Syllabus "Mathematics I" **2013/2014**

Code: 102345
ECTS: 6

Degree	Year	Semester
950 Business Management and Administration (EHEA Degree)	1	2

Contact

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Language

English

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

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 course **Mathematics 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.

Competences and learning outcomes

Code: 1991:E01
Type: E
Competence: Demonstrate understanding of the language and some methods of mathematical proof.
Outcome of learning:
1991:E01.07 - Compute and study the extremes of functions.

1991:E01.08 - Compute integrals of functions of one variable.
1991:E01.09 - Compute inequalities and sequences.
1991:E01.10 - Analysis and graphical representation of functions.
1991:E01.11 - Inference of properties of a function from its graphical representation.
1991:E01.12 - Use of the notions of limit, derivative, and integral from an intuitive, graphical, and formal approach.

Code: 1991:E39
Type: E
Competence: Apply mathematical tools to simplify complex business and economic situations.
Outcome of learning:
1991:E39.02 - Set and solve analytically optimization economic problems.
1991:E39.03 - Solve economic problems involving the use of integral calculus (consumer and producer surplus, etc.).

Code: 1991:T01
Type: T
Competence: Ability to communicate orally and in writing in Catalan, Spanish and English.
Outcome of learning:
1991:T01.00 - Ability to communicate orally and in writing in Catalan, Spanish and English.

Code: 1991:T04
Type: T
Competence: Organize work, in terms of good time management and its ordering and planning.
Outcome of learning:
1991:T04.00 - Organize work, in terms of good time management and its ordering and planning.

Code: 1991:T09
Type: T
Competence: Using information technologies available and adapt to the new technological environments.
Outcome of learning:
1991:T09.00 - Using information technologies available and adapt to the new technological environments.

Course contents

Topic 1: Introduction
Objective: Review basic concepts related to sets of real numbers. Introduce the meaning of mathematical proof and 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
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 fundamental theorem 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.

Learning activities and outcomes

Activities	Hours	ECTS	Learning outcomes
Type: Directed			
Theory classes	30		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03
Type: Supervised			
Solving problem sets	15		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03, 1991:T01.00, 1991:T04.00, 1991:T09.00
Follow-up of homeworks	3		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03, 1991:T01.00, 1991:T04.00, 1991:T09.00
Tutorials	7		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03, 1991:T09.00
Type: Self learning			
Study	90		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03, 1991:T04.00, 1991:T09.00

Assessment

Activities and instruments used in the evaluation:
1. Individual written tests
Two individual written tests will be scheduled. The first one will take place in the eighth week (approximately); the second test will take place in week 15 (approximately). These tests will last 40 minutes and no support materials (calculators, class notes, etc.) will be allowed.

2. An individual comprehensive final exam.
This exam is designed to force students to make a last effort of learning necessary to consolidate the knowledge already acquired.
The exam will be comprehensive and all students have to take it. The exam will last up to two hours and no support materials (calculators, class notes, etc.) will be allowed.
This double rating system aims at maximizing success in the learning process of the largest number of students.

3. Delivery of problem sets
Students may be required to solve up to two problem sets. This activity will be carried out as teamwork. A team will consist of a minimum of three persons and a maximum of six.

All students are required to take the exams and perform the other tasks in the dates set in the calendar of the course. No evaluation activity can take place in other dates than the indicated.

Evaluation criteria:

(a) The final grade of the course obtains from the individual written tests and the individual final exam. Scoring each of the two activities with a value between 0 and 10, the final grade follows from the following weighted average:
FINAL GRADE = 50% (written activities) + 50% (final exam).
The weight of each of the two tests written will be the same (20%). If problem sets are delivered, their weight will be 10% of the final grade. In this case, the written tests will reduce their weight to 40%.

(b) The course will be considered as “passed” if the final grade is greater than or equal to 5.

(c) For those students who have obtained a final grade equal to or greater than 4 and less than 5, there will be a re-evaluation.
The re-evaluation consists in an individual written test scheduled in the last week of the semester. Those students with a right to attend the re-evaluation will obtain at most 1 point to be added to the student’s grade. If the re-evaluated final grade reaches 5 points, the student will pass the course.

(d) A student is considered as “No-show” in the evaluation whenever he/she has not participated in any evaluation activities.

Therefore, a student **participating in a single activity** cannot opt to be considered as “no-show” and a grade will be assigned.

Assessment activities

Activities	Weight	Hours	ECTS	Learning outcomes
Final exam	0.4	3		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03
Written tests	0.6	2		1991:E01.07, 1991:E01.08, 1991:E01.09, 1991:E01.10, 1991:E01.11, 1991:E01.12, 1991:E39.02, 1991:E39.03, 1991:T01.00, 1991:T04.00, 1991:T09.00

References

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.