Department of Mathematics & Statistics
Concordia University

MACF 402 (MAST 729/881), Sec. A

Mathematical & Computational Finance II

Fall 2020

Instructor: Dr. C. Hyndman
Email: cody.hyndman@concordia.ca

Preface: Due to exceptional circumstances, this course will be taught and all assessments will be done completely ONLINE.

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 changes.

Office Hours: TBA via Zoom (accessible through the course Moodle page).

Class Schedule: Tuesdays and Thursdays, 16:15-17:30 via Zoom (accessible through the course Moodle page). Some lectures will be conducted live using Zoom and the recordings posted following the lecture. In other cases a lecture may be prerecorded and the scheduled class time will be available for guided discussion and problem solving.

Text: **There is no required text. Lecture notes can be supplemented and reinforced with material, available on reserve or electronically through the library website, listed in the reading/reference list to be provided on Moodle.**

Outline: This course focuses on computational aspects, implementation, continuous-time models, and advanced topics in Mathematical and Computational Finance. We shall cover the following topics:

- Brownian motion and stochastic calculus: elements of continuous-time finance, the Black-Scholes model, interest rate models;
- Monte-Carlo methods: Monte-Carlo for option valuation and Greeks, variance reduction techniques: antithetic variates, control variates, Longstaff-Schwartz method for American option valuation;
- Finite-difference techniques: heat equation, discretization, stability and convergence, Crank-Nicolson;
- Volatility: implied volatility, historical volatility, volatility surfaces, stochastic volatility;
- Hedging: discrete-time hedging, continuous-time hedging;
- Exotic derivatives: barrier options, lookback options, Bermudan options, Asian options;

- Risk management: risk measures, credit risk;
- Other topics (time permitting).

Course Evaluation: Weighted average of:
Assignments (40%), Moodle Quizzes (20%), and the Final Examination (40%).

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.

Assignments: There will be 5 or 6 assignments, due approximately every other week, which may include both theoretical and computational exercises. Your assignment solutions must be uploaded through Moodle as a single PDF document. Please use a (mobile) document scanner for any handwritten component and compile your solutions in the order in which the questions are posed. Source code from computational exercises must be included as an appendix.

Moodle Quizzes: There will be short Moodle Quizzes posted approximately weekly to reinforce online material and promote engagement. These quizzes can be completed during a fixed time period and/or following the viewing a particular video, lecture, module, or assigned reading. Some quizzes/problems will provide immediate feedback and multiple attempts so that students have an opportunity to return to the course material (e.g. watch a video lecture/module again) to reinforce their understanding.

Final Examination: The final exam will be a **take-home (open book) exam**. The exam problems will be provided at a certain date (to be determined) during the examination period and your solutions uploaded through Moodle before the specified deadline. Students are expected to work independently and not discuss the exam with classmates for the duration of the take-home exam period.

Programming: Some assignment and final exam problems will require programming for computational and numerical exercises. Students are encouraged to use an object oriented programming language such as C++ or Java for programming, as these are the industry standards for Quantitative Finance. Python or 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.

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: concordia.ca/students/academic-integrity." *[Undergraduate Calendar, Sec 17.10.2]*

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Disclaimer: In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in the course is subject to change.