APPROVED BY
THE STUDY COMMISSION
Minutes No. 02-12-2026-14
as of 24th August 2026

MATHEMATICAL FINANCE

Course code	*GRAE017*
Course title	*Mathematical Finance*
Type of course	*Compulsory*
Level of course	*Graduate*
Year of study	*1st*
Number of credits	*6 ECTS (36 contact hours + 2 consultation hours, 124 individual work hours)*
Lecturer	*Prof. Dr. Jens K. Perret*
Prerequisites	*None*
Teaching language	*English*

THE AIM OF THE COURSE

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' in greater depth in other courses. This course serves dual purposes: ensuring students have the mathematical preparation needed to further study financial economics and introducing them to the rigorous mathematical models used in modern academic and professional financial modelling. The first part of the course will ensure students have appropriate knowledge of set theory, linear algebra, probability, and optimization as well as calculus. The course will reference exemplary applications from asset pricing that apply to stocks, bonds, and options. The course will conclude with an analysis of the application of modern technologies in financial markets. Emphasis will be not only on problem solving, but also on intuitive understanding of theory and application, history, and communication of ideas.

MAPPING OF COURSE LEVEL LEARNING OUTCOMES (OBJECTIVES) WITH DEGREE LEVEL LEARNING OBJECTIVES (See Annex), ASSESMENT AND TEACHING METHODS

Course level learning outcomes (objectives)	Degree level learning objectives (Number of LO)	Assessment methods	Teaching methods
CLO1. Illustrate and utilise mathematical optimization and simulation approaches.	LO3.1, LO4.1	Final exam	Lectures
CLO2. Define and utilize interest rates as they are applied to different types of saving and debt instruments or option valuation.	LO3.1, LO4.1	Midterm	Lectures
CLO3 Apply basic mathematical concepts from calculus and linear algebra.	LO3.1, LO4.1	Midterm	Lectures
CLO4. Identify issues and projects surrounding the rapidly changing world such as AI and blockchain	LO1.1, LO2.1, LO3.1, LO4.1	Final exam	Lectures

ACADEMIC HONESTY AND INTEGRITY

The ISM University of Management and Economics Code of Ethics, including cheating and plagiarism are fully applicable and will be strictly enforced in the course. Academic dishonesty, and cheating can and will lead to a report to the ISM Committee of Ethics. With regard to remote learning, ISM remind students that they are expected to adhere and maintain the same academic honesty and integrity that they would in a classroom setting.

AI USE POLICY

During the midterm and the final exam, the use of computers, smartphones, smartwatches and other AI-based applications is strictly forbidden. This includes but not solely the use of LLMs. AI use however is allowed for preparation of the materials (e.g. summary, structuring, expanding) which are taken into the exams. In additional written works, the

use of AI is only allowed within the boundaries stated in the respective tasks.

COURSE CONTENT

DATES	TOPIC	IN-CLASS HOURS	SUGGESTED READINGS
2026 09 04	Introduction Mathematical Basics Financial Mathematics (Interests, saving plans, annuities, investment valuation)	4	See list at the end of the syllabus
2026 09 07	Financial Mathematics (Interests, saving plans, annuities, investment valuation)	4	See list at the end of the syllabus
2026 09 09	Linear Algebra (Set Theory and Preferences, Matrices and Systems of Equations)	4	See list at the end of the syllabus
2026 09 10	Linear Algebra (Markov Chains)	4	See list at the end of the syllabus
2026 09 14	Calculus (Extrema without constraints, extrema with equality constraints)	4	See list at the end of the syllabus
2026 09 16	Calculus (Differential equations, Option Pricing and Black Scholes) Mathematical Optimization (Extrema with inequality constraints, Simplex algorithm)	4	See list at the end of the syllabus
2026 09 17	Mathematical Optimization (Simplex algorithm) MIDTERM (In-class)	4	See list at the end of the syllabus
2026 09 23	Probability Theory and Statistics (Probabilities and Distributions, Regression)	4	See list at the end of the syllabus
2026 09 24	Monte Carlo Simulations Machine Learning and AI in Finance Current Topics	4	See list at the end of the syllabus
		Total: 36 hours	
	CONSULTATIONS	2	
	FINAL EXAM	2	

