

# MATHEMATICS FOR THE PH.D.: PRE-COURSE

FABIO TONOLI

Dipartimento di Scienze delle Decisioni, Università “Luigi Bocconi”

Via Roentgen 1, 20136 Milano – Italy

e-mail: fabio.tonoli@unibocconi.it

This course seeks to cover the basic mathematical concepts needed by incoming Master students. In particular, the content of this course is designed to full the mathematics requisites for studies in Quantitative Finance and Financial Economics.

**Prerequisites of the pre-course:** A standard background in Calculus for Economics. According to the textbook in (A), the following chapters are required:

- Part I, Chapters 15 (Calculus of One Variable );
- Part V, Chapters 12-15 and Part VII Chapters 29,30 (Calculus of Several Variables);
- Appendix A4 (Integral Calculus)

In order to follow actively the course, the knowledge of the prerequisites is **strongly required** *before* the starting of the course. It is strongly suggested that students take a look at books A or B and check their knowledge level on prerequisites before the course begins. These book explain widely and in elementary way the basic topics in prerequisites, like sets, numbers, functions in one variable (and their graphs, derivatives, tangent lines), matrices and determinants.

## Textbook:

- A) C. Simon and L. Blume, *Mathematics for Economists*, W W Norton & Company
- B) Sydsaeter, K., Hammond,P.; *Mathematics for Economic Analysis*, Prentice Hall (1995).
- C) Chiang, A. C.; *Fundamental methods of mathematical economics*, 1984, McGraw-Hill.
- D) L. Peccati, S. Salsa and A. Squellati, *Mathematics for Economics and Business*, Egea

Textbook A is a standard, widely adopted, entry-level textbook which covers most mathematical arguments used in economics

Textbook B offers a step-by-step approach to basic topics. It could be an useful integration to textbook A, especially because it helps to develop a more formal language, necessary for reading textbook C.

Textbook C is also a widely adopted book, which offers a more formal approach and covers nearly all background topics which are supposed to be math prerequisite in Economics.

Another aviable book on the subject which may also be used for covering the prerequisites is the textbook D, available at secretary's office.

## TOPICS COVERED DURING THE PRE-COURSE

### 1. Unconstrained Optima

- First-Order Conditions
- Second-Order Conditions
- [Using the First- and Second-Order Conditions](#)
- [Exercises](#)

### 2. Equality constraints and the Theorem of Lagrange

- Constrained Optimization Problems
- Equality Constraints and the Theorem of Lagrange
- Second-Order Conditions

- Using the Theorem of Lagrange
- Exercises

### 3. Inequality constraints and the Theorem of Kuhn and Tucker

- Statement of the theorem
- The Constraints qualification
- The Kuhn-Tucker Multipliers
- The general case: Mixed Constraints
- Using the Theorem of Kuhn and Tucker
- Exercises

The precourse will be covered in 6 sessions necessarily within the first week.

1	Exercises to check the knowledge of prerequisites on functions in one variable and differential calculus. Partial derivatives, First and second order differentials..
2	Unconstrained Optima: First- and Second- order Conditions. Exercises.
3	Equality constraints: the Theorem of Lagrange Exercises.
4	Equality constraints: Second-Order Conditions. Exercises.
5	Inequality constraints: The Theorem of Kuhn and Tucker Exercises.
6	Inequality constraints: mixed constraints and the Kuhn Tucker multipliers Exercises.