



FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
Subject name	Calculus
Subject code	E000012785
Main program	Grado en Análisis de Negocios / Business Analytics por la Universidad Pontificia Comillas
Involved programs	Grado en Análisis de Negocios/Bachelor in Business Analytics y Grado en Relaciones Internacionales [First year] Grado en Análisis de Negocios/Bachelor in Business Analytics y Grado en Derecho [First year] Grado en Análisis de Negocios/Bachelor in Business Analytics [First year] Grado en Admin. y Dirección de Emp. y Grado en Análisis de Negocios/Bachelor in Business Analytics [First year]
Quarter	Semestral
Credits	6,0 ECTS
Type	Básico
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Coordinator	Luis Ángel Calvo Pascual

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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

In the professional profile of a Business Analytics graduate, the Calculus course aims to develop key skills, such as the ability to model business and economic problems using differential and integral calculus, analyze and synthesize information in mathematical language, and establish precise quantitative and optimization models. Additionally, this course promotes the resolution of complex problems and optimal decision-making in a business context. The knowledge and competencies acquired by students at the end of the semester will not only be fundamental for their professional development but also serve as a solid foundation for subsequent courses.

Prerrequisitos

Basic knowledge of mathematics from high school studies is assumed. It is recommended to take the Mathematics course offered in the Pre-University Campus and to consult the reinforcement materials available on the E-learning Comillas Preu-mat Moodle page.

Competencias - Objetivos

Competencias

Resultados de Aprendizaje

CN6	Resultados del proceso de Formación y de Aprendizaje: CN6. Conoce las herramientas matemáticas necesarias que les capacite para plantear y resolver los problemas reales planteados derivados del entorno empresarial.
HA6	Resultados del proceso de Formación y de Aprendizaje: HA6. Utiliza las herramientas y técnicas matemáticas más adecuadas a cada problema, implementarlas, interpretar adecuadamente los resultados y sus limitaciones, y comunicarlos a un público no técnico.
CM7	Resultados del proceso de Formación y de Aprendizaje: CM7. Usa herramientas y técnicas matemáticas para dar solución a problemas y toma de decisiones en un entorno de datos masivos tanto cuantitativos como cualitativos, así como es capaz de aprender y trabajar autónomamente en la sociedad de la información.
RA1	CÁLCULO. RA.1 Ser capaz de analizar y sintetizar la información recibida en lenguaje matemático.



BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

Bloque 1: Contenidos de la asignatura

Topic 1: THE DEFINITE INTEGRAL

1. Concept of a primitive function.
2. Concept of Riemann Integral.
3. Properties of the Riemann Integral.
4. Integral Function

Topic 2: FUNCTIONS OF SEVERAL VARIABLES

1. Definition of functions of several variables. Scalar function and vector function.
2. Mathematical domain, economic subdomain, and range.
3. Graph of a scalar function and level curves.
4. Limits and continuity.
5. Directional derivatives. Partial derivatives.
6. Gradient vector. Properties.
7. Applications in economics: marginal magnitudes in economics, marginal rate of substitution.
8. Concept of differential
9. Higher order derivatives. Hessian Matrix.
10. Second differential.
11. Taylor polynomial. Taylor's theorem.

Topic 3: COMPOSITE AND HOMOGENEOUS FUNCTIONS

1. Partial derivatives of composite functions. Chain Rule. Dependency trees.
2. Homogeneous functions. Euler's Theorem. Returns to scale.

Topic 4: INTRODUCTION TO OPTIMIZATION

1. Conceptos de programa y sus tipos. Modelización.
2. Concepto de óptimo y tipos de óptimos.
3. Elementos de topología y teorema de Weierstrass.
4. Resolución gráfica de un programa de optimización.
5. Conjuntos convexos. Definición y caracterización de funciones cóncavas y convexas.

Topic 5: UNCONSTRAINED OPTIMIZATION

1. Unconstrained optimization

Topic 6: OPTIMIZATION WITH CONSTRAINTS

1. Optimization with equality constraints. Lagrange multipliers method.
2. Interpretation of the Lagrange multipliers.
3. Khun-Tucker optimization



Block 2: Computer Practices

Practical computer sessions will be conducted using Matlab as a tool for symbolic calculation. Students will use it as a direct application of the theory taught in class.

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

Metodología Presencial: Actividades

Expository Lesson: The professor will explain the fundamental concepts of each topic, focusing on the most important aspects, and then solve a series of typical problems, through which the students will learn to identify the essential elements of the approach and begin to acquire the skill and fluency in solving problems related to the topic.

Problem-Solving in Class: In these sessions, problems from each topic similar to those solved in the expository lessons will be explained, corrected, and analyzed, as well as more complex problems previously proposed by the professor and worked on by the student. However, there won't be a drastic distinction between expository lessons and problem-solving, but they will be interwoven naturally and dynamically.

