Department of Mathematics & Statistics
Concordia University

MACF 402 (MAST 729/MAST 881), Sec. A (Fall 2026)
Mathematical & Computational Finance II

Instructor:	Dr. C. Hyndman
Email Address:	cody.hyndman@concordia.ca
Office Hours:	Tuesdays, 14:00-15:30.
Important:	Students should get the above information from their instructor and from the course Moodle site. The instructor is the person to contact should there be any questions about the course.
Class Schedule:	Tuesdays and Thursdays, 16:15-17:30.
Prerequisites:	MACF 401

Reading Week

Begins on Saturday, October 10 and ends on Friday, October 16, 2026. No classes that week.

Text

There is no required text. Lecture notes, slides, and exercises are self-contained. Recommended reference texts are listed on Moodle and available to download through the library website.

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:

- review of discrete-time option pricing, model calibration and implied-volatility trees;
- probability foundations, Brownian motion and stochastic calculus;
- continuous-time financial models, risk-neutral pricing and hedging;
- Monte Carlo simulation, SDE discretization and variance reduction;
- volatility estimation, implied volatility and volatility surfaces;
- stochastic interest rates and term-structure models;
- PDE valuation and finite-difference methods, including selected American or path-dependent claims;
- risk measures, Greeks, hedging and model risk; and
- selected additional topics, as time permits.

Course Evaluation

This course uses a combination of take-home, supervised and cumulative assessments. The assessment design is intended to develop both mathematical understanding and the ability to implement, validate and explain computational methods.

Take-home assignments (15%), Supervised computational assessments (20%), Staged integrated project (20%), In-class theory checks (5%), Final examination (40%).

Exact dates and detailed instructions will be posted on Moodle. Students will receive reasonable advance notice of supervised assessments and project milestones. The instructor may adjust the schedule to reflect the pace of the course, while preserving the published assessment weights.

Take-Home Assignments

Take-home assignments (approximately 3) provide sustained practice with the mathematical theory and computational methods developed in the course. They may include derivations, theoretical questions, programming tasks, numerical experiments and interpretation of results.

Assignments are intended to prepare students for the supervised computational assessments and final examination. Students are responsible for understanding and being able to explain all submitted work. Permitted use of generative-AI tools is governed by the Generative AI section of this syllabus and by the instructions for each assignment.

In-Class Theory Checks

Short theory checks (approximately 6) will be held periodically during scheduled class time. A theory check will normally take approximately 5–10 minutes and will focus on one or two important concepts from recent course material.

Questions may ask students to:

- state or apply a definition or theorem;
- complete a short derivation;
- identify an error in a mathematical argument;
- interpret a formula or modelling assumption;
- determine whether a proposed statement is true and justify the answer; or
- explain the mathematical reason for a computational result.

Theory checks are completed individually and normally without notes, electronic devices or generative-AI tools unless otherwise specified. They are intended to encourage regular engagement and provide prompt feedback about conceptual understanding.

The lowest theory-check score will be omitted when calculating the theory-check grade. This provision is intended to accommodate one occasional absence or short-term disruption. Additional absences are governed by the departmental policy stated in the **NOTE** below.

Supervised Computational Assessments

Supervised computational assessments will be completed individually during scheduled class time using a computer. These assessments evaluate whether students can independently apply and explain the computational methods developed in the course.

Students may be asked to:

- complete or modify partially provided code;
- implement a mathematical or numerical method;
- diagnose and correct an error;
- select an appropriate method or parameter;
- interpret numerical output;
- assess convergence, accuracy or computational efficiency;
- validate results against theoretical properties or benchmark values; and
- provide a brief mathematical explanation of their approach.

The assessment may provide starter code, data, formulas or documentation. The permitted software, programming language and other resources will be announced in advance. Unless explicitly permitted, communication with other people, external messaging, generative-AI systems and previously prepared solution code are not allowed.

Students are responsible for becoming familiar with the computational environment(s) used in the course. Practice materials and information about the expected software will be provided before the first assessment. Instructions will also explain how work is to be saved and submitted.

Supervised computational assessments may be conducted in a computer laboratory (LB-915.04); information will be posted on Moodle in advance.

