

# **POLSCI 599**

## **Statistical Methods in Political Research I**

### **Fall 2021**

Yuki Shiraito                      Fabricio Vasselai

Department of Political Science  
University of Michigan

This is the first course of the Political Science graduate methods sequence to provide students with the foundations in statistics that will be required in the subsequent courses of the sequence. Topics covered include probability spaces, random variables, expected values and moments, sampling distributions, hypothesis testing and confidence intervals, limit theorems, and the maximum likelihood estimation. The course prerequisites are calculus and linear algebra equivalent to the Political Science Math Camp, and proficiency in the statistical programming language R or concurrent enrollment in POLSCI 514. Also, students are strongly encouraged to enroll concurrently in POLSCI 598. A previous background in statistics is useful but not required.

## **1 Contact Information**

	Yuki Shiraito (Instructor)	Fabricio Vasselai (GSI)
Office:	4259 ISR-Thompson	7740 Haven Hall
Phone:	734-615-5165	N/A
Email:	shiraito@umich.edu	vasselai@umich.edu

## **2 Logistics**

- Lectures: Monday and Wednesday, 8:30–9:50am, 3330 Mason Hall
  - No class on September 6, October 18, and November 24
- Sections: Thursday, noon–1pm, 3207 LSA
  - No class on September 2 and November 25
- Yuki’s office hours:
  - Tuesday 4:30–5:30pm and Friday 8:50–9:50am, *6632 Haven Hall*
  - Stop by anytime at the ISR office
- Fabricio’s office hours:
  - Monday, 1–3pm, 7740 Haven Hall
  - By appointment

### 3 Questions and Announcements

In addition to sections and office hours, please use the *Piazza Discussion Board* when asking questions about lectures, problem sets, and other course materials. This allows all students to benefit from the discussion and to help each other understand the materials. Both students and instructors are encouraged to participate in discussions and answer any questions that are posted.

To join the POLSCI 599 **Piazza** site, click on “Piazza” from the modules in the **Canvas** course site. You will then be prompted to create your account and confirm enrollment. Once you create your account, the **Piazza** course page can also be accessed by logging in from <https://piazza.com> or its mobile apps. In addition, all class announcements will be made through **Piazza**. **Canvas** will still be used for hosting all class materials.

### 4 Prerequisites

There are two prerequisites for this course:

- Materials covered in the University of Michigan Political Science Math Camp.
- Statistical programming in **R** at the level of the following textbook of POLSCI 514. If you are not proficient in **R** and  $\text{\LaTeX}$ , you are strongly encouraged to take POLSCI 514 concurrently in Fall 2021.

Kosuke Imai. *Quantitative Social Science: An Introduction*. Princeton University Press, Princeton, 2017.

In addition, the following is recommended but not required:

- Concurrent enrollment in POLSCI 598: Basic real analysis and calculus.

### 5 Course Requirements

The final grades are based on the following items:

- **Participation** (10%): The level of engagement in exercise sessions, sections, and **Piazza** discussions.
- **Problem Sets** (66%): Total eleven problem sets will be given weekly throughout the semester. Each problem set will equally contribute to the final grade and contain analytical questions. In addition, approximately every other week, the problem sets include data analysis questions.

The following instructions will apply to all problem sets:

- *Collaboration policy*. Collaboration on the problem sets is encouraged, because it provides opportunities for learning from each other. However, to facilitate individual learning, you should try all problem set questions before working together with other students and you must write your answers by yourself. Copying any part of someone else’s answers is considered as academic misconduct (see below for the University’s academic misconduct policy).

- *Submission policy.* Hand in your answers individually through **Canvas**. All answers must be typed via  $\text{\LaTeX}$ , which is covered in POLSCI 514 at the beginning of the semester. You can use the problem set template available at <http://jenpan.com/resources/>. The **R** source code should also be included in your answers whenever you use **R**. Please ensure your code adheres to the Google's **R** Style Guide rules available at <https://google.github.io/styleguide/Rguide.xml>.
- **Take-home Final Exam** (24%): The take-home open-book final exam will be given on December 8 and be due on December 17. The exam consists of both analytical and data analysis questions. Except that *no collaboration is allowed for the final exam*, the above submission policy also applies.
- **Incomplete Policy:** No incompletes will be given.

