



## TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Dynamic Methods
Subject code	E000006609
Mainprogram	<a href="#">Bachelor's Degree in Business Administration and Management</a>
Involved programs	Grado en Administración y Dirección de Empresas (E-2) [Segundo Curso] Grado en Administración y Dirección de Empresas (E-2) - Bilingüe en inglés [Segundo Curso]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Optativa (Grado)
Department	Departamento de Métodos Cuantitativos
Coordinator	CRISTINA LOZANO
Office hours	PREVIA PETICIÓN POR EMAIL

Teacher Information	
Teacher	
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## SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject
<b>Contribution to the professional profile of the degree</b>
<p>The subject provides a student with the mathematical methods that are needed to model those phenomena that evolve over time. This is especially intended for the benefit of whom, in the future, will be using these quantitative tools as a graduate student in Finance or in Economics.</p> <p>The subject also provides the student with the needed degree of self reliance and self sufficiency when applying mathematical methods to an object of investigation, which is a particularly useful skill when undergoing technical studies in his/her professional life.</p>



## Prerequisites

Differential calculus of functions of several variables.

Integral calculus of functions of one variable.

## Competencies - Objectives

### Competences

#### GENERALES

<b>CG01</b>	Capacidad de análisis y síntesis	
	<b>RA1</b>	Capacidad para expresarse en lenguaje matemático
	<b>RA2</b>	Capacidad de utilización de las matemáticas en otras materias de Grado
<b>CG02</b>	Resolución de problemas y toma de decisiones	
	<b>RA1</b>	Capacidad para la formulación en lenguaje matemático de los problemas que surgen en la gestión empresarial y de la resolución de los mismos
<b>CG14</b>	Capacidad para aprender y trabajar autónomamente	
	<b>RA1</b>	Lee, sintetiza y comprende críticamente materiales bibliográficos de referencia
	<b>RA2</b>	Desarrolla habilidades necesarias para el estudio e investigación independiente
	<b>RA3</b>	Encuentra por si mismo aplicaciones y extensiones de los conceptos y metodologías estudiadas

#### ESPECÍFICAS

<b>CE08</b>	Conocimiento de técnicas matemáticas que permiten modelizar y resolver problemas en el ámbito económico-empresarial	
	<b>RA1</b>	Aplica la abstracción la simplificación para modelar en términos matemáticos el problema al que se enfrenta
	<b>RA2</b>	Conoce los instrumentos matemáticos necesarios para la modelización

## THEMATIC BLOCKS AND CONTENTS

### Contents - Thematic Blocks



## **BLOCK 1: INTRODUCTION TO DYNAMIC MODELS FOR BUSINESS ECONOMICS**

### **Topic 1: INTRODUCTION TO DYNAMIC MODELS FOR BUSINESS ECONOMICS**

- 1.1 The role of dynamic models in Economics
- 1.2 Continuous-time dynamic models: differential equations.
- 1.3 Discrete-time dynamic models: finite-differences equations.

## **BLOCK 2: MODELING TRAYECTORIES IN CONTINUOUS AND DISCRETE TIME**

### **Topic 2: FIRST-ORDER DIFFERENTIAL EQUATIONS**

- 2.1 Solution of differential equations of separate variables
- 2.2. Solution of linear differential equations. Economic applications
- 2.3 Solution of the Bernoulli Equation.
- 2.4 Qualitative analysis of a first-order differential equation

### **Topic 3: LINEAR DIFFERENTIAL EQUATION OF DEGREE n**

- 3.1 Concept of linear differential equation of order n
- 3.2 Homogeneous Equations. Functional linear dependence *versus* independence
- 3.3 Solution to a homogeneous equation and to the complete equation
- 3.4 Methods of integration for linear equations.
- 3.5 Economic applications.

