UNIVERSITY OF RICHMOND
ROBINS SCHOOL OF BUSINESS

ECON 341 Fall 2026
Mathematical Economics, 1 unit

SYLLABUS

Instructor:	Tom Zylkin
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Office Hours:	Tuesdays & Wednesdays, 9:15am - 10:15am & by appt.

Course Description: Mathematical Economics is the use of mathematical and computational techniques to construct, solve, and characterize economic models. Although the name of the course may sound like it refers to a more mathematical version of Economics, the goal is broader and more practical. Put simply, this course is about how economists turn verbal reasoning into models that can be solved.

As you have already learned in your economic theory courses, most economic models begin with a story about choices and constraints. A consumer decides how to spend a limited budget. A firm decides how much to produce given its costs and demand. A worker decides how much time to devote to labor, leisure, and learning new skills. Competing firms choose prices or quantities while anticipating each other's behavior. In each case, the underlying economic reasoning can be written as an optimization problem. Once we have written down all of the relevant objective-maximizing conditions and constraints, the model becomes a system of equations, which can then be solved to reveal the model's equilibrium outcomes as well as what determines them.

This idea will serve as the organizing principle for the class: economic models are often solvable systems of equations derived from optimizing behavior. We will build on tools you have already encountered in your previous classes—optimization from calculus, systems of equations from linear algebra, probability distributions from probability and statistics, and economic models from your intermediate theory classes—and use them in a more integrated way. The emphasis will be on learning how to set up models, solve them, interpret their

solutions, and ask how their predictions change when assumptions or parameters change.

At the same time, this is not intended to be a purely theoretical or mathematical course. We will use mathematics because it helps us say exactly what we mean, and we will use computational methods because many interesting economic models cannot be solved neatly by hand. Some of the course will involve pencil-and-paper analysis, some will involve writing code in Python, and much of it involve translating back-and-forth between economic intuition, mathematical structure, and numerical results. The larger goal is for you to become more fluent in the modeling process itself. This includes learning how models are built, how they are solved, and how their implications are characterized. These skills are valued not just in Economics but in any environment where complicated problems require structured thinking, including careers in finance, policy analysis, consulting, and data analytics.

Learning Objectives: This course fulfills the following objectives as part of the Economics Department's learning goals:

- Learning goal 1: Our graduates will be able to analyze and think critically to solve complex economic problems.
  - Objective 1.1: Students will produce solutions to economic problems using appropriate quantitative and qualitative techniques.
  - Objective 1.2: Students will identify core issues and evaluate and apply evidence in support of a coherent position or recommendation.
- Learning goal 4: Our graduates will demonstrate economic knowledge.

My own, more specific learning goals include developing the following abilities:

- the ability to view economic models as solvable systems of equations,
- the ability to select the appropriate analytical and/or numerical methods for solving a given model,
- the ability to use Python to implement numerical methods and present results, and
- the ability to conduct and interpret meaningful analysis using economic models, including for policy analysis and explaining real-world phenomena.

In addition, I aim for students to gain an integrated understanding of how concepts from linear algebra, calculus, and probability may be applied to the formulation and analysis of economic models.

Note: This section of ECON 341 does not include an optional research component and does not carry the "written communication" designation for general education. Only sections of ECON 341 listed as "Mathematical Economics (with research component)" carry this designation, and only for students who complete the optional research component.

COURSE REQUIREMENTS AND POLICIES

EXPECTATIONS. You should be prepared to work hard, ask questions, and learn new things. You should also expect the class to have significant theoretical, practical, and discursive elements. At times, you will need to learn some math in order to understand a new concept. At other times, you will be expected to implement the technical material you have learned by writing appropriate code in Python. In addition, I will ask you to explain why it is that a method should be expected (or should not be expected) to be applicable to a particular economic model.

That said, this is not a math class but rather a capstone class that draws on foundational math knowledge you will have learned in other classes and aims to apply it in new ways. As such, you can expect a typical unit to start by reviewing the relevant math concepts before then illuminating how they can be applied in Economics and how to carry out an appropriate computational analysis using Python. The latter aspect of the class is supported by having an extra half-hour "lab" component where we will practice writing code together. Not every class meeting will make full use of the lab portion, but you should plan to bring a computer with you to most classes.

