

**Mathematical Economics**  
**Economía Matemática - Maestría (14700004)**  
**Universidad del Rosario - Facultad de Economía**  
**Semestre 2015 – II**

**Syllabus**

**Instructor:** Çağatay Kayı.

**Class Hours:** Mondays & Wednesdays: 11:00 – 13:00.

**Lecture Hall:** Auditorio I, Pedro Fermin.

**Email:** cagatay.kayi@gmail.com, kayi.cagatay@urosario.edu.co.

**Office:** Pedro Fermin 3 – 15 Ext. 4138.

**Office Hours:** Thursdays: 9:00 – 11:00. Otherwise, please e-mail me to arrange a mutually convenient time.

**Teaching Assistant:** María Lucía Florez **Email:** florezj.maria@urosario.edu.co.

**Problem Sessions:** TBA.

**Objectives:** This course is aimed for students in the Master of Economics. The purpose of the course is to provide some basic mathematics tools used in economics research. At the end of the course, students are able to deal with mathematical structures behind economic models and solve problems of static and dynamic optimization, and difference equations.

**Requirements:** There are lectures (twice a week) and problem sessions (every one or two weeks, starting from second week). Evaluation is based on two partial exams (29% each), a final exam (32%), and the unannounced quizzes in the lectures (10%). There are problem sets that you do not have to hand them in but these problems are good preparation for the exams and the quizzes. The final is cumulative. There is an objection period after each exam for a week. If a student misses an exam, we follow the regular procedure determined by the academic regulations. There are NO make-up exams without documented medical evidence that should be presented within one week of the exam. Failure to do so results in a score of zero on the missed exam. After the final, there is no rounding for grades and the grades are not subject to change unless there exists a well-founded claim.

The schedule is as follows:

- *First day of classes:* 27 July 2015, Monday.
- No classes on August 17, September 21 and 23, October 5 and 7 (Semana Rosarista), October 12, and November 2 and 16.
- *First exam:* 28 September 2015, Monday.
- *Second exam:* 19 October 2015, Monday.
- *Last day of classes:* 18 November 2015, Wednesday.
- *Final:* 25 November 2015, Wednesday.

**Course Outline:**

1. Mathematical Preliminaries

- (a) Mathematical Logic and How to Write a Proof.
- (b) Sets and the Set of Real Numbers.
- (c) Sequences, Functions, Continuity, and Differentiability.
- (d) The Implicit Function Theorem and the Inverse Function Theorem.
- (e) Homogeneous Functions and the Euler Theorem.
- (f) Matrices and Quadratic Forms.

2. Optimization in  $\mathbb{R}^n$ .
  - (a) Existence of Solutions: Weierstraß Theorem.
  - (b) Unconstrained Optimization.
  - (c) Equality Constraints and Theorem of Lagrange.
  - (d) Inequality Constraints and Theorem of Kuhn and Tucker.
  - (e) Convex Structures in the Optimization Theory.
  - (f) Quasi-Convexity and Optimization.
  - (g) Convex Sets and Separating Hyperplanes.
  - (h) Envelope Theorem.
3. Correspondences.
  - (a) The Theorem of Maximum.
  - (b) Fixed Point Theorems (Brouwer, Kakutani, and Tarsky).
  - (c) An Application of Fixed-Point Theorems: Existence of Nash Equilibrium.
4. Metric Spaces.
  - (a) Cauchy Sequences and Completeness.
  - (b) Contraction Mappings and the Contraction Mapping Theorem.
  - (c) Uniform Convergence, Pointwise Convergence, and the Uniform Convergence Theorem.
5. Difference Equations.
  - (a) First-order Linear Difference Equations and System of Linear Difference Equations.
  - (b) Second-order Linear Difference Equations.
  - (c) Stability of Solutions.
6. An Introduction to Dynamic Optimization.
  - (a) Dynamic Programming: Sequential Problem and Functional Equational Problem.
  - (b) Bounded Returns and Euler Equation.
  - (c) The One-sector Model of Optimal Growth.
7. An Introduction to Measure Theory
  - (a) Event Spaces.
  - (b) Borel  $\sigma$ -algebras and Probability Spaces.
  - (c) Probability Measures and Random Variables.

**Suggested Readings:**

- Sundaram, R. (1996) A First Course on Optimization, Cambridge University Press.
- Stokey, N. L. and Lucas, R.E. (1989) Recursive Methods in Economic Dynamics, Harvard University Press.
- Ok, E.A. (2007) Real Analysis with Economic Applications, Princeton University Press.
- Escobar D. (2005) Economía Matemática, Ediciones Uniandes, Alfaomega.
- Pecha, A. (2012) Optimización Estática y Dinámica en Economía, Universidad Nacional de Colombia.