UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Calculus I

2526-1-E4104B002

Learning objectives

This course mainly aims at providing a rigorous introduction to differential and integral calculus for functions of one variable.

1. *Knowledge and understanding* This course provides knowledge and understanding of:

- The language of Mathematics and the method of studying math issues;
- the nature of integer and real numbers, definition and handling of numerical sequences and series;
- families of functions and their properties;
- nature and properties of integrals which are relevant in Statistics.

2. *Ability to apply knowledge and understanding* At the end of the course and of their personal work the students will be able to:

- Schematise a technical or scientific problem, to approach this latter by finding suitable examples, to break the problem into steps, to recognise similar problems which may suggest a solution
- Understand the mathematical language used in math or statistical books or papers
- Use the tools of differential and integral calculus in a critical way
- Carry out by herself/himself calculations related to numerical series, differentiation, integration, and cumulative distribution functions

The course provides a solid background of one dimensional differential and integral calculus, needed in every working environment. Moreover such a background is fully necessary for the completion of statistical studies.

3. *Making judgements* The course aims to foster independent and critical thinking, especially in the context of abstract concepts, through:

- identifying the logical structure of mathematical problems;
- choosing appropriate analytical tools to solve them;

- interpreting and validating results with rigor.

4. *Communication skills* Students will be encouraged to clearly articulate complex mathematical arguments using:

- formal mathematical language;
- logical and coherent exposition.

5. *Learning skills* The course will strengthen the student's ability to learn independently and continuously by providing:

- theoretical and methodological tools for reading advanced texts;
- mathematical skills necessary to approach subsequent courses;
- familiarity with formalization and abstraction.

Contents

Real numbers.
Real functions of a real variable.
Sequences and series.
Differential calculus of one variable. Functions.
Taylor series.
Integral calculus of one variable.
Integral functions and cumulative distribution functions.

Detailed program

Real numbers: metric and arithmetic properties. Powers with a real exponent. Equations and inequalities. Supremum. Sequences and limits. Monotone sequences. Indeterminate forms. The number "e". Computing some limits. Series. Geometric series.

Limits and continuity of functions. Composition of functions. Differentiation of a function. Using differential calculus to draw the graph of a function. The mean value theorem. Higher order derivatives. Convexity. Taylor expansions and Taylor series. The exponential series.

Riemann integral. The fundamental theorem of Calculus. Improper integrals. Numerical series and improper integrals. The Gamma function. Cumulative distribution functions and their graphs.

Prerequisites

- Algebra: inequalities (I and II degree, irrational, exponential, logarithmic).
- Euclidean Geometry.
- Analytic Geometry.
- Trigonometry (trigonometric functions, equations and inequalities).
- Elementary properties of integer and rational numbers.

Teaching methods

72 hours of frontal lectures, on theoretical contents and exercises. Tutoring sessions.

Assessment methods

Written exam, and optional oral exam, only if requested either by the teacher or a student. An oral examination may be requested by a student only after achieving a mark of at least 18/30 in a written exam. No midterm exam.

The written exam consists of exercises on the contents of the course. Texts and detailed solutions of several written exams of past years are available on the course's elearning site. The aim of the written exam is to check the ability to solve Calculus problems in a correct and detailed way, and to show math skills and ability of reasoning and applying the tools provided during the course.

The oral exam, which generally includes writing on paper or a board, checks knowledge and understanding of the proofs of the theorems presented during the course, as well as the ability to introduce and discuss definitions and computational techniques. Depending on the outcome of the written exam, solving some exercises may be part of the oral exam.

Textbooks and Reading Materials

Main reference:
M. Bramanti, C. Pagani, S. Salsa, Analisi Matematica 1, Zanichelli, 2008.

Useful references:
M. Bramanti, G. Travaglini, Matematica. Questione di Metodo, Zanichelli.
M. Bramanti, Precalculus, Progetto Leonardo, Esculapio.
M. Bramanti, Esercizi di Calcolo Infinitesimale e Algebra Lineare, Seconda Edizione, Progetto Leonardo, Esculapio.
M. Boella, Analisi matematica e algebra lineare, vol.1, Pearson.

Notes, videos of all the lessons and solved exercises will be available on the course's elearning site.

Semester

First semester (roughly from October to January)

Teaching language

Italian

Sustainable Development Goals

QUALITY EDUCATION