University of Iowa

ACTS:4380
Mathematics of Finance II
Course Syllabus
Spring 2018

MWF, 40 SH
4:30 p.m. – 5:20 p.m.

COLLEGE OF
LIBERAL ARTS & SCIENCES
Department of Statistics & Actuarial Science
241 Schaeffer Hall
Iowa City, Iowa 52242-1409
319-335-0712 *Fax* 319-335-3017
www.stat.uiowa.edu

Department of Statistics and Actuarial Science

1 Contact Information

- **Instructor:** Professor Ambrose Lo, PhD, FSA, CERA
  - ▷ *Office:* 368 SH
  - ▷ *Phone:* (319) 335-1915
  - ▷ *Email:* `ambrose-lo@uiowa.edu`
    (Note: Please put "ACTS:4380" in the subject line)
  - ▷ *Personal homepage:* `https://sites.google.com/site/ambroseloyp`
    (This page is mainly about my research endeavors. Feel free to visit it from time to time!)
  - ▷ *Office hours:* 3:00 p.m. – 3:30 p.m. and 5:30 p.m. – 6:00 p.m., Monday, Wednesday, and Friday, and by appointment
- **Grader:** Mr. Zhaofeng Tang
  - ▷ *Office:* 356 SH
  - ▷ *Phone:* (319) 353-2298
  - ▷ *Email:* `zhaofeng-tang@uiowa.edu`
    (Note: Please put "ACTS:4380" in the subject line)
- **DEO:** Professor Joseph B. Lang
  - ▷ *Office:* 241 SH
  - ▷ *Phone:* (319) 335-0712
  - ▷ *Email:* `joseph-lang@uiowa.edu`

2 Course Description and Objectives

Prerequisites: ACTS:3080 (Mathematics of Finance I) with a minimum grade of C+ and status as Actuarial Science major

Corequisite: STAT:4100 (Mathematical Statistics I) or STAT:5100 (Statistical Inference I).

Building upon students' prior exposure to actuarial science and preparation in mathematical statistics, this intermediate course on mathematical finance for B.S. and M.S. in Actuarial Science students explores option pricing in a reasonably mathematical manner and prepares you adequately for the *derivatives portion* (i.e., Topics 6 to 10) of the Investment and Financial Markets (IFM) Exam offered by the Society of Actuaries (SOA). It consists of four interrelated parts of varying degrees of technical sophistication:

Part I.	Conceptual Foundation on Derivatives	(approx. 4 weeks)
Part II.	Pricing of Derivatives: Discrete-time Option Pricing Models	(approx. 2.5 weeks)
Part III.	Pricing of Derivatives: Continuous-time Option Pricing Models	(approx. 7.5 weeks)
Part IV.	Investment Risk and Project Analysis	(approx. 1 week)

The central theme of the course is to determine the fair price of a financial derivative in the context of different pricing models. Together with FIN:3300 (Corporate Finance), the course adequately covers the syllabus of the July 2018 Exam IFM.

After taking this course, the successful student is expected to:

1. Understand the mechanics and typical use of different kinds of financial derivatives.
2. Price options on a wide variety of underlying assets using different pricing methodologies.
3. Realize the assumptions and limitations of each class of option pricing models.
4. Take and, most importantly, pass Exam IFM in July 2018 with considerable ease.
5. (For graduate students) Proceed to more advanced courses on mathematical finance with strong confidence.

3 Exam IFM

Exam IFM is a three-hour exam that consists of 30 multiple-choice questions, each of which includes 5 answer choices identified by A, B, C, D, and E. It will be offered for the first time in July 2018 and replace its predecessor, Exam MFE (Models for Financial Economics), which was exclusively about the use and pricing of derivatives. Exam IFM encompasses much of the MFE derivatives material, but with a lot of corporate finance added. Roughly speaking, 50% of IFM is about derivatives (Topics 6 to 10) and the other 50% is about corporate finance (Topics 1 to 5). There are two released MFE past exams (Spring 2007 and Spring 2009), 60 sample questions on introductory derivatives, and 40 sample questions on advanced derivatives, all with detailed solutions. More information about Exam MFE/IFM can be found at `https://www.soa.org/education/exam-req/edu-exam-mfe-detail.aspx`.

