



**Course:** Optimization  
**Faculty:** Tomás Rodríguez  
**Term:** 2016-2017 (First term)  
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**Office Hours:** Upon Request

**Description:**

This course provides practice in reading definitions and proving theorems and introduces some of the main mathematical methods to be used throughout the Master's program

**Objective:**

This course has two main goals:

(1) Help students to make the transition into being comfortable reading and using definitions and proving theorems.

10 weeks is a short period of time. Thus, rather than teaching math up to some pre-defined level, the main objective of the course is to provide each of you with some tools to help you self-propel wherever you find yourselves right now in your path towards mathematical maturity, and more specifically in your mastery of those branches of mathematics most often used in economics.

(2) Provide an overview of some of the main mathematical tools that will be used throughout the Master's program.

Having said the above (in 1), most of the courses that you will take in the master's program do have some mathematical pre-requisites, so a second objective of the course is to provide a rigorous introduction to some of these materials, and useful pointers to help you dig further according to your own needs and interests.

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## Outline:

- (1) Order: Partially ordered sets, lattices, monotone functions. (Ch 1.2)
- (2) Metric spaces: open and closed sets, sequences, convergence, Cauchy criterion, compact sets. Basic general point set topology. (Ch1.3)
- (3) Vector spaces, convexity (Ch 1.4)
- (4) Interaction of structures: Normed linear spaces (Ch 1.5)
- (5) Functions, monotone functions, continuity, uniform continuity. Correspondences, continuity of correspondences. The continuous maximum theorem, Fixed point theorems: Tarski, Banach, Brower. (Ch 2)
- (6) Linear functions, convex functions, separations theorems: Hahn-Banach, Duality, Theorem of the alternative (Ch 3)
- (7) Derivatives and Differentiability (Ch 4)
- (8) Optimization with equality and inequality constraints: necessary and sufficient conditions, Envelope Theorem, Monotone comparative statics. (Ch 5 and 6)
- (9) Dynamic optimization (Ch 7 and supplementary material).

## References:

Required: Michael Carter's "Foundations of Mathematical Economics".

### Suggested:

- (1) How to Read and Do Proofs: An Introduction to Mathematical Thought Processes by Daniel Solow.  
This is highly recommended as a warm up for the course, specially for those of you that haven't had much experience writing proofs.
- (2) Introduction to Real Analysis by Michael J. Schramm is another great reference for those of you that haven't taken a course in real analysis and have little experience writing proofs. It uses a similar approach as (1) above.
- (3) Real Analysis with Economic Applications by Efe Ok.  
I highly recommend this book as an alternative to Carter's (although its scope is narrower), and as a very good reference in general.

## Grading:

Grades will be based on two components: Problem sets (50%) and a Final Exam (50%). The problem sets, which will be a mixture of problems from Carter's book and from other sources, will only be awarded one of three marks reflecting perceived effort. This is somewhat difficult to do and ultimately quite arbitrary. The whole point is that you should work very hard on them without being concerned about having the right answer. Complete solutions will be provided, in fact there are publicly available official

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solutions to all the problems in Carter's book. The point of the exercises will be to learn how to build proofs, so don't consult them. In any case, it will not affect your problem sets grade in any way.

The Final Exam will be graded according to performance (whether you provide correct proofs).

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