
THE UNIVERSITY OF IOWA
College of Liberal Arts and Sciences
Department of Statistics and Actuarial Science

ACTS:4380 Mathematics of Finance II

Spring 2016
1:30 p.m. – 2:20 p.m., MWF, at E105 SSH

1 Contact information

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2 Course description and objectives

Building upon the conceptual foundation on financial derivatives in the prerequisite course ACTS:4130 (Quantitative Methods for Actuaries), this intermediate course on mathematical finance for B.S. and M.S. in Actuarial Science students explores option pricing in a reasonably mathematical level. It consists of three interrelated parts of increasing level of technical sophistication:

Part I. Discrete-time option pricing models (approx. 3–4 weeks)

Part II. Continuous-time option pricing models (approx. 6–7 weeks)

Part III. Interest rate derivatives (approx. 4–5 weeks)

The overarching theme is to determine the fair price of an option in the context of different pricing models. After taking this course, you are expected to:

- Price options on a wide variety of underlying assets using different pricing methodologies.
- Understand the assumptions and limitations of each class of option pricing models.
- Take and, most importantly, pass Exam MFE with considerable ease.
- Proceed to more advanced courses on mathematical finance with strong confidence.

Figure 1 shows a flowchart of more advanced actuarial courses taken by a typical UI student after successfully completing this course (each arrow means a transition conditional on a grade of C+ or above in the preceding course).

3 Exam MFE

In 2016, Exam MFE will be offered via computer-based testing (CBT) in March (11–17) and July (7–13)ⁱ and November (17–23). The registration deadlines are February 2, May 26 and October 5 respectively. More information about Exam MFE (e.g. syllabus, sample exam questions, etc.) can be found at <https://www.soa.org/education/exam-req/edu-exam-mfe-detail.aspx>.

ⁱI recommend taking Exam MFE in July after completing this course.

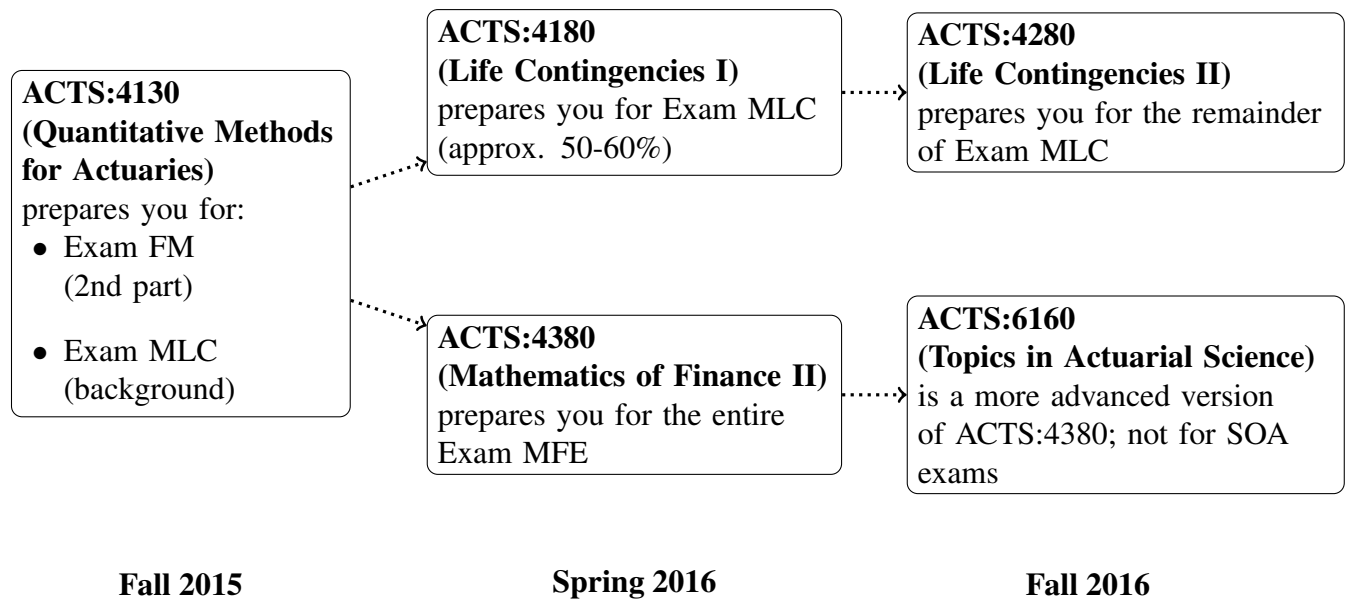


Figure 1: The actuarial courses you can take after satisfactorily completing ACTS:4380.

