



Course Syllabus

Department/Area of Study:	Economics
Discipline:	Mathematics for Economics (EA025)
Number of credits:	4
Academic hours:	60 h/a
Prerequisites:	Fundamentals of Mathematics for Economics.

1 Overview

The course develops the basic methods for deal with dynamic problems in Economics.

2 Objectives

By the end of the course students will be able to:

1. Solve the main differential equations of first and second order.
2. Draw and interpret phase plane diagrams.
3. Solve the main difference equations of first and second order.
4. Solve and understand the qualitative properties of optimal control.
5. Understand the basic methods for solving dynamic programming problems.

3 Contents

1. First Order Ordinary Differential Equations (**ODE 1**): Separable equations; Linear equations; Exact equations; Transformation of variables; Qualitative Theory.
2. Second Order Ordinary Differential Equations and Systems in the Plane (**ODE 2**): Linear equations of second order; Systems of differential equations; Stability; Phase Plane Analysis; Stability of nonlinear systems; Saddle Points.
3. Calculus of variations(**CV**): The Euler equation; Terminal conditions; Examples.
4. Control Theory (**CT**): Regularity conditions; The maximum principle; Sufficient Conditions; The current Value Formulation; Scrap Value; Infinite Horizon; Phase Diagrams.
5. Difference Equations (**DE**): First Order Equations; Second order equations; systems of difference equations; Stability of nonlinear systems.
6. Introduction to dynamic programming (**DIP**): The Euler equation; Infinite Horizon; The maximum principle; Stochastic Optimization.



4 Texts

The course follows [5] as textbook, because the course objective is to describe the basic techniques used in dynamic economics, the exposition is not detailed. However, students can extend the basic knowledge by reading the complementary material (see below).

Chap.	Principal	Complementary
ODE 1	[5, chap. 5]	[6, chap. 1-3]
ODE 2	[5, chap. 6]	[6, chap. 4-7]
CV	[5, chap. 8]	[3, chap. 5]
CT	[5, chap. 9]	[3, chap. 6-10]
DE	[5, chap. 11]	[2]
DIP	[5, chap. 12]	[4], [1]

Table 1: List of readings

5 Contact Information

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References

- [1] Dimitri P. Bertsekas. *Dynamic Programming and Optimal Control (2 Vol Set)*. Athena Scientific, 2012.
- [2] Samuel Goldberg. *Introduction to Difference Equations*. Dover Publications Inc., 1987.
- [3] Daniel Leonard and Ngo Van Long. *Optimal Control Theory and Static Optimization in Economics*. Cambridge University Press, 1992.
- [4] Lars Ljungqvist and Thomas J. Sargent. *Recursive Macroeconomic Theory*. MIT Press Ltd, 2012.
- [5] Knut Sydsaeter, Peter Hammond, Atle Seierstand, and Arne Strom. *Further Mathematics for Economic Analysis*. Prentice Hall, 2008.
- [6] Morris Tenenbaum and Harry Pollard. *Ordinary Differential Equations*. Dover, 1985.