

European University Institute  
Background Course on Mathematics  
Fall 2021

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Office Hours: usually after class.  
Teaching Assistant: Elia Moracci  
Teaching Assistant Office Hours: ...

### Prerequisites

Students are supposed to be familiar with the topics usually taught in basic courses on Calculus and Linear Algebra. Those topics are covered in the following books or notes.

1.

Either

Apostol, T. M., (1967), *Calculus, Volume 1*, 2nd edition, John Wiley & Sons, New York, NY: Chapters 1-7 included, 9-10,

or

Spivak, M., (1980), *Calculus*, 2nd ed., Publish or Perish, Inc., Houston, TX: all but chapters 16, 20, from 23 to 29, included.

2.

Either

Clark, C., (1982), *Elementary Mathematical Analysis*, 2nd edition, Wadsworth Publisher of Canada, Ltd., Belmont, CA. Appendix 1,

or

Villanacci, A., (2020), Mathematics for Economics 1, mimeo, Università degli Studi di Firenze: Chapter 1.

3.

Villanacci, A., (2020), Basic Linear Algebra, Metric Spaces, Differential Calculus and Nonlinear Programming: Chapters 1, 2 and 3; Sections 5.1 and 5.2.

### Content of the course

Linear algebra. Some topology in metric spaces. Differential calculus in Euclidean spaces. Nonlinear programming. An introduction to Dynamic Programming.

### Reading material

Mandatory.

Villanacci, A., (2021), Basic Linear Algebra, Metric Spaces, Differential Calculus and Nonlinear Programming, Class Notes.

Villanacci, A., (2020), Basic topics in Dynamic Programming, Parts I, III and V, Class Notes. (Very preliminary version).

→→ *Students are supposed to have read and understood the contents of Chapters 1, 2 and 3 and Sections 5.1, 5.2 in Villanacci (2019) before the beginning of the course.* ←←

### Exercises

Students are strongly advised to do a large part of the following exercises (all the exercises are solved in some detail in the file listed below).

a. exercises inserted at the end of almost all chapters or parts of the Notes; they are taken from Lipschutz (1991), Lipschutz (1965), handwritten file by Tito Pietra (I will give further information about these exercises in class);

b. Problem sets at the end of the Notes;

c. past final exams.

## Main sources of the Notes.

### I. Linear algebra

Lang S. (1971), *Linear Algebra*, second edition, Addison Wesley, Reading.

Lipschutz, S., (1991), *Linear Algebra*, 2nd edition, McGraw-Hill, New York, NY.

### II Some topology in metric spaces.

Lipschutz, S., (1965), *General Topology*, McGraw-Hill, New York, NY.

McLean, R., (1985), Class notes for the course of Mathematical Economics (708), University of Pennsylvania, Philadelphia, PA, mimeo.

Ok. E. A., (2007), *Real Analysis with Economic Applications*, Princeton University Press, Princeton NJ.

Simmons, G. F., (1963), *Introduction to Topology and Modern Analysis*, McGraw-Hill, New York.

### III Differential calculus in Euclidean spaces

Apostol, T. M., (1974), *Mathematical Analysis*, 2nd edition, Addison-Wesley Publishing Company, Reading, MA.

### IV Nonlinear programming.

Cass D., (1991), *Nonlinear Programming for Economists*, University of Pennsylvania, Class Notes.

### V Basic Dynamic Programming

Cugno, F., and Montrucchio, L., (1998), *Scelte intertemporali; Teoria e modelli*, (in Italian), Carocci, Roma.

Stokey, N. L., and Lucas, R.E., (1989), *Recursive Methods in Economic Dynamics*, Harvard University Press, Cambridge, MA.

## Lectures and Review Sessions

The course is organized on 14 lectures and 5 review sessions. Review sessions will be devoted to the discussion and solutions of exercises. Class time will be organized as follows: 1 hour and 15 minutes class; 15 minutes break; 1 hour class.

## Exam Requirements

There will be a final exam and 3 or 4 homework assignments. The final grade will be based on the final exam (90 per cent of the final grade) and on the problem sets (10 per cent of the final grade).

The final exam will be open notes-open books.