## 6 COVID Safety Protocols

The following protocols are based on the University policies as of August 2021. They may change depending on the COVID situation over the semester.

- **Vaccination Requirement:** The University of Michigan COVID-19 Vaccination Policy requires faculty, staff, and students to be fully vaccinated for COVID-19 and submit their proof of vaccination information to U-M no later than August 30.<sup>1</sup>
- **Face Covering:** The University of Michigan Face Covering Policy for COVID-19 requires all students, staff, faculty, and visitors to wear a face covering that covers the mouth and nose when indoors on U-M property.<sup>2</sup> Therefore, everyone attending in-person POLSCI 599 lectures and sections must wear a face covering, unless exceptions set by the Policy apply. When choosing your face covering, please see CDC's guidance available at <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover-guidance.html>. In particular, surgical masks are recommended over cloth masks.
- **Social Distancing:** The instructors may ask students to keep proper social distance during lectures, sections, and office hours.
- **Ventilation:** The instructors may open doors and windows to ventilate the room during lectures, sections, and office hours.
- **Class Attendance and Assignment Submission Flexibility:** Everyone should not hesitate to avoid attending a class in case there are any symptoms of COVID-19. Missing classes or submission deadlines due to infection prevention measures will not be punished in grading.

## 7 Other Course Policies

- **Student Sexual Misconduct Policy:** Title IX prohibits sex discrimination to include sexual misconduct: harassment, domestic and dating violence, sexual assault, and stalking. If you or someone you know has been harassed or assaulted, you can receive confidential support and academic advocacy at the Sexual Assault Prevention and Awareness Center (SAPAC). SAPAC can be contacted on their 24-hour crisis line, 734-936-3333 and online

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<sup>1</sup>[https://ehs.umich.edu/wp-content/uploads/2021/07/COVID-19\\_Vaccination\\_Policy.pdf](https://ehs.umich.edu/wp-content/uploads/2021/07/COVID-19_Vaccination_Policy.pdf)

<sup>2</sup><https://ehs.umich.edu/wp-content/uploads/2020/07/U-M-Face-Covering-Policy-for-COVID-19.pdf>

at [sapac.umich.edu](https://sapac.umich.edu). Alleged violations can be reported non-confidentially to the Office for Institutional Equity (OIE) at [institutional.equity@umich.edu](mailto:institutional.equity@umich.edu). Reports to law enforcement can be made to University of Michigan Police Department at 734-763-3434.<sup>3</sup>

- **Accommodations for Students with Disabilities:** If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734-763-3000; <http://ssd.umich.edu>) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.<sup>4</sup>
- **Religious-Academic Conflicts:** While the university does not observe religious holidays, it is the policy of the University of Michigan to make every reasonable effort to allow members of the university community to observe their religious holidays without academic penalty. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. Students who expect to miss classes as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to make-up missed academic work. It is the obligation of students to provide faculty with reasonable notice of the dates on which they will be absent. When the absence coincides with an exam or other assignment due date, the options to make up that missed work may be limited and will be determined by the instructor within the boundaries of the respective class.<sup>5</sup>
- **Academic Misconduct:** The University of Michigan community functions best when its members treat one another with honesty, fairness, respect, and trust. The college promotes the assumption of personal responsibility and integrity, and prohibits all forms of academic dishonesty and misconduct. All cases of academic misconduct will be referred to the Office of the Assistant Dean for Undergraduate Education. Being found responsible for academic misconduct will usually result in a grade sanction, in addition to any sanction from the college. For more information, including examples of behaviors that are considered academic misconduct and potential sanctions, please see <https://lsa.umich.edu/lsa/academics/academic-integrity.html>.<sup>6</sup>
- **Student Mental Health and Wellbeing:** The University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact *Counseling and Psychological Services (CAPS)* at (734) 764-8312 and <https://caps.umich.edu/> during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult *University Health Service (UHS)* at (734) 764-8320 and <https://www.uhs.umich.edu/mentalhealthsvcs>, or for alcohol or drug concerns, see <https://www.uhs.umich.edu/aodresources>. For a listing of other mental health resources available on and off campus, visit: <http://umich.edu/>

