



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]
Credits	6,0 ECTS
Type	Básico
Department	Departamento de Métodos Cuantitativos
Coordinator	Luis Ángel Calvo

Datos del profesorado	
Teacher	
Name	Luis Ángel Calvo Pascual
Department	Departamento de Métodos Cuantitativos
E-Mail	lcalvo@icai.comillas.edu
Teacher	
Name	Federico Brazzi
Department	Departamento de Métodos Cuantitativos
E-Mail	fbrazzi@icade.comillas.edu
Teacher	
Name	José Daniel Madrigal Martínez
Department	Departamento de Métodos Cuantitativos
E-Mail	jdmadrigal@comillas.edu
Teacher	
Name	José Portela González
Department	Departamento de Métodos Cuantitativos
Office	Santa Cruz de Marcenado 26
E-Mail	Jose.Portela@iit.comillas.edu
Phone	2741
Teacher	
Name	Patricia Yagüe Inglada



Department	Departamento de Métodos Cuantitativos
EEmail	pyague@icade.comillas.edu

DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

This subject aims to develop in the profile of the Business Analytics graduate the following skills: modelling business and economic problems in terms of differential and integral calculus, analysis and synthesis of information received in mathematical language, solving business problems and making optimal and timely decisions through the application of mathematical techniques and tools developed in the subject. Furthermore, the knowledge and skills acquired by students at the end of the semester will lay the groundwork for the learning of other subjects they will study in subsequent courses.

Prerrequisitos

Basic knowledge of mathematics from high school studies is assumed. It would be advisable for students to have completed the Mathematics course offered at the Preuniversity Campus.

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.
RA2	CÁLCULO. RA.2 Modelizar en términos del cálculo diferencial e integral en situaciones dependientes de varias variables.

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

Bloque 1: Contenidos de la asignatura



Tema 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.

Tema 4 y 5: OPTIMIZACIÓN

1. Concepts of mathematical programs and their types. Modelling.
2. Concept of optimum and types of optima.
3. Elements of topology and Weierstrass theorem.
4. Graphical resolution of an optimization program.
5. Convex sets. Definition and characterization of concave and convex functions.
6. Unconstrained optimization
7. Optimization with equality constraints. Substitution method, Lagrange multipliers method.



- 8. Interpretation of the Lagrange multipliers.
- 9. 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 in a natural and dynamic way.

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: Four 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, the third and fourth 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:

1. 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.
2. Consider only the 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.

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	
3	Partial exam: Topic 1 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: Introduction to optimization	
10	Topic 4: Introduction to optimization	
11	Topic 5: Unconstrained optimization	
12	Topic 5: Unconstrained optimization 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



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UNIVERSIDAD PONTIFICIA

ICAI

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CIHS

Syllabus
2023 - 2024

- Anthony, M., Biggs, N., Mathematics for economics and finance. Methods and modelling. Cambridge University Press, 1996

Bibliografía Complementaria

- García, A., López, A., Romero, S., Rodríguez, G., Villa, A. de la. Calculo II: Teoría y problemas de funciones de varias variables (2ª edición). CLAG, 2006.
- Martínez Estudillo, F.J., Introducción a las matemáticas para la economía. Desclée De Brouwer, S.A., 2005