

Political Science 5052: Mathematical Modeling for Political Science

Ryan T. Moore*

2 September 2009, at 10:00

Course Information

L32 Political Science 5052
Mathematical Modeling for Political Science
Tuesday and Thursday, 1.00-2.30pm
Seigle Hall, Room 303

Instructor Information

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Problem Sessions: Monday, noon-1pm, 206 Seigle Hall
Office Hours: Wednesday, 3-4pm

Readings

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press,
New York, 2006. ISBN-13: 9780521684033; ISBN-10: 052168403X.

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<http://rtm.wustl.edu>.

Course Description

Is turning out to vote genetic? Do individual voters have stable, coherent preferences? Do protections for bureaucratic whistleblowers generate better public agency projects? What's the relationship between parliamentary ministerial tenure and government tenure? Does religious extremism affect the choice of suicide terror attacks? Quantitative modeling and analysis techniques have been used by political scientists to address all of these questions recently (in fact, in the May 2008 issue of the American Political Science Review).

This course is designed to provide mathematical tools useful for the rest of the statistical methods sequence, as well as for other courses in formal theory or mathematical modeling. Throughout the course, the mathematical tools are motivated by applications to the general problem of how politics can be modeled for purposes of statistical analysis, deductive reasoning, or conceptual theorizing. This motivation is accomplished by means of a consistent focus on such processes as individual decision making, the representation of issues, statistical phenomena, and phenomena of change over time. The course assumes a sufficient background in elementary algebra, logic, functions, and graphs; remedial work in these areas will be offered through review work during the last week of summer. Mathematical topics covered include: sets and relations; probability; differential calculus and optimization; difference equations; and linear algebra.

By learning to solve problems covering the mathematical topics above, students will learn to represent political phenomena symbolically, to reason about social inquiry formally, and to test theories and hypotheses quantitatively. These core skills apply to future courses in methodology as well as substantive politics.

Requirements and Evaluation

Students are required to do the weekly reading, attend class, complete problem sets and exams, and participate in course discussions about the material. Using the course email to ask and answer questions is strongly encouraged, and will contribute to your participation evaluation.

The student's final course assessment is based on ten (roughly) weekly problem sets (20%), two midterm exams (10% and 20%), the final exam (40%), and participation in asking and answering questions in course discussions (10%). Problem sets will be posted and submitted through the course Telesis website (see <https://telesis.wustl.edu>). Problem sets will be due at the beginning of lecture on the specified date, and will be scored 0 to 10. Your solution sets should be typeset and legible. We strongly encourage you to work together on the problem sets, but each keystroke of your solution set must be your own (cut-and-paste solutions are not acceptable). Exams will be posted and submitted through the course Telesis website. Textbooks, solution sets, and the like are acceptable exam resources. Other individuals, help lists, etc., are unacceptable exam resources. If you have a question during an exam, email me directly ([rtm \(at\) wustl \(dot\) edu](mailto:rtm@wustl.edu)); if appropriate, I will anonymize your question and email a reply to the entire class. Exams will be available on Thursdays, and due on Tuesdays. Plan your calendar accordingly. No late work will be accepted.

We encourage you to use our office hours and email to discuss any specific exercises, difficulties, or questions about the course.

No late work will be accepted. If you cannot submit an assignment on time, arrange to submit it early. I encourage you to use office hours to discuss any specific assignments, difficulties, or questions about the course.

Academic integrity is a core value of institutions of higher learning. It is your responsibility to avoid plagiarism, cheating, and dishonesty. If you haven't done so recently, reread the Uni-

versity policy on academic integrity at <http://www.wustl.edu/policies/undergraduate-academic-integrity.html>.

Course Evaluation

The course evaluation will be available at <http://evals.wustl.edu> towards the end of the semester. Students who submit the evaluation will earn one percentage point toward the participation grade.

Calendar

I. Introduction

A) Introduction and Definitions

27 August

Introduction, Notation, Sets, Functions

1 September

Functions, Logs & Exponents

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §1.2-1.6, 7.3

3 September

Binary Relations

PS 0 due

8 September

Relations, Subrelations, Proof, Maximal Elements

10 September

Preferences, Choice, Utility, Rationality

PS 1 due

15 September

Limits: Definitions, at Infinity, One-sided, Properties. Continuity

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §5.1-5.2

17 September

Secants, Tangents, Derivatives
PS 2 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §5.3

22 September

Derivatives: Properties, Chain Rule, Higher Orders

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §5.4.1-5.4.2, 6.4

24 September

L'Hospital's Rule, Mean Value Theorem
PS 3 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §5.4.3-5.4.4

29 September

Implicit, Logarithmic, Parametric, and Partial Differentiation

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §6.1-6.3

1 October

Review and Discussion
PS 4 due
Exam 1 out

6 October

Area under Curves, Integration
Exam 1 due

8 October

Integration by Substitution, Integration by Parts

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §5.5-5.7

13 October

Multidimensional Integrals

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §6.5

15 October

Vectors

PS 5 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §3.1-3.2

20 October

Matrix Algebra

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §3.3-3.6

22 October

Matrix Geometry

PS 6 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §4.1-4.7

27 October

Eigen Structures. Vector Calculus.

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §4.8-4.9, 6.7

29 October

Unconstrained and Constrained Optimization
PS 7 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U
Press, New York, 2006. §6.8

3 November

Constrained Optimization

5 November

Counting, Probability
PS 8 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U
Press, New York, 2006. §7.1-7.2, 7.4-7.5

10 November

Bayes Rule, Independence, Odds

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U
Press, New York, 2006. §7.6-7.8

12 November

Review and Discussion
PS 9 due
Exam 2 out

17 November

Random Variables. Discrete Distributions
Exam 2 due

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U
Press, New York, 2006. §8.1-8.3.6

19 November

Continuous Distributions

Required reading.

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §8.3.7-8.3.11

24 November

Central Tendency, Dispersion, Expectation, Variance
PS 10 due

Jeff Gill. *Essential Mathematics for Political and Social Research*. Cambridge U Press, New York, 2006. §8.4-8.10

26 November

No class. Thanksgiving Break.

1 December

Equality and Inequality of Random Variables. Balance.

3 December

Covariance, Correlation, Properties, Moments
PS 11 due

10 December

Final Exam out, 1.00pm.

15 December

Final Exam due, 2.30pm.