POL-GA 2251: Quantitative Methods III  
Fall 2021  
Tuesdays 10:00-11:50am EST  
Recitation: Thursdays 6:00-7:00pm EST  
19 W. 4th Room 217

Instructor Information

<table>
<thead>
<tr>
<th>Professor</th>
<th>Email</th>
<th>Office Hours</th>
<th>Sign-up</th>
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<tbody>
<tr>
<td>Tara Slough</td>
<td><a href="mailto:tara.slough@nyu.edu">tara.slough@nyu.edu</a></td>
<td>F 10 am - 12 pm or by appointment</td>
<td>Sign-up</td>
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<tr>
<th>Teaching Assistant</th>
<th>Email</th>
<th>Office Hours</th>
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<tbody>
<tr>
<td>Jiawei Fu</td>
<td><a href="mailto:jf3739@nyu.edu">jf3739@nyu.edu</a></td>
<td>F 4 - 6 pm</td>
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Tara’s office hours can be virtual (via Zoom) or in person (19 W. 4th, Office 415). Please indicate your preference on the sign-up. Jiawei’s office hours will be virtual (via Zoom) except through prior arrangement.

Course Overview and Prerequisites

The course covers a range of techniques for data analysis and modeling: maximum likelihood, Bayesian inference, and non-parametric methods (“machine learning”). The class will enable students to engage with current political science literature that uses advanced methods and to apply these methods in their own work. The course assumes working knowledge of probability theory, matrix algebra, calculus, and statistical inference at the level of Quant I and Quant II. The course is restricted to NYU PhD students in the Department of Politics.

Expectations

Reading and participation (20%):
You are expected to read all required readings prior to the class in which they are discussed. If you do not understand the readings, please come prepared to discuss what you did and did not follow.

Problem sets (20%):
During the semester, there will be 10 problem sets. The problem sets are relatively short but will be assigned almost weekly. Problem sets will be released on Tuesdays immediately after class and are due the following Tuesday by 10:00 am (before class). You can find and submit your problem sets on the course Brightspace.

Replication and Extension (20%):
At the end of the semester, you should submit a short report (1,000-2,000 words) and code replicating a political science paper that uses any method covered in this class. You should [sign up]

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1This class is designed after Arturas Rozenas’ Quant III. Many aspects of this syllabus are inspired by his 2020 syllabus.
with the article you intend to replicate and confirm that replication data is available by November 2. We will cover some ideas for the replication and extension in class in November.

In-Class Midterm (20%)
There will be an in-class midterm on October 19. The exam is open book and open note, but will be timed. You will not be required to write any code for the midterm.

Take-Home Final (20%)
There will be a take-home exam administered on December 14 (in lieu of the last class session). This exam is open note and open book, but you may not communicate with class members. There may be questions that require you to use R on the final.

Course Materials
Textbooks
We will use two textbooks frequently throughout the course:


ISL is a popular introductory text on non-parametric methods with examples in \(\text{R}\). BDA is the most popular textbook on Bayesian statistics and data analysis. I recommend that you purchase these books if you like to have physical copies. You can access the full text of ISL online through NYU Libraries. BDA is available for non-commercial use at [http://www.stat.columbia.edu/~gelman/book/BDA3.pdf](http://www.stat.columbia.edu/~gelman/book/BDA3.pdf). The following textbooks may also be useful for reference, particularly if you choose to delve further into topics covered in this course:


- Trevor Hastie, Robert Tibshirani, and Jerome Friedman. 2001. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Second Edition. Springer. This is the main textbook upon which ISL is widely used in the “machine learning” community. You can access the full text online through NYU Libraries.
Software
This class will use R, and prior experience at the level of Quant 1 and Quant 2 is assumed.

