# UNIVERSITÀ DEGLI STUDI DI PALERMO

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| **DEPARTMENT** | Scienze Economiche, Aziendali e Statistiche |
| **ACADEMIC YEAR** | 2022/2023 |
| **BACHELOR'S DEGREE (BSC)** | ECONOMICS AND BUSINESS ADMINISTRATION |
| **SUBJECT** | MATHEMATICS FOR BUSINESS |
| **TYPE OF EDUCATIONAL ACTIVITY** | A |
| **AMBIT** | 50062-Statistico-matematico |
| **CODE** | 20620 |
| **SCIENTIFIC SECTOR(S)** | SECS-S/06 |
| **HEAD PROFESSOR(S)** | GAGLIO ANTONINO Professore a contratto Univ. di PALERMO |
| **OTHER PROFESSOR(S)** | |
| **CREDITS** | 10 |
| **INDIVIDUAL STUDY (Hrs)** | 168 |
| **COURSE ACTIVITY (Hrs)** | 82 |
| **PROPAEDEUTICAL SUBJECTS** | |
| **MUTUALIZATION** | |
| **YEAR** | 1 |
| **TERM (SEMESTER)** | Annual |
| **ATTENDANCE** | Not mandatory |
| **EVALUATION** | Out of 30 |
| **TEACHER OFFICE HOURS** | **GAGLIO ANTONINO**<br>Tuesday 13:00 14:00 Aula D<br>Wednesday 13:00 14:00 Aula D |

**DOCENTE:** Prof. ANTONINO GAGLIO

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| **PREREQUISITES** | Elementary knowledge of calculus, Power laws and their properties, Logarithms and their properties. |
| **LEARNING OUTCOMES** | Knowledge and understanding<br>The student will acquire the basic knowledge of quantitative methods for business and financial management problems. He will know the fundamental definitions and theorems of one-variable calculus. The student will be able to describe the basic economic models, starting from the linear models of supply and demand, cost, revenue and profit.<br>The student will be able to describe the main financial activities, recognizes the consequences of the time value of the capital and she is able to associate the financial instruments to a given financial activity. The student will outline mathematical models to evaluate financial activities. She will also be able to describe the main models and strategies to manage market risk.<br>Recognize and understand the terminology and the financial vocabulary.<br><br>Applying knowledge and understanding<br>Application of mathematical models for the representation, evaluation and analysis of business and financial problems, Evaluation of financial instruments and the financial risk of interest rate. Selection of the relevant market information to provide evaluations.<br><br>Making judgments<br>Ability to evaluate and analyse the logical and deductive reasoning process of a mathematical model.<br>Ability to identify the financial data needed to solve problems of assessment and hedging interest rate risk. Assessment of the most suitable mathematical model to evaluate financial instruments and to manage interest rate risk. Ability to critically examine the consequences of the adoption of a given financial instrument or strategy, and appraisal of the limits of the theoretical models.<br><br>Communication skills<br>The student has to illustrate the consequences of using a specific mathematical and financial instrument for evaluating business and financial variables.<br><br>Learning ability<br>The student will be able to describe a business and financial problem by means of mathematical models. |
| **ASSESSMENT METHODS** | Written test consisting of 8 exercises (four for each didactic unit), with 3 questions each, for a total of 24 questions to be terminated in a total of 4 hours. Each question has the same score for a total of 24 points . Each question is rated 1 if the answer is correct; 0.5 , if the answer is not complete ; 0 if the answer is incorrect . Calculation errors do not lead to penalties if the student describes the procedure performed.<br>It is mandatory to detail the process adopted to get to the result. The exam is sufficient (mark 18) if the student collects a score of at least 4 for each didactic unit. The maximum mark (30) is obtained by correctly answering 24 questions . A linear interpolation<br>is used to determine the intermediate marks. The latter can be computed using the straight line through the points (4,18) and (12,30) . The approximations to the integer mark are at professors' discretion. Final mark is calculated as the simple mean of the two didactic unit marks. |
| **EDUCATIONAL OBJECTIVES** | EDUCATIONAL OBJECTIVES DIDACTIC UNIT 1:<br>At the end of the course students will be able to : 1 ) demonstrate knowledge and comprehension of basic theorems for continuous functions of one variable and know how to apply them to real problems; 2) understand the basic theorems of differentiable functions of one variable; 3) demonstrate theoretical knowledge about the logical-deductive process that would allow them to represent, analyze, and solve a real problem by a mathematical model.<br>EDUCATIONAL OBJECTIVES DIDACTIC UNIT 2:<br>At the end of the course students will be able to : 1 ) analyse a financial problem and represent it through a mathematical model; 2 ) compute the value of interest rate based financial instruments 3 ) implement strategies to hedge interest rate risk. |
| **TEACHING METHODS** | Frontal teaching (72 hours) practice (12 hours). The course is made of two didactic units: 1) Function of one real variable; limits and continuity; differential calculus; linear algebra and matrix calculus; 2) Financial calculus |
| **SUGGESTED BIBLIOGRAPHY** | -Strumenti quantitativi per la gestione aziendale. Seconda edizione. S. Waner e S.R. Costenoble. Maggioli Editore<br>-Matematica per l'Azienda. C.Mattalia. Giappichelli Editore – Torino<br>-Manuale di Finanza G. Castellani, M. De Felice, F.Moriconi Vol I Tassi di interesse, mutui e obbligazioni. Il Mulino<br>-Andrea Consiglio. Matematica Finanziaria. Disponibile gratuitamente sul sito del docente |

