
Mathematics and Probability

Preparatory Course

SYLLABUS

Information at a glance

Course:	Mathematical Economics
Web Site:	http://www.dma.unive.it/~ferretti
Professor:	Paola Ferretti (email: ferretti@unive.it)
Course:	Probability
Web Site:	http://www.dst.unive.it/~sartori
Professor:	Nicola Sartori (email: sartori@unive.it)

Purpose of course. This preparatory course reviews the standard content of a second level course in mathematical optimization and of an undergraduate-master level course in probability. The first lectures are devoted to the presentation of some basic results on unconstrained and constrained optimization. Topics covered in the second part of the course include: axioms of probability, conditional probability and independence, random variables and their distributions, conditional distributions and expectations, convergence of random variables, laws of large numbers, central limit theorem.

Prerequisites. You are expected to be familiar with standard material in analysis and some elementary notions on probability (both at the undergraduate level). More precisely, the following topics are assumed to be well-known: matrix algebra, determinants, linear independence, vector spaces, basis, systems of linear equations (chapters 8–11, 26–28 of C. P. Simon, L. Blume (1994); alternatively, chapter 1 of A. Vaglio (2004)). For the probability part of the course, you are expected to be familiar (at an undergraduate level) with the basic concepts of Probability theory, such as the concept of probability itself (of course!), independence, expected values, and conditional distributions.

Teaching method. There will be twenty meetings: ten of mathematics and ten of probability. Additional material can be made available on the class websites.

Examination policy. This course is administered on a pass/fail basis, which is decided based on a final test. Students who choose not to attend this course must obtain a waiver or pass the test. Homework sets are proposed during the class.

Contents. The first ten lectures of the preparatory course ((**ME**) course) cover the following topics:

- ME1.** Unconstrained maximization. Existence of solutions. First-order conditions. Second order conditions.
- ME2.** Constrained maximization. The case of equality constraints; Lagrange's method.
- ME3.** Constrained maximization. The case of inequality constraints; Kuhn-Tucker's method.
- ME4.** Metric spaces; normed spaces; Cauchy sequences.
- ME5.** Contractions; uniform continuity. Fixed points. Banach's Theorem.

The second part of the preparatory course ((**P**) course) covers the following topics:

- P1.** Definition of probability, independence, conditional probability.
- P2.** Random variables.
- P3.** Transformation of random variables.
- P4.** Expectation.
- P5.** Sampling distributions and limits.

Reading material in Mathematical Economics

The textbooks for the class are R. K. Sundaram (1999) and C. P. Simon, L. Blume (1994). A list of papers on covered topics will be published on the course webpage.

- 1) R. K. Sundaram (1999), *A First Course in Optimization Theory*, Cambridge University Press, Cambridge. [Chapters 3–6 and Appendix C.]
- 2) C. P. Simon, L. Blume (1994), *Mathematics for Economics*, WW Northorn & Company. [Chapters 16–19,29,30.]
- 3) A. Vaglio (2004), *Matematica per Economisti*, Apogeo, Milano.

Reading material in Probability

The textbooks for this part of the course are Evans and Rosenthal (2003, Chapters 1–4) and Casella and Berger (2002, Chapters 1–5). More detailed reference to these (and other) books will be given during the lectures.

- 1) M.J. Evans and J.S. Rosenthal (2003). *Probability and Statistics - The Science of Uncertainty*. W. H. Freeman.
- 2) G. Casella and R.L. Berger (2002). *Statistical Inference*, second edition. Duxbury Thompson Learning.
- 3) C.M. Grinstead and J.L. Snell (2006). *Introduction to Probability*. Available for free at <http://math.dartmouth.edu/~prob/prob/prob.pdf>.
- 4) D. Stirzaker (2003) *Elementary Probability*, Cambridge University Press.