

NATALIA LAZZATI

MATHEMATICS FOR ECONOMICS

OVERVIEW OF THE NOTES

The day before each class you will receive the lecture note corresponding to that class. The notes start by describing the material that was used to prepare them. I expect you to read first the corresponding chapters in Simon and Blume (1994), and then the lecture note. All these notes have open questions that you should try to answer before the class.

Week I: Preliminary Concepts

Most of the models economists are interested in are nonlinear and thereby hard to study. Because differentiable functions admit good linear approximations, so do differentiable models; this gives us a tractable way to analyze them. When we use calculus to study a nonlinear model, we are in fact constructing a linear approximation to it in some neighborhood of an initial point. The assumption that the behavioral functions in the model are differentiable means that the approximation error is small. To study the local properties of the model after linearization, we use the tools of linear algebra. Notes 1 through 5 cover all the mathematical preliminaries we need to implement this approach.

Note 1: Linear Algebra

Searle and Willett (2001) and Simon and Blume (1994, Ch. 6, 7, 8, 9, 11, 26 and 27).

Note 2: Differential Calculus

de la Fuente (2000, Ch. 4) and Simon and Blume (1994, Ch. 14).

Note 3: The Implicit Function Theorem

Apostol (1975, Ch. 13), de la Fuente (2000, Ch.5) and Simon and Blume (1994, Ch. 15).

Note 4: Quadratic Forms

Searle and Willett (2001) and Simon and Blume (1994, Ch. 16).

Note 5: Convex Sets and Concave Functions

Madden (1986, Ch. 1, 2, 4 and 7) and Simon and Blume (1994, Ch. 13 and 21).

Week II: Nonlinear Programming and Parametric Optimization

One objective of using economic models is to make predictions concerning the behavior of individuals and groups in situations of interest. This is possible if their behavior exhibits some sort of regularity. In economic theory it is often assumed that individuals have well-specified and consistent preferences over the set of possible results and their actions; and that, given those preferences, they choose their actions so as to obtain the best result among those available. These postulates lead us to model the behavior of economic agents as the outcome of either a constrained or an unconstrained optimization problem. Notes 6 through 8 develop the "technology" for analyzing such problems, that is, nonlinear programming.

Most of the economic analysis considers whole families of optimization problems instead of just one in isolation. Note 9 studies how the predictions of our model change when the environment changes.

Notes 6 through 9 are the core of this course.

Note 6: Nonlinear Programming—Unconstrained Optimization

de la Fuente (2000, Ch. 7), Madden (1986, Ch. 3 and 5) and Simon and Blume (1994, Ch. 17).

Note 7: Nonlinear Programming—The Lagrange Problem

de la Fuente (2000, Ch. 7) and Simon and Blume (1994, Ch. 18 and 19).

Note 8: Nonlinear Programming—The Kuhn-Tucker Problem

de la Fuente (2000, Ch. 7) and Simon and Blume (1994, Ch. 18 and 19).

Note 9: Parametric Optimization—Envelope Theorem and Comparative Statics

de la Fuente (2000, Ch. 7), Madden (1986, Ch. 8) and Simon and Blume (1994, Ch. 19).

Week III: (a) Quasiconcave Programming

Quasiconcave programming is a subclass of nonlinear programming that unifies many of its results. Notes 10 and 11 extend part of the analysis of Weeks I and II to frameworks that entail weaker conditions.

Note 10: Quasiconcave and Pseudoconcave Functions

Madden (1986, Ch. 13, 14) and Simon and Blume (1994, Ch. 21).

Note 11: Quasiconcave Programming

de la Fuente (2000, Ch. 7), Madden (1986, Ch. 20), Simon and Blume (1994, Ch. 21) and Dr. Walker's Lecture Notes.

Week III: (b) Homogeneity and Homotheticity

There are two special functions that often appear as solutions of parameterized families of problems in economics: homogenous and homothetic functions. Note 12 studies them.

Note 12: Homogeneous and Homothetic Functions

Madden (1986, Ch. 9) and Simon and Blume (1994, Ch. 20).