Mathematical Finance
September 2019

Course code	*GRAE017*
Course title	*Mathematical Finance*
Type of course	*Compulsory*
Year of study	*MSc 1st year*
Semester	*Winter 2019*
Number of credits / ECTS	*6 ECTS*
	36 academic hours of lectures/seminars, 124 hours of self-study, 2 hours of consultations
Lecturer	*Tom Hashimoto (Room 205)*
	tomhas@ism.lt
Study form	*Full-time (consecutive / evening)*
Course prerequisites	*Undergraduate course in mathematics and statistics*

Course description:

This introductory course surveys various mathematical concepts utilised in financial economics. Together with Financial Econometrics, it constitutes the foundation of the 'research' pillar in MSc Financial Economics at ISM. As such, some of the topics will be 'repeated', but more in depth, in other courses. As clients' profiles and objectives have become increasingly global and complex over the past few decades, financial institutions have come up with more sophisticated and more structured products, alternatives, and approaches, some of which are reviewed in this course from a pricing and mathematical perspective. Given the current political environments (e.g. Brexit, transpacific trade war), we pay significant attention to the assumptions behind formulae and models, while we practice not only calculations but also explanations to prepare ourselves for the contemporary regulatory environment, most notably characterised by the MiFID II.

Course objectives:

Upon successful completion of this course, students will be able to:

Course learning outcomes (CLO)	Study methods	Assessment methods
CLO1. Illustrate and utilise the axioms of rationality in pricing.	Lectures, self-study	Midterm, Final exam

CLO2. Define and explain interest rates as they are applied to different types of debt instruments.	Lectures, seminars, self-study	Midterm, Final exam	
CLO3. Define and explain the structuring considerations for various derivative products.	Lectures, seminars, self-study	Midterm, Final exam	
CLO4. Identify issues and projects surrounding the rapidly changing world such as hybrid securities, financial engineering, and blockchain.	Seminars, self-study	Final exam	

Course schedule:

The dates are in September. The relevant readings are indicated by the initial of the author and chapter number (e.g. D chapter 1). See the 'textbook' section below.

	Topics
1	**Introductory discussion**. Overview of MSc Financial Economics. Review of probability theory. (D chapter 1)
2	Mathematics of compounding. (CM chapter 1.1 & 1.2) Simple, compound, and varying interest rates,
3	Mathematics of compounding. (CM chapter 1.3 – 1.5) Annuities, bonds, yield rates.
4	Basic price models. (CM chapter 2.2 & 2.3) Binomial model, log-normal model, Law of One Price.
5	Discrete time market models. (D chapter 3) Cox-Ross-Rubinstein model, option pricing.
6	**Review.** **Midterm**.
7	Basics of Ito calculus and stochastic analysis. (D chapter 4) Brownian motion, Diffusion Markov processes.
8	The Black-Scholes Formula (review) (R chapter 7) Estimation, properties, put options. **Review**
9	**Final exam**
TBA	**Re-take exam**

Assessment methods

The final grades are calculated as following.

Midterm	40 %
Final exam	60 %

The 're-take' exam for the students who did not meet the passing score is normally scheduled 1-2 weeks after the announcement of the final grades. The details are to be communicated in due course.

Midterm and Final Exams

Both the midterm and final exams are open book. Students can refer to their notes and textbooks during the exam.

The mid-term exam will cover the topics from the first five lectures. The final exam will cover all topics discussed during the course with more weight on the topics covered after the mid-term. The re-take exam will cover the all topics without such preferences.

Textbook

Please utilise them as encyclopaedia rather than core readings.

- Campolieti, G. & Makarov R.N. (2014) *Financial Mathematics*. London: CRC Press.
- Dokuhcaev, N. (2007) *Mathematical Finance*. London: Routledge.
- Ross, S. M. (1999) *An Introduction to Mathematical Finance*. Cambridge: Cambridge University Press.

Additional remark

Students are expected to be acquainted with the undergraduate level of mathematics and statistics. Therefore, if a student feels shortage of knowledge and wants to improve his/her understanding in quantitative methods, the lecturer is available for further consultation by appointment.

MSc Financial Economics programme at ISM has zero tolerance policy towards cheating, plagiarism, and other academic misconducts. Such incidents will be referred to the Committee on Ethics.