



## TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Business Mathematics II
Subject code	E000011445
Main program	<a href="#">Bachelor's Degree in Business Administration and Management (E-2)</a>
Involved programs	Grado en Administración y Dirección de Empresas (E-2) [First year] Grado en Administración y Dirección de Empresas y Grado en Derecho [First year] Grado en Administración y Dirección de Empresas con Mención en Internacional (E-4) [First year] Grado en Administración y Dirección de Empresas y Grado en Relaciones Internacionales [First year] Grado en Administración y Dirección de Empresas (E-2) - Bilingüe en inglés [First year] Grado en Psicología y Grado en Administración y Dirección de Empresas [First year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Básico
Department	Departamento de Métodos Cuantitativos
Coordinator	GLORIA MARTIN ANTÓN

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## SPECIFIC DATA OF THE SUBJECT

### Contextualization of the subject

#### Contribution to the professional profile of the degree

A student that obtains the Degree in Business Administration needs to develop the ability for abstract thoughts in the business world. A quantitative modeling skill and the use of a formal language, that are essential to develop these skills, are largely provided

#### Prerequisites

None. It could be advisable for students to take the Mathematics Course offered at the Pre-University Campus

### Competencies - Objectives

#### Competences

##### GENERALES

<b>CG1</b>	Adquirir una base de conocimientos sólida y relevante sobre la disciplina científica y empresarial	
	<b>RA1</b>	Capacidad de expresarse en lenguaje matemático
	<b>RA2</b>	Capacidad de utilización de las matemáticas en otras materias del grado
<b>CG14</b>	Capacidad para aprender y trabajar autónomamente.	



	<b>RA1</b>	Desarrolla habilidades necesarias para el estudio e investigación independiente
	<b>RA2</b>	Encuentra por sí mismo aplicaciones y extensiones de los conceptos y metodologías estudiadas
<b>CG2</b>		Capacidad de gestionar información y datos provenientes de fuentes diversas para hacer un análisis crítico y un correcto diagnóstico de la realidad empresarial.
	<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>ESPECÍFICAS</b>		
<b>CE8</b>		Conocimiento de técnicas matemáticas que permiten modelizar y resolver problemas en el ámbito económico-empresarial
	<b>RA1</b>	Ante un enunciado de un problema empresarial es capaz de utilizar los instrumentos matemáticos que mejor representan el problema.
	<b>RA2</b>	Apoyándose en el análisis gráfico, verbal y los datos cuantitativos y cualitativos es capaz de integrarlos en modelos gradualmente más complejos.
	<b>RA3</b>	Es capaz de aplicar correctamente a los problemas empresariales el álgebra lineal, análisis funcional, cálculo integral y búsqueda de óptimos.

## THEMATIC BLOCKS AND CONTENTS

### Contents - Thematic Blocks

#### BLOQUE I: FUNCTIONS OF SEVERAL VARIABLES I

##### TOPIC 1: FUNCTIONS OF SEVERAL VARIABLES I

- 1.1 Definition of function of several variables. Domain and Range.
- 1.2 Graphical representation. Level curves.
- 1.3 Limits and continuity
- 1.4 Directional derivatives. Partial derivatives.
- 1.5 Gradient. Properties.
- 1.6 Higher order derivatives. Hessian matrix.
- 1.8 Taylor polynomial. Taylor's theorem

##### TOPIC 2: FUNCTIONS OF SEVERAL VARIABLES II

- 2.1 Several variable function composition. Chain rule
- 2.2 Homogeneous functions. Euler's theorem of homogeneous functions.



## BLOQUE II: OPTIMIZATION THEORY

### TOPIC 3: INTRODUCTION TO OPTIMIZACIÓN

- 3.1 Optimization programs. Modeling.
- 3.2 Optimal points.
- 3.3 Graphical resolution of an optimization program.
- 3.4 Elements of Topology.
- 3.5 Theorem of Weierstrass.

### TOPIC 4: CONVEXITY ANALYSIS

- 4.1 Convex sets and properties.
- 4.2 Concave and convex functions. Properties.
- 4.3 Characterization of convexity for class  $C^1$  functions.
- 4.4 Characterization of convexity for class  $C^2$  functions.
- 4.5 Convex programs. Local-Global Theorem.

