



## Advanced Financial Modelling 2013/2014

Statistical Science 9521B/4521G Section 001

### Course Outline

#### Instructor Information

<b>Instructor</b>	Rogemar Mamon
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#### 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](#) A minimum mark of 60% in either Statistical Sciences 3520A/B (or the former Statistical Sciences 4520A/B) or Applied Mathematics 3613B and a minimum mark of 60% in Statistical Sciences 2857A/B. A minimum mark of 60% in either Statistical Sciences 3520A/B.

**Pre,Co-requisites Warning** Unless you have either the prerequisites 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

**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 (8th ed) *Options, Futures, and Other Derivatives*, Prentice Hall, New Jersey. [JH]

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

**NOTE: Whilst the materials will be based on JH and JCFZ, 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.

#### Course Objectives

#### Assessment



### Assignments and/or Quizzes

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: 30 January 2014 for Assignment #1; 04 March 2014 for Assignment #2; and 03 April 2014 for Assignment #3.

**Submit your assignments in class before the lecture begins on the due date. Under no circumstances will late assignments be accepted.**

### Midterms or Tests

Two 2-hour mid-term tests will be given on 13 February 2014 (Thursday) and 13 March 2014 (Thursday).

Venue: TBA

### Final Exam

The date and time of the 3-hour final exam in April 2014 is set by the Registrar's Office.

### 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:  $0.2*A + 0.4*M + 0.4*F$ .

NOTE: 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.

### Course Website Information

Announcements and certain course materials will be posted in the course website. You can find the URL link from this address: <http://www.stats.uwo.ca/faculty/rmamon>

Please check the course website before coming to the lecture.

### Computing and/or Calculator Requirement

Any non-programmable calculator may be used for tests and the final exam.

### Notes on Office Hours

My office hours are: 10:45 – 11:50 Mon, Wed and Fri.

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.

### 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.



## 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).

## Specific topics to be covered with relevant readings for SS4521G/FM(9521B)

**JH**-John Hull's text 8<sup>th</sup> ed.

**JCFZ**-J Cvitanic & F Zapatero's textbook

- Recap of certain pricing/valuation concepts from Stats 3520. Basic elements of stochastic processes, 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:** Chapter 13 and sections 14.1-14.8 in JH; and 7.2 in JCFZ

- Extension of Black-Scholes to the pricing of options on stock indices, currencies and futures.

**Relevant readings:** Sections Chapter 16 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 13.3, 20.6 in JH and section 11.2.1 in JCFZ

- Recap of American options and their valuation

**Relevant readings:** Sections 12.5-12.9 in JH and section 7.3 in JCFZ

- The "Greeks" and hedging in practice

**Relevant readings:** Chapter 18 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 19 in JH. No relevant materials from JCFZ.

- Estimating Volatilities (ARCH/GARCH)

**Relevant readings:** Chapter 22 in JH and section 7.8 in JCFZ



- Exotic options

**Relevant readings:** Chapter 25 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 30.1-30.8 in JH.

## Department Policy on Missed Course Requirements

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://www.stats.uwo.ca/accommodation\\_medical.pdf](http://www.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://www.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](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: [http://www.health.uwo.ca/mental\\_health/module.html](http://www.health.uwo.ca/mental_health/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**

*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 during exams [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.

### **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).

### **Classroom Environment**

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](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/uwoom/mentalhealth/> for a complete list of options about how to obtain help.