On a day-to-day basis, I expect you to attend all class meetings and to have completed all assigned work before class. To be successful, you should be prepared to devote no less than 11 to 15 hours each week, including time spent in class. If you are having trouble with material from previous classes or with completing assignments, please do not hesitate to come to me for help.

EXAMS.There will be two in-class midterms and a final exam. In line with the overall aims of the course, the format of these exams will combine questions that will test your ability to apply concepts in practice as well as your understanding of the underlying theory and mathematical techniques.

HOMEWORK ASSIGNMENTS. You can expect there to be regular homework assignments throughout the course. Because the type of learning we will be doing is varied, the assignments, too, will be varied. Broadly speaking, you can expect graded assignments to be divided into two types: shorter and longer. In shorter assignments, you can expect to solve shorter math-based problems with pen-and-paper, work with short Python scripts to produce numerical results, and answer short answer questions that test your conceptual knowledge. In longer assignments, you can expect to have to answer longer pen-and-paper problems and write your own Python code to demonstrate mastery of the associated computational techniques.

QUIZZES. There will also be occasional in-class quizzes in lieu of a graded assignment. You

can expect these quizzes to be short and closely related to ungraded "homeworks" you will be given to practice on beforehand.

LAB CREDIT. Most class meetings will have some sort of lab component that expose you to the computational techniques and coding conventions needed to complete assignments and exam questions. Often there will be some sort of deliverable, usually a completed code notebook file, that you will be required to submit for a grade. Your lab credit grade will also reflect your overall participation and engagement in class, including attendance.

GRADING POLICY. The grade that you get in the class will be the grade that you have earned. The only time that I will be willing to change a grade is when I have made a mistake and it has been brought to my attention before the end of the semester. Your final grade will be determined as follows:

Lab credit	(10%)
Homework & quizzes	(15%)
Midterm I	(15%)
Midterm II	(25%)
Final exam	(35%)

For assigning letter grades, I prefer **5 point increments**. 95-100 is an A, 90-94 is an A-, 85-89 is a B+, and so on (B: 80-84: B. B-: 75-79. C+: 70-74. C: 65-69. C-: 60-64. D: 50-59. F: <50). The highest grade on the final exam in each section automatically receives an A for the course.

NOTE. Your grade on written work for this class will not be merely based on content. I will expect you to express your thoughts in a smooth, clear, and logical sequence, using the concepts we have established in class in an appropriate manner

A WORD ON ACADEMIC INTEGRITY. Violations of the Honor System in this class will not be tolerated and may result in severe academic sanctions. In order to familiarize yourself with the University of Richmond's Honor System as well as the policies in place regarding academic misconduct and dishonesty, you may refer to the following web site:

https://studentdevelopment.richmond.edu/AcademicIntegrityGuide_Students.pdf.

If you have any doubts or questions, please, consult with me.

UNIVERSITY OF RICHMOND POLICIES

Americans with Disabilities Act: Students with documented disabilities who need course accommodations, have emergency medical information or require special arrangements for building evacuation should submit an application to Disability Services and inform the instructor as quickly as possible so we may take steps to accommodate your needs. For further information, visit: http://disability.richmond.edu/students/process/index.html.

Course evaluation: Your feedback about the course and instructor is the only way instructors and academic units can improve the quality of a course and its content. Your honest feedback is greatly appreciated and will benefit students taking this course in the future.

Minimum attendance requirement: Students who are absent without a valid excuse for more than 25% of all scheduled classes will receive a grade of "V" (failure due to excessive absences) and no credit for the course.

COVID-19 guidelines: In the classroom, students will be expected to adhere to any and all guidelines set by the university with respect to COVID-19. In addition, all of us are called on to make an effort to be flexible and to make decisions in the best interest of the community, including staying home when sick. Students who are sick should not attend class, will not be required to provide formal documentation from a health care provider, and will not be penalized for absences. I will still expect you to notify me in advance if possible, keep up with classwork to the best of your ability, and stay in close communication so I know what is happening with you.

Generative AI policy: Generative AI tools such as ChatGPT may be used in certain contexts in this class, but these permissible contexts will not include generating answers, responses, or content that directly fulfill the purposes of assignments, quizzes, or exams, as this would violate academic integrity principles as well as the university Honor Code. I reserve the right to update this policy during the semester, but you can expect allowable use to include assignments and demonstrations that ask you to use and/or evaluate generated output. Among its useful purposes, generative AI has the potential to be a valuable assistant for coding-related tasks, and I want my students to be able to use it productively without trading off their learning and while understanding its limitations. To be clear, using AI to generate answers to assigned course work is absolutely not allowed. Check with me if you have any doubts on what is considered acceptable use.