### **Topic 4: DIFFERENCE EQUATIONS**

- 4.1 Difference operator and its properties
- 4.2 Difference equation: concept and kinds of solutions
- 4.3 Methods of integration for linear equations.
- 4.4 Economic applications

## **BLOCK 3: DINAMIC OPTIMIZATION IN CONTINUOUS TIME**

### **Tema 5: THE CALCULUS OF VARIATIONS**

- 5.1 Previous concepts



5.2 Stating the basic problem of the Calculus of Variations

5.3. Euler's condition. Legendre condition. Sufficient condition.

### **Tema 6: PRONTRYAGUIN MAXIMUM PRINCIPLE**

6.1 Control and state variables. Stating the basic problem of an optimal control approach

6.2 The Pontriaguin Maximum Principle. Sufficient maximum conditions

6.3 Application: the distribution of wealth between consumption and investment in a given period of time as an optimal control problem

## **TEACHING METHODOLOGY**

### **General methodological aspects of the subject**

#### **In-class Methodology: Activities**

##### **Theoretical classes:**

All concepts and methods that are part of the subject program as well as their relationships will be explained in class. The methodology will vary depending on the topic.

##### **In-class practice:**

To complement the time that a student should individually devote to studying the subject, a certain amount of class time will be devoted to practicing the applications of the concepts being taught. This activity will be subsequently reviewed by the teacher.

##### **Presentation of models:**

Pairs of students will be required to present in class a model in which the studied methodology is fully applied. Each student is expected to present at least one model throughout the course.

CG01, CG02,  
CG14, CE08

#### **Non-Presential Methodology: Activities**

##### **Review of the theoretical classes:**

On a weekly basis, the student is expected to make sure that the new concepts are clearly understood, and contact the teacher with any questions he/she might have.

##### **Practical work:**

On a weekly basis, the student will be assigned a number of exercises to solve and will be given information about which of them will have to be submitted to the teacher. Submissions will be made in pairs

##### **Preparation of a model:**



Throughout the semester, by groups students will study a model in which the studied methodology is applied. For the best preparation of the model it is essential to make use of the assigned bibliography

## SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS		
Lecciones de carácter expositivo	Ejercicios y resolución de casos y de problemas	Exposición pública de temas o trabajos
35.00	20.00	5.00
NON-PRESENTIAL HOURS		
Ejercicios y resolución de casos y de problemas	Estudio individual y/o en grupo y lectura organizada	Trabajos monográficos y de investigación, individuales o colectivos
35.00	35.00	20.00
<b>ECTS CREDITS: 6,0 (150,00 hours)</b>		

## EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
Final examen	Understanding the concepts - Solving the basic exercises of the method object of study - Stating and correctly demonstrating the most relevant theoretical results - Correctly stating the models presented in class	55
Submission of exercises	Make a first delivery of all the exercises within the deadline - Showing the degree of learning in the subsequent submissions of each exercise	15
Presentation of a model	- Understanding the concepts presented in class - Satisfactory preparation of a presentation	15



	- Correctly and clearly exposition	
Written midterm on topics 1,2 & 3	In case the student's is at least 7 the topics covered by this test will not be required for the final exam	12

## Ratings

The above percentages will be applied only to students participating in the ordinary call. The score for students with a *dispensa de escolaridad* and for students who examine in subsequent calls is the score earned in the final exam, provided it is higher than the average calculated as indicated above.

## BIBLIOGRAPHY AND RESOURCES

### Basic Bibliography

Cerdá, Emilio. *Optimización Dinámica*. Prentice Hall, 2001

Chiang, Alpha C.; Wainwright, Kevin *Métodos Fundamentales de Economía Matemática*. Mc Graw Hill. Méjico, 2006

Outlines, exercises and practices that are available in the *Portal de Recursos*

### Complementary Bibliography

Chiang, Alpha C. *Elements of Dynamic Economics*. McGraw-Hill, 1992

Gandolfo, Giancarlo. *Economic Dynamics* Springer-Verlag. Berlin, 1997

Kamien, Morton I.; Schwartz, Nancy L. *Dynamic Optimization. The Calculus of Variations and Optimal Control in Economics and Management*. North-Holland. Amsterdam, 1993 (1ª ed. 1991)

Kiseliov, A.; Krasnov, M.; Makarenko, G. *Problemas de ecuaciones diferenciales ordinarias*. Ed. Mir. Moscú, 1984 (4ª edición; 1ª ed. 1968)

Rumbos Pellicer, Beatriz; Lomelí Ortega, Héctor. *Métodos dinámicos en economía: otra búsqueda del tiempo perdido*. Thomson. Méjico, 2003

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