Department of Statistical and Actuarial Sciences

Mathematics of Financial Options, Financial Modelling 9578A, Section 650

Course outline for Fall 2020

Although this academic year might be different, Western University is committed to a **thriving campus**. We encourage you to check out the Digital Student Experience website to manage your academics and well-being. Additionally, the following link provides available resources to support students on and off campus: https://www.uwo.ca/health/.

Technical Requirements and Important Dates:

Stable internet connection

Laptop or computer

Working microphone

Working webcam

Classes Start	Reading Week	Classes End	Study day(s)	Exam Period
September 9	November 2 - 8	December 9	December 10	December 11 - 22

* November 12, 2020: Last day to drop a first-term half course or a first-term full course without penalty

1. Course Information

- Course name: FM 9578A, Mathematics of Financial Options (Term 1208).
- Lecture hours: Mondays 9:30-11:30 am, Wednesdays 9:30-10:30 am
- Lecture delivery mode: Online via Zoom

List of Prerequisite(s)

Enrollment in a quantitative graduate program at UWO.

List of Antirequisite(s)

None

Pre-requisites Warning: 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	Contact Information
Javad Rastegari	jrastega@uwo.ca

Teaching Assistant	Contact Information
Xing Gu	xgu55@uwo.ca

Instructor Office Hours	Zoom or MS Teams or in Person
Tuesday 10:30-12:00	Zoom

- Any changes 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, and 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 (differentiation, integration, Taylor series, elementary differential equations, etc.) and probability (discrete and continuous random variables, expectation and variance, etc.) will be assumed in the course.

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

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.

Online Participation and Engagement

☒ Students are expected to attend the lectures and participate in discussions.

☒ Students can also participate by interacting in the forums with their peers and instructor.

4. Course Materials

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

- John Hull. Options, Futures, and other Derivatives. Pearson. (8th 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.

Students should check OWL (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. Students are responsible for checking OWL on a regular basis.

All course material will be posted to OWL: http://owl.uwo.ca. Any changes will be indicated on the OWL site and discussed with the class.

If students need assistance, 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.

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click here.

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. 14, 9:30 am
Assignment 2	10%	Due by Nov. 11, 9:30 am
Assignment 3	15%	Due by Dec. 9, 9:30 am

Tests and Final Exam: The Midterm test will be held online during class time. The Final Exam will also be online. The exact time of Midterm test and Final exam is TBA. See “Academic Policies” for more details on online examinations.

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 without illness self-reports will be subject to a late penalty of 20% (of the assignment grade) if submitted within 24 hours of the deadline.
- Late assignments without illness self-reports can not be submitted later than 24 hours past the deadline, and will receive a grade of zero.
- Late assignments with illness self-reports should be submitted within 24 hours of submission of the last illness self-report
- 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.
- If permission to waive the requirement that students receive evaluation on work totaling 15% of their final grade at least three days prior to the deadline for withdrawal without

academic penalty has been obtained from the Dean's Office, a statement to this effect must be made.

Rounding of Marks Statement

Across the Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. ***Final grades*** on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.4 becomes 74, and 74.5 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g. a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark "bumping" will be denied.

6. 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 Academic Accommodation for Students with Disabilities policy can be found at:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

Academic Consideration for Student Absence

Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the semester, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

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 policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs, see:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf
and for the Student Medical Certificate (SMC), see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Religious Accommodation

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar:
https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

7. Academic Policies

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

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, 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.

Participants in this course are **not** permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

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.

Online Examinations

Tests and examinations in this course will be conducted using both Zoom and the remote proctoring service, such as Proctortrack.

When 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. The exam session using Zoom will not be recorded.*

Proctortrack will require you to provide **personal information** (including some biometric data). The session will be **recorded**. By taking this course, you are consenting to the use of this software.

More information about remote proctoring is available in the Online Proctoring Guidelines at the following link:
https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf

Completion of this course will require you to have a reliable internet connection and a device that meets the system and technical requirements for both Zoom and Proctortrack. Information about the system and technical requirements are available at the following links:
https://www.proctortrack.com/tech-requirements/
https://support.zoom.us/hc/en-us

* Please note that Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please provide this information to the instructor in advance of the test or examination.

Professionalism & Privacy

Western students are expected to follow the Student Code of Conduct. Additionally, the following expectations and professional conduct apply to this course:

☒ Students are expected to follow online etiquette expectations provided on OWL

☒ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared

☒ Recordings are not permitted (audio or video) without explicit permission

☒ Permitted recordings are not to be distributed

☒ Students will be expected to take an academic integrity pledge before some assessments

☒ All recorded sessions will remain within the course site or unlisted if streamed

Copyright Statement

Please be aware that all course materials created by the instructor(s) are copyrighted and cannot be **sold/shared**. Those include materials used in tests/quizzes, midterms, and finals. Any posting/sharing of such materials in part or whole without owner's consent is considered as violation of the Copyright Act and will be considered as a scholastic offence.

In addition, online services such as Chegg are actively monitored. Any questions that are coming out during midterms and finals and are posted to an online service will be searched. Such an activity will be considered as a scholastic offence and will result in academic penalty.

8. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on add/drop 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 Student Accessibility Services (SAS) at (519) 661-2147 if you have any questions regarding accommodations.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

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/mental_health) 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.