

# Mathematics - Preparatory Course

## Syllabus

### MISSION

The course is addressed to the students of more PhD programs in Bocconi University.

The course aims to enforce basic skills in Mathematics and to review the classic Static Optimization Theory which is commonly developed in an intermediate Mathematics course. It also aims to level the differences in basic knowledge in Mathematics between the various students.

The course includes theoretical explanations and exercises. There will be Homework sheets for each of the three topics of the course.

The course consists in 6 slots of two hours, usually held each day in the week before the start of PhD lessons. It is recommended to follow the course day by day, because there will be an exam shortly after the course (within 2 weeks after the end of the course).

### SYLLABUS (12 hours)

The course describes the following topics:

#### 1. Unconstrained Optima

- Differential calculus and Weierstrass Theorem
- 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
- Two economical examples. 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

### Textbook:

C. Simon and L. Blume, *Mathematics for Economists*, W W Norton & Company, 1994. (A PDF copy of the book can be easily found online)

### Prerequisites:

A standard background in Calculus for Economics is suggested. According to the textbook, the following chapters are required in order to follow in an optimal way the math preliminary course:

- Chapters 1-5: One variable calculus

Functions (domain and graphs of basic functions); first and second derivatives; maxima and minima (main theorems, 3.3 and 3.4); chain rule, inverse functions and their derivatives; exponents and logarithms (with properties and derivatives).

- Chapters 8.1-8: matrix algebra  
Addition, multiplication with a scalar, row-column multiplication, matrix multiplications, laws of matrix algebra, transposed matrix. Special kind of matrices. Algebra of squared matrices, inverse matrices.
- Chapter 9.1: determinants:  
Learn to compute the determinants of  $2 \times 2$  and  $3 \times 3$  matrices: do exercises! We will start from this and learn how to compute determinants of squared matrices of bigger size.

The video lectures on calculus from MIT (or any other online course that you might prefer) can be of help to the ones who approaching these topics for the first time, but also for the ones who have to refresh their memory.

- <http://ocw.mit.edu/courses/mathematics/18-01sc-single-variable-calculus-fall-2010/>

If you are already an expert, you can then proceed and read also

- Chapters 12-15 and Part VII Chapters 29, 30 (Calculus of Several Variables: open, closed, and compact sets, functions of several variables, partial derivatives, level curves and implicit functions).

FABIO TONOLI

Dipartimento di Scienze delle Decisioni, Università “Luigi Bocconi”

Via Roentgen 1, 20136 Milano – Italy

e-mail: [fabio.tonoli@unibocconi.it](mailto:fabio.tonoli@unibocconi.it)