Department of Mathematics & Statistics
Concordia University

MACF 401 (MAST 729/MAST 881), Sec. F
Mathematical & Computational Finance I
Winter 2024

Instructor: Dr. P. Gaillardetz, Office: LB 1041.23 (SGW), Phone: 514-848-2424, Ext. 3249
Email: patrice.gaillardetz@concordia.ca

Class Schedule: Tuesdays & Thursdays, 16:15-17:30 in LS 105, SGW Campus.

Office Hours: TBA.

Behaviour: All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the Code of Rights and Responsibilities which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

Text: *Stochastic Calculus for Finance I: The Binomial Asset Pricing Model,* by Steven Shreve, Springer, 2005. (Required).

Outline: This course is an introduction to mathematical and computational finance. The focus is on the general theory through a thorough study of Binomial Models. The topics covered include:

- The binomial no-arbitrage price model: one-period, multi-period.
- State prices: change of measure, Radon-Nikodym derivatives, capital asset pricing model; utility maximization and optimal investment.
- European and American derivative securities: call and put options, stopping times; exotic derivative securities.
- Random walks: first passage times, reflection principal; perpetual American put option.

- Interest-rate derivatives: binomial model for interest rates, bonds, fixed income derivatives, forward measure; Ho-Lee and Black-Derman-Toy models.
- Forward and Futures contracts.
- Hedging: the Greeks, Delta hedging.
- Convergence of the Binomial Model to the Black-Scholes model. The Black-Scholes Formula.
- Numerical methods.
- Other topics (time permitting).

Evaluation: Weighted average of Assignments (35%), Midterm Examination (25%), and the Final Examination (40%).

You are expected to work independently on all Assignments and Exams.

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

Midterm Exam: March 7th, 2024 (during class 4:15-5:30 pm).

Programming: Some assignment problems will require programming. Students are encouraged to use an object oriented programming language such as C++ or Java for programming exercises on assignments, as these are the industry standards for Quantitative Finance. Python and R are also acceptable languages if students do not have previous experience in object oriented programming. If the University provides an appropriate online programming platform (such as Jupyter notebooks) students may be required to use this platform for programming exercises.

Intellectual Property: Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities. As specified in the Policy on Intellectual Property, the University does not claim any ownership of or interest in any student IP. All university members retain copyright over their work.

Academic Integrity and the Academic Code of Conduct

This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: https://www.concordia.ca/conduct/academic-integrity.html" *[Undergraduate Calendar, Sec 17.10.2]*

Extraordinary circumstances

In the event of extraordinary circumstances and pursuant to the Academic Regulations the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the change.