COURSE OF STUDY Statistics and Methods for Economics e Finance (SMEF)
ACADEMIC YEAR 2024-2025
ACADEMIC SUBJECT Mathematical Models for Finance and Insurance

General information	
Year of the course	*First year*
Academic calendar (starting and ending date)	*First semester*
Credits (CFU/ETCS):	8
SSD	*SECS-S/06*
Language	*Italian*
Mode of attendance	*Optional*

Professor/ Lecturer	
Name and Surname	Marta Biancardi
E-mail	marta.biancardi@uniba.it
Telephone	
Department and address	*Department of Economics and Finance*
Virtual room	TEAMS
Office Hours (and modalities: e.g., by appointment, on line, etc.)	As indicated on the professor's homepage

Work schedule			
Hours			
Total	Lectures	Hands-on (laboratory, workshops, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
200	*56*		*144*
CFU/ETCS			
8	*8*		

Learning Objectives	*The course aims to provide the basic knowledge of the actuarial technique of life insurance. In particular, the course allows students to acquire the methodologies for evaluating the insurance products characteristic of the management activity of an insurance company operating in the life branch and for risk management in the insurance sector. Furthermore, at the end of the course, the student should be able to understand the most relevant models relating to the pricing of derivative securities, to determine the efficient composition of a portfolio of securities with n risky and one non-risky assets, to make choices under conditions of uncertainty.*
Course prerequisites	*Elements of Financial Mathematics and Probability Calculation. Application of differential and integral calculus and knowledge of Linear Algebra.*

Teaching strategie	*Lectures and exercises related to the topics covered in class. At the end of each CFU, the exercises will consist in carrying out the exams of the previous sessions.*
Expected learning outcomes in terms of	
Knowledge and understanding on:	At the end of the course, the student will have to be able to choose, based on risk and return, the optimal financial portfolio according to the needs of the individual in terms of risk aversion/propensity and will also have to know how to

	determine the price of the most important instruments derivatives. Furthermore, the student must be able to determine the single and periodic premiums for each type of insurance contract (life and death) and the composition of the mathematical provisions.
Applying knowledge and understanding on:	*The student must be able, even through Excel, to get to solve the problems of choosing the optimal portfolio and determining the price of derivatives according to the binomial models, monte carlo and Black-Scholes. In addition, the student should be able to calculate insurance premiums based on the age and health condition of the individual.*
Soft skills	• *Making informed judgments and choices:* the student will have to acquire clear and effective communication skills, thanks to a good command of the vocabulary concerning the topics covered during the course. • *Communicating knowledge and understanding:* the student must be able to communicate effectively on financial and insurance matters, using adequate technical language. There multidisciplinary economic-financial and mathematical-statistical communication skills is, from this point of view, the main result of the course. • *Capacities to continue learning:* the student must have developed good learning skills, which allow them to autonomously deepen the knowledge acquired during the course by tackling personalized study paths.
Syllabus	Insurance part (4 ECTS) **Probabilistic model for the description of the life span**. The random variable "residual life span" and related characteristic values. Survival function. Intensity of mortality. Mortality coefficient and central mortality rate. Analytical models for the survival function. Models for aggravated risks. Mortality tables. **Traditional forms of life insurance**. Life insurance, death insurance, mixed insurance. Life annuities. Determination of the pure premium. Natural premium and reserve premium. Mathematical reserve. Finance (4 credits) **Evaluation of operation under conditions of uncertainty**. Criteria for evaluating random quantities. The mean value criterion and fair games. Limits to the mean value criterion. The St. Petersburg paradox. The utility function. The utility of uncertain sums. The concept of certain equivalent. Risk aversion. Stochastic dominance of first order and second order. The mean-variance criterion. The risk-return analysis. **Valuation of derivatives**. Evaluation of financial options. Options overview. Call and put parity relationship. Uniperiod binomial model. Cox-Ross-Rubinstein model. American options pricing. The Black and Scholes model. The Monte Carlo method for pricing options.
Content knowledge	
Texts and readings	• *G. Castellani, M. De Felice, F. Moriconi. "Manuale di Finanza Vol III. Modelli stocastici e contratti derivati". Eds Il Mulino.*

	• *Pitacco E. Elementi di matematica delle assicurazioni, Luglio Editore, Trieste, 2022.*
Notes, additional materials	*https://www.uniba.it/it/docenti/villani-giovanni* *https://www.uniba.it/it/docenti/biancardi-marta*
Repository	

Assessment	
Assessment methods	*The verification of knowledge will take place through a written test and an oral test. The final grade will be given by an average of the two tests. The written test will focus on exercises proposed during the course. Furthermore, there are two exemptions (insurance part and financial part) at the end of the course (December 2023) (which exempt from the written test). In the event of a positive outcome of the two exemptions, the oral exam can be taken by the third session of March 2024.*
Assessment criteria	*The written test consists in carrying out some exercises on the main topics of the course. For example: pricing of derivatives using the binomial method, Black and Scholes formula and Montecarlo simulation; single and periodic premiums for life, death and mixed cases. The oral part of the exam can be taken by the student who will have reported, in the written test, an evaluation of at least 18/30.* *The oral part of the exam will ascertain the level of the overall preparation on all the topics of the program. For a sufficient assessment, the student will have to show knowledge of concepts (through their definitions) and links between the various topics, as well as an understanding of mathematical reasoning*
Final exam and grading criteria	*• <18 Fragmentary and superficial knowledge of the contents, errors in applying the concepts, deficient exposition;* *• 18-20 Sufficient but general content knowledge, simple exposition, uncertainties in the application of theoretical concepts;* *• 21-23 Appropriate but not in-depth knowledge of content, ability to apply theoretical concepts, ability to present content in a simple way;* *• 23-26 Appropriate and broad knowledge of contents, good ability to apply knowledge, ability to present contents in an articulated way.* *• 27-29 Broad, complete and in-depth knowledge of the contents, good application of the contents, good capacity for analysis and synthesis, safe and correct presentation.* *• 30-30L Very broad, complete and in-depth knowledge of the contents, well-established ability to apply the contents, excellent capacity for analysis, synthesis and interdisciplinary connections, mastery of exposition..*
Further information	
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