Religious observance: The University is a secular institution that values diversity of religious expression. The observance of religious holidays is considered a valid reason to be absent from class. If any of the course deadlines and/or exam dates conflict with the observance of your religious obligations, please inform your instructor ASAP.

Dropping a course or withdrawing from a course: Once a student is registered, it is

his/her responsibility to attend the course, drop the course, or withdraw from the course. Dropping and withdrawing are distinct actions governed by different policies and impact a student's course enrollment status differently, Dropping a course causes the name of the course to disappear from the student's transcript. Withdrawing from a course causes both the name of the course and the grade of "M" (if withdrawing with a passing grade) or "W" (if withdrawing with a failing grade) to appear on the student's transcript. Before withdrawing from a course, students should consult the instructor. For further information on these procedures, please see the following website: http://registrar.richmond.edu/services/policies/add-drop.html.

Incomplete policy: A grade of "I" or "Y" may be given if the student's course work has not been completed by the end of the term. The "I" is a provisional failing grade, to be given when the student's reasons for incomplete work are deemed unjustifiable by the instructor. The "Y", which does not count as a failing grade, is given when the student's reasons for not completing are deemed justifiable. In the case of an "I", the work is to be made up by a deadline to be set by the instructor, which may be no more than 45 days beyond the last day of the term. Otherwise, the "I" will become an "F".

Final exams: No final exams will be given outside the exam period without the permission of the Dean. All final exams are scheduled by the University Registrar.

University closure: During the course of a semester, it is possible the university will experience closure. Make-up assignments or make-up sessions of equivalent face-to-face length may be scheduled to make up for lost class time.

Resources for Students: As the university's main hub for supporting student academic skills, the Weinstein Learning Center (https://wlc.richmond.edu/) provides support for general academic skills coaching (including effective studying and time managment), English language learning, quantitative and programming skills, speech and oral, communication (including getting feedback on presentations), and feedback on written work.

For students in need of non-academic support, especially support for mental health and during times of personal crisis, please do not hesitate to contact Counseling and Psychological Services (https://caps.richmond.edu/ or 289-8119). Services include brief consultations, short-term counseling, skills-building classes, therapy groups, crisis interventions, and other related services.

Other policies: More information on policies, procedures, and general governance may be found at the Provost's website. Specific policies and forms for the Robins School of Business are available in Canvas.

	TENTATIVE LECTURE OUTLINE	ASSIGNMENTS
M AUG 24	Course introduction. What is Mathematical Economics?	Check Jupyter access
W AUG 26	Sets, functions, and notation	HW #1 due.
M AUG 31	Economic models as systems of equations	
W SEP 2	Linear algebra for equilibrium systems	HW #2 due.
M SEP 7	Comparative statics in linear systems	
W SEP 9	Microfounding supply and demand	In-class Quiz #1
M SEP 14	Optimization	
W SEP 16	Optimization, continued	
M SEP 21	KKT conditions and corner solutions	
W SEP 23	Review for Midterm I	HW #3 (longer) due
M SEP 28	**MIDTERM I**	
W SEP 30	Linearization, log changes, and elasticities	
M OCT 5	Introduction to nonlinear models	
W OCT 7	Equilibrium in nonlinear systems	
M OCT 12	**FALL STUDY BREAK**	
W OCT 14	Introducing numerical methods for nonlinear models	HW #4 due
M OCT 19	Numerical methods, continued	
W OCT 21	Catching up	In-class Quiz #2
M OCT 26	Game theory I: best responses and Nash equilibrium	
W OCT 28	Review for Midterm II	HW #5 (longer) due
M NOV 2	**MIDTERM II**	
W NOV 4	Game theory II: oligopoly	
M NOV 9	Models with uncertainty	
W NOV 11	Monte carlo simulation and numerical expectations	HW #6 due
M NOV 16	Dynamic models	
W NOV 18	Dynamic models, continued	In-class Quiz #3
NOV 23-25	**THANKSGIVING BREAK**	
M DEC 2	Trade models	
W DEC 4	Trade models, continued	
M DEC 9	Review for final exam	HW #7 (longer) due
T DEC 15	**FINAL EXAM**	**GOOD LUCK!!!**