Financial Modelling I, 2019-2020
FM3520A

Course Outline

Instructor Information:
Instructor: Antoine Kornprobst
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Office hours: Friday 4:30-6:30pm

Course Information:
Course description: This course is a first course in modern financial mathematics. Its main focus is on pricing and hedging derivative securities but investmement startegies, hedging techniques and risk measures are also explored in details. We will work in a discrete time setting throughtout the course. Finance in continuous time is covered in FM4521B and FM3613B. A detailed list of the course objectives is given below.

Pre-requisites: Unless you have either the prerequisites for this course or written special permission from your Dean to enroll it the course, you may be removed from the 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 the course for failing to have the necessary prerequisites. The prerequisites for this course are the following:
- A minimum mark of 60% in one of the following courses: BUS4413A/B, FM2557A/B, or the former AS2557A/B.
- A minimum mark of 60% in SS2857A/B.

Co-requisites: None. **Anti-requisites:** The former SS3520A/B.
Lecture hours: Monday, Wedesday and Friday at 3:30-4:20pm in WSC240.

Course Material:
Required Textbook:
- Robert L. McDonald (2013), *Derivatives Markets* (3rd edition), Pearson Education, ISBN: 978-0-32154-308-0.
  The material that will be taught in the course is contained inside the following chapters: Chapter 1 (Introduction), Chapter 2 (Put and Call options), Chapter 3 (Put-Call Parity, Spreads), Chapter 9 (Put-Call Parity), Chapter 10 (Replication, Binomial Trees), Chapter 11 (Binomial Trees), Chapter 12 (Black-Scholes Formula), Chapter 13 (Delta Hedging), Chapter 14 (Exotic Options), Chapter 25 (Black Derman Toy model), Chapter 26 (Value at Risk).

Other useful books for the course:
- John Hull (2015), *Options, Futures, and other Derivatives* (9th edition), Pearson Prentice Hall, ISBN: 978-0-13-345631-9.

- Jaksa Cvitanic and Fernando Zapatero (2004), *Introduction to the Economics and Mathematics of Financial Markets*, MIT Press, ISBN: 978-0-262-03320-6.

Course Objectives:

After completing this course, students will understand the fundamental economic and mathematical aspects of financial markets in a discreet-time setting. In particular, students will be able to:

- Define and recognize the following terms: call and put options, expiration date, strike price, moneyness, and long/short positions.
- Calculate the payoff and profit on both long and short positions with respect to both call and put options.
- Explain the cash flow characteristics of exotic options: Asian (arithmetic and geometric), barrier, compound, gap, exchange, and lookback.
- Explain how the following option based strategies can be used as tools to manage financial risk or speculate on price or volatility: option spreads (bull, bear, ratio), collar, straddle, strangle, and butterfly spread.
- Evaluate the payoff and profit of option based investment strategies. Build and compare payoff and profit diagrams.
- Apply put-call parity to European options on stocks with no dividends, continuous dividends, and discrete dividends.
- Compare options with respect to term-to-maturity and strike price.
- Identify factors affecting the early exercise of American options and the situations where the values of European and American options are the same.
- Understand the concept of arbitrage, what the no arbitrage condition means and the risk-neutral approach to valuing derivatives securities.
- Understand the risk-neutral approach to valuing derivatives securities in the context of the Binomial Option Pricing Model and in particular the Cox Rox Rubinstein (CRR) framework.
- Use the Binomial Option Pricing Model to calculate the value of call and put options.
- Explain the properties of the lognormal distribution and its applicability to option pricing. Understand the assumptions underlying the Black-Scholes model.
- Use the Black-Scholes Formula to price European calls and puts on stocks with no dividends, stock indices with continuous dividends, stocks with discrete dividends and futures contracts.
- Compute and interpret Option Greeks, including Delta, Gamma, Theta, Vega, Rho, and Psi.
- Compute the elasticity, Sharpe ratio, and risk premium for both an individual option (call or put) and a portfolio consisting of both options of multiple types and the underlying stock.
- Perform delta hedging by calculating the quantities of option units, stock shares, and cash to hold, and whether those positions should be long or short.
- Perform gamma hedging by calculating the quantities of option units (of various types) and stock shares to hold, and whether those positions should be long or short.
- Apply options and other derivatives in the context of actuarial-specific risk management. In particular, understand how life insurers use derivatives to hedge long-term risks from the
- asset portfolio and how options are employed in both pension funding and asset/liability
- management.
- Compute the Value at Risk for assets and portfolio of assets and understand the value of diversification.
- Understand the limitations of Value at Risk as a risk measure and know some alternatives commonly used in the banking industry (Expected Shortfall, Tail VaR, Stress VaR).