Note that because of time constraints, this course is largely dedicated to the *derivatives portion* (i.e., Topics 6 to 10) of the IFM exam syllabus. If time permits, we will also cover Topic 4. To help you learn the *corporate finance portion* (i.e., Topics 1, 2, 3, and 5), it is strongly suggested that you also take **FIN:3300 (Corporate Finance)**, in addition to ACTS:4380, in the same semester. The reasons are two-fold:

1. While FIN:3300 may not use the same text as in the IFM exam syllabus, the course has a significant overlap with the required IFM corporate finance topics (e.g. risk-return trade-off, asset pricing models, market efficiency, capital structure) and will be highly conducive to you mastering the IFM exam material and, by extension, taking Exam IFM in July 2018.

2. Getting a B- or above in FIN:3300 allows you to receive the VEE credit in Corporate Finance under the current SOA exam structure, which translates into the VEE credit in Accounting and Finance after July 2018. The latter requires FIN:3300 as well as ACCT:2100 (Introduction to Financial Accounting). In other words, you have to take FIN:3300 no matter what, but you save one course by taking FIN:3300 early! Check the paragraph entitled "VEE Corporate Finance - Accounting and Finance" on this page: `https://www.soa.org/Education/General-Info/2016-vee-requirements.aspx`.

In 2018, Exam MFE will be offered via computer-based testing (CBT) for the very last time in March (9–15). The registration deadline is February 6. Beginning July 2018, Exam MFE will be replaced by Exam IFM, which will be administered in **July (5–11)** and November (15–21). The registration deadlines are May 30 and October 9, respectively (please refer to `https://www.soa.org/Education/Exam-Req/Exam-Day-Info/edu-2018-cbt-test-schedule.aspx`). It is advisable that you take the exam in **July** after you fully grasp the material on derivatives from taking ACTS:4380 and the material on corporate finance from taking FIN:3300.

4 Texts

There are no required textbooks in this course. We shall follow closely the instructor's comprehensive course package, regarded as a mini-textbook, which will be made available on ICON (`http://icon.uiowa.edu`) chapter by chapter:

Lo, A., *Course Package for ACTS:4380 Mathematics of Finance II (Spring 2018 Edition)*.

These course notes, which are in the process of becoming a textbook in the market, not only address all important topics required in the derivatives portion of Exam IFM, but also present lots of intuition for you to understand the subject matter deeply, and a wide variety of examples and practice problems for exam preparation. *Please print out and bring a copy of the relevant portions of the course notes for each class meeting.* During lecture, you will fill in missing details, work out examples together with the instructor, and take supplementary notes.

The optional texts for this course are:

1. *Derivatives Markets* (Third Edition), 2013, by McDonald, R.L., Pearson Education, ISBN: 978-0-32154-308-0.

2. *Corporate Finance* (Fourth Edition), 2017, by Berk, J. and DeMarzo, P., Pearson, ISBN: 978-0-13408-327-8.

These are the two official textbooks for Exam IFM. We shall cover, in a different but more cohesive order, the following required sections in the exam syllabus:

1. *Derivatives Markets*:

   - Chapter 1: Introduction to Derivatives, Sections 1.1, 1.2, 1.4, 1.5
   - Chapter 2: An Introduction to Forwards and Options, Sections 2.1–2.4
   - Chapter 3: Insurance, Collars, and Other Strategies
   - Chapter 5: Financial Forwards and Futures, Sections 5.1–5.2, Section 5.3 (through the middle of p.136), Section 5.4 (through the top of p.143)
   - Chapter 9: Parity and Other Option Relationships, Sections 9.1 and 9.3
   - Chapter 10: Binomial Option Pricing, Sections 10.1–10.5, Section 10.6 (through the middle of p.315)
   - Chapter 11: Binomial Option Pricing, Section 11.1
   - Chapter 12: The Black-Scholes Formula, Sections 12.1–12.3, Appendices 12.A and 12.B
   - Chapter 13: Market-Making and Delta-Hedging
   - Chapter 14: Exotic Options: I, Sections 14.1–14.3, Section 14.4 (through the bottom of p. 419), Sections 14.5–14.6
   - Chapter 18: The Lognormal Distribution, Sections 18.1–18.4
   - Appendices A (The Greek Alphabet), B.1 (The Language of Interest Rates), and C (Jensen's Inequality)
   - IFM-22-18: Supplementary Material for Derivatives: "Actuarial-Specific Applications of Options and other derivatives, and Expanded Coverage on Exotic Options"

2. *(Time permitting) Corporate Finance*:

   - Chapter 8: Fundamentals of Capital Budgeting, Section 5
   - Chapter 22: Real Options

Unless otherwise stated, chapter appendices are not included in the required readings. 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:

- **Attendance and attitude:** $\pm\varepsilon\%$[i]

  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 adversely affect your final grade. It is also

[i] In mathematics, ε usually denotes a small positive number.

impossible to get a copy of any course material you miss or inquire about any announcements made in class. Likewise, your participation, preparedness, and work ethic may affect your final grade (positively or negatively).

