

Department of Statistical & Actuarial Sciences
The University of Western Ontario
London, Ontario, Canada

FINANCIAL MODELLING 4521B/9521B
(Advanced Financial Modelling)
Winter 2018

Instructor: Dr Rogemar S Mamon
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Course Website: Announcements and certain course materials will be posted in the OWL course website. Please check this site before coming to the lectures.

Office Hours: 13:00– 14:30 Tuesday and 14:00-15:30 Thursday

To ensure that you are able to see me and do not have to wait as other students may already have a prior appointment, please send me a brief email stating that you would like to have an appointment , the nature of your queries, and the time you will drop by.

If the times and days above are not convenient for you, just propose a few alternatives, and the instructor will work around his daily schedules.

Lectures: Tuesday 11:30-12:20 and Thursday 11:30-13:20 in WSC 248.

Prerequisites: A minimum mark of 60% in either FM 3520A/B or FM 3613A/B.

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.

Main Texts: The lectures will be based (see also note below) on John Hull's 10th Ed *Options, Futures, and Other Derivatives*, Prentice Hall, New Jersey.

NOTE: Whilst the materials will be based on Hull, 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.

The sequencing of specific topics together with the relevant sections from the Hull's book is given at the latter part of this course outline.

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

sections of chapters 5, 8, 9 and 11 from Cvitanic and Zapatero are relevant to the topics that will be discussed in class.

- Evaluation:** Students will be assessed on the basis of **3 assignments (A)**, **two midterm tests (M)**, and **a final examination (F)**. Your final grade will be computed as follows:
 $0.2*A + 0.4*M + 0.4*F$
- A mark of 80% or better in this course in combination with a mark of 80% or better in SS3520A/B can be used as an exemption from the MFE exam of the Canadian Institute of Actuaries.
- Assignments:** There will be three problem sets in this course and will be given every **3-4 weeks**. Each problem set will be posted in the course website one week before the due date of the questions required for submission, which will be taken from the problem sets. The due dates are: **01 February 2018** for Assignment #1; **13 March 2018** for Assignment #2; and **03 April 2018** for Assignment #3. **Submit your assignments in class before the lecture begins on the due date.** **Under no circumstances will late assignments be accepted.**
- Tests:** Two 2-hour tests will be given in class on **08 February 2018 (Thursday)** and **20 March 2018 (Tuesday)**. For both exams, **Time: 18:30-20:30** **Venue: EC 2155**
- Calculators:** Any non-programmable calculator may be used for tests and the final exam.
- Missed Tests or Assignments:** If you have a conflict, please see me as soon as possible (and **prior** to the test). There will be no make-up tests or assignments. For those who legitimately miss a test and provide the required supporting documentation, the standard practice will be that the weight of the missed test will be reassigned to the final exam. For those who are unable to hand in an assignment and provide the required supporting documentation, the standard practice will be that the weight of the missed assignment will be distributed equally to the other assignments.
- Distinction between FM 9521 and FM 4521:** FM 9521 students are taken by students registered in the graduate programmes whilst FM 4521 students are taken by students registered in the undergraduate programmes. FM 4521/9521 will have the same assignments and midterms.
- However, for the final exam, only 70% of the questions will be the same for all students. The remaining 30% of the questions will be set appropriate to 4th-year undergrad level (for FM 4521) and Master's level (for FM 9521).
- Student's responsibility:** If a student is unable to meet a course requirement due to illness or other serious circumstances, the student must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact his or her instructor immediately. It is the student's responsibility to make alternative arrangements with his or her instructor once the accommodation has been approved and the instructor has been informed. 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://www.uwo.ca/univsec/handbook/appeals/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 here:
https://studentservices.uwo.ca/secure/medical_document.pdf

Or, request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services."

E-mail Policy:

Only e-mails originating from your UWO e-mail accounts will be answered. E-mail is a good medium to (i) set up an appointment, (ii) inform me about absences [you still need to obtain the appropriate documentation] and (iii) ***clarify assignment questions or solutions and very short questions that require very short answers.*** There will be NO reply to e-mail that entails lengthy and detailed explanations; it is imperative that you make an appointment **and** see me in my office to discuss such questions/concerns in person.

Plagiarism:

Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

Other:

Mutual Expectations of Students and Instructors

Official university documents state that as part of its mission UWO “seeks to provide an environment of free and creative enquiry within which critical thinking, humane values, and practical skills are cultivated and sustained.” A first step in creating and maintaining this environment in the class is to have some mutual expectations between the instructor and the students on the atmosphere for instruction in the course.

From the students, the instructor should expect:

1. **that students will not engage in disruptive behaviour, including talking out of turn or social chatting, during class time;**
2. that the submitted version of an assignment represents the student’s independent work—this does not preclude true collaboration in discussing problems (the submission of a fraudulent assignment is a **Scholastic Offence** as outlined in Senate Regulations in the Western Academic Calendar; and

From the instructor, students should expect:

1. to receive at the beginning of term a clear course outline (see Senate Regulations as outlined on the web at www.uwo.ca/univsec/handbook/exam/crsout.pdf for content of the outline);
2. that the instructor will come prepared for class;
3. that the instructor will attend lectures regularly;
4. that the instructor will begin punctually and not run beyond the allotted time for the class;

5. that out of class the instructor will hold and be available at regularly posted office hours; and
6. that term tests and assignments will be returned within a reasonable period of time after submission.

Attendance

Any student who, in the opinion of the instructor, is absent too frequently from class or lab period in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

Support Services

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.

The policy on Accommodation for Students with Disabilities can be found here:

www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here:

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

Specific topics to be covered with relevant readings

JH-John Hull's text 8th ed.

JCFZ-J Cvitanic & F Zapatero's textbook

- ❖ Recap of certain pricing/valuation concepts from Stats 3520. Basic elements of stochastic processes, random walk and their properties, Brownian motion, Itô's lemma, risk-neutral/martingale measure, Black-Scholes PDE, risk-neutral valuation and the connection between pricing PDE and conditional expectation under the martingale measure.
Relevant readings: Chapters 14 and 15 in JH; and 7.2 in JCFZ
- ❖ Extension of Black-Scholes to the pricing of options on stock indices, currencies and futures.
Relevant readings: Chapter 17 in JH and sections 7.4.2, 7.5.1, 7.5.2 in JCFZ
- ❖ Introduction to the basics of Monte-Carlo methods in finance. Simulation of correlated assets
Relevant readings: Sections 14.3-14.4, 21.6 in JH and section 11.2.1 in JCFZ
- ❖ Recap of American options and their valuation
Relevant readings: Sections 13.5-13.9 in JH and section 7.3 in JCFZ
- ❖ The "Greeks" and hedging in practice
Relevant readings: Chapter 19 in JH and sections 9.3.1-9.3.5, 9.3.7, 9.3.8 in JCFZ

- ❖ Volatility smiles/smirks, skews and volatility surfaces
Relevant readings: Chapter 20 in JH. No relevant materials from JCFZ.
- ❖ Estimating Volatilities (ARCH/GARCH)
Relevant readings: Chapter 23 in JH and section 7.8 in JCFZ
- ❖ Exotic options
Relevant readings: Chapter 26 in JH; and sections 7.5.3 and 7.6 in JCFZ
- ❖ Basic introduction to stochastic interest rate models (Vasicek and Cox-Ingersoll-Ross models) and term-structure derivatives
Relevant readings: Sections 32.1-32.8 in JH.