

ECON 6105: ADVANCED MATHEMATICS AND STATISTICS FOR ECONOMISTS

Northeastern Department of Economics
Fall 2022

Contact Information

Course Instructor: Matthew B. Ross, Ph.D.

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Office Hours: Fridays from 10-1PM at School of Public Policy & Urban Affairs (360 Renaissance Park) and by appointment.

Course Schedule

Semester Start/End Dates: Sep 07, 2022 - Dec 17, 2022

Meeting Day/Time: Wednesdays 2:50PM – 6:10PM

Course Location: Behrakis Health Sciences Cntr 210

COURSE DESCRIPTION

This course is an intensive review of mathematics that is necessary for graduate coursework in economics. It is intended to help students prepare to the rigor of core courses in microeconomics, macroeconomics, and econometrics. Topics covered in this course include single and multivariate calculus, optimization with and without constraints, linear algebra, set theory, methods of proof, probability theory, properties of estimators, hypothesis testing, and a variety of related topics.

Note: Differential equations and dynamic programming will not be covered in this course. Students interested in pursuing macroeconomics should contact the instructor for advice about additional readings on these particular topics.

LEARNING OUTCOMES

By the end of this course, students will be able to:

- Understand basic operations and concepts in multivariate calculus and linear algebra
- Understand and apply the concepts and tools of constrained optimization to economics
- Understand and apply the concepts and tools of comparative statics in economics
- Understand probability theory, common families of distributions, and moment generating functions.
- Understand and evaluate properties of estimators and the central limit theorem
- Understand and apply hypothesis testing

COURSE PREREQUISITES

At a minimum, students should have undergraduate training in multivariate calculus and statistics. Students are not required to have previous exposure to linear algebra, probability theory, or real analysis. However, these topics will be covered quickly, and additional preparation may be necessary for students without prior training in these areas. On an individual basis and as necessary, students are encouraged to contact the instructor for additional reference texts and study materials on these

subjects.

COURSE MATERIALS

Required Materials

1. (SB) Mathematics for Economists by Carl. P. Simon & Lawrence Blume
2. (CB) Statistical Inference by George Casella & Roger L. Berger

GRADING AND ASSIGNMENTS

Assignments and grading in this course are geared towards the development of skills in mathematics which are necessary for graduate coursework in microeconomics, macroeconomics, and econometrics. T

Practice Problems (2 at 15%)

Two sets of practice problems will be distributed during the course. Students are encouraged to work together on these practice problems. However, students should turn in their own individual answers which should include proper derivations and should not mirror another student's work. Handwritten or Latex format is acceptable.

Midterm Examination (30%)

The midterm exam will cover linear algebra, multivariate calculus, and optimization methods as well as the economic application of these methods to problems of consumer and producer choice. Students will be expected to demonstrate a mastery of these concepts on both a mathematical and intuitive level. This examination will take place during the class.

Final Examination (40%)

The final exam will be cumulative and include content from the first half of the course as well as probability theory and distributions, theory of random samples, CLT, point estimation, and hypothesis testing. Students will be expected to demonstrate a mastery of these concepts on both a mathematical and intuitive level. This examination will take place during the class.

Grading Scheme

Student grades will be assigned according to the following criteria:

- (A) Excellent: Exceptional work for a graduate student. Work at this level is unusually thorough, well-reasoned, creative, methodologically sophisticated, and well written. Work is of exceptional, professional quality.
- (A-) Very good: Very strong work for a graduate student. Work at this level shows signs of creativity, is thorough and well-reasoned, indicates strong understanding of appropriate methodological or analytical approaches, and meets professional standards.
- (B+) Good: Sound work for a graduate student; well-reasoned and thorough, methodologically sound. This is the graduate student grade that indicates the student has fully accomplished the basic objectives of the course.
- (B) Adequate: Competent work for a graduate student even though some weaknesses are evident. Demonstrates competency in the key course objectives but shows some indication that understanding of some important issues is less than complete. Methodological or

analytical approaches used are adequate but student has not been thorough or has shown other weaknesses or limitations.

- (B-) Borderline: Weak work for a graduate student; meets the minimal expectations for a graduate student in the course. Understanding of salient issues is somewhat incomplete. Methodological or analytical work performed in the course is minimally adequate. Overall performance, if consistent in graduate courses, would not suffice to sustain graduate status in “good standing.”
- (C/-/+) Deficient: Inadequate work for a graduate student; does not meet the minimal expectations for a graduate student in the course. Work is inadequately developed or flawed by numerous errors and misunderstanding of important issues. Methodological or analytical work performed is weak and fails to demonstrate knowledge or technical competence expected of graduate students.
- (U) Unsatisfactory: Work fails to meet even minimal expectations for course credit for a graduate student. Performance has been consistently weak in methodology and understanding, with serious limits in many areas. Weaknesses or limits are pervasive.