### TOPIC 5: UNCONSTRAINED OPTIMIZATION

- 5.1 Necessary condition
- 5.2 Sufficient condition
- 5.3 Sufficiency of the necessary condition

### TOPIC 6: CONSTRAINED OPTIMIZATION

- 6.1 Types of constrained optimization programs.
- 6.2 Optimization with equality restrictions.
- 6.3 Implicit Functions. Existence Theorem.
- 6.4 Lagrange multipliers method.
- 6.5 Sufficient condition of local optimum.
- 6.6 Lagrange multiplier interpretation.
- 6.7 Optimization with inequality constraints, Kuhn-Tucker conditions

## TEACHING METHODOLOGY

### General methodological aspects of the subject

### In-class Methodology: Activities



Expository lectures	CG1, CG2, CG14, CE8
General content presentation sessions	
Public presentations of topics and works	
Exercises and problem resolution	
<b>Non-Presential Methodology: Activities</b>	
Tutorial sessions	CG1, CG2, CG14, CE8
Learning in groups	

## SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS		
Lecciones de carácter expositivo	Ejercicios y resolución de casos y de problemas	Sesiones tutoriales
34.00	20.00	16.00
NON-PRESENTIAL HOURS		
Sesiones tutoriales	Estudio individual y/o en grupo y lectura organizada	
12.00	78.00	
<b>ECTS CREDITS: 6,0 (160,00 hours)</b>		

## EVALUATION AND CRITERIA

Evaluation activities	Evaluation criteria	Weight
WRITTEN EXAM: with theory and problems	<ul style="list-style-type: none"> <li>Same Criteria for all students of the course.</li> <li>In order to carry out the weighted average between the final grade and the tests, it is necessary to obtain, at least, 4 over 10 in the Final Exam.</li> </ul>	70 %
CONTINUOUS EVALUATION: WRITTEN EXAMS <ul style="list-style-type: none"> <li>1st exam on partial derivatives and Unit 1 until 1.7</li> <li>2nd exam on Unit 1 from 1.7 to the end, Unit 2 and Unit 3</li> <li>3rd exam on Units 4 and 5</li> </ul> PRESENTIAL ACTIVITIES	A 25% will be obtained from the average: <ul style="list-style-type: none"> <li>The 1st exam</li> <li>The highest scores of the other exams</li> </ul> A positive valuation will be weighted on presential activities mentioned in the qualification part	30 %



## Ratings

### EVAUATION SYSTEM

FINAL EXAM: 70% WRITTEN

EXAMS: 25% of the average obtained with the mark of the first exam and the better of remaining two exams

- Exam 1: on partial derivatives and Unit 1 until 1.7 (this test always counts)
- Exam 2: on Unit 1 from 1.7 to the end plus Unit 2 and Unit 3
- Exam 3: on Units 4 and 5

PRESENIAL ACTIVITIES: a additional valoration 5% over of the grade is given by the teacher for the completion of the following activities:

- Class participation.
- Attendance to individual and group tutorials
- Expositions on the blackboard
- Proposed voluntary works

### FINAL CONSIDERATIONS:

- In order to carry out the weighted average between the final grade and the tests, it is necessary to obtain, at least, 4 over 10 in the Final Exam.
- \*If a student cannot take an exam at the given time, it will not be repeated
- Use of fraudulent means used will result in a 0 in the corresponding activity. Furthermore, the student may be subject to disciplinary action.
- Use of any artificial intelligence tools should be clearly stated so as not to be mistaken as work done by the student. In the lack of such clarification the work may be subject to consideration as fraudulent.
- Failure to attend classes according to the regulations set by each faculty may result in the student not being allowed to take the final exam.

### EXTRAORDINARY

- The final califications will be the best of the these two options: 70% exam + 30% the rest or 100% the exam.

## BIBLIOGRAPHY AND RESOURCES

### Basic Bibliography

Giménez Abad, M<sup>a</sup> J., Martín Antón, G. y Serrano Rey, A.: Matemáticas para ADE. Teoría y ejercicios. Editorial Pearson. Madrid 2020

### Complementary Bibliography

Martínez Estudillo, Francisco J.: "Introducción a las Matemáticas para la Economía". Editorial DDB. 2005

Sydsaeter, K. y Hammond, P.J.: "Matemáticas para el análisis económico". Editorial Prentice Hall. 1999



# COMILLAS

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**Syllabus**  
**2023 - 2024**

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