Western Science

Department of Statistical and Actuarial Sciences

Mathematics of Financial Options, Financial Modelling 9578A
Course Outline for Fall 2021

1. Course Information

Course Information

- Course name: FM 9578A, Mathematics of Financial Options. (Term 1225)
- Lecture hours: Mondays 9:30-11:30 am, Wednesdays 9:30-10:30 am
- Location: TC 342

List of Prerequisites

Enrollment in a quantitative graduate program at UWO.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

Instructor	Email	Office Hours
Javad Rastegari	jrastega@uwo.ca	Online via Zoom (schedule TBA)

TA	Email	Office Hours
Yuyang Cheng	yche259@uwo.ca	-

- Any changes or additional information will be announced on OWL course website.
- Appointments are required for office hours.
- Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

3. Course Syllabus, Schedule, Delivery Mode

The goal of this course is to establish the mathematical foundation for valuation and hedging of financial derivatives in the context of discrete and continuous time stochastic processes. Securities such as bonds, futures, European and American options, and their arbitrage relations will be discussed. Discrete-time stochastic models for securities prices will be introduced. No arbitrage pricing and replication of securities in these models will be investigated. Martingales, risk-neutral valuation, and asset pricing

theorems in discrete time will be covered. The Cox-Ross-Rubinstein binomial model and its application to valuation of various types of options will be studied in more details. In continuous-time the Brownian motion, the Black-Scholes differential equation and its solutions will be discussed. The Black-Scholes pricing formula and its hedging parameters will be covered. Note that some of these topics may be omitted and others studied, as time and interests allow.

Note: Background knowledge in linear algebra, calculus, differential equations, and probability theory will be assumed in the course.

Learning Outcomes

Upon successful completion of this course, students will be able to:

- understand the properties of financial securities such as call and put options;
- understand uses of these securities in hedging, trading and financing;
- assess the risk/reward of trading strategies;
- identify arbitrage opportunities and construct trading strategies to exploit them;
- replicate the payoff of various securities;
- construct discrete-time stochastic models for securities prices;
- understand properties of discrete-time stochastic processes such as conditional expectation and martingales;
- price securities by risk-neutral valuation and by no-arbitrage;
- dynamically hedge securities using discrete-time models;
- price and hedge equity options using Cox-Ross-Rubinstein binomial model;
- understand the difference between complete and incomplete market models;
- price exotic options involving various assets and/or path dependency.
- understand the Brownian motion, the Black-Scholes differential equation and its pricing formula
- price and hedge equity options using Black-Scholes formula.

Table of Lectures Schedule

Type	Mode	Dates	Time	Frequency
Lecture	In-person	Mondays	9:30-11:30 am	weekly
Lecture	In-person	Wednesdays	9:30-10:30 am	weekly

Key Sessional Dates

- Classes begin: September 8, 2021
- Reading Week: November 1–7, 2021
- Classes end: December 8, 2021

Contingency plan for an in-person class pivoting to 100% online learning
In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

4. Course Materials

The instructor will use his own set of course notes during lectures. The course content is mainly based on selected material from the following textbooks:

- John Hull. Options, Futures, and other Derivatives. Pearson. (10th edition or later)
- Cvitanic and Zapatero. Introduction to the Economics and Mathematics of Financial Markets. MIT Press, Cambridge Massachusetts.
- Campolieti and Makarov. Financial Mathematics: A comprehensive treatment.

The following textbook is also recommended for further studying:

- Shreve. Stochastic Calculus for Finance I & II.

Students are responsible for checking the course OWL site (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class. All course material will be posted to OWL: http://owl.uwo.ca.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Technical Requirements

- Laptop or computer with working microphone and webcam
- Stable internet connection
- Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently.

5. Methods of Evaluation

Students will be evaluated on the basis of three Assignments, a Midterm Test, and a Final Exam. The overall course grade will be calculated as listed below:

Assignments(3)	35%
Midterm Test	25%
Final Exam	40%

Assignments: Assignments constitute an essential part of the course and may require solving practice problems, learning about more financial instruments and models, and using Excel worksheets and/or codes in MATLAB or Python to apply option pricing models to market data. Weights and due dates are:

	Weight	Deadline
Assignment 1	10%	Due by Oct. 6, 9:30 am
Assignment 2	10%	Due by Nov. 10, 9:30 am
Assignment 3	15%	Due by Dec. 8, 9:30 am

Tests and Final Exam: The midterm test and final exam will be in online linear format. Students can use course textbooks, course slides, course lecture notes, and course assignments during exams. Any changes to the exam format will be announced on OWL website. The midterm test will be held on **Monday, Oct. 18, 2021,** during class time (tentative date; subject to the Exam Central's confirmation). The exact time of the Final exam is TBA. See "Academic Policies" for more details on online examinations.

Note: Any request regarding the remark of midterm must be submitted to the instructor within **one week** after the exam grades are revealed.

Accommodated Evaluations

- There will not be any make-up tests. For those who do legitimately miss the midterm test and provide the required supporting documentation, the weight of the midterm will be transferred to the final exam.
- Late assignments will be subject to a late penalty of 20% of the assignment weight if submitted within 24 hours of the deadline, and will receive a grade of zero if submitted later than 24 hours past the deadline.
- An assignment cannot be submitted after the solution has been released to the class. The weight of a legitimately missed assignment will be transferred to the final exam.

6. Student Absences

Academic Consideration for Student Absences

Students who experience an extenuating circumstance (illness, injury or other extenuating circumstance) sufficiently significant to temporarily render them unable to meet academic requirements may submit a request for academic consideration through the following routes:

(i) For medical absences, submitting a Student Medical Certificate (SMC) signed by a licensed medical or mental health practitioner to the Academic Counselling office of their Faculty of Registration.

(ii) Submitting appropriate documentation for non-medical absences to the Academic Counselling office in their Faculty of Registration.

Note that in all cases, students are required to contact their instructors within 24 hours of the end of the period covered, unless otherwise instructed in the course outline.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For the policy on Academic Consideration for Student Absences – Undergraduate Students in First Entry Programs, see:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

and for the Student Medical Certificate (SMC), see:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Religious Accommodation

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

Absences from Final Examinations

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

7. Accommodation and Accessibility

Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD), which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf,

8. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,

the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Only **non-programmable calculators** may be used for tests and exams. Other electronic devices such as PDA's, cell phones, etc., will be **not** be allowed for exam. Softwares, packages, spreadsheets, online calculators, etc., will **not** be allowed for exam.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Tests and examinations in this course will be conducted using Zoom or a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at:

https://remoteproctoring.uwo.ca.

In case Zoom is used for exam invigilation, you will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam.

9. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at (519) 661-2147 if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (http://www.sdc.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mentalhealth) for a complete list of options about how to obtain help.

Additional student-run support services are offered by the USC, http://westernusc.ca/services.