4 Texts

As in ACTS:4130, there are no required textbooks in this course. We shall follow closely the course lecture notes, regarded as a mini-textbook, which will be made available on ICON chapter by chapter. The notes not only address all important topics required in Exam MFE, but also equip you with lots of intuition to understand the subject matter deeply, and a wide variety of examples and practice problems for exam preparation. *You are strongly recommended to have a copy of the lecture notes during class meetings.*

The recommended text is

McDonald, R.L., 2013. Derivatives Markets (Third Edition). Pearson.

This is the official textbook for Exam MFE. We shall cover, in a different but more cohesive order, the following required sections in the SOA Exam MFE syllabus:

- *Chapter 9: Parity and Other Option Relationships*
- *Chapter 10: Binomial Option Pricing: Basic Concepts* (excluding “Options on Commodities” on pages 315 and 316)
- *Chapter 11: Binomial Option Pricing: Selected Topics*, Sections 11.1–11.3, Appendices 11.A and 11.B
- *Chapter 12: The Black-Scholes Formula* (Sections 12.1–12.5, Appendix 12.A)

- *Chapter 13: Market-Making and Delta-Hedging* (including Appendix 13.B)
- *Chapter 14: Exotic Options: I*
- *Chapter 18: The Lognormal Distribution*
- *Chapter 19: Monte Carlo Valuation*, Sections 19.1–19.5
- *Chapter 20: Brownian Motion and Itô’s Lemma*, Sections 20.1–20.3 (up to but excluding “Modeling Correlated Asset Prices” on pages 612–613), 20.4 (excluding “Multivariate Itô’s Lemma” on pages 616–617), 20.5–20.6 (up to but excluding “Valuing a Claim on $S^a Q^b$ ” on pages 621–622)
- *Chapter 21: The Black-Scholes-Merton Equation*, Sections 21.1–21.2 (excluding “What If the Underlying Asset Is Not an Investment Asset” on pages 635–637) and 21.3 (excluding “The Backward Equation” on pages 637–638, and excluding the last two paragraphs of the section on page 639)
- *Chapter 23: Exotic Options: II*, Section 23.1 (but with only those definitions in Tables 23.1 and 23.2 that are relevant to Section 23.1)
- *Chapter 24: Volatility*, Sections 24.1–24.2 (up to the second paragraph on page 721, but including footnote 4 on page 721 and the top panel in Figure 24.3 on page 723)
- *Chapter 25: Interest Rate and Bond Derivatives*, Sections 25.1–25.4 (up to the first paragraph on page 773), 25.5 (excluding “LIBOR Market Model” on pages 781–783), Appendix 25.A (this appendix contains only a reference to the following site for download, <http://wps.aw.com/wps/media/objects/14728/15081864/appendices/McDonald-web-25-A.pdf>)

Pearson has published *Student Solutions Manual to Derivatives Markets*, which provides solutions to all even-numbered end-of-chapter problems in the text.

5 Grading system

Assessment in this course comprises the following items:

1. **Attendance:** $\pm \epsilon \%$

You may choose to attend or not to attend classes, but everyone needs to be aware that absence from classes without a valid reason can negatively affect the final grade. It is also impossible to get a copy of any course material you miss and inquire about any announcements made in class.

2. **Assignments: 8%**

There will be about 4 individual assignments in this course. Most of the assignment questions will come from the end-of-chapter problems in the lecture notes. You will have about 10 days to work on each assignment. Late homework will be severely penalized (see the instructions on the assignment sheet). Illustrative solutions will be provided.

A note on collaboration: Discussion with other students on homework problems is encouraged. However, what you hand in must ultimately be your own work.

3. **Short quizzes: 8%**

There will be about 4 announced 15-minute quizzes throughout the semester. These quizzes are intended to motivate you to study regularly (not just cram before the Final Exam!) and will consist of reasonably straightforward questions. The quiz with the lowest score will be dropped when it comes to computing the final grade. No make-up quizzes will be given.

4. **Midterm Exams: 48%**

There will be two equally-weighted 90-minute written Midterm Exams to be held in the evenings (6:30 p.m. – 8:00 p.m.) of **March 11, 2016** (Friday) and **April 22, 2016** (Friday). They will consist mainly of a series of short computational questions similar in style to SOA Exam MFE problems and/or problems in the lecture notes. You will therefore find that problems from released Exam MFE past/sample exams and the lecture notes are useful in preparing for the Midterm Exams.

5. **Final Examination: 36%**

A two-hour comprehensive written examination will take place in the week of May 9–13, 2016. Like the Midterm Exams, it comprises mainly short computational questions similar in style to SOA Exam MFE problems and/or problems in the lecture notes. The exact date and time will be announced by the Registrar in mid-February. Please do not plan your end-of-semester travel plans until the final exam schedule is made public. It is your responsibility to know the date, time, and place of the final exam.

All quizzes and exams in this course are closed-book and no formula sheet is allowed (and on all SOA exams as well!). Only SOA/CAS-approved calculators listed on Point 9 of <https://www.soa.org/Files/Edu/edu-rules-reg-instructions.pdf> are allowed.