- **Assignments: 20%**

  There will be weekly assignments consisting of about 4 to 6 end-of-chapter problems in the course package, usually assigned on Wednesday and due the next Wednesday. Any exceptions will be announced in class or in ICON. Late homework will be severely penalized (see the generic assignment instructions on ICON). For students' edification, illustrative solutions will be posted on ICON shortly after each homework is due.

  A note on collaboration: Discussion with other students on homework problems is encouraged. However, you should always write up your own solutions.

- **Short quizzes: 17%**

  There will be a total of six 15-minute quizzes held on Fridays. These quizzes are intended to motivate you to study regularly (not just cram before the Midterm and Final Exams!) and will consist of relatively straightforward questions. The quiz with the lowest score will be dropped when it comes to computing the final grade.

- **Midterm Examination: 27%**

  There will be a 90-minute written Midterm Examination to be held in the evening (6:30 p.m. – 8:00 p.m.) of **March 26, 2018 (Monday)** at W207 PBB testing the material in Chapters 1 to 6 of this course. It will consist mainly of a series of short computational questions similar in style to MFE/IFM problems and/or end-of-chapter problems in the course package. You will therefore find that problems from released MFE past/sample exams and the course package are useful in preparing for the Midterm Exam.

- **Final Examination: 36%**

  A two-hour comprehensive written Final Examination will take place in the week of May 7–11, 2018. Like the Midterm Exam, the Final Exam will comprise mainly short computational questions similar in style to MFE/IFM problems and/or problems in the course package. 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 you are not allowed to bring your own formula sheet (the same applies to 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 permitted.

A note on absences from exams. If, because of illness, you are unable to take any exam in this course as scheduled, you should inform the course instructor *within 24 hours* of the exam, and submit original documentation as soon as possible. Approval for absences for other reasons such as mandatory religious obligations, certain University activities, or unavoidable circumstances should be sought well in advance with documentation provided. Otherwise, a zero score will be awarded.

Grading scheme. Plus/minus grades will be given 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	$[89, 94.5)$	A+	$[94.5, 100]$
B-	$[67, 72.5)$	B	$[72.5, 78)$	B+	$[78, 83.5)$
C-	$[50.5, 56)$	C	$[56, 61.5)$	C+	$[61.5, 67)$
D-	$[34, 39.5)$	D	$[39.5, 45)$	D+	$[45, 50.5)$
F	$[0, 34)$				

Graduate students					
A-	$[85, 90)$	A	$[90, 95)$	A+	$[95, 100]$
B-	$[70, 75)$	B	$[75, 80)$	B+	$[80, 85)$
C-	$[55, 60)$	C	$[60, 65)$	C+	$[\underline{\mathbf{65}}, 70)$
D-	$[40, 45)$	D	$[45, 50)$	D+	$[50, 55)$
F	$[0, 40)$				

These are not completely absolute scales and the instructor reserves the "option" to adjust the cutoffs, depending on the difficulty of the exams. 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 (Topics in Actuarial Science), which will be offered in Fall 2018 for graduate students.
2. This is *not* an easy course for most students. Each week you should spend about 3 to 6 hours outside of class meetings reviewing the course notes and working on the end-of-chapter problems independently. It is fine to work harder, but working less is risky. Let me know if you encounter any problems with your learning.

6 Tentative Teaching, Assignment, and Quiz Schedule

This approximate schedule will be updated as needed as the semester unfolds.

Teaching Week	Lecture	Date	Topic[ii]
Part I: Conceptual Foundation on Derivatives			
1	—	January 15, 2018 (Mon)	(University Holiday)
	L01	January 17, 2018 (Wed)	Chapter 1
	L02	January 19, 2018 (Fri)	Chapter 2, Assignment 1
2	L03	January 22, 2018 (Mon)	Chapter 2
	L04	January 24, 2018 (Wed)	Chapter 2, Assignment 2
	L05	January 26, 2018 (Fri)	Chapter 2, **Quiz 1**

[ii] Refer to the numbering in the lecture notes, not McDonald (2013) or Berk and DeMarzo (2017).

