Mathematics I 2015/2016

Code: 102345
ECTS Credits: 6

Degree	Type	Year	Semester
2501572 Business Administration and Management	FB	1	1
2501573 Economics	FB	1	1

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Use of languages

Principal working language: catalan (cat)

Prerequisites

Being a course in the first semester of the first course of the degree, obviously it will not be necessary to have previously attained any knowledge or skills given by any of the courses of the degree. However, the course cannot "start from scratch" since the learning of mathematics is part of the studies in secondary school. Basic knowledge of algebraic manipulation like solving first and second degree equations, algebraic simplification, working with elemental mathematical functions, etc. will ease the achievement of the competences of the course. Even though the first two chapters of the program are devoted to these issues, starting the course having revised them will prove useful.

Objectives and Contextualisation

In the education of any student of the area of economics, the courses of mathematics have a dual function. On the one hand, they convey the set of concepts, tools of consistent reasoning and technical tools necessary for the proper development of many other subjects using quantitative analysis. On the other hand, they provide the opportunity for an in-depth analysis of important issues dealing with the setting and solving problems in the economic and business environment.

In this sense, the course of Mathematics I has a leveling role that should enable students to acquire and consolidate their knowledge and skills to correctly understand and handle basic mathematical concepts and tools of real univariate analysis. Also, the course must allow to work with simple models inspired by economics and business problems.

The objectives of the course are thus,

1. To familiarize students with the mathematical formulation and reasoning.
2. To introduce the role of mathematical models in economics and business.
3. To identify and learn how to manipulate the main families of functions.
4. To working with derivatives and solve limits of functions of one variable.
5. To understand and learn how to determine the basic properties of real functions of one variable. 6. To introduce the graphical representation techniques of functions of one variable.

7. To solve optimization problems in one variable. 8. To learn the basic integration techniques.

At the end of the course, students must be able to use the elementary calculus techniques (derivatives, limits, integration), to explain the way these techniques are used, and to apply them to particular functions and models, as well as to develop coherent reasoning.

Basic training in mathematics continues with the courseMathematics II dealing with the study of real functions of several variables. Thus, the achievement of the basic notions of analysis in real functions of one variable are also key to follow properly this sequel.

Skills

Business Administration and Management

- Apply mathematical instruments to synthesise complex economic-business situations.
- Capacity for oral and written communication in Catalan, Spanish and English, which enables synthesis and oral and written presentation of the work carried out.
- Demonstrate an understanding of mathematical language and some methods of demonstration.
- Organise the work in terms of good time management, organisation and planning.
- Use of the available information technology and adaptation to new technological environments.

Economics

- Demonstrate an understanding of mathematical language and some methods of demonstration.

Learning outcomes

1. A capacity of oral and written communication in Catalan, Spanish and English, which allows them to summarise and present the work conducted both orally and in writing.
2. Analyse and draw functions.
3. Analytically consider and solve optimisation problems in the context of the economy.
4. Be able to work with inequalities and sequences.
5. Calculate and study the extrema of functions.
6. Calculate the functional integrals of a variable.
7. Deduce the properties of a function based on its graph.
8. Organise work, in terms of good time management and organisation and planning.
9. Solve problems that involve considering integrals in problems in the context of the economy (consumer and producer surplus, etc.).
10. Use available information technology and be able to adapt to new technological settings.
11. Work intuitively, geometrically and formally with the notions of limits, derivatives and integrals.

Content

Topic 1: Introduction

Objective: Review basic concepts related to sets of real numbers. Introduce the meaning of its techniques.

1.1. The set of real numbers.
1.2. Working with real numbers: simplification, absolute value and distance. 1.3. The real line: inequalities and intervals.
1.4. The mathematical proof: some basic examples.

Topic 2: Functions and economics

mathematical

proof and

Objective: Introduce the basic concepts and definitions used in the formal description of the functions of one variable. Review the main families of elementary functions and their properties. Introduce by means of specific economic situations, the role of mathematical models and assumptions in economics and business.

2.1. Real functions of real variable: definitions and examples. Domain and image, graphical representation.
2.2. The families of functions: linear, potential, polynomial, exponential, logarithmic, and trigonometric. Properties and graphical representations.
2.3. The analytical expression of a function and role of operations with functions. Composition and inverse function.
2.4. Basic characteristics describing the behavior of a function: continuity, monotonicity, curvature, extremes, long term behavior.

Supervised activity: The use of functions to model economic situations: some examples.

