CS 476/676: Numeric Computation for Financial Modelling  
Winter 2018

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Lecture Times:  
MWF 10:30-11:20 AL 208
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Calendar Description: [http://www.ucalendar.uwaterloo.ca/1112/COURSE/course-CS.html#CS476](http://www.ucalendar.uwaterloo.ca/1112/COURSE/course-CS.html#CS476)  
Schedule of Classes: [http://www.adm.uwaterloo.ca/infocour/CIR/SA/under.html](http://www.adm.uwaterloo.ca/infocour/CIR/SA/under.html)

Course Description


Course Objectives

To provide students with an overview of modern numerical algorithms for use in financial applications.

Week of Jan 2-5  
Introduction to Options  
Random Walks on a Lattice
Week of Jan 8-12  
Ito’s Lemma  
Black-Scholes
Week of Jan 15-19  
No Arbitrage Lattice  
Hedging  
Assignment 1 out
Week of Jan 22-26  
Monte Carlo Methods  
Risk Neutral Valuation
Week of Jan 29-Feb 2  
Hedging  
Delta, Gamma and Greeks  
Assignment 1 in (due Feb 2)
Week of Feb 5 - 10  
Correlated Random Numbers  
Finite Difference I  
Assignment 2 out
Week of Feb 12 - Feb 17  
Finite Difference II  
Assignment 3 out
Week of Feb 19 - 23  
No Classes  
Reading Week
Week of Feb 26 - Mar 2  
American Options  
VaR and CVaR risk measures  
Assignment 2 in (Feb 26)
Week of Mar 5 - 9  
Convexity and Optimality  
Assignment 3 out
Week of Mar 12 - 16  
Portfolio Optimization
Week of Mar 19 - 23  
Option model calibration
Week of Mar 26 - 30  
Data driven modeling
Week of Apr 2  
review  
Assignment 3 in (April 2)

• **Reference Material**  
Course notes are on sale in the DC copy center. The notes also have a list of reference books.

• **Background Assumed**  
You should have taken
- An introductory course in numerical computation, similar to CS370.
- An introductory course in statistics.
- Basic calculus and linear algebra.
- Ability to program in Matlab

I will assume you know nothing about finance.

- **Course Accounts** You will need to register in the course to obtain a computing account on the CS student computing environment. You should register in CS476/676. After you do this, you can obtain a password by going to see the Math Faculty consultants in MC3011 (you must be registered in the course and have a Watcard). If you have a problem which can’t be resolved by the consultants, see Lori Suess in MC3011b. By being on the student environment, you will get a license to use matlab. If you use a research machine, you may not have a license for matlab (depending on your supervisor).

- **Assignments** Must be submitted in class on the due date. Assignments will be posted on the Web page for the course. Check to make sure you are using the most recent version (corrections will be made to the Web posting if necessary).

- **Assignment Marking.** The assignments will consist of programming problems and analytic work. **IMPORTANT:** most of the marks for the programming problems will be given for your description of your algorithms (i.e. pseudo-code) and explanation of the results. Simply handing in “raw code” will get very few marks.

Assignment figures and graphs should be carefully thought out to present the data and your conclusions in an effective and clear manner. Poor presentation of your work will result in a poor mark.

In all cases, I expect you to explain your algorithms, and describe what you see in detail. You should also submit hard copies of your code, along with some documentation. Matlab has good plotting facilities. Create figures with Matlab to include in your assignments.

Assignment solutions will be discussed in class. Assignment solutions will not be posted on the Web. Assignments will be returned in class. Assignments not picked up at that time must be picked up from the TA or instructor office hours.

- **Late Policy** On the due date of an assignment, the work done to date should be submitted in class; further material may be submitted for one-half credit at the start of the next class.

- **Class Grade** The course is planned to have three marked assignments and a final examination. The course grade will be made at the discretion of the instructor; the guidelines for this are as follows. For undergraduate students, the assignments count 50% and the final exam, 50%. All assignments are equally weighted. For graduate students, the assignments count 60% and the final exam, 40%. There will be extra assignment questions for the graduate students. All assignments are equally weighted. The final exam will be open book (all course notes and your notes and assignments may be used). You must pass the final examination (i.e. 25/50) in order to pass the course. If you fail the final examination, the final examination mark will be the mark awarded.

- **Graduate Students** To obtain credit for CS676, graduate students will have to complete extra questions on the assignments.

- **Programming Languages** Matlab tutorials can be found on the CS370 Web page:

  [http://www.student.cs.uwaterloo.ca/~cs370](http://www.student.cs.uwaterloo.ca/~cs370)

There are many sources of Matlab information on the Web. There are also many reference books available. You are responsible for getting up to speed on Matlab.
• **Final Examination** Students are advised not to make any travel arrangements before the final examination times are posted. Note that in the event that the final examination is postponed, the final examination will be rescheduled for the day following the end of the regular examination schedule. Under no circumstances will alternate examinations be scheduled for students who have made travel arrangements which conflict with the final examination.

Students must inform the registrar’s office if they have a conflict in the final examination schedule, by the date posted on the registrar’s web site. Note that there is a precise definition of conflict as defined by the registrar. The course instructors will then be contacted by the registrar’s office to make alternate arrangements. Under no circumstances will the instructor’s make alternate arrangements for a final examination unless given instructions by the registrar’s office.

• **Assignment Retention** Unclaimed assignments will be retained for one month after term grades become official in quest. After that time, they will be destroyed in compliance with UW’s confidential shredding procedures:


• **Collaboration** We encourage you to discuss general concepts and problems with classmates, tutors, TAs, and instructors. However, the solution that you submit must be worked through by yourself and written in your own words. It is not acceptable to work on an assignment with somebody else and write it up individually. The only exceptions are assignments or projects which the instructor designates as group activities. When discussing course matters, do not take notes, and do not look at another person’s partial solutions, or show them yours.

Note that current Math faculty policy is that a mark of -100% can be recorded for the assignment in question in the case of cheating/copying.

• **Academic Integrity** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

• **Grievance**: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department’s administrative assistant who will provide further assistance.

• **Discipline**: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about ‘rules’ for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

• **Appeals**: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: The Office for persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.
• Intellectual Property:

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a students educational experience. However, sharing this intellectual property without the intellectual property owners permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository). Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.