3	L06	January 29, 2018 (Mon)	Chapter 3
	L07	January 31, 2018 (Wed)	Chapter 3, Assignment 3
	L08	February 2, 2018 (Fri)	Chapter 3
4	L09	February 5, 2018 (Mon)	Chapter 3
	L10	February 7, 2018 (Wed)	Chapter 3, Assignment 4
	L11	February 9, 2018 (Fri)	Chapter 3, **Quiz 2**
Part II: Pricing Derivatives – Discrete-time Option Pricing Models			
5	L12	February 12, 2018 (Mon)	Chapter 4
	L13	February 14, 2018 (Wed)	Chapter 4, Assignment 5
	L14	February 16, 2018 (Fri)	Chapter 4
6	L15	February 19, 2018 (Mon)	Chapter 4
	L16	February 21, 2018 (Wed)	Chapter 4, Assignment 6
	L17	February 23, 2018 (Fri)	Chapter 4, **Quiz 3**
Part III: Pricing Derivatives – Continuous-time Option Pricing Models			
7	L18	February 26, 2018 (Mon)	Chapter 4
	L19	February 28, 2018 (Wed)	Chapter 5, Assignment 7
	L20	March 2, 2018 (Fri)	Chapter 5
8	L21	March 5, 2018 (Mon)	Chapter 6
	L22	March 7, 2018 (Wed)	Chapter 6, Assignment 8
	L23	March 9, 2018 (Fri)	Chapter 6, **Quiz 4**
—	—	March 12, 2018 (Mon)	(Spring Break - No class!)
	—	March 14, 2018 (Wed)	
	—	March 16, 2018 (Fri)	
9	L24	March 19, 2018 (Mon)	Chapter 6
	L25	March 21, 2018 (Wed)	Chapter 6, Assignment 9
	L26	March 23, 2018 (Fri)	Chapter 6
10	—	March 26, 2018 (Mon)	**(No class. Midterm in evening!)**
	L27	March 28, 2018 (Wed)	Chapter 7
	L28	March 30, 2018 (Fri)	Chapter 7
11	L29	April 2, 2018 (Mon)[iii]	Chapter 7
	L30	April 4, 2018 (Wed)	Chapter 8, Assignment 10
	L31	April 6, 2018 (Fri)	Chapter 8
12	L32	April 9, 2018 (Mon)	Chapter 8
	L33	April 11, 2018 (Wed)	Chapter 8, Assignment 11
	L34	April 13, 2018 (Fri)	Chapter 8, **Quiz 5**
13	L35	April 16, 2018 (Mon)	Chapter 8
	L36	April 18, 2018 (Wed)	Chapter 8, Assignment 12
	L37	April 20, 2018 (Fri)	Chapter 9
14	L38	April 23, 2018 (Mon)	Chapter 9
	L39	April 25, 2018 (Wed)	Chapter 9, Assignment 13
	L40	April 27, 2018 (Fri)	Chapter 9, **Quiz 6**

[iii] Drop date for undergraduate students (This course is also offered in Fall 2018 for those who wish to retake it ☻)

Part IV: Investment Risk and Project Analysis			
15	L41	April 30, 2018 (Mon)	Chapter 10
	L42	May 2, 2018 (Wed)	Chapter 10
	L43	May 4, 2018 (Fri)	Chapter 10 / Final Review
—	—	May 7–11, 2018	**Final Examination**
⋮	⋮	⋮	⋮
—	—	July 5–11, 2018	**July 2018 Exam IFM**

More about the Instructor ("Shameless" self-introduction...)

Professor Ambrose Lo was born (in 19X9), raised, and educated in Hong Kong. He 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 of 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*, *Scandinavian Actuarial Journal* and *ASTIN Bulletin: The Journal of the International Actuarial Association*.

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, advanced probability theory, and regression and time series analysis. His emphasis in teaching is always placed on the development of a thorough understanding of the subject matter complemented by concrete problem-solving skills. He is also the sole author of the 1349-page ACTEX CAS Exam MAS-I Study Manual (Spring 2018 Edition).

The College of Liberal Arts & Sciences: Important 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 correspondences (Operations Manual, III.15.2, k.11).

Accommodations for Disabilities

The University of Iowa is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (which includes but is not limited to mental health, attention, learning, vision, and physical or health-related conditions). 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. Reasonable accommodations are established through an interactive process between the student, instructor, and SDS. See `http://sds.studentlife.uiowa.edu/` for information.

Nondiscrimination in the Classroom

The University of Iowa is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity, `diversity@iowa.edu` or visit `diversity.uiowa.edu`.

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 Office of the Sexual Misconduct Response Coordinator 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****