

EE 518: Mathematics and Tools for Financial Engineering (4 units)

Fall 2022

Day and Time: Mon, Wed 1:30-3:20 pm
Location: OHE 132, DEN@Viterbi
Instructor: George Papavassilopoulos
Office: EEB 114
Office Hours: W 3:30pm-5:30pm
Contact Info: email: yorgos@usc.edu
yorgos@netmode.ntua.gr

Discussion session: Friday 6:00pm-6:50pm
Location: OHE 122, DEN@Viterbi
Teaching Assistant: Gary Rostomyan
Office: TBA
Office Hours: TBA
Contact Info: email: rostomya@usc.edu

Graders: [Bosi Tu](#), bositu@usc.edu

Course Description

The course is specifically designed to review the fundamental mathematical principles and their application to Financial Engineering. Java and Matlab and the Financial Toolbox will be introduced as part of the course. The course will help students understand the fundamental mathematics and software tools in order to be able to understand higher level courses that are relevant to Financial Engineering.

Learning Objectives

At the end of the course the participants will understand the fundamental mathematics associated with financial engineering and how they apply them in solving some basic financial problems. It will help the participants handle more advanced courses in Financial Engineering. The participants will also learn the use of Java, Matlab and Financial toolbox.

Prerequisite(s)

Graduate standing. Students should have completed at least three years of undergraduate University studies in the fields of Engineering or Business or Economics or Mathematics or Physics.

Characteristics of the course

This lecture-based course will be offered on Viterbi's Distant Learning System (DEN) to be accessible to remote students in addition to on-campus students. Blackboard will be used to post Lecture Notes and Assignments

Textbook

Ioannou P., '*Mathematics and Tools for Financial Engineering*', SIAM, 2021

Software Tools: Use of Matlab/Simulink with Financial Engineering Toolbox.

Course Topics:

Review of background math: Set Theory; Linear Algebra; Sequences and Series
(To be reviewed by students and discussed during discussion session)

Lecture Topics:

- 1. Functions Properties and Analyses:**
Continuity, Differentiation, Integration, Taylor Series; Mean Value Theorem; Linearity; convexity; Approximations and Numerical Techniques; Newton's Method
(5 Lectures)
- 2. Random Processes:**
Review of probability and random processes; Normal and lognormal distributions; Independent Random Variables; Conditional Expectation; Stochastic Processes; Brownian Motion; Stochastic Differential Equations; Ito's Lemma
(5 Lectures)
- 3. Interest Rates and Money Value:**
Compounding; Present and Future Value; Internal Rate of Return; Inflation and Taxes; Annuities and Mortgages
(2 Lectures)
- 4. Bonds:**
Bond Pricing; Bond Yield; Bond Duration and Convexity; Immunization; Numerical Calculation of Yield
(2 Lectures)
- 5. Asset Models:**
Binomial model; additive and multiplicative models; ARMA models; discrete and continuous time models.
(4 Lectures)
- 6. Portfolio Theory and Optimization:**
Asset returns; Random returns; Mean and Variance of returns; Diversification; Mean-standard deviation diagram; Markowitz model; Portfolio Optimization; Lagrange Multipliers; Capital Asset Pricing Model
(6 Lectures)
- 7. European Option Pricing:**
Law of one Price and arbitrage; Put-Call Parity; Derivation of Black Scholes Formulas; The Greeks; Implied volatility; Hedging; Approximations; Numerical Calculation of implied volatility.
(5 Lectures)**

Use of Matlab and other software tools to be taught during discussion sessions

**Number of Lectures is approximate. Two lectures correspond to one week.

Course Grading Breakdown

Assignment	% of Grade	Dates
Homework	10%	About one per week
Quiz 1 Based on review material of Chapters 1, 2	5%	September 16, 6:00 pm - 6:50 pm
Quiz 2 Based on review material of Chapter 3	5%	Date TBA 6:00 pm - 6:50 pm
Quiz 3 Chapter 4	5%	Date TBA 6:00 pm - 6:50 pm
Quiz 4 Chapter 5, 6	5%	Date TBA 6:00 pm - 6:50 pm
Midterm Chapters 6, 7, 8, 9	30%	Date TBA 1:30pm-3:20pm
Final Chapters 5,6,7,8,9,10,11	40%	Wednesday, December 14, 11am-1pm
Total	100%	

The purpose of the quizzes 1,2 is to assess the mathematical background and give a chance to students to drop the class. Quizzes 1, 2 are based on material that all admitted FE students supposed to know. For this reason the material will be discussed during the discussion session only.

Assignment Submission Policy

Assignments are to be submitted *a week after assigned*. No late submissions of assignments are acceptable.

Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information

for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, (www.usc.edu/scampus or <http://scampus.usc.edu>) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

Emergency Preparedness/Course Continuity in a Crisis

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.