CS 476/676: Numeric Computation for Financial Modelling

Winter 2021

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Calendar Description: http://www.ucalendar.uwaterloo.ca/1112/COURSE/course-CS.html#CS476
Schedule of Classes: 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.

Jan 11 Introduction to Options
Random Walks on a Lattice
Jan 18 No Arbitrage Pricing
Lattice Construction
Jan 25 Pricing European and American Option on Lattice
Convergence and Black-Scholes Model
Feb 1 Ito’s Lemma Assignment 1 Due Feb 1
Risk Neutral Valuation
Feb 8 MC Method I
Hedging, Delta, Gamma and Greeks
Feb 15 Reading Week
Feb 22 VaR and CVaR Risk Measures Assignment 2 Due Feb 22
Implied Volatility, Volatility Smile
Mar 1 MC Method II: Correlated Assets
BS PDE
Mar 8 American Options: Complementarity PDE
Finite Difference Method
Mar 15 Mar 14-15, additional break Assignment 3 Due Mar 17
Explicit Finite Difference Method
Mar 22 Implicit Finite Difference Method, Stability, Convergence
Penalty Method
Mar 29 Option Model Calibration,
CVaR Portfolio Optimization
April 5 Nonlinear Optimization
Optimality
April 12 Review Assignment 4 Due April 14
• **Reference Material**  Course notes can be downloaded in LEARN. 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

  The course assumes some mathematics as well as computing maturity from students. No finance background is assumed.

• **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. If you use a research machine, you may not have a license for Matlab (depending on your supervisor).

• **Assignments**  Assignments will be posted in LEARN. Make sure that you check for announcements in LEARN frequently. Assignments must be submitted on the due date to **Crowdmark**. A link will be sent to you for submission. Please check Crowdmark website for information. If you need further assistance, please contact TA.

• **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 online recording. Assignment solutions will not be posted.

• **Late Policy**  On the due date of an assignment, the work done to date should be submitted via Crowdmark; further material may be submitted for one-half credit 24 hours after the due date.

• **Grade**  There are 4 assignments with their weights in the final grade as follows:
  
  – Assignment 1: 20%
  
  – Assignment 2: 20%
  
  – Assignment 3: 30%
  
  – Assignment 4: 30%

• **Graduate Students**  To obtain credit for CS676, graduate students will have to complete extra questions.

• **Programming Languages**  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:**  No final exam.

• **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, 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. 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: Note for Students with Disabilities: AccessAbility Services, located in Needles Hall, Room 1401, 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 AccessAbility Services 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).
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