</b></p> <ul style="list-style-type: none"> <li>• Coding of Binary Dependent Variables and Count Models</li> <li>• Midterm Review</li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• <b>Prepare for Midterm</b></li> </ul>
8	<p><b>No class, Take Home Midterm (CSS Comprehensive Exam)</b></p>
9	<p>Read:</p> <ul style="list-style-type: none"> <li>• <i>Introduction to Statistical Learning</i>, Chapter 5</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video 1: Classification</b></li> <li>• <b>Video 2: Cross-validation</b></li> </ul> <p><b>Lecture:</b></p> <ul style="list-style-type: none"> <li>• <b>Classification and cross-validation in R</b></li> </ul> <p>Do:</p>
10	<p>Read:</p> <ul style="list-style-type: none"> <li>• <i>Introduction to Statistical Learning</i>, Chapter 6</li> </ul> <p>Watch:</p> <ul style="list-style-type: none"> <li>• <b>Video 1: Regularization</b></li> </ul> <p><b>Lecture:</b></p> <ul style="list-style-type: none"> <li>• <b>Implementing Lasso and Ridge in R</b></li> </ul> <p>Do:</p> <ul style="list-style-type: none"> <li>• <b>Problem set 5 due Tuesday, March 5</b></li> </ul>