Topic 3: Continuity

Objective:
Review and explore the concepts of limit and continuous function, so far treated only intuitively, giving accurate definitions and explaining their scope. Understanding the "concept" of indeterminacy, and know how to solve it according to its type.

3.1. Limits and determining the behavior of a function. Limit at a point and limit at infinity. 3.2. One-sided limits. Concept of continuous function. Discontinuities and their types. 3.3. Properties of continuous functions. Bolzano's theorem.

Case study: computation of indeterminate forms.

Topic 4: Derivatives and their use in economics

Objective: Provide a detailed introduction to the concept of derivative taking into account its economic interpretation. Compute and simplify the derivative of any function.

4.1. Introduction: rates of change of a function.
4.2. The concept of derivative. Economic and geometric interpretations of the derivative.

4.3. The derivative function. Derivatives of elementary functions and rules of derivation. Higher-order derivatives. 4.4. Examples and exercises.

Supervised activity: Computation and simplification of derivatives.

Topic 5: Differentiation and characterization of the behavior of a function

Objective: Introduce in an orderly manner, and with all the necessary mathematical formality, the most important results of monotonicity and convexity of differentiable functions. Learn to distinguish between different types of results (necessary conditions, sufficient conditions and characterizations) and apply them correctly.

5.1. Characterization of monotone differentiable functions.
5.2. Study of the monotonicity intervals of a function. Monotonicity and local extrema.
5.3. Characterization of concave and convex functions and once and twice differentiable.
5.4. Study of intervals of curvature of a function. Inflection points.
5.5. Computation of limits and indeterminacies. L'Hôpital rule. Resolution of other indeterminacies. 5.6. Asymptotes.
5.7. Study and construction of the graph of a function.

Case study: study of the monotonicity and curvature of several functions.
Supervised activity: graphic representations of functions ... what is the function that we seek?

Topic 6: Single-variable optimization

Objective: Introduce specific tools for the determination of optima of single-variable functions that do not require the study of the entire function. Study examples of economic situations that can be modeled with a single variable and compute the optimal value of that function in a given range.

6.1. Optimization problems in economics. Local maxima and minima and the optimal solution of a problem. 6.2. Optimization in a closed interval. Weierstrass theorem.
6.3. Local maxima and minima of differentiable functions. Necessary and sufficient conditions.
6.4. Determination of the optimal solution of a problem.

Supervised activity: Solving optimization problems in economics and business.

Topic 7: Integration

Objective: Introduce the concept of integral in the sense defined by Riemann, as areas under curves. Relate the concepts of primitive and derivative, and understand the fundamental results that allow to calculate the value of an integral from the knowledge of a primitive. Understand the two basic mechanisms for calculating primitives: method of integration by parts and by substitution, and learn to apply them both to determine primitives and to compute integrals. Understand the basic economic applications of integration.

7.1. Introduction: the definite integral as the area under the curve of the function. 7.2. Concept of integral. The fundamentaltheorem of calculus. Barrow's rule.
7.3. Obtaining primitives and integration. Immediate primitives and basic methods. 7.4. Integration by parts and integration by substitution.

Supervised activity: integration in economics.

Methodology

To achieve the objectives of the course, the following taxonomy of activities will be used:

1. Theory classes where teachers develop the main concepts.

The objective of this activity is to present the fundamental notions of course, and to facilitate their learning through the analysis of examples illustrating the intuitions and economic applications.

2. Exercises sessions devoted to the resolution of problems.

This activity aims to discuss and answer any questions that students may have in solving the problem sets, and at the same time to correct mistakes. These sessions will also stimulate the participation of students presenting the solutions of the problem sets either orally or in written form.

3. Organized supervised activities, to apply the concepts studied to economic situations

The objective of this activity is to encourage the student to establish links between the mathematical tools and their use in economics. When possible, these sessions will be organized in small groups of students.

4. Problem solving by students

Each topic will have a list of associated problems that must be solved independently by students.
The objective of this activity is two-fold: on the one hand it aims at the reinforcement of the theoretical concepts and tools exposed in the theory sessions; on the other hand it aims at the acquisition of the skills required to solve exercises and problems.
We promote the cooperative resolution of problems in stable working groups of 3 or 4 students throughout the semester, to stimulate team work to overcome the difficulties that may arise to their components.

