

Stochastic Processes with Applications in Finance and Actuarial Science Fin Mod 9590A. Course Outline

1. Course Information

Course Information

Course Description: The aim of this course is to provide stochastic tools for financial modelling and pricing. It covers the basis theories of stochastic processes and stochastic calculus, with examples coming from finance.

Lecture Hours: Fridays 2:30-5:30 pm (WSB248), in-person.

List of Prerequisites

SS 2858A/B or equivalent and consent of instructor if you are not enrolled in the DSAS graduate programmes.

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 |
|---------------------|-----------------------|--------|-------|-----------------------------------|
| Marcos Escobar-Anel | marcos.escobar@uwo.ca | WSB282 | | Wed, 8-10am, WSB282, in-person |
| TA (TBD) | | | | |

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

3. Course Syllabus, Schedule, Delivery Mode

Course Objectives:

After completing this course, students will be able to:

- understand essential elements of stochastic processes such as filtrations, conditional expectation, martingales;
- work with multidimensional Brownian motion;
- understand Ito's processes and the Ito's differentiation rule;

- show existence and uniqueness of solutions of Stochastic Differential Equations;
- understand Feynman-Kac formula and applications;
- understand Girsanov theorem and numeraire processes;
- replicate the payoff of various securities using self-financing portfolios;
- construct continuous-time models for security prices;
- price securities by risk-neutral valuation and by no-arbitrage;
- understand implied volatility, surface and various volatility models;
- price and hedge equity options using Black-Scholes in a continuous-time framework;
- simulate stochastic processes using Euler discretisation;
- generate Monte Carlo simulation for option pricing;
- explore stochastic interest rate models and Bond pricing.

See lecture notes for a break-down of course topics in a “table of contents” format with an approximate timeline.

Lecture Hours: Fridays 2:30-5:30 pm (WSB248), in-person.

Classes begin: September 7, 2023; January 8, 2024

Fall Reading Week: October 30 – November 5, 2023; February 17 – 25, 2024

Classes end: December 8, 2023; April 8, 2024

Exam period: December 10 – 22, 2023; 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

Textbook(s):

Tomas Björk (2009). *Arbitrage Theory in Continuous Time*. Oxford University Press, Oxford.

Bingham & Kiesel (2004): *Risk-neutral valuation*, 2nd ed.

Note that these textbooks will only be used as a guide. The instructor will use his own set of course notes during lectures.

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

Assignments and/or Quizzes: Two assignments of equal weight (15%). Due dates: 29-Sept, and 10-Nov.
Midterms or Tests: One midterm, 25%, (combining Multiple Choice with open-Ended questions), 2 hours long on 20-October.

Final Exam: One final exam, 45%, 3 hours long, 11-Dec, 9am-12pm, room to be determined.

Evaluation: Students will be evaluated on the basis of assignments, one mid-term test, and a final examination. The final mark will be based on a weight of 30% for assignments, 25% for the mid-term test, and 45% for the final exam.

6. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

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.

In case of valid documentation, there will be a reweighting of the final examination; in the absence of valid documentation, the student will receive a zero on the missing examination (no make up exam or extensions).

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](#)).

Note: missed work can *only* be excused through one of the mechanisms above. Being asked not to attend an in-person course requirement due to potential COVID-19 symptoms is **not** sufficient on its own.

6. 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.

7. 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.

Non-scientific calculators will be allowed in exams, no other device would be allowed.

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.

[If Remote Proctoring Software may be used in this course, including in the event of health lock-down] Tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at:

<https://remoteproctoring.uwo.ca>.

8. 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/>.