Canadian Institute of Actuaries University Accreditation Program:

This course is accredited under the Canadian Institute of Actuaries (CIA) University Accreditation Program (UAP). Achievement of the established exemption grade in this course may qualify a student for exemptions from writing certain preliminary exams. Please note, a combination of courses may be required to achieve a single exemption. Please see the following link for full details: http://www.cia-ica.ca/membership/uap/information-for-students

For actuarial science students please note that this course is one of the CIA accreditation courses. This course, together with FM2555 and FM 2557, cover the learning objectives required in the section of Financial Economics in SOA/CAS Exam MFE. More information regarding SOA can be found here: https://www.soa.org/education/exam-req/edu-exam-mfe-detail.aspx

Methods of Evaluation:

There will be one Assignment, counting for 15% of the final grade and two Midterms, each counting for 15% of the final grade. These test are tentatively scheduled as follows:
- Assignment is given on Monday September 30th 2019 and due on Monday October 7th 2019.
- Midterm 1 will take place on Monday October 28th 2019.
- Midterm 2 will take place on Monday November 25th 2019.

The Final Exam, counting for 55% of the grade, will take place in December and will be scheduled by the Registrar's Office.

No electronic devices may be in your possession during exams except for a simple scientific calculator. Formula sheets and written materials are not allowed.

Course work evaluation prior to course dropping deadline:

Effective September 2016, a new Senate regulation has come into effect. It states that students must receive an evaluation of course work totaling 15% of their final grade at least one week prior to the deadline for withdrawal without academic penalty. The Academic Calendar is available by clicking on the following link:
http://www.westerncalendar.uwo.ca/SessionalDates.cfm.

Course Website Information:

The instructor will provide weekly slides or summary of lectures and exercises and lists of topics and exercises to be covered the following week. These will be available on the course website on OWL (http://owl.uwo.ca). This is the primary method by which information will be disseminated to students. Students should check regular for news and updates. You are responsible for the lecture materials you miss if you are unable to attend the class.

Missed Course Requirement Due to Illness or Special Circumstances:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at scibmsac@uwo.ca. For further information about absences, including the **self-reporting procedure** and requirements, please click on the following link:

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

You may also be eligible to write a Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

If you miss Midterm 1 for a valid reason, its weight is shifted to Midterm 2. If you miss Midterm 2 for a valid reason, its weight is shifted to the Final Exam. Considering the Final Exam, if you miss an exam for a valid reason, you must go to your Faculty's academic counselling office with proof as to why you missed the exam. A "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. A makeup exam date will be arranged for all students who missed the exam with a valid reason. If you require academic accommodation due to illness, you should use the Student Medical Certificate when visiting an off-campus medical facility. The form can be found here:

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

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

Attendance:

The department of Statistical and Actuarial Sciences views classroom attendance as a very important part of the learning process. You are expected to attend all classes. You are advised that excessive absenteeism may result in being debarred from the final examination.

Policy on e-mail communication:

E-mail can be an efficient and effective way to communicate with your Professor, but it should be used very rarely, only to provide us with information or to ask a question that requires a very brief response. We do not wish to see emails that ask "What did I miss in class today?". For more lengthy discussions, you should raise questions after class or during office hours, or make a separate appointment if necessary. Please remember that we will only read e-mails from your UWO student account. E-mails from other accounts (e.g. hotmail, yahoo, etc.) will not be read. **Please conduct yourselves professionally if you choose to e-mail your Professor.**

Support Services:

Learning-skills counsellors at the Student Development Centre (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.
Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.

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 Student Accessibility Services (SAS) at 661-2147 if you have any questions regarding accommodations. The policy on Accommodation for Students with Disabilities can be found here:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_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

Classroom Environment:

We have adopted a "Mutual Expectations" policy governing the classroom environment and all work submitted by students. The full text of the policy can be found on the Statistical and Actuarial Science departmental web page (https://www.uwo.ca/stats/undergraduate/mutual-expectations.html. In summary, all interactions between students and faculty should be governed by the principles of courtesy, respect and honesty. Students are encouraged to ask questions in the class. Also any unnecessarily loud talking among students is to be discouraged. The goal is to reduce any behaviour by students that may disrupt other students.

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