UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

Department of Economics and Finance

COURSE OF STUDY business Economics
ACADEMIC YEAR 2023-2024
ACADEMIC SUBJECT Mathematics for Economics (L-Z)

General information	
Year of the course	I
Academic calendar (starting and ending date)	I semester (11 september 2023- 15 december 2023)
Credits (CFU/ETCS):	10
SSD	SECS-S06
Language	Italian
Mode of attendance	Free

Professor/ Lecturer	
Name and Surname	Marta Biancardi
E-mail	marta.biancardi@uniba.it
Telephone	
Department and address	Largo Abazia Santa Scolastica Bari
Virtual room	Microsoft Teams
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Weekly as indicated on the professor's webpage, in presence or online

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
250	70		180
CFU/ETCS			
10	10		

Learning Objectives	
Course prerequisites	Basic knowledge of algebra and analytical geometry

Teaching strategie	Lectures. Tutorials.
Expected learning outcomes in terms of	
Knowledge and understanding on:	At the end of the teaching activities the student must know and understand the mathematical tools illustrated during the course.

	In particular the concepts of differential and integral calculus and linear algebra.
Applying knowledge and understanding on:	At the end of the teaching activities the student must be able to apply the quantitative techniques learned to the solution of economic and financial problems.
Soft skills	• Making judgments At the end of the teaching activities the student must be able to acquire independent judgment in the formulation and modeling of economic and financial problems. • Communication skills At the end of the teaching activities the student must acquire and use the typical technical language of mathematics. • Ability to learn independently At the end of the teaching activities the student must be able to continue the study of the discipline and must be able to apply the tools learned to the study of economics, mathematics and statistics present in the course of study.
Syllabus	
Content knowledge	**Elements of set theory**. Logical symbols. Notion of equality and inclusion. Set of parts of a set. Union, intersection, difference and complement operation. De Morgan formulas. Covering and partitioning of a whole. Cartesian product. Functions. Direct image. Reciprocal image. Injective, surjective, invertible functions. Restriction and extension of a function. Compound functions. **Numeric sets**. The set of natural, rational and real numbers. Intervals. Absolute value. Minor and major, upper and lower extremity, maximum and minimum of a subset of R. Characteristic property of the upper/lower extremity. Separate sets. Separator element. Contiguous sets. Countable sets. Completeness properties of R. Power of a number. Root nth. Logarithms and their properties. Open and closed sets. Accumulation points. **The space R^n**. Concept of distance on R^n. Scalar product. Standard of a carrier. Around a point. Open and closed sets. Accumulation points. **Elements of linear algebra**. Fundamental definitions on matrices and vectors. Operations between matrices. Inverse matrix. Determinants and related properties. Laplace's theorem. Rule of Sarrus. Linearly independent vectors. Rank of a matrix. Kronecker's theorem. Systems of n equations in n unknowns. Cramer's rule. Systems of m equations in n unknowns. RouchéCapelli's theorem.

	Eigenvalues and eigenvectors. Characteristic polynomial. Positive, negative and undefined definite matrices. Quadratic forms. Economic applications. **Real functions of real variable**. Cartesian representation. Symmetries (parity, disparity, periodicity). Monotony. Global and local maxima and minima of a function. Convexity and inflection points. Elementary functions. **The notion of limit for functions**. The notion of limit. Uniqueness of the limit. Limit from right and left. Operations with limits. Indeterminate forms. Theorem on the permanence of the sign. Forced convergence theorem. Remarkable limits. Theorem on the limit of monotone functions. **Succession**. Limit of successions. Nepero's number. **Continuous functions**. The notion of continuity. Operations with continuous functions. Continuity of elementary functions. Discontinuity points. Zero theorem. Bolzano theorem. Compact sets. Weierstrass theorem. **Differential calculus**. Concept of derivative. Geometric meaning of the derivative. "Economic" meanings of the derivative. Angular and cuspidal points. Operations with derivable functions. Higher order derivatives. Derivatives of elementary functions. Elasticity of a function. Taylor formula and applications. Necessary conditions for the existence of relative maxima and minima (Fermat's theorem). Sufficient conditions for the existence of relative extremes. Convex functions. **Real functions of several real variables**. Partial derivability. Partial derivatives of higher order. Schwarz's theorem. Differentiability and differential. Directional derivatives. Gradient. Hessian matrix. Taylor formula. Necessary conditions for the existence of relative maxima and minima (Fermat's theorem). Sufficient conditions for the existence of relative maximums and minimums. Northwest minors rule (Sylvester criterion). Functions implicitly defined. Dini's theorem. Maximum and minimum constraints. The Lagrange multiplier method. **Applications to the economy**. Unconstrained optimization in economics. Cobb-Douglas production functions. Homogeneous functions. Returns to scale. Marginal replacement rate. Constrained optimization in economics. The consumer problem. **The indefinite integration**. Primitive and indefinite integral. Integration by parts. Integration by replacement.

	Integration according to Riemann. Integral defined according to Riemann. Geometric interpretation of the integral. Existence theorem of primitives. Fundamental theorem of integral calculus. Average theorem. Calculation of areas.
Texts and readings	• L. Maddalena, Matematica, seconda edizione, Giappichelli Editore • C. Mattalia, F. Privileggi, Matematica per le scienze Economiche e sociali, Vol. I e II, Maggioli Editore
Notes, additional materials	Materials available to students on the professor's webpage.
Repository	

Assessment	
Assessment methods	Written and oral exam. At least one intermediate test will be carried out during the course, which aims to evaluate and verify the skills acquired by the students on the topics covered up to the moment of the test.
Assessment criteria	The written test, consisting of open-ended questions and the oral test, are designed to identify the knowledge acquired in solving exercises and in the knowledge of abstract theoretical notions applied to economics and finance. Furthermore, the exam ascertains the ability to acquire the specific language of the discipline, the ability to synthesise and communicate.
Final exam and grading criteria	The grade, both for the written and the oral exams, is given out of thirty. The exam is considered passed when the vote is greater than or equal to 18. Access to the oral exam is granted after passing the written exam. The final mark is the result of the average between the mark of the written test and that of the oral test. In the written test, the individual questions are assigned a different score referring to the difficulty of the question itself, for the oral test the questions/topics of the program contribute equally to the formulation of the final mark.
Further information	
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