Missed supervised computational assessments cannot be made up. Students who miss an assessment must follow the University's procedures for reporting an absence and contact the instructor as soon as reasonably possible. The treatment of a missed assessment is governed by the departmental policy stated in the **NOTE** below.

Staged Integrated Project

Students will normally work in small teams to produce an integrated computational analysis or system modelled on a collaborative quantitative-finance workflow. Each student will have primary responsibility for an identifiable mathematical and computational component. The team will be responsible for defining appropriate interfaces, integrating the components, validating the combined results and communicating the overall conclusions.

Project components may include market-data preparation, model calibration, derivative pricing, numerical implementation, risk measurement, validation or model comparison. The precise structure will depend on the assigned or approved project topic.

The project will be completed through a series of individual and team milestones. These may include a team proposal and interface specification, an individual mathematical and computational plan, a component demonstration, an integration checkpoint, a final reproducible submission and a brief

individual verification. Detailed milestone requirements and approximate submission windows will be posted on Moodle. Milestones are part of the assessment and are not merely optional drafts.

Assessment will consider the mathematical formulation, correctness of the implementation, integration and reproducibility, verification and validation, interpretation of numerical results, recognition of assumptions and limitations, and clarity of communication.

Grades will reflect both individual work and the quality of the integrated result. Individual grades may differ within a team. Each student must be able to explain their own component and demonstrate an understanding of how it interacts with the complete project. A failure or delay in one component will not automatically determine the grades of other team members, provided they have fulfilled their individual responsibilities.

Permitted use of generative-AI tools is governed by the Generative AI section of this syllabus and by the detailed project instructions.

NOTE: It is the Department's policy that assessments missed for any reason, **including illness**, cannot be made up. If you miss an assessment such as an assignment or in-class presentation **because of illness** ***(Short-Term Absence form or valid medical note required)*** the value of the assessment may be transferred to the final exam.

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.

PLEASE NOTE: Students are responsible for finding out the date and time of the final exam once the schedule is posted by the Examination Office. Any conflicts or problems with the scheduling of the final exam must be reported directly to the Examination Office, **not** to your instructor. It is the Department's policy and the Examination Office's policy **that students are to be available until the end of the final exam period. Conflicts due to travel plans will not be accommodated.**

Programming

Programming is an integral part of the take-home assignments, supervised computational assessments and staged project. R and Python will be the principal supported languages. Instructions for each assessment will specify the required or permitted language, software, packages and computational environment. Other languages, including C++ or Java, may be used only where expressly permitted. Students will be expected to read, run, modify, debug and validate computational code. Starter code or computational templates may be provided for some activities.

Generative AI

Generative artificial intelligence tools may be used to support learning and practice in this course. Permitted use in work submitted for credit depends on the type of assessment.

Generative-AI tools may be used on take-home assignments and designated stages of the project unless the instructions for a particular assessment state otherwise. They may not be used during in-class theory checks, supervised computational assessments, individual project-verification activities or the final examination unless their use is explicitly authorized.

Any permitted use of generative AI in submitted work must be documented in an appendix. The documentation must identify the tool or tools used, describe the tasks for which they were used, and explain how the resulting material was checked, modified and incorporated into the submission. More detailed disclosure requirements may be included in individual assessment instructions.

Material drawn from generative-AI tools must be acknowledged. Students remain responsible for the correctness of all mathematics, code, citations, numerical results and conclusions in their submissions, regardless of how the material was produced. Submitting fabricated information, inappropriate responses to the assigned problem, or material that the student is unable to explain, verify or modify constitutes misuse of generative AI and may also constitute an academic offence under the Academic Code of Conduct.

Permitted use of generative AI does not replace the student's responsibility to learn the course material independently. Students may be asked to explain, reproduce, validate or modify any part of submitted work.

Student Services

You may wish to access the many services available to you as a Concordia student. An overview of these resources can be found here: https://www.concordia.ca/students/services.html

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]*

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.

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.

Use of Concordia email

Your Concordia email is the official channel for all university communications, as required by the university's Policy on Concordia email accounts for students and employees. Please use your Concordia email for all communication related to this course and check it regularly so you don't miss important information. Learn more about how to access your Concordia email.

As a student, you are expected to follow the email policy and to use your Concordia email in a respectful and responsible manner. The policy helps ensure that communication across the university is secure, reliable, and consistent.

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.