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<sup>3</sup>This statement is taken from: <https://sapac.umich.edu/article/faculty-resources-sample-syllabus-language>.

<sup>4</sup>This statement is taken from: <https://ssd.umich.edu/article/syllabus-statement>.

<sup>5</sup>This statement is taken from: *Handbook for Faculty and Instructional Staff 2018*, p. 17.

<sup>6</sup>This statement is taken from: *Handbook for Faculty and Instructional Staff 2018*, p. 16.

~health.<sup>7</sup>

## 8 Textbooks

There is no single textbook for this course. However, you are likely to find it useful in this course and for the future to keep the following textbooks in your bookshelf (henceforth, they are referred by the authors' initials).

The course materials are based mainly on the following two books:

Joseph K. Blitzstein and Jessica Hwang. *Introduction to Probability*. Chapman and Hall/CRC, 2014.

Morris H. DeGroot and Mark J. Schervish. *Probability and Statistics*. Pearson Education, Boston, 4th edition, 2012.

It is recommended to read relevant chapters (indicated in Section 9) for your preview and review of the class materials.

If you would like to study more advanced materials, read:

Larry Wasserman. *All of Statistics: A Concise Course in Statistical Inference*. Springer Texts in Statistics. Springer, New York, 2004.

George Casella and Roger L Berger. *Statistical Inference*. Duxbury, Pacific Grove, 2nd edition, 2002.

If time permits, the course covers the basics of statistical causal inference. Standard references on causal inference for social scientists are:

Donald B. Rubin and Guido W. Imbens. *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. Cambridge University Press, New York, 2015.

Joshua D. Angrist and Jörn-Steffen Pischke. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press, Princeton, 2009.

**DS**, **CB**, and **AP** are requested to be reserved in the Shapiro Undergraduate Library. The other textbooks are available online at the University of Michigan Library website.

## 9 Course Outline

Each section of the course is followed by the list of supplementary readings. Additional optional readings may be provided in lectures. Note that sections do not divide the course evenly. The plan is subject to change, depending on how students are keeping up with the course materials.

### Probability

- Probability spaces
- Counting
- Independence and conditional probability

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<sup>7</sup>This statement is taken from: *Handbook for Faculty and Instructional Staff 2018*, p. 16.

- Bayes' Theorem
- **Readings**
  - **BH** Ch. 1-2
  - **DS** Ch. 1-2

## Random Variables

- Random Variables
- Distribution, mass, density, and quantile functions
- Joint distribution
- Independent random variables
- Conditional distribution
- **Readings**
  - **BH** Ch. 3, 5, and 7
  - **DS** Ch. 3 and 5

## Expectation and Moments

- Expectation
- Moments
- Conditional expectation
- Change of variables
- Moment generating functions
- Sample moments
- **Readings**
  - **BH** Ch. 4, 6, 8.1-2, and 9
  - **DS** Ch. 4

## Statistical Inference

- Method of moments
- Sampling distributions
- Hypothesis testing and interval estimation
- Asymptotic inference
- Maximum likelihood estimation

- **Readings**

- **BH** Ch. 10
- **DS** Ch. 6, 7, 8, and 9
- **W** Ch. 9 (optional)
- **CB** Ch. 7-10 (optional)

## **Causal Inference (time-permitting)**

- Potential Outcome Approach

- Randomized Experiments

- **Readings**

- **IR** Ch. 1-4, and 6
- **AP** Ch. 1-2