

Mathematics for Economists (BGSE, doctoral students)

Winter term 2021/22

Urs Schweizer

Angel de la Fuente: Mathematical Methods and Models for Economists, Cambridge University Press: 2000.

[David Gale: The Theory of Linear Economic Models (Chapter 3), McGraw-Hill Book Company: 1960.]

Urs Schweizer: Mathematics for Economists, Script, 2021

Preparation before attending the class:

It is highly recommended to study chapter 1 (pp. 1-38) of the Fuente book before entering the BGSE

Outline of the course

- 1. Introduction**
 - 1.1. The Edgeworth Box**
 - 1.2. The second welfare theorem**
- 2. The real number system**
 - 2.1. Fields**
 - 2.2. Ordered fields**
 - 2.3. Complete ordered fields**
- 3. Real vector spaces**
 - 3.1. Definition and examples**
 - 3.2. Finitely dimensional vector spaces**
 - 3.3. Kernel and image of a linear mapping**
 - 3.4. Parenthesis: invertible mappings**
 - 3.5. Invertible linear mappings**
 - 3.6. Matrix multiplication**
 - 3.7. Matrix representation of linear programming**
 - 3.8. Linear equations**
- 4. Metric spaces and normed vector spaces**
 - 4.1. Definitions**
 - 4.2. The Cauchy-Schwartz Inequality**
 - 4.3. Infinite sequences in metric spaces**
 - 4.4. Infinite sequences in \mathbb{R}**
 - 4.5. Cauchy-sequences in metric spaces**
 - 4.6. Topology in metric spaces**
 - 4.7. Compact subsets of \mathbb{R}**
 - 4.8. Euclidean vector spaces as metric spaces**
 - 4.9. Continuous mappings between metric spaces**
 - 4.10. The contraction mapping theorem**

5. *Linear mappings between normed vector spaces*
 - 5.1. *Continuous linear mappings*
 - 5.2. *The supremum norm of continuous linear mappings*
 - 5.3. *Linear mappings between Euclidian vector spaces*
 - 5.4. *Linear operators*
6. *Differential calculus*
 - 6.1. *Limits of functions*
 - 6.2. *Differentiability of functions from \mathbb{R} to \mathbb{R}*
 - 6.3. *Partial and directional derivatives*
 - 6.4. *Differentiability*
 - 6.5. *Continuous differentiability*
 - 6.6. *The chain rule*
 - 6.7. *The generalized mean value theorem*
7. *The inverse function theorem*
 - 7.1. *Statement of the theorem*
 - 7.2. *Proof of the inverse function theorem*
 - 7.3. *The implicit function theorem*
 - 7.4. *Proof of the implicit function theorem*
8. *Optimization subject to constraints*
 - 8.1. *Concave functions*
 - 8.2. *Optimization without constraints*
 - 8.3. *Non-negativity constraints*
 - 8.4. *More general constraints*
 - 8.5. *The Lagrange theorem*
 - 8.6. *The Kuhn-Tucker theorem*
9. *Concave programming*
 - 9.1. *Introduction*
 - 9.2. *Summary and extension of known results*
 - 9.3. *Further topological concepts*
 - 9.4. *Separating and supporting hyperplanes*
 - 9.5. *The main theorem of concave programming*
 - 9.6. *Finitely generated cones*
 - 9.7. *The main theorem of linear programming*
10. *The introduction revisited*
11. *Assigning questions to sections*