SCIENTIFIC AND PROFESSIONAL ETHICS

The work you do in this course must be your own. Feel free to build on, react to, criticize, and analyze the ideas of others but, when you do, make it known whose ideas you are working with. You must explicitly acknowledge when your work builds on someone else's ideas, including ideas of classmates, professors, and authors you read. If you ever have questions about drawing the line between others' work and your own, ask the course professor who will give you guidance. Exams must be completed independently. Any collaboration on answers to exams, unless expressly permitted, may result in an automatic failing grade and possible expulsion from the Program.

Students should be familiar with Northeastern’s academic integrity policy and Honor Code. Academic dishonesty includes cheating, fabrication, plagiarism, unauthorized collaboration, participation in academically dishonest activities, and facilitating academic dishonesty. All members of the Northeastern University community— students, faculty, and staff—share the responsibility to bring forward known acts of apparent academic dishonesty. Any member of the academic community who witnesses an act of academic dishonesty should report it to the appropriate faculty member or to the director of the Office of Student Conduct and Conflict Resolution. The charge will be investigated and if sufficient evidence is presented, the case will be referred to the Northeastern University Student Judicial Hearing Board. Visit www.northeastern.edu/osccr for a full description of these policies and procedures.

ACCOMMODATIONS

Students should notify the professor within the first three class periods of their need for accommodations. Such requests should be accompanied by the appropriate paperwork from the Disability Resource Center. As noted in the handbook: Northeastern University and the Disability Resource Center (DRC) are committed to providing disability services that enable students who qualify under Section 504 of the Rehabilitation Act and the Americans with Disabilities Act Amendments Act (ADAAA) to participate fully in the activities of the university. To receive accommodations through the DRC, students must provide appropriate documentation that demonstrates a current substantially limiting disability. Accommodations are provided based on an evaluation of the information provided by students and their clinicians, on a case-by-case basis.

Students should provide documentation to the DRC at their earliest convenience to allow for sufficient time for review. After the documentation has been reviewed, a disability specialist will contact the student regarding appropriate next steps. For additional information on the DRC, visit their website at

MANDATORY REPORTING

Title IX of the Education Amendments of 1972 protects individuals from sex or gender-based discrimination, including discrimination based on gender-identity, in educational programs and activities that receive federal financial assistance. Northeastern's Title IX Policy prohibits Prohibited Offenses, which are defined as sexual harassment, sexual assault, relationship or domestic violence, and stalking. The Title IX Policy applies to the entire community, including male, female, transgender students, and faculty and staff. Alleged violations can be reported non-confidentially to the Title IX Coordinator within The Office for Gender Equity and Compliance at: titleix@northeastern.edu and/or through NUPD (Emergency 617.373.3333; Non-Emergency 617.373.2121). Reporting Prohibited Offenses to NUPD does NOT commit the victim/affected party to future legal action.

COURSE SCHEDULE

Note: SB= Simon & Blume, CB=Casella & Berger

	Lecture	Topics Covered	Readings	Assignments
Prep for Micro/Macro Theory	L1: 9/7, 2:50-6:10 PM	Review of Multivariate Calculus: Derivation, Integration, Implicit Function Theorem, Maximum/Minimum	SB 2-5, 14 & 15	
	L2: 9/14, 2:50-6:10 PM	Review of Linear Algebra 1: Row operations and Reduced Row Echelon Form, Determinants, Inverse Matrix and Cramer's Rule	SB 7-9 & 26 + notes	Problem set 1 distributed
	L3: 9/21, 2:50-6:10 PM	Review of Linear Algebra 2: Vector Space and Linear Independence, Rank, Eigenvalue and Eigenvector, Quadratic Forms and Definite Matrices	SB 11, 23, & 28 + notes	
	L4: 9/28, 2:50-6:10 PM	Unconstrained Optimization and Implicit functions	SB 14- 17	
	L5: 10/5, 2:50-6:10 PM	Constrained Optimization, Equality Constraints, Inequality Constraints, Mixed constraints, and Second Order Conditions	SB 18 & 19	
	L6: 10/12, 2:50-6:10 PM	Economic Applications: Consumer/Producer's Problem and Comparative Statics	notes	Problem set 1 due
	10/19, 2:50-6:10 PM	Midterm Exam		
Prep for Econometrics	L7: 10/26, 2:50-6:10 PM	Probability Theory, Expectations, Moments & Moment Generating Functions	CB 1 & 2	
	L8: 11/2, 2:50-6:10 PM	Common Families of Distributions, Joint & Conditional Distributions	CB 3.1-3.4 & 4.1-4.3	Problem set 2 distributed
	L9: 11/9, 2:50-6:10 PM	Properties of a Random Samples, Proof of CLT, Convergence Concepts	CB 5.1-5.5	
	L10: 11/16, 2:50-6:10 PM	Sufficiency, Likelihood, and Equivalence Principle	CB 6	
	L11: 11/30, 2:50-6:10 PM	Point Estimation: MLE, Method of Moments, Methods of Evaluating Estimators	CB 7	
	L12: 12/7, 2:50-6:10 PM	Hypothesis Testing	CB 8	Problem Set 2 due
	12/14, 2:50-6:10 PM	Final Exam		

