COURSE OF STUDY Economics and business administration

ACADEMIC YEAR 2024/2025

ACADEMIC SUBJECT Applied Mathematics for Economics and finance

General information	
Year of the course	I
Academic calendar (starting and ending date)	*16-09-2024- 20-12-2024*
Credits (CFU/ETCS):	8
SSD	SECS-S/06
Language	*Italian*
Mode of attendance	*Optional*

Professor/ Lecturer	
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Telephone	
Department and address	Ionic Department in "Legal and Economic Systems of the Mediterranean: society, environment, culture"
Virtual room	*TEAMS: os5svsf*
Office Hours (and modalities: e.g., by appointment, on line, etc.)	Agreed weekly with the students with notice on the department website

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
200 (8x25)	*64*		*136*
CFU/ETCS			
8	*8*		

Learning Objectives	*The educational objectives of mathematics for economic and financial applications are to provide students with the mathematical tools needed to tackle economic and financial problems such as mortgages, financing, investments in various securities and any financial financing and investment transactions. Learning to read and manage the financial market by taking a critical attitude so as to anticipate future moves.*
Course prerequisites	*Basic knowledge of algebra and analytical geometry*

Teaching strategies	
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. The studennts must know the concepts of: o Differential equation o Integral calculus o Financial tools o Economic tools
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. o financial phenomena o financial market o economic phenomena
Soft skills	• *Making informed judgments and choices* At the end of the teaching activities, the student must be able to acquire independent assessments in the formulation and modeling of economic and financial problems. • *Communicating knowledge and understanding* At the end of the teaching activities, the student must acquire and use the technical language typical of mathematics to solve o financial probloems o economic problems. • *Capacities to continue learning* At the end of the teaching activities, the student must be able to acquire independent assessments in the formulation and modeling of economic and financial problems.
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.

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

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. 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.

Applications to the finance: The time value of money. Discounting. The Internal Rate of Return (IRR). The bond market. Valuing bonds.
The term structure of interest rates. Forward rates.
Interest rate risk. Perpetuities and Annuities.
Amortizing loans. The stock market.
Valuing projects. The Net Present Value (NPV) decision rule.
Interest Rate Bond.

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	Bertsch M., Dal Passo R., Giacomelli L., Analisi matematica 2/ed, McGraw Hill. Torriero A., Scovenna M.,Scaglianti L. Manuale di Matematica. Metodi e Applicazioni - CEDAM – Padova. Sydsaeter K., Hammond P., Strom A., Metodi matematici per l'analisi economica e finanziaria, Pearson ed. Castellani G., De Felice M., Moriconi F., Manuale di finanza I, Il Mulino, 2005. C. Mari, Appunti di Matematica Finanziaria (scaricabile dalla piattaforma e-learning dell'Università).
Notes, additional materials	
Repository	

Assessment	
Assessment methods	Written test with theory questions and exercises. Optional oral exam.

Assessment criteria	The course is in line with the general objective of the course of study to provide economic skills and mathematical-financial techniques for an adequate understanding of the economic system and the functioning of financial markets.
	The course, in particular, aims at equipping students with the technical tools necessary for understanding financial phenomena.
	
	• *Knowledge and understanding*
	• The course is in line with the general objective of the course of study to provide economic skills and mathematical-financial techniques .
	Applying knowledge and understanding
	• The course is in line with the general objective of the course of study to provide economic skills and mathematical-financial techniques for an adequate understanding of the economic system and the functioning of financial markets.
	
	• *Autonomy of judgment*
	• The course, in particular, aims at equipping students with the technical tools necessary for understanding financial phenomena *Communicating knowledge and understanding*
	At the end of the teaching activities, the student must acquire and use the technical language typical of mathematics to solve
	    o financial problems
	    o economic problems
	
	• *Communication skills*

	- To learn the basic concepts and tools of modern finance; - To know how to formulate and solve basic problems of modern finance. *Capacities to continue learning* - At the end of the teaching activities, the student must be able to acquire independent assessments in the formulation and modeling of economic and financial problems.
Final exam and grading criteria	The written test, consisting of open-ended questions are designed to identify the knowledge acquired in the resolution of exercises and knowledge of abstract theoretical notions and applied to economics and finance. In addition, the examination test ascertains the ability to acquire the specific language of the discipline, the ability to synthesize and communicate.
Further information	
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