Poli270: Math Bootcamp

Faculty Coordinator:	Scott Desposato & Seth Hill.
Instructors:	Matt Bergman & Alex Hughes
Dates:	2 Sept – 23 Sept 2014
Room:	SSB 104 & SSB Computing Lab

Goal of the Course   This course is intended to serve as an refresher (or perhaps introduction) to the core math concepts used in principled thinking about a probabilistic world. Because the scope of the course is sweeping we will spend a very limited amount of time on each topic. Matt and Alex will both be *very* available to help with difficult concepts.

This course is designed to be combined with *Poli204b*, taught in the fall. Here we provide you with the tools to think about the political world: calculus and optimization, linear algebra, and probability theory. In *204b* you will learn about how to identify systematic patterns in a noisy world.

These tools are important and will form the basis of your understanding in the program and for your career. Additionally, we are told that there are typically non-academic reasons that this boot-camp is useful – this is a introduction to the friends and peers that you will have throughout the program and the rest of your (and our!) careers.

Structure   We will hold three sessions most days. In the morning we will hold two 1.5 hour lectures introducing the concepts and reviewing the reading for the day. In the afternoon, interested students can participate in a lab session where the instructors and students will work through additional practical exercises and the concepts. Grades will be based on homework (due at the beginning of the morning session) and on a final exam covering the course's topics. The exam will be 3 hours, open book, open notes, open internet.

Books for the Course   The primary text for the course is Moore and Siegel (2013). The interested student might also consider purchasing the text we have used in previous years, Gill (2006). Both texts are written by political scientists and do a good job motivating and justifying concepts with relevant political science examples. For the student interested in a high-level undergrad treatment we recommend Larsen and Marx (2006).

Required

- Moore, Will H. and David A. Siegel. 2013. *A Mathematics Course for Political & Social Research.* Princeton University Press, Princeton, NJ.

Optional

- Gill, Jeff. 2006. *Essential Mathematics for Political and Social Research.* Cambridge University Press, Cambridge, MA.
- Larsen, Richard J. and Morris L. Marx. 2011. *An Introduction to Mathematical Statistics and its Applications, 5th Ed.* Pearson Pretice Hall, Upper Saddle River, NJ.

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Software for the Course In the second part of this course we will focus on bringing you up to speed with the computing tasks that you will be expected to perform as a modern political scientist. Core emphasis will be placed on the two core statistical packages R and STATA. Before beginning the course, we recommend you obtain a copy of both software packages.

1. R can be obtained for free for all platforms at this link. Check that you obtain a "bit-version" that is compatible with your operating system. If you computer was made in the last two years, it is most likely that utilizes 64-bit architecture, but, here's how you check!

   - **Mac Users:** Follow this link.
   - **Windows Users:** Follow this link.

2. STATA can be purchased for the low-low price of $395 at this link. If you are going to purchase, we suggest the SE level not the IC. But, think carefully about plunking down this money. The computer lab in our building has licenses of STATA that are available to all graduate students. In addition, the campus computing lab has a really great virtual computing lab that you can utilize to access STATA from you laptop anywhere you have an internet connection. There almost certainly are illicit means of obtaining this software, but this comes at the risk of hackey-performance, computer viruses, and crippling lawsuits. We don't endorse this.

For the computing section, we recommend getting an introductory text for R and Stata. Matt and Alex continue to consult these references almost every day we're working on our stats. For an introduction to R I like Dalgaard (2008), available here. This gives a nice introduction to how R handles data and dataframes. A less thorough introduction introduction by John Fox is available as a PDF here. Stata publishes a good introduction available here. The primary benefit of using a *good* book is that the concepts are presented with some sort of logic underlying them – your frantic google searches when deadlines loom in the future will not!

Recommended

- Dalgaard, Peter. 2008. *Introductory to Statistics with R, 2nd Ed.* Springer, New York.
- Acock, Alan. 2012. *A Gentle Introduction to Stata, Revised 3rd Ed.* Stata Press.
- UCLA Stats Department website. Link here.

