



Advanced Financial Modelling 2018/2019

[Financial Modelling 9521B/4521B Section 001](#)

Course Outline

Instructor Information

Instructor	Hao Yu
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Office Hours	TBA

Course Information

Course Description	Continuous-time models, Brownian motion, stochastic integrals, Ito's lemma. Black-Scholes-Merton market model, arbitrage and market completeness, Black-Scholes PDE, risk-neutral pricing and martingale measures. Greeks and hedging, extensions of Black-Scholes model, implied volatility, American option valuation. Vasicek and Cox-Ingersoll-Ross interest rate models.
Prerequisites	SS2857A/B , SS3520A/B A minimum mark of 60% in either Financial Modelling 3520A/B (or the former Statistical Sciences 3520A/B), or Financial Modelling 3613A/B (or the former Applied Mathematics 3613A/B) and a minimum mark of 60% in Statistical Sciences 2857A/B. A minimum mark of 60% in either Statistical Sciences 3520A/B.
Antirequisites	SS4521F/G The former Statistical Science 4521F/G.
Pre,Co-requisites	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. You can be deregistered at any time even after writing the final exam. 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
Warning	
Lecture Hours	Tue 11:30 AM-12:30 PM WSC 248; Thu 11:30 AM-1:30 PM WSC 248;

Book Information

Text Book(s)

The lectures will be based (see also note below) on John Hull's (10th ed) *Options, Futures, and Other Derivatives*, Prentice Hall, New Jersey. [H]

Jaksa Cvitanic and Fernando Zapatero (2004). *Introduction to the Economics and Mathematics of Financial Markets*. MIT Press, Cambridge, Massachusetts. [CZ]

NOTE: Whilst the materials will be based on H and CZ, **the instructor will supplement these with more mathematical materials based on his course/lecture notes.** You are responsible for the lecture materials that you miss if you are unable to attend the class.



Course Objectives

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.

Assessment

Assignments and/or Quizzes

There are four assignments.

Midterms or Tests

Two midterm tests, given in class.

The first midterm: Feb (TBA)

The second midterm: March (TBA)

Final Exam

Final examination: TBA

Evaluation

Four assignments, 5% each; Two midterm tests, 20% each; Final examination, 40%.

Computing and/or Calculator Requirement

R will be needed for assignments.

Calculators: Any non--programmable calculators may be used for tests.

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

1. Recap of pricing concepts from SS3520. 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 Chapter 12, 13, 14 and CZ Section 7.2.
2. Extension of Black--Scholes to the pricing of options on stock indices, currencies, and futures. **Readings:** H Chapter 16 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 20.6 and CZ Section 11.2.1.
4. American Options and their valuation using binomial trees. **Readings:** H Section 12.5 and CZ Section 7.3.
5. The Greeks and hedging in practice. **Readings:** H Chapter 18, 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 19.
7. ARCH and GARCH. **Readings:** H Chapter 22 and CZ Section 7.8.
8. Exotic Options. **Readings:** H Chapter 25, CZ Sections 7.5.3 and 7.6.
9. Introduction to stochastic interest rate models (Vasicek/CIR) and term structure derivatives. **Readings:** H Sections 30.1--30.2.

Department Policy on Missed Course Requirements and Student Health and Wellness



If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your Dean's office as soon as possible, and contact your instructor immediately. If accommodation is approved by your Dean's office, your instructor will be notified, then it is your responsibility to make alternative arrangements with your instructor. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see: http://fisher.stats.uwo.ca/accommodation_medical.pdf. A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility. The form can be found at: <http://fisher.stats.uwo.ca/medicalform.pdf>. Or, request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services.

Missed Midterm or Test: The policy of the department of Statistical and Actuarial Sciences is that there will be no make-up exams for a missed midterm. For those that do legitimately miss a midterm and provide the required supporting documentation, the standard practice will be that the weight of the midterm will be reassigned to the final exam. If your reason is not deemed valid, then you will receive a mark of 0.

Student Health and Wellness: As part of a successful student experience at Western, we encourage students to make their health and wellness a priority. Western provides several on campus health-related services to help you achieve optimum health and engage in healthy living while pursuing your degree. For example, to support physical activity, all students, as part of their registration, receive membership in Western's Campus Recreation Centre. Numerous cultural events are offered throughout the year. Please check out the Faculty of Music web page <http://www.music.uwo.ca/>, and our own McIntosh Gallery <http://www.mcintoshgallery.ca>. Information regarding health- and wellness-related services available to students may be found at <http://www.health.uwo.ca/>.

Students seeking help regarding mental health concerns are advised to speak to someone they feel comfortable confiding in, such as their faculty supervisor, their program director (graduate chair), or other relevant administrators in their unit. Campus mental health resources may be found at http://www.health.uwo.ca/mental_health/resources.html.

To help you learn more about mental health, Western has developed an interactive mental health learning module, found here: https://www.uwo.ca/health/mental_wellbeing/education/module.html. This module is 30 minutes in length and provides participants with a basic understanding of mental health issues and of available campus and community resources. Topics include stress, anxiety, depression, suicide and eating disorders. After successful completion of the module, participants receive a certificate confirming their participation.

Accessibility: 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 Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.

Support Services: Learning-skills counsellors at the Student Development Centre (SDC) (<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.

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



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

Email Communication

You are welcome to communicate with your instructor by email, but email communication should only be used to provide them with information or to ask a question that requires a brief response. For more lengthy discussions and for discussions on lectures/course material please see your instructor during their scheduled office hours or by appointment. If you do email them, please use your UWO account, as these are often the only emails read (as emails sent from other addresses often get spammed).

Attendance

Attendance: Classroom attendance is viewed as an important part of the learning process. Students are advised that excessive absenteeism may result in the student being disbarred from the final exam (see Western Academic Calendar). **Class Environment Policy:** The Department has adopted a "Mutual Expectations" policy governing the classroom environment and all work submitted by students. The full text of the policy can be found at: http://www.stats.uwo.ca/mutual_expectations.pdf. In summary, the policy was developed under the premise that all interactions between students and faculty should be governed by the principles of courtesy, respect and honesty. Students who are in emotional/mental distress should refer to Mental Health@Western <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help. **Academic Integrity:** We expect our students to conduct themselves academically in a manner that upholds the integrity and reputation of our academic programs. Cheating on assignments, exams, essays and term papers is considered to be a serious violation of ethical conduct, and will not be tolerated.

Classroom Environment

Registrarial Services: <http://www.registrar.uwo.ca/> Learning-skills services at the SDC: <http://www.sdc.uwo.ca/> Universities Students' Council: <http://westernusc.ca/>