Schedule
The course meets Tuesdays from 4:00-5:50pm. The schedule for the semester is summarized in the table below:

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<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assigned</th>
<th>Due</th>
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<tbody>
<tr>
<td>1</td>
<td>September 7</td>
<td>Introduction</td>
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<td>2</td>
<td>September 14</td>
<td>Maximum Likelihood Estimation: Theory</td>
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<td>1</td>
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<td>3</td>
<td>September 21</td>
<td>Maximum Likelihood Estimation: Applications I</td>
<td>3</td>
<td>2</td>
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<tr>
<td>4</td>
<td>September 28</td>
<td>Maximum Likelihood Estimation: Applications II</td>
<td>4</td>
<td>3</td>
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<td>5</td>
<td>October 5</td>
<td>Bayesian Inference: Theory</td>
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<td>4</td>
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<td>6</td>
<td>October 12</td>
<td>Bayesian Inference: Applications</td>
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<td>5</td>
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<td>7</td>
<td>October 19</td>
<td>In-class midterm</td>
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<td>8</td>
<td>October 26</td>
<td>Bayesian Inference: Computation</td>
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<td>9</td>
<td>November 2</td>
<td>Latent Variable Models</td>
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<td>6</td>
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<td>10</td>
<td>November 9</td>
<td>Mixture Models</td>
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<td>7</td>
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<td>11</td>
<td>November 16</td>
<td>High-Dimensional Data</td>
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<td>8</td>
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<td>12</td>
<td>November 23</td>
<td>Structural vs. Reduced-Form Approaches</td>
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<td>9</td>
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<td>13</td>
<td>November 30</td>
<td>Semi- and Non-Parametric Regression</td>
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<td>10</td>
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<td>14</td>
<td>December 7</td>
<td>Tree-Based Models</td>
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<td>15</td>
<td>December 14</td>
<td>Take-home final</td>
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<td></td>
<td>December 22</td>
<td>Replication due</td>
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Course and assignment schedule. Assignments will be released after class and are due before class on the following Tuesday.

A detailed schedule of topics and readings, by class session, appears below. You are responsible for reading all readings in the “required readings” lists prior to the class section.

September 7: Introduction
Note: The first section will be virtual.

- Required readings:
  1. ISL chapter 2
  2. BDA chapter 1
- Additional readings:

September 14: Maximum Likelihood Estimation (MLE): Theory
- Required readings:
1. Pawitan chapters 2 and 4.

- Additional readings:

**September 21: Maximum Likelihood Estimation (MLE): Applications I**

- Required readings:
  1. ISL chapter 4

- Additional readings:

**September 28: Maximum Likelihood Estimation (MLE): Applications II**

- Required readings:
  1. ISL chapter 4

- Additional readings:

**October 5: Bayesian Inference: Theory**

- Required readings:
  1. BDA chapters 2-3

- Additional readings:
1. McElreath chapters 1-3

**October 12: Bayesian Inference: Applications**

- **Required readings:**
  
  1. BDA chapters 14-15

- **Additional readings:**
  

**October 19: In-Class Midterm**

*Note:* There will be no section on October 21.

**October 26: Bayesian Inference: Computation**

- **Required readings:**
  
  1. McElreath chapter 8
  2. BDA chapters 11-12

- **Additional readings:**
  

**November 2: Latent Variables**

*Note:* Chris Fariss will join us virtually to guest lecture for part of this class meeting.

- **Required readings:**
  

- Additional readings:

**November 9: Mixture Models**

- Required readings:
  1. BDA chapter 22

- Additional readings:

**November 16: High-Dimensional Data**

- Required readings:
  1. ISL 5-6

- Additional readings:
November 23: Structural vs. Reduced Form Models

**Note:** This class session will (provisionally) be held virtually. We will focus on structural and reduced form interpretation of conjoint surveys for preference elicitation. There will be no section on November 25.

- **Required readings:**

- **Additional readings:**

November 30: Semi- and Non-Parametric Regression

- **Required readings:**
  1. BDA chapter 20
  2. ISL chapter 7

- **Additional readings:**

December 7: Tree-Based Models

- **Required readings:**
  1. ISL chapter 8

- **Additional readings:**