Note on absence from exams If, for medical reasons, you are unable to take any exam in this course, you should inform the course instructor *within 48 hours* of the exam, and submit original documentation as soon as possible. Otherwise, a zero score will be awarded. Absence for other reasons will not be allowed, unless approval from the instructor is sought well in advance.

Grading scheme Plus or minus grading system will be used in this course, and undergraduate and graduate students will be treated as two separate groups when it comes to assigning final grades. An *approximate* guide is as follows:

Undergraduate students		
A-	[83.5, 89)	A [89, 94.5)
B-	[67, 72.5)	B [72.5, 78)
C-	[50.5, 56)	C [56, 61.5)
D-	[34, 39.5)	D [39.5, 45)
F	[0, 34)	

Graduate students		
A-	[85, 90)	A [90, 95)
B-	[70, 75)	B [75, 80)
C-	[55, 60)	C [60, 65)
D-	[40, 45)	D [45, 50)
F	[0, 40)	

These are not completely absolute scales and the instructor reserves the “option” to lower the cutoffs. Note that with this grading scheme you are not “graded on a curve”, and so you are not competing with fellow students. Therefore, you are not penalized in any way for working together to better understand concepts and to perform better in this course.

IMPORTANT NOTE

1. A grade of C+ or higher in this course is a prerequisite for ACTS:6160, which will be offered in Fall 2016 for postgraduate students. The department has the right to de-register students who fail to meet the prerequisite requirement.
2. This is *not* an easy course for most students, *even for those who have passed Exam MFE*. Each week you should spend about 3 hours outside of class meetings reviewing the course notes and working on the end-of-chapter problems. It is fine to work harder, but working less is risky. Let me know if you encounter any problems with your learning.

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About the instructor Professor Ambrose Lo earned his B.S. in Actuarial Science (first class honors) and Ph.D. in Actuarial Science from The University of Hong Kong in 2010 and 2014 respectively. He joined the Department of Statistics and Actuarial Science at The University of Iowa in August 2014 as an assistant professor in actuarial science. He is a Fellow of the Society of Actuaries (FSA) and a Chartered Enterprise Risk Analyst (CERA). His research interests lie in dependence structures, quantitative risk management as well as optimal (re)insurance. His research papers have been published in top-tier actuarial journals, such as *Insurance: Mathematics and Economics* and the *Scandinavian Actuarial Journal*.

Besides dedicating himself to actuarial research, Ambrose attaches equal importance to teaching, through which he nurtures the next generation of actuaries and serves the actuarial profession. He has taught courses on financial derivatives, mathematical finance, life contingencies, credibility theory and advanced probability theory. His emphasis in teaching is always placed on concrete problem-solving skills complemented by a thorough understanding of the subject matter. He is also the sole author of ACTEX CAS Exam S Study Manual (Spring 2016 Edition).

College of Liberal Arts & Sciences: Policies and Procedures

Administrative Home

The College of Liberal Arts and Sciences is the administrative home of this course and governs matters such as the add/drop deadlines, the second-grade-only option, and other related issues. Different colleges may have different policies. Questions may be addressed to 120 Schaeffer Hall, or see the CLAS Academic Policies Handbook at <http://clas.uiowa.edu/students/handbook>.

Electronic Communication

University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (@uiowa.edu). Faculty and students should use this account for correspondence (Operations Manual, III.15.2. Scroll down to k.11).

Accommodations for Disabilities

A student seeking academic accommodations should first register with Student Disability Services and then meet with the course instructor privately in the instructor's office to make particular arrangements. See www.uiowa.edu/~sds/ for more information.

Academic Honesty

All CLAS students or students taking classes offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty: "I pledge to do my own academic work and to excel to the best of my abilities, upholding the IOWA Challenge. I promise not to lie about my academic work, to cheat, or to steal the words or ideas of others; nor will I help fellow students to violate the Code of Academic Honesty." Any student committing academic misconduct is reported to the College and placed on disciplinary probation or may be suspended or expelled (CLAS Academic Policies Handbook).

CLAS Final Examination Policies

The final examination schedule for each class is announced by the Registrar generally by the fifth week of classes. Final exams are offered only during the official final examination period. **No exams of any kind are allowed during the last week of classes.** All students should plan on being at the UI through the final examination period. Once the Registrar has announced the date, time, and location of each final exam, the complete schedule will be published on the Registrar's web site and will be shared with instructors and students. It is the student's responsibility to know the date, time, and place of a final exam.

Making a Suggestion or a Complaint

Students with a suggestion or complaint should first visit with the instructor (and the course supervisor), and then with the departmental DEO. Complaints must be made within six months of the incident (CLAS Academic Policies Handbook).

Understanding Sexual Harassment

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI Comprehensive Guide on Sexual Harassment for assistance, definitions, and the full University policy.

Reacting Safely to Severe Weather

In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit the Department of Public Safety website.

**** END OF COURSE SYLLABUS ****