

FM4521B/9521B Course Outline for Winter 2024

1. Course Information

Course Information

Course Name:	Advanced Financial Modelling
Course Number:	FM4521B/9521B
Academic Term:	Winter, 2024
Lecture Hours:	Tu 11:30 – 12:30 PM; Th 11:30 – 1:30 PM
Lecture Room:	WSC-240

List of Prerequisites

A minimum mark of 60% in either [Financial Modelling 3520A/B](#), or [Financial Modelling 3613A/B](#) and a minimum mark of 60% in [Statistical Sciences 2857A/B](#).

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Counselling) 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

Instructors	Email	Office	Phone	Office Hours
Dr. Hao Yu	hyu@stats.uwo.ca	WSC 217	519-661-3622 (x83622)	TBA
TA: Neslihan Serra Desdemir	ndesdemi@uwo.ca			
TA: Kaize Pan	kpan26@uwo.ca			

Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

Office hour format: in-person or through Zoom by appointment.

3. Course Syllabus, Schedule, Delivery Mode

In this course, you will learn continuous-time models, Brownian motion, stochastic integrals, Ito's lemma, Black-Scholes-Merton model, arbitrage, and market completeness, Black-Scholes PDE, risk-neutral pricing and martingale measures. Other topics include Greeks and hedging, extensions of Black-Scholes model, implied volatility, American option valuation, Vasicek and Cox-Ingersoll-Ross interest rate models.

Learning Outcomes

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

- Use stochastic integral (SDE) to represent underlying risk assets.
- Use Ito's lemma to work out various SDE forms.
- Explain the concepts underlying the risk-neutral approach to valuing derivative securities.
- Implement the risk-neutral pricing formula using Monte Carlo simulation.
- Interpret and compute option Greeks (Delta, Gamma, Theta, Vega, and Rho).
- Understand the concept of implied volatility.

Classes begin:	January 8, 2024
Winter Reading Week:	February 17 – 25, 2024
Classes end:	April 8, 2024
Exam period:	April 11 – 30, 2024

Contingency plan

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will **not** change. Any assessments affected will be conducted online as determined by the course instructor.

4. Course Materials

Main Text: John Hull (2022). Options, Futures, and Other Derivatives, 11th edition. Pearson Prentice.

Reference: Jaksza Cvitanic and Fernando Zapatero (2004). Introduction to the Economics and Mathematics of Financial Markets. MIT Press, Cambridge, Massachusetts.

Specific Topics to covered with text and reference readings: H = Hull text; CZ = Cvitanic and Zapatero reference

1. Recap of pricing concepts from FM3520. Basic elements of stochastic processes, Brownian motion, Ito's lemma, risk-neutral and martingale measures, Black-Scholes PDE, risk-neutral valuation, the connection between PDE and conditional expectation under the risk neutral measure pricing approaches. **Readings:** H Chapters 13, 14, 15 and CZ Section 7.2.
2. Extension of Black-Scholes to the pricing of options on stock indices, currencies, and futures. **Readings:** H Chapter 17 and CZ Sections 7.4.2, 7.5.1, 7.5.2.
3. Introduction to the basics of Monte Carlo Methods in Finance. **Readings:** H Section 21.6 and CZ Section 11.2.1.
4. American Options and their valuation using binomial trees. **Readings:** H Section 13.5 and CZ Section 7.3.
5. The Greeks and hedging in practice. **Readings:** H Chapter 19, CZ Sections 9.3.1--9.3.5, 9.3.7 and 9.3.8.
6. Implied Volatilities; volatility smiles, smirks, skews, and surfaces. **Readings:** H Chapter 20.
7. ARCH and GARCH. **Readings:** H Chapter 23 and CZ Section 7.8 (when time permits).
8. Exotic Options. **Readings:** H Chapter 26, CZ Sections 7.5.3 and 7.6.
9. Introduction to stochastic interest rate models (Vasicek/CIR) and term structure derivatives. **Readings:** H Sections 31.1--31.2.

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.

5. Methods of Evaluation

The overall course grade will be calculated as listed below:

Assignments (4)	20% [Given out roughly every three weeks]
Midterm Tests (2)	35% [In-class Exam 1: February 29, 2024 & In-class Exam 2: March 21, 2024]
Final Exam	45% [To be determined by the Registrar's Office]

Assignments: There are 4 assignments, given out roughly one every three weeks. All assignments must be done electronically (all assignments must be prepared using RStudio Markdown/Notebook (PDF)) and be submitted to owl before deadline. No late assignment is allowed unless a coupon(s) is used. See details in Section 6.

Accommodated evaluations for midterms: If you miss a midterm due to an excused absence (see also Section 6) then the weight of that assessment will be moved to the final exam. If the absence is not excused, then you will receive a grade of zero with no option to submit late or alternate work.

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. Student Absences

For students enrolled in FM4521B, if you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

- (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.

For students enrolled in FM9521B, you are required to contact their instructors within 24 hours of the end of the period covered to get approved, unless otherwise instructed in the course outline.

Assessments worth less than 10% of the overall course grade:

Each student has two coupons that can be used for handling assignments after passing the deadline. Each coupon allows up to 24 hours after deadline. That is, if an assignment is due on Feb 28, 11:55 pm, you can handle in your assignment before Feb 29, 11:55 pm with one coupon used. You can stack two coupons together so that you can handle in your assignment on March 1, 11:55 pm.

Late Submissions if two coupons are already used up.

- Assignments that are submitted late will be subject to a 20% penalty per day or portion thereof, including weekends and holidays.
- Assignments that are submitted 5 or more days late will not be graded.

Assessments worth 10% or more of the overall course grade:

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at

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

The Student Medical Certificate is available at

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

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

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>.

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, 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 their official university address is attended to in a timely manner.

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.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

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/>.

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

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (<https://learning.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.

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

This course is supported by the Science Student Donation Fund. If you are a BSc or BSc student registered in the Faculty of Science or Schulich School of Medicine and Dentistry, you pay the Science Student Donation Fee. This fee contributes to the Science Student Donation Fund, which is administered by the Science Students' Council (SSC). One or more grants from the Fund have allowed for the purchase of equipment integral to teaching this course. You may opt out of the Fee by the end of September of each academic year by completing the online form linked from the Faculty of Science's Academic Counselling site. For further information on the process of awarding grants from the Fund or how these grants have benefitted undergraduate education in this course, consult the Chair of the Department or email the Science Students' Council at ssc@uwo.ca.