UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematics - 2

2627-1-E3305M003-T2

Learning objectives

The course aims at providing students with the mathematical knowledge of the topics useful to understand models describing economic phenomena. In particular, students will learn how to use the mathematical tools which, starting from the function analytic formulation, allow to draw a qualitative graph of the function.
Students are expected to successfully apply the theoretical concepts seen during the course to simple problems, similar to those solved in the lectures and practical exercise sessions.

Expected Learning Outcomes (Dublin Descriptors):

1. Knowledge and understanding
   Students will acquire a solid understanding of the theoretical aspects connected with the topics covered during the course, such as limits, derivatives, numerical sequences and series, integral calculus.

2. Applying knowledge and understanding
   Students will be able to effectively apply mathematical methods to solve practical problems consistent with the course topics and to deal with real-world economic situations.

3. Making judgements
   Students will learn logical and analytical skills useful for tackling and solving complex problems, including those interdisciplinary in nature, and for critically evaluating the obtained results.

4. Communication skills
   Students will learn how to correctly use the mathematical language, so as to accurately and coherently express the acquired theoretical notions, as well as to effectively communicate ideas, methods and results.

5. Learning skills
   Students will learn an independent study method, enabling them to approach subsequent, more advanced studies with awareness and success.

Contents

Analysis of functions of one variable.
Series.
Introduction to the study of functions of two variables.
Integrals.

Detailed program

Introduction to functions.

Functions of one real variable: domain, image set, graph of a function. Elementary and quasi-elementary functions. Monotonicity, maxima and minima. Composite functions and inverse function.

Limits and related theorems.

Sequences and series: definition of series (behavior and summation), necessary condition for convergence, geometric series, telescopic series, harmonic and generalized harmonic series, series with non-negative terms (convergence criteria), alternating series (Leibniz criterion) and series with terms of any sign.

Continuous functions: Weierstrass theorem, intermediate value theorem, Bolzano theorem. Discontinuities.

Indeterminate forms in the computation of limits.

Differential calculus: definition of the derivative and geometric interpretation. Equation of the tangent line. Points of non-differentiability. Relationship between continuity and differentiability. Rolle, Lagrange and Fermat theorems.

L'Hopital's rule. Taylor's theorem.

Convexity and concavity of a function: definition and characterization based on the second order derivative.

Study of the graph for functions of one real variable.

Functions of two real variables: domain, level curves, partial derivatives, critical points.

Indefinite integral: definition and main properties, antiderivative computation (integration by substitution, by parts, integration of rational functions). Definition of the Riemann integral, main properties and results. Improper integrals, convergence criteria for improper integrals.

Prerequisites

Elementary tools from algebra, equations and inequalities, basic knowledge of analytic geometry.

Teaching methods

The course comprises 56 hours of lectures and 24 hours of practical exercise sessions.

Some of the lectures might be delivered online (at most 30% of the total hours).
The teacher will communicate with adequate notice which lessons will be delivered online.
Most of the lectures and practical exercise sessions will be based on conventional teaching methods.

Assessment methods

Final written exam and (subsequent, optional) oral exam if the grade assigned to the written exam is at least 18/30.

There will be a midterm written exam, lasting 1.5 hours.

In the written exam covering all course topics (lasting 2 hours), students have to solve 5 practical exercises and answer 2 open theoretical questions.

For the two theoretical questions, it is required to enunciate and prove theorems (if the proof has been illustrated during the lectures), and to provide definitions presented during the course.

The structure of the exercises is as follows:
Exercise 1: Transformations of the graph of elementary functions
Exercise 2: a) Limits b) Series
Exercise 3: a) Miscellaneous b) Functions of two variables
Exercise 4: Integrals
Exercise 5: Study of a function of one real variable

Also in the midterm written exam students have to solve practical exercises and answer open theoretical questions.

In grading the midterm and final written exams, in addition to the correctness of the results, the ability in explaining the various steps will be considered as well.

The (optional) oral exam starts with a discussion of the written exam, followed by some questions regarding the topics of the course.
It can contribute either positively or negatively to the final grade.

Textbooks and Reading Materials

Slides and further teaching material will be made available on the e-learning course webpage.

Suggested textbooks:

Guerraggio, A. "Matematica", second, third or (better) fourth edition. Pearson Prentice Hall
Scaglianti, L., Torriero, A., Scovenna, M. "Manuale di Matematica - Metodi e applicazioni". Edizioni CEDAM
Scovenna, M., Grassi, R. "Matematica - Esercizi e temi d’esame". Edizioni CEDAM

Semester

First semester.

Teaching language

Italian.

Sustainable Development Goals

GENDER EQUALITY