Math Camp
September 5th- September 23rd
GSL, 9-12 noon.

Instructor: Justin Grimmer, Political Science Department

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Office Hours: Open door. Stop by, email, gchat or call if you need help.

Teaching Assistants: Will Marble and Hans Lueders

Lab Schedule (see below): 130- 300 pm

This course is a mathematics boot camp to prepare you for the graduate methods sequence. Our task is to begin developing skills that political scientists use for the systematic analysis of politics. In service of this ultimate goal, this course will provide students with an introduction to the mathematical foundations that form the basis of many methods used to systematically study politics. By the end of the course students should have an understanding of basic mathematical operations, a familiarity with core mathematical concepts used in the social sciences, a working knowledge of basic probability theory, and an initial competence with the `R` programming language.

Prerequisites

This course has no formal prerequisites. The most successful students will have previously taken courses in differential and integral calculus. But if you haven't taken these courses, we can help you catch up and develop your math skills—indeed, the first two weeks of math camp are intended to do this. And these skills are essential as you proceed with your graduate school training. Political science is an increasingly mathematical discipline and empirical political scientists will need to regularly draw on ideas from differential and integral calculus (and probably linear algebra as well). Political scientists who do serious formal theory will also want a solid understanding of Real Analysis (through measure theory) and Topology. There is no secret to mathematical training and *everyone* in this class is capable of learning all the math you need to be a successful political scientist. We're happy to talk with students at any point about their mathematical preparation, how they can catch up, or how to develop their skill sets further.

Evaluation

Homework During math camp students will be asked to complete brief nightly homework assignments and more in depth lab assignments. All of the derivations/mathematics in the homeworks can be handwritten. We will ask you to email us your `R` code from the more indepth assignments. You are encouraged to work together in groups, but you'll get the most out of the math camp if you produce your own work.

Math Camp Assessment At the end of math camp there will be an assessment about the concepts covered. This will be closed book, in class, and will take an hour.

Participation Students are strongly encouraged to participate in the class. This includes regularly attending class and section, regularly asking questions while in class, and posting questions/responding to questions on the course listserve.

Required Readings

1) Simon, Carl and Blume, Lawrence (SB). Mathematics for Economists. (Order online, please).

2) Bertsekas, Dimitri P. and Tsitsiklis, John (BT) Introduction to Probability Theory (second edition) (order online please)

3) Online `R` Tutorials:

   - http://thomasleeper.com/Rcourse/CourseOutline.html
   - https://cran.rstudio.com/web/packages/dplyr/vignettes/introduction.html

Students with documented disabilities Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Student Disability Resource Center (SDRC) located within the Office of Accessible Education (OAE). SDRC staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the SDRC as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, 723-1067 TTY).

Class Schedule

Class Pace

We understand that students come from diverse mathematical backgrounds. The class has an aggressive schedule, but we'll move to the next topic only if *every* student understands the material. The only way we'll know if students don't understand the material is if they ask questions. So questions are *strongly* encouraged. There are three ways to ask questions. First, students should always feel free to interrupt lectures with questions. These are the most important questions– they'll indicate that we need to slow down the course. Second, we've set up a class list serve on piazza.com. Posting to this listserve provides students the opportunity to discuss conceptual issues from homework assignments, points of misunderstanding from lectures, or interesting insights that are closely related to the course. Because posting questions and responding to the listserve are part of your participation grades the instructors will let everyone in the class have 12-24 hours to respond to any posted questions (unless they require more immediate attention). After letting participants in the class respond, the instructors will respond to the post. Third, you can come to our offices, google chat Professor Grimmer, or send us emails to ask questions.

Readings

Students should plan on reading the material *before* each class meeting. The books are mathematically challenging texts. The best way to read math text books is to work through the derivations with a pencil and paper close by. Working through the derivations will be very useful.

Scheduled Meetings

Mathematics

9/5: Notation, Functions, and R (Morning)

- SB 2.1-2.2, 5.1-5.4, Appendix 1

9/6: Sequences, Limit, Continuity, Derivatives (Morning)

- SB 2.4, 3.1-3.4, 4

Lab 1: An Introduction to R (Afternoon)

9/7: Optimization (Morning)

- SB 3.5

9/8: Integration + Infinite Series (Morning)

- Appendix A-4

Lab 2: Functions, Optimization, and Simulation in R (Afternoon)

9/9: Matrix Algebra (Morning)

- SB Chapters 7-8, 10.1-10.5
- Handout on Linear Algebra rules

9/12: Multivariable Calculus (Morning)

- SB Chapters 13-14, 15.1

Lab 3: Matrix Algebra in R (Afternoon)

9/13: Multivariate Optimization (Morning)

- SB Chapters 16-17
- Handout on Numerical Optimization

Probability Theory

9/14: A Rigorous Model of Probability (Afternoon))

- BT Chapter 1

9/15: Properties of Probability (Morning)

- BT Chapter 1

Lab 4: Optimization and Simulation in R (Afternoon)

9/16: Discrete Random Variables (Morning)

- BT Chapter 2

9/19: Continuous Random Variables (Morning)

- BT Chapter 3

Lab 5: Working with Random Variables in `R` (Afternoon)

9/20: Properties of Expectation, Moment Generating Functions, and Transformations (Morning)

- BT Chapter 4

9/21: Joint Distributions (Morning)

- Handout (Chapter 6, Ross)

9/22: Convergence, Limit Theorems, and Inequalities (Morning)

- BT Chapter 5

9/23: Review and Introduction to the Methods Sequence (Morning)

9/23: Lab 6: Math Camp Assessment