



FALL 2022
Department of Economics
TOBB University of Economics and Technology

ECON 561: MATHEMATICS FOR ECONOMISTS (1st PART)

INSTRUCTOR: Ayça Ozdogan Atabay	TIME: 10:30-13.20 Mondays
OFFICE: 236	CLASSROOM: 158
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This course will jointly be given by Ayca Ozdogan Atabay and Ismail Sağlam. The best way to contact me is through email. Emails will be returned within 24 hours except over the weekends. Important information such as the announcements about homework assignments and tests will be sent to students' university email accounts, as well as posted on **Piazza** at <https://piazza.com>. It is **YOUR responsibility** to check your *emails*, *Piazza*, and *ortam* platforms at least once a week.

COURSE DESCRIPTION/CONTENT

This course aims to equip the incoming graduate economics students with basic mathematical skills required for solid graduate programs. The 1st Part will familiarize students with the proof techniques, introduction to real analysis and static constraint optimization. And, the 2nd Part is to introduce dynamic optimization techniques in discrete and continuous time, using several examples drawn from macroeconomics.

TEXTBOOK

I will not follow a textbook. The recommended resources for the 1st part is listed below:

- Lucas, R.E. and N.L. Stokey (with E.C.Prescott), *Recursive Methods in Economic Dynamics*, Harvard University Press, 1989.
Ok, E., *Real Analysis with Economic Applications*, 2007.
Rudin, W., *Real and Complex Analysis*, McGraw-Hill, Third Ed.
Protter, M.H. and C.B. Murrey, *A First Course in Real Analysis*, Springer, Second Ed.
Royden, H.L., *Real Analysis*, Prentice Hall, Third Ed.
Simon, C. P. and L. Blume, *Mathematics for Economists*, Cambridge, First Ed.
Sundaram, R.K., *A First Course in Optimization Theory*, Cambridge University Press, 1996.

GRADING POLICY (for the 1st part)

This part will make 60% of the course. There will be several homework assignments, one announced quiz and one midterm exam to evaluate your performance in the course. The weights in this part:

Homework (%30)

There will be 5-6 homework assignments. Students are encouraged to work together; however, each student must hand in her or his own homework citing the references s/he uses and the names of the class mates s/he works with. The lowest homework assignment score will be dropped from the average.

Quiz (%20)

There will be one announced quiz. Make ups are not allowed for the quiz under any circumstances, except in medical emergencies for which a doctor's note is required. If a student knows he/she will be absent on the day of the exam for legitimate reasons (such as participation in activities sponsored by the university etc.), it is his/her responsibility to notify the instructor as far in advance as possible (again, with documentation).

Midterm (50%)

The midterm covers all material studied in the 1st part. The make-up will be granted only in case of a valid and documented reason. Absence without any valid documentation will result in a grade of zero from that exam. In case of an illness, you are required to bring a formal doctor's note from a hospital. Students who want to take a make-up exam need to inform me by email as early as possible.

The Final Exam of the course will test only the materials covered in the 2nd part of the course. However, the Retake (Bütünleme) Exam will be cumulative (all the subjects discussed both in the 1st and 2nd half).

NOTES

- Students are responsible for material covered in both the lecture and the supporting material assigned in related books. Everything discussed in class is part of the course and will appear on exams.
- Attendance is essential. If you miss more than 30% of the lectures, you fail complying with the rules of YÖK.
- Please use technology “responsibly” while you are in the lecture. This means TURNING OFF your cell-phones and any other devices. The instructor thanks you in advance.

NOTES ON ACADEMIC HONESTY AND STUDENT CONDUCT

All the work submitted must be that of student. You are encouraged to work with others in understanding the concepts and problems. However, each student must hand in their own homework assignment and all the sources of information and references used including a classmate (except for the textbook, lecture and recitation notes) must be **cited**. Identical answers will receive a score of zero. If the academic dishonesty occurs on a final or midterm, a grade of F will be received. Cheating and plagiarism will be penalized according to the disciplinary rules of the university and YÖK.

TENTATIVE COURSE PLAN

I: INTRODUCTION TO REAL ANALYSIS

1. Preliminaries -- 1st/2nd week
 - Why Math? Methodology of Math
 - Basic logic and proof techniques
 - Elementary set theory
 - Relations and mappings

2. Metric spaces (with a focus on Real numbers \mathbb{R}, \mathbb{R}^n) – 2nd/3rd weeks
 - Definitions
 - Sequences (convergence, monotonicity, Bolzano-Weierstrass theorem etc.)
 - Limit, Limsup, Liminf
 - Introduction to the topology of $(\mathbb{R}, \mathbb{R}^n)$ (open, closed sets, compactness, denseness)

3. Functions: Continuity and Limit – 4th/5th week
 - Different definitions and notions of continuity,
 - Uniform continuity,
Continuity and compactness, Weierstrass theorem
 - Intermediate value theorem,
 - Lipschitz functions and contraction mapping

4. Correspondences – 6th week
 - Continuity: Upper-hemi continuity, lower-hemi continuity
 - Theorem of Maximum

5. Fixed point theorems – 7th week
 - Brouwer fixed point theorem
 - Kakutani fixed point theorem
 - Contraction mapping theorem (Banach fixed point theorem)

II. OPTIMIZATION UNDER CONSTRAINTS



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ECON 561 MATHEMATICS FOR ECONOMISTS
PART II

Instructor	: İsmail Sağlam (joint with Ayça Özdoğan Atabay, who teaches Part I)
Office	: 245
Phone	: 4221
E-mail	: isaglam@etu.edu.tr
Classroom	: 158
Class Hours	: Monday 10:30 - 13:20
Office Hours	: Monday 14:00 - 15:00 (or by appointment)

Course Objective

The main objective of the second part of this course is to introduce dynamic optimization techniques in discrete and continuous time, using several examples drawn from macroeconomics.

Textbooks

- [KS] Kamien, M.I. and N.L. Schwartz, *Dynamic Optimization*, North-Holland, 1991.
- [A] Acemođlu, D., *Modern Economic Growth* [Chapters 6-7, 16, Appendix B], Princeton Press, 2009.
- [LS] Ljungqvist, L. and T.J. Sargent, *Recursive Macroeconomic Theory*, MIT Press, 2000.
- [LSP] Lucas, R.E. and N.L. Stokey (with E.C.Prescott), *Recursive Methods in Economic Dynamics*, Harvard University Press, 1989.

Grading for Part 2 (out of 40%)

Homeworks : 10%

Final Exam : 30%

Course Outline

Week 9	Calculus of Variations	[KS], [A]
Week 10	Optimal Control	[KS], [A]
Weeks 11-12	Dynamic Programming	[A], [LS], [LSP]

Class Rules

- 1. Attendance:** Students are required to attend to at least 70% of classes in order to get a letter grade other than U.
- 2. Disruptive Behaviors:** Disruptive behaviors are not permitted. Students with repetitive and disruptive behavior may be removed from class.
- 3. Plagiarism, Cheating and Collusion:** Students are expected to refrain from any form of plagiarism, cheating and collusion. Cheating, plagiarism, and collusion are serious offenses resulting in a grade penalty and disciplinary action.
- 4. Exams:** The exams will cover all material that is taught during the class or assigned to students.
- 5. Make-up Exams:** A make-up will be given under the conditions accepted by the Institute. Make-up exams will not be easier than the regular exam. There will be no make-up of homeworks or make-up exams.
- 6. Grade Changes:** A grade change will be made only in the unlikely case of an error of fact.