Boğaziçi University
Department of Economics
Fall 2018
EC 521 MATHEMATICAL METHODS FOR ECONOMICS

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Useful textbooks:

Vohra, R. V., *Advanced Mathematical Economics*, Routledge Advanced Texts, 2005

Ok, E. A., *Real Analysis with Economic Applications*, Princeton University Press, 2007.

Sundaram, R.K., *A First Course in Optimization Theory*, Cambridge University Press.

Dixit, A. K., *Optimization in Economic Theory*, Oxford University Press, 1990.

Royden, H. L., *Real Analysis*, Macmillan, 3rd edition.

Copson, E. T., *Metric Spaces*, Cambridge University Press, 1988.

Rudin, W., *Principles of MathematicalAnalysis*, McGraw-Hill,

Rudin, W., *Real and Complex Analysis*, McGraw-Hill, 2nd Edition, 1987.

Simon, C.P., Blume, L., *Mathematics for Economists*, Norton, 1994

Mas Colell, A., Whinston, M.D. and Green, J.R., *Microeconomic Theory: Mathematical Appendix*, Oxford University Press, 2005.

Course Description:

This course is designed to introduce certain mathematical tools and methods that are going to be useful in graduate level economics. We will first deal with a number of economic applications like linear production model, equilibrium in exchange economies, principal-agent problems and Nash equilibrium, focusing on subjects like convex sets, non-linear programming, fixed point theory. Then, we will study the fundamentals of real analysis, including metric spaces, open and closed sets, sequences, connectedness, compactness, completeness and continuity. By the end of the course you will both get familiar with certain mathematical tools and also develop skills in formal proof making.

Grading: Quizzes (20%), Midterm (35%), Final (45%).

Quizzes: There will be 5 **announced** quizzes. Only the highest 4 quiz grades will be used to calculate your overall quiz grade. No makeup quiz will be given.

Midterm: The midterm exam will be on **October 31, Wednesday, in class**.

Final: The final exam will be during the final period the exact date of which will be announced later by the Registrar's Office. It will be cumulative.

Problem Sets: There will be 6-8 problem sets available, posted every other week. These problem sets are **not** going to be graded, **however** working on them diligently is the most effective way to prepare for the exams and quizzes. I recommend you first work on them on your own and then discuss them in groups. For your questions on these problems you can come to my office hour and/or to your TA's office hour.

Makeup for the midterm: In case you have to miss the midterm, I will NOT ask you to bring any documented excuse. BUT, you have to contact me (either by email or through phone or in person) at least 12 hours before the midterm, that is, no later than 30th of October, Tuesday, 23:00, and tell me why you will not be able to take the exam. If you do this, then the weight of your midterm will be transferred to the final exam. I will not be giving any makeup exam for the midterm. If you don't contact me at least 12 hours before the midterm and miss the midterm, you will get no credit for the midterm. Keep in mind that the final exam tends to be tougher than the midterm exam, because there will be more topics which will be more advanced.

Makeup for the final: If you miss the final exam, you need to apply to the excuse committee for permission to take the makeup. If your excuse is accepted, you can take the makeup exam that will be given during the excuse exams. The makeup exam will be cumulative. Again keep in mind that the makeup exam will be more difficult, for fairness reasons.

Course Outline: (tentative!)

Part I: *Preliminaries*
- Some basic facts from Linear Algebra and Real Analysis
- Real sequences, Bolzano-Weierstrass Theorem

Part II: *Convex Sets*
- Convexity, Separating hyperplane theorems, Farkas Lemma
- Application: linear production model

Part III: *Non-linear Programming*
- Necessity for optimality, Karush-Kuhn-Tucker Theorem
- Sufficiency for optimality, Concave programming
- Envelope Theorem, Implicit Function Theorem
- Application: principal-agent problem

Part IV: *Fixed Point Theory*
- Banach fixed point theorem
- Brouwer fixed point theorem
- Application(s): Nash equilibrium, equilibrium in exchange economies

Part V: *Real Analysis*
- Metric spaces, Open and Closed sets
- Connectedness, Compactness, Completeness
- Continuity of functions and correspondences