Course Plan

Assumed Knowledge   We will assume that you are comfortable with some core concepts before we start the class. Most of this content should be approachable. Don't worry about focusing on the very particular properties of any concept; instead focus on having a working knowledge of each and be ready to apply it to the core concepts of the course.

1. "Preliminaries," Chapter 1. Moore and Siegel, pp. 1-26.

2. "Algebra Review," Chapter 2. Moore and Siegel, pp. 28-41.

3. "Functions, Relations, and Utility," Chapter 3. Moore and Siegel, pp. 44-78.

4. "Limits and Continuity, Sequences and Series, and More on Sets," Chapter 4. Moore and Siegel, pp. 81-100.

Meeting 1: Linear Algebra   (2 Sept)

1. "Fun with Vectors and Matrices," Chapter 12. Moore and Siegel, pp. 273-303.

2. "Vector Spaces and Systems of Equations," Chapter 13. Moore and Siegel, pp. 204-326

Meeting 2: Derivative Calculus   (4 Sept)

1. "Introduction to Calculus and the Derivative," Chapter 5. Moore and Siegel, pp. 101-116.

2. "The Rules of Differentiation," Chapter 6. Moore and Siegel, pp. 117-132.

Meeting 3: Multivariate Derivative and Integral Calculus   (8 Sept)

1. "The Integral," Chapter 7. Moore and Siegel, pp. 133-151.

2. "Multivariate Calculus," Chapter 15. Moore and Siegel, pp. 353-375.

3. "Unconstrained Optimization." Chapter 16.1, Moore and Siegel, pp. 376-382.

4. "Constrained Optimization: Equality Constraints," Chapter 16.2, Moore and Siegel, pp. 383-391.

Meeting 4: Introduction to Probability   (10 Sept)

1. "An Introduction to Probability," Chapter 9. Moore and Siegel, pp. 173-197.

2. "Probability Theory," Chapter 7. Gill, pp. 284-330.

Meeting 5: Discrete Probability Functions   (12 Sept)

1. Chapter 10. Moore and Siegel, pp. 198-218.

2. "Discrete Random Variables," Chapter 3. Larsen and Marx, pp. 148-161.

Meeting 6: Continuous Probability   (16 Sept)

1. Chapter 11. Moore and Siegel, pp. 242-272.

2. "Continuous Random Variables," Chapter 3. Larsen and Marx, pp. 161-173.

Meeting 7: Common Distributions   (17 Sept)

1. Sections of Chapters 10 and 11. Moore and Siegel, pp. 218-229; 258-271.

2. "Random Variables," Chapter 8. Gill, pp. 330-383.

Meeting 8: An Introduction to Computing with R   (22 Sept)

1. Install R from the CRAN website.

2. Take 45 minutes to watch and follow along with videos 1.1-2.5 available here.

3. (*Recommended*) Read pages 1-95 in Dalgaard (2008).

Meeting 9: An Introduction to Computing with STATA   (23 Sept)

1. Install or gain access to a Stata distribution.

2. "A Gentle Introduction to Stata."Available at Amazon here.

3. "Stata Tutorial," Princeton. Available here.

4. "A Brief Introduction to Stata with 50+ Basic Commands," Tobias Pfaff. Available here.

5. "Introduction to Stata," UNC at Chapel Hill. Available here

Meeting 10: Review and Wrap up   (25 Sept)

1. Review of Core Math and Probability Concepts

2. Advanced Topics in R & STATA

3. Student Requested Topics: Regression, Further Distributions, Computing Best Practices

References

Dalgaard, Peter. 2008. *Introductory Statistics with R*. 2 Springer.

Gill, Jeff. 2006. *Essential Mathematics for Political and Social Research*. Analytical Methods for Social and Political Research New York: Cambridge University Press.

Larsen, Richard J. and Morris L. Marx. 2006. *An Introduction to Mathematical Statistics and its Applications*. 4 ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Moore, Will H. and David A. Siegel. 2013. *A Mathematics Course for Political & Social Research*. Princeton, NJ: Princeton University Press.