UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematics for Business

2526-1-E1805M006

Learning objectives

The course presents some mathematical tools and methodologies related to their possible applications in the financial and economic fields. It is divided into two main parts: a section on General Mathematics and a section on Financial Mathematics.
In the General Mathematics part, the course aims to develop the ability to use mathematical tools such as functions, limits, differential calculus, emphasizing the importance of acquiring logical reasoning skills and encouraging students to fully understand the topics covered.
In the Financial Mathematics section, the basic principles and concepts of classical Financial Mathematics are introduced, including laws of capitalization and discounting, annuities, capital formation, loan repayment, and financial operations. These topics are treated from both a theoretical and an applied perspective. The approach is fundamentally deductive, seen as a logical continuation and application of the notions learned in the General Mathematics part.
Overall, the course aims to provide knowledge and foster a critical understanding of mathematical concepts, as well as the ability to identify and use appropriate mathematical tools to solve financial and economic problems.

Expected learning outcomes:

1. **Knowledge and understanding**: Students will acquire solid knowledge and understanding of the main disciplinary contents and develop logical-deductive reasoning skills.
2. **Ability to apply knowledge and understanding**: Students will be able to use the studied mathematical tools in various applied fields, particularly to solve concrete problems consistent with the course program and interpret real situations in the economic and financial domain. They will be able to analyze complex financial problems, use appropriate mathematical tools, and formulate formulas to solve them.
3. **Autonomy of judgment**: Stimulated by logical reasoning through the study of mathematical proofs and financial problem analysis, students will develop logical and analytical skills useful for tackling and solving complex, even interdisciplinary, problems, critically evaluating the results obtained.
4. **Communication skills**: Students will learn to use clear and rigorous mathematical and financial language to precisely and coherently express acquired knowledge and effectively communicate ideas, procedures, and results.

5. **Learning ability**: Students will develop an autonomous study method that will enable them to approach subsequent, more advanced studies with greater awareness and success.

Contents

For the **General Mathematics** part:
Functions, limits, differential calculus, and their applications.

For the **Financial Mathematics part**:
Financial operations, laws of capitalization, annuities, capital formation, amortizations, and decision criteria.

Detailed program

For the **General Mathematics part**:
Basic elements of mathematics: sets, absolute values, inequalities.
Functions: definition, domain, even/odd/periodic functions, sign, composite functions, inverse functions, elementary functions, concave and convex functions.
Limits: definition, indeterminate forms, limit calculation.
Continuity: definition, zero theorem, Weierstrass theorem.
Differential calculus: derivative, geometric interpretation, rules.
Applications of differential calculus: monotonicity, concavity, function study, Taylor formula.

For the **Financial Mathematics** part:

1. Laws of capitalization. Financial operations. Future value, interest, discount. Laws of capitalization and discounting. Interest rates and discount rates. Equivalent rates. Force of interest. Divisibility.
2. Annuities. Classification of annuities. Value of an annuity at a given time t. Calculation of present values, future values, and key quantities of specific types of annuities. Mean maturity, arithmetic mean maturity, duration.
3. Capital formation and amortizations. Capital formation. Loan repayment. Amortizations.
4. Financial operations. Decision criteria for financial operations: IRR, NPV, payback period. Nominal interest rate (TAN) and effective annual rate (TAEG).

Prerequisites

For the **General Mathematics part**:
To attend the course successfully, students need to have knowledge of the following topics: algebraic calculations, polynomials and their operations, solving equations and inequalities (first and second degree, with radicals, rational fractions, exponentials, logarithms, absolute value), analytic geometry, solving basic linear systems, and elements of logic.

For the **Financial Mathematics** part:
To effectively engage with the course content, students must possess all the basic knowledge provided by the General Mathematics section of the course "Mathematics for Business" (understanding elementary functions, ability to graph elementary functions, calculating limits, and knowledge of differentiation rules).

Teaching methods

The course will be delivered in a Blended Learning mode. "*Blended learning*" means a mixed approach that combines traditional classroom teaching with online learning methods. The course thus integrates in-person sessions (introductory lectures and frontal exercises) with online activities via the e-learning platform (multimedia-supported lessons, moderated thematic forums, synchronous and asynchronous web conferences involving active student participation, and self-assessment quizzes).

More specifically, **both for the General Mathematics and Financial Mathematics parts, the course includes 10 hours of in-person lectures** scheduled on Saturdays according to the calendar available on the e-learning page and website, **plus 20 hours of activities** that include remote synchronous lessons, asynchronous video lessons, and online activities to be completed independently by students (**totaling 60 hours)**.

For each thematic block, students will undertake the following activities:
• Remote and in-person lessons supported by slides provided by the instructor;
• Autonomous study supported by readings and videos;
• Self-assessment quizzes: quizzes to evaluate their understanding independently;
• Individual or group exercises: practical exercises with self-evaluation options; students can compare their answers with provided solutions to verify correctness.

Assessment methods

A **mandatory written exam** can be taken in three ways:
a) An intermediate test in General Mathematics at mid-term (November) and a final test in Financial Mathematics during one of the scheduled sittings;
b) Separate tests in General Mathematics and Financial Mathematics, each taken in different scheduled sittings;
c) A single comprehensive exam taken during one of the scheduled sittings.

In cases where the General Mathematics and Financial Mathematics exams are taken separately (cases a and b), passing each test is valid only for the academic year (up to the September 2026 sitting).

All written exams include open-ended theoretical questions and problems/exercises.

The scores for both parts—General Mathematics and Financial Mathematics—are each out of 32 points, and their average constitutes the final grade.

A oral exam may be required in the following cases:

1. Student summoned by the instructor;
2. Student requesting to take the oral exam;
3. Possible confirmation of the distinction ("lode") obtained in the final evaluation of the entire "Mathematics for Business" course.
   All students taking the oral exam will receive a second evaluation during the session, which will be averaged with the written exam score. The overall grade (written + oral) can increase or decrease based on this. If the average falls below 18, the student is considered failed and must retake the written exam. The same written exam cannot be used for more than one oral exam.
   In both types of assessments, correctness of the formal steps, appropriateness of mathematical language, and the skills and knowledge acquired during the course will be evaluated.

Textbooks and Reading Materials

For the** General Mathematics** part:
• "Mathematics for Economics and Business," Lorenzo Peccati, Sandro Salsa, Annamaria Squellati, EGEA, 1999.
• "Mathematical Methods for Economics and Management," Marco Abate, McGraw Hill, 2024.

For the **Financial Mathematics** part:
• "Elements of Financial Mathematics and an Introduction to Linear Programming," S. Stefani - A. Torriero - G.M. Zambruno, Giappichelli, Turin, 2011, 4th edition.
• "Elements of Financial Mathematics and an Introduction to Linear Programming, Exercises," G. Bolamperti, G. Ceccarossi, Giappichelli, Turin, 2009.

Semester

First semester.

Teaching language

Italian.

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | DECENT WORK AND ECONOMIC GROWTH