Computer Practices: Practical computer sessions will be conducted where students will exercise the concepts and techniques studied by solving practical problems using the Matlab programming language.

Tutoring: Will be conducted both in groups and individually, to resolve the various doubts that arise for students, after having studied the different topics and worked on the different problems. Group tutoring will be conducted at the end of each topic in a pre-scheduled classroom and time, and will serve to resolve general doubts about the topic developed or the problems in the corresponding Worksheets A. Individual tutoring will take place during the professor's scheduled tutoring hours.

Conducting Monitoring Tests (during class hours) and the Final Exam of the Course: Three monitoring tests will be conducted throughout the semester during class hours. The first will be held at the end of Topic 1, the second at the end of Topic 2 and the third at the end of Topic 5.

Metodología No presencial: Actividades

Independent work on theoretical contents by the student. Individual and personal study by the student of Concepts presented in the expository lessons.

Independent work on practical contents by the student. Solving practical problems outside of class hours by the student.

Completion of collaborative work by the students. Group preparation of the practical work.

RESUMEN HORAS DE TRABAJO DEL ALUMNO

CLASSROOM HOURS	
Lecciones de carácter expositivo	Sesiones tutoriales
56.00	4.00



NON-PRESENTIAL HOURS

Estudio y lectura organizada	Ejercicios y resolución de casos y de problemas
40.00	50.00

ECTS CREDITS: 6,0 (150,00 hours)

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Evaluation activities	Evaluation criteria	Weight
Final Exam	<ul style="list-style-type: none">Understanding of concepts.Application of concepts, techniques, and procedures to solve practical problems.Analysis and interpretation of the results obtained in problem-solving.Presentation and written communication.	70
There will be 4 monitoring and control tests throughout the semester.	<ul style="list-style-type: none">Understanding of concepts.Application of concepts, techniques, and procedures to solve practical problems.Analysis and interpretation of the results obtained in problem-solving.Presentation and written communication.	30

Calificaciones

Ordinary Examination Session

The student's grade in the ordinary examination session of the course, provided that they achieve a minimum score of 4.25 points in the final exam of the same will be:

- 70% of the grade will be the score obtained in the final exam of the course.
- 30% of the grade will be the average score of the monitoring tests carried out throughout the semester.

Observation: If the score obtained in the final exam of the course is less than 4.25 points, the student's grade will be the score obtained in that exam.

Extraordinary Examination Session

The student's grade in the extraordinary examination session of the course will be considered the best of the following two options:

- Use the same criterion as in the ordinary examination session, considering that in the extraordinary examination, a score higher than 4.25 must be obtained.
- Consider only 100% of the grade from the extraordinary examination session.

Observation: If the score obtained in the final exam of the course is less than 4.25 points, the student's grade will be the score obtained in that exam.



Subject Rules

- Failure to attend more than 25% [CLC1] of the scheduled class hours for the subject throughout the semester (9 absences) may result in the student losing the right to take the exam in the ordinary session for that academic year (cf. Article 93. Schooling, General Regulations of the University).
- Any student who engages in any irregularity during the completion of an evaluative test will receive a Fail (0) grade for that test and will face disciplinary proceedings under Article 168 Infractions and Sanctions for Students, General Regulations of the University.
- The use of books or class notes will not be permitted during any exam for this subject.
- Misuse of artificial intelligence tools will be considered a fraudulent act.

PLAN DE TRABAJO Y CRONOGRAMA

Activities	Date of realization	Delivery date
Week Topics		
1 Topic 0: Functions of one variable		
Topic 1: Integrals		
2 Topic 1: Integrals		
Partial exam: Topics 0 and 1		
3 Topic 2: Functions of several variables		
4 Topic 2: Functions of several variables		
5 Topic 2: Functions of several variables		
6 Topic 2: Functions of several variables		
7 Topic 2: Functions of several variables		
Partial exam Topic 2		
8 Topic 3: Composite and Homogeneous Functions		
9 Topic 4: Introducción a optimización		
10 Topic 4: Introducción a optimización		
11 Topic 5: Unconstrained optimization		
Topic 5: Unconstrained optimization		
12 Partial exam Topics 3, 4 y 5		
13 Topic 6: Constrained optimization		
14 Topic 6: Constrained optimization		

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

- Sydsaeter, K., Hammond, P. J., Matemáticas para el análisis económico. Prentice Hall, 1999
- Anthony, M., Biggs, N., Mathematics for economics and finance. Methods and modelling. Cambridge University Press, 1996
- Giménez Abad, M^a J., Martín Antón, G. y Serrano Rey, A.: Matemáticas para ADE. Teoría y ejercicios. Editorial Pearson. Madrid 2020



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Syllabus
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Bibliografía Complementaria

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- Martínez Estudillo, F.J., Introducción a las matemáticas para la economía. Desclee De Brouwer, S.A., 2005