

## Math Camp 2015 Syllabus

Dates: August 3-14, 2015  
Lecture: 9:30-11:30 AM (Monday-Friday)  
Office Hours: 1-3 PM (Monday-Friday)  
Location TBD

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This course presents key mathematical concepts and ideas students need to know before beginning their study of the formal and quantitative tools used in political science research. Topics covered include probability and statistics, vectors, matrices, single-variable and multi-variable calculus, and optimization. Obviously this is a lot to cover in two weeks, so we will selectively focus on specific mathematical concepts that are most commonly used in applied formal and quantitative research. The goal of this two week course is provide a foundation in order to help students succeed in subsequent methods courses.

There will be seven problem sets assigned throughout the course. At the end of the two weeks, there will be a diagnostic exam given in order to give students a sense of what their strengths and weaknesses are.

We will **not** be covering computational skills in this course. If you are planning on doing empirical work or are planning to take PS 231A in the fall, you will be expected to learn either R or Stata. The learning curve for computational skills can be a bit steep in the beginning, so if you haven't done much computational work, you may want to consider taking a class or workshop on R or Stata over the summer. The D-Lab in Barrows offers excellent workshops on these topics. Another topic we will not be doing full justice in this course are proofs. We will cover basic proofs in lecture and on the problem sets, but if you are planning to focus on formal theory you may want to look into additional resources (listed below) for more detailed coverage.

### **We will use the following required texts for the course:**

1. Sean Gailmard, *Statistical Modeling and Inference for Social Science* (New York: Cambridge University Press, 2014)
2. Carl P. Simon and Lawrence Blume, *Mathematics for Economists* (New York: Norton, 1994)

Other optional references for calculus (single-variable and multi-variable) and linear algebra include:

- Alpha C. Chiang *Fundamental Methods of Mathematical Economics*
- Will H. Moore and David Siegel, *A Mathematics Course for Political and Social Research*

- Jeff Gill, *Essential Mathematics for Political and Social Science Research*

Other optional references for probability and statistics include:

- David Friedman, Robert Pisani, and Roger Purves, *Statistics*
- Joshua Angrist and Jorn Steffen Pischke, *Mostly Harmless Econometrics* (advanced textbook)
- George Casella and Roger Berger, *Statistical Inference* (advanced textbook)
- Jeff Gill, *Essential Mathematics for Political and Social Science Research* (coverage of basic probability theory and random variables)

A great optional references for writing proofs is:

- Kevin Houston, *How To Think Like a Mathematician* (a free PDF of this book is available online if you google the title of the book)

## Outline of Topics

1. Single-variable calculus: Critical Points, First and Second Order Conditions, Local and Global Maxima and Minima
  - i. Readings: Simon and Blume 51-57, 851-857
2. Probability and Statistics
  - a. Outcomes, Events, Probabilities, and Bayes' Law
    - i. Readings: Gailmard 83-98
  - b. Random Variables, Cumulative Distribution Functions, Densities, Expectations, Mean, Variance, and Correlations
    - i. Readings: Gailmard 98-106, 116-121, 128-132
3. Linear Algebra
  - a. Vectors and Matrices
    - i. Readings: Simon and Blume 199-213, 153-159, 165-166
  - b. Vector Dot Products
    - i. Readings: Simon and Blume 213-220
4. Multi-variable calculus: Optimization
  - a. Unconstrained Optimization
    - i. Readings: Simon and Blume 396-397
  - b. Constrained Optimization with Equality Constraints
    - i. Readings: Simon and Blume 411-423
  - c. Constrained Optimization with Inequality Constraints
    - i. Readings: Simon and Blume 423-434