5. Tutorial attendance

Students have several hours where the teachers of the course may help them to resolve any doubts that may arise in the

study of the course and in the solution of the problem sets. These sessions cannot be on-line, but face-to-face between the teacher and the students.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Preparing and solving exercises	15	0.6	2, 5, 6, 1, 7, 4, 8, 3, 9, 11, 10
Theory classes	30	1.2	2, 5, 6, 7, 4, 3, 9, 11
Type: Supervised			
Follow-up of homework	3	0.12	2, 5, 6, 1, 7, 4, 8, 3, 9, 11, 10
Tutorships	7	0.28	2, 5, 6, 1, 7, 4, 8, 3, 9, 11, 10
Type: Autonomous			
Study	90	3.6	2, 5, 6, 1, 7, 4, 8, 3, 9, 11, 10

Evaluation

The course evaluation will be done continuously through a series of partial evaluation activities, and a final exam. The weight of each of the above components in the calculation of the final grade is as follows: - At least 60% for the final exam - At least 20% for the remaining part of assessment activities.

Partial evaluation activities: At least there will be a partial exam. If there is only one activity, it will be a compulsory exam that will have a maximum time resolution of 90 minutes. Other evaluation activities can be envisaged. None of the assessment activities will liberate topics for the final exam.

Final Exam: It is a comprehensive exam of all the topics of the course. The exam is designed to force students to make a last effort of learning. Such effort is necessary to consolidate previously acquired knowledge. The maximum resolution time is 3 hours. All students are required to take the final exam and participate in all the other assessment activities on the dates indicated in the academic calendar. No evaluation activities will be programmed outside of the dates indicated.

If using the weights mentioned above a student's grade is 5 or higher, the course will be considered as passed and it can not be the subject of a new assessment. In the case of a grade below 4, the student must retake the course the following year. For those students who have obtained a grade equal to or greater than 4 and less than 5 there will be a re-evaluation. Teachers will decide the design of the re-evaluation. The re-evaluation is scheduled in the last week of the semester. Its grtading will be qualitative and only admit two possible outcomes: pass or fail. A student obtaining a grade of PASS is considered to have passed the course with a maximum numerical grade equal to 5. If the student receives a grade of fail, fail the course and the final grade will be equal to the grade obtained before the re-evaluation.

A student is considered "no graded"inthe subject only if has not participated in any of the evaluation activities. Therefore, the participation in a single of the several activities eliminates the no graded outcome.

Code of honor: Without prejudice to other disciplinary action deemed appropriate and in accordance with current academic standards, any irregularity committed by the student that may lead to a change in the qualification of an act of assessment will convey a grade of zero. Therefore, copying or allowing to copy in any assessment activity will involve suspending it with a zero. Also, if passing such activity is necessary to pass the course, the entire course will be graded as fail. The activities failed due to violations of the code of honor will not be recoverable by the assessments described and the course will be graded as fail directly without the opportunity to recover in the same academic year.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Final exam	at least 60%	3	0.12	2, 5, 6, 1, 7, 4, 3, 9, 11
Partial assessments	at least 20%	2	0.08	2, 5, 6, 1, 7, 4, 8, 3, 9, 11, 10

Bibliography

Main textbooks:
Sydsaeter, K. and P.J. Hammond, 1995, Mathematics for Economic Analysis. London, Prentice Hall.

Sydsaeter, K. and P.J. Hammond, 2002, Essential Mathematics for Economic Analysis. London, Prentice Hall.

These are textbooks of great tradition and acceptance. Due to their renewed editions they have managed to be reference textbooks. In addition, these books also cover the subjects of Mathematics II. They are complete and friendly texts, including economic applications in all their chapters.

Complementary textbooks:

The textbooks listed below can be helpful to complement the explanations contained in the main textbook and also to students wishing to enlarge their knowledge.

Alejandre, F., F. Llerena, and C. Villela, 1995, Problemes de matemàtiques per a econòmiques i empresarials, Editorial Media.

Chiang, A.C., 2005, Fundamental Methods of Mathematical Economics, McGraw-Hill. Demidovich, B.P., 1976, Problems in Mathematical Analysis, Moscow, MIR Publishers.

Hoffmann, L.D., G.L. Bradley, G., and K.H. Rosen, 2005, Applied Calculus for Business, Economics, and the Social and Life Sciences, McGraw-Hill.

Larson, R., R. Hostetler, and B. Edwards, 1994, Calculus with Analytic Geometry, Lexington, D.C. Heath.

Other complementary material will be uploaded in the webpage of the course.