FINAL GRADE COMPOSITION

Type of assignment	**%**
Individual Components 100%	
Midterm (Financial Mathematics, Linear Algebra, Calculus)	50%
Final exam (Markov Chains, Simplex, Probabilities, Regression, Simulations, ML and AI in Finance)	50%
Total:	**100**

DESCRIPTION AND GRADING CRITERIA OF EACH ASSIGNMENT

(Provide short descriptions and grading criteria of each assignment)

1. The midterm examination will be given in-class and will be allotted 90 minutes.
2. The Final examination will be given after the final lecture in-person. Solutions will be scanned and sent to the instructor for grading.
3. Both the midterm and final exams are open book. Students can refer to their notes and textbooks during the exam as long as they are paper based. Students are not to confer with each other, but they may ask questions of the instructor. Students may use a non-programable four-function or scientific calculator if they so choose.
4. During the midterm and the final exam, the use of computers, smartphones, smartwatches and other AI-based applications is strictly forbidden. This includes, in particular but not solely the use of LLMs. AI use however is allowed for preparation of the materials (e.g. summary, structuring, expanding) which are taken into the exams. In additional written works, the use of AI is only allowed within the boundaries stated in the respective tasks.

RETAKE POLICY

The retake exam for the students who did not meet the passing score is normally scheduled 1-2 weeks after the announcement of the final grades. It covers 100% of the total grade. It will be held in-person and is also open-book, open notes. A four-function or scientific calculator is again permitted.

SUGGESTED READINGS

Sydsaeter, K.; Hammond, P.; Strom, A.; Carvajal, A. (2021) “Essential Mathematics for Economic Analysis (Business and Economics)”, Pearson.
Matousek, J.; Gärtner, B. (2010) “Understanding and using Linear Programming”, Springer.
Aw, E.C.-X.; Leong, L.-Y.; Hew, J.-J.; Rana, N.P.; Tan, T.M.; Jee, T.-W. (2023) “Counteracting dark sides of robo-advisors: Justice, privacy and intrusion consideration”, International Journal of Bank Marketing, 42(1), 133-151.
Sahu, S.K.; Mokhade, A.; Bokde, N.D. (2023) “An overview of machine learning, deep learning, and reinforcement learning-based technologies in quantitative finance: Recent progress and challenges”, Applied Sciences, 13, 1956.

ADDITIONAL READINGS

Regular attendance is strongly encouraged as all exams are open book.

Questions are welcomed and encouraged during class.

Office hours can be scheduled at the request of the student via email.

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

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ANNEX

DEGREE LEVEL LEARNING OBJECTIVES

Competency goals and learning objectives for the Master of Social Science

Programmes:
Financial Economics

Competency Goal	Learning Objective
Students will demonstrate advanced disciplinary knowledge.	LO1.1. Students will demonstrate advanced discipline knowledge through the independent development of a Master's thesis, showing a deep understanding and appropriate application of theories, concepts, and methods relevant to their field of study.
Students will be digitally competent.	LO 2.1. Students will demonstrate digital agility competencies by selecting and applying appropriate tools, platforms or technologies, integrating digital insights into business decision-making, and adapting digital approaches in response to evolving project requirements and contextual changes.
Students will be critical thinkers	LO3.1. Students will be able to identify underlying assumptions, limitations of previous research; evaluate managerial solution alternatives.
Students will be independent learners	LO4.1. Students will become **independent learners** and develop their own comprehension of scientific theories, models, and concepts
Students will be socially responsible leaders	LO5.1. Students will be able to evaluate past and current practices in their discipline from an **ethical perspective**.
Students will be effective communicators	LO6.1. Students will develop and deliver a **coherent oral presentation**
	LO6.2. Students will develop and deliver a **coherent written research paper**