COURSE OUTLINE

(1) GENERAL

SCHOOL	BUSINESS		
ACADEMIC UNIT	DEPARTMENT OF FINANCIAL AND MANAGEMENT ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**OI0115**	**SEMESTER**	**10**
COURSE TITLE	FINANCIAL SCENARIOS SIMULATION		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	SPECIAL BACKGROUND/SPECIALISED GENERAL KNOWLEDGE/ SKILLS DEVELOPMENT
PREREQUISITE COURSES:	● DERIVATIVES AND NEW FINANCIAL PRODUCTS ● FINANCIAL SCENARIOS SIMULATION ● STOCHASTIC MODELS
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.fme.aegean.gr/el/c/prosomoiose-khrematooikonomikon-senarion

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course is the first well-structured effort to solve vital financial problems based on algorithmic methods. The algorithmic techniques presented here, find a wide range of applications in every aspect of modern finance, with particular emphasis in the modeling of randomness, in the valuation of financial derivative products and risk management. The course is addressed to the undergraduate students of the Financial Engineering Track and focuses on the basic algorithmic techniques used in the simulation of various financial scenarios. More specifically, the Monte Carlo family of simulation methods are applied to a wide range of financial related problems (with particular emphasis in (a) the simulation of various important stochastic processes (random walk, scaled random walk, Brownian motion, Geometric Brownian motion), (b) the valuation of financial derivatives (options - both vanilla and exotic), and (c) portfolio risk quantification (estimation Value at Risk). Finally, alternative pricing methods (such as binomial trees, trinomial trees) are presented keeping in line with the classical model of Fisher Black and Myron Scholes. Upon the successful completion of the course, students will be able to:

- easily generate pseudo-random numbers from any continuous distribution, with emphasis on uniform and normal distributions.
- simulate basic important stochastic processes that appear naturally in Finance (random walk, Brownian motion, Geometric Brownian motion) and also to have a deep understanding of their statistical structure.
- simulate a required number of paths for the above stochastic processes.
- have a deep understanding of the main idea behind the tree methods for pricing options (binomial and trinomial tree).
- write code (in R) for the pricing of European options with tree methods.
- have understood the limiting relationship between the binomial option pricing model and the Black-Scholes model and also to be able to write code (in R) that implements the Black-Scholes pricing model.
- apply Monte-Carlo simulation methods to a wide range of financial problems with emphasis in option valuation (European and mainly Exotic options).
- know the basic variance reduction techniques for the Monte-Carlo method (antithetic variates, control variates).
- know how to simulate the basic stochastic processes that describe the evolution of the volatility of stock prices (stochastic variability models; Heston model, Hull-White model).
- apply Monte Carlo option pricing techniques under stochastic volatility models.
- access the risk of a portfolio (value-at-risk method).

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

Stochastic processes in finance: The need for simulation. Generating pseudo - random numbers from uniform and normal distributions. A basic model for the evolution of stock prices: the random walk model. From random walk to Brownian motion. From Brownian motion to geometric Brownian motion. The Black-Scholes equation: Introduction to financial option valuation. Pricing of European options with the binomial tree. Pricing of European options with the trinomial tree. Monte Carlo simulation methods, part I: Application to financial option valuation under the risk-neutral measure. Monte Carlo simulation methods, part II: variance reduction techniques. Monte Carlo simulation methods, part III: pricing of exotic options. Monte Carlo simulation methods, part IV: simulation of stochastic volatility models: Application in options pricing. Evaluation of a portfolio's risk with the value-at-risk method: Monte Carlo and empirical simulation techniques.

Every part of the syllabus is accompanied by laboratory applications in R along with personal notes of the instructor.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Use of ICT in teaching.** **Use of ICT in laboratory education.**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examinations at the end of the semester, in Greek, which include questions of knowledge development and understanding of the content of the course, as well as problem solving. Additional assessment of candidates on the basis of projects given on a regular basis. Final grade is calculated as: Final exam: 70% Exercises: 30%

Activity	***Semester workload***
Lectures/Laboratory practice	39
Study and analysis of the bibliography	90
Projects	18
Final exam	3
Course total	**150**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Brandimarte, P., Numerical Methods in Finance. A MATLAB Based Introduction, Wiley, 2002.
- Glasserman, P., Monte Carlo Methods in Financial Engineering, Springer-Verlag, 2003.
- Higham, D., An Introduction to Financial Option Valuation, Cambridge, 2005.
- L. Clewlow, C. Strickland. Implementing Derivatives Models (1998). Wiley.
- Hull, J., Options, Futures and other derivatives, Prentice Hall, 2014.
- Neftci, S., Introduction to the Mathematics of financial derivatives, Academic Press, 2000.

- Related academic journals:

- Journal of Financial Economics.
- The Review of Financial Studies.