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| | -Joseph Andria. Appunti di Matematica Finanziaria. Chiedere al docente<br>-John Hull. Introduction to Options, Futures and Other Derivatives. Prentice Hall |

## SYLLABUS

| Hrs | Frontal teaching |
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| 1 | Presentation of the learning objectives of the subject (didactic unit 1) |
| 3 | Basic Concepts of Set Theory: Operations on sets. Cartesian products. Numerical Sets. Intervals, Neighbourhoods. Maximum and Minimum. Infimum and Supremum |
| 2 | Formal definition of a function. Monotone, concave and convex functions. Odd and even functions |
| 3 | Study of a function. Elementary functions. Linear functions and models.Non-Linear functions and models. |
| 2 | Compound and Inverse functions |
| 4 | Limits and continuous functions. Indeterminate forms. Asymptotes. |
| 4 | Differential calculus. Definition of derivative and its geometric meaning. Differentiability of a function. |
| 4 | The Taylor-MacLaurin's formula. Differential calculus theorems. |
| 3 | Derivatives and the study of a function. |
| 5 | Linear systems and matrices. |
| 5 | Matrix algebra and applications |
| 1 | Presentation of the learning objectives of the subject (didactic unit 2) |
| 3 | Spot and forward contract. Simple interest, financial basis, discount rate. Discount and capitalization factor. Forward rate. The linear interest model. The linear discount model. |
| 2 | Compounded and continuous capitalization. Rate conversion and nominal rates |
| 2 | Intensity based models. Financial streams and portfolios. |
| 3 | Annuities and amortization schedule of a loan. |
| 2 | Fixed income assets. Yield of a fixed income bond. Par rate |
| 3 | Market hypotheses. Definition of arbitrage. The no-arbitrage assumptions. Fundamental arbitrage theorems |
| 4 | The term structure of interest rates. The relationship between spot and forward rates. Determining the term structure of interest rates. Arbitrage opportunities in the term structure. |
| 3 | Risk of an interest rate bond. The value function. The duration and the first order approximation of the value function. The duration as a measure of the volatility of an interest rate bond. The convexity and the second order approximation of the value function. |
| 3 | Definition of hedging. Definition of long and short position. Hedging through cash-flow creation. Hedging using duration.The hedge ratio using duration. |
| 4 | Criteria of profitability of a project in capital budgeting. The Net Present Value (NPV). NPV additivity. Incremental cash flows. Profitability index. Repeatable projects and balance constraints. NPV criticism.The Internal rate of Return (IRR). The IRR for anticipated and posticipated cash flows. TIR criticism. |
| 3 | Futures contracts definition. Main features and differences with respect to forward contract. The mark-tomarket mechanism. Arbitrage value of a future: the cash-and-carry price. The conversion factor. The cheapestto-delivery. Hedging with futures. |
| 3 | Definition of Swap. Hedging interest rate risk by swap. Swap evaluation. Bootstrapping the swap yield curve |

| Hrs | Practice |
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| 12 | Limits and continuity of one-variable real functions. Application of differential calculus, linear algebra and matrix calculus. Application of mathematical models for business and finance. |