

INTRODUCTION TO THE MATHEMATICS OF FINANCE

MATH 194

PROFESSOR R. J. WILLIAMS

WINTER 2009

Time: MWF 5-5.50pm. **Location:** PCYNH 120.

Professor: R. J. Williams, AP&M 6121, email: williams at math dot ucsd dot edu

Office hours: MF 1-1.50pm, W 12-12.50pm.

Course Website: <http://math.ucsd.edu/~williams/courses/math194.html>

Sections: W 6-6.50pm, W 7-7.50pm. **Section Location:** WLH 2110.

Teaching Assistant and Office Hours: Michael Scullard, AP&M 6333, Th 1.30-3.30pm, F 2.30-4.30pm.

Description: This course provides an introduction to the mathematics of some financial models. The aim is to provide students with an introduction to some basic probabilistic models of finance and associated mathematical machinery. The course focuses largely on financial derivatives and related mathematics.

The course begins with the development of the basic ideas of hedging and pricing of derivatives in the discrete (i.e., discrete time and discrete state) setting of binomial tree models. Single period models are treated first, then multiperiod models. These ideas are applied to price European and American options. The famous Black-Scholes option pricing formula is derived as a limit from binomial models. Following this, a general discrete finite market model is introduced, and the fundamental theorems of asset pricing are proved in this setting.

Mathematical concepts and tools from probability theory covered in the course include conditional expectation, filtration, (super)martingale, change of probability, martingale representation and optimal stopping.

The graduate course, Math 294, which has a similar title, is at a more advanced level and has much more emphasis on continuous time models which use measure theory.

Prerequisites: Math 20D, Math 20F, and Math 180A or Math 183 (or equivalent courses). Math 194 requires a solid background in probability, preferably at the level of the undergraduate probability course Math 180A at UCSD, or at a minimum Math 183. It also uses a certain amount of geometric linear algebra, so it is a good idea to review background from Math 20F. If you are in doubt as to your preparation, please consult Professor Williams in person.

Text: There is no required text for the course. Students are strongly encouraged to take notes in class. Some summary notes will be provided to accompany the course. (Students will need the login and password provided in class to access these notes from the course webpage.) A list of extra references is provided on the course webpage. Some of these books are on reserve in the Science and Engineering library.

Homework: Homework is an essential part of this course. To assimilate the theoretical material presented in lectures, it is necessary to solve problems. *IT IS OF GREAT IMPORTANCE THAT YOU MAKE EVERY EFFORT TO COMPLETE EVERY HOMEWORK ASSIGNMENT, AND THAT YOU SEEK HELP WITH PROBLEMS YOU HAVE NOT BEEN ABLE TO HANDLE.* Homework will count for 20% of your grade. Homework assignments will generally be given weekly and will be due on Fridays in the TA homework box by 11pm. Please consult the course webpage for these assignments and due dates. *Late homework will not be accepted.* If you have questions about the homework, please see the Professor or the TA in office hours or in section. Neither the Professor nor the TA will be able to provide homework assistance via email.

Examinations: There will be *one* exam in class during the quarter plus a *final* exam. The in class exam will count for 25% of your grade and the final exam for 55%. Make-up exams will not be given.

Exam dates: *In class exam:* Wed, February 11, 2009. *Final exam:* Monday, March 16, 2009, 7–10 p.m.

Final course grade: For your final grade, the homework will count 20%, the in-class exam 25%, and the final exam 55%. In addition, you must pass the final exam in order to pass the course. University regulations prohibit providing grade information by email. If you have an inquiry about your grade, please do this in person in office hours or in section, or in person after making an appointment by email. Final grades will be available via Tritonlink after the end of the quarter.

Use of email: If you wish to send email to the Professor or TA, please do this from your UCSD email address. Email from other addresses is very likely to be filtered out by spam filters without reaching the recipient. Please note that grade information cannot be provided by email and assistance with homework is not available by email. If you need help with the homework, please go to the Professor or TA office hours or section. If you cannot come at those times, please make an extraordinary appointment, but please allow enough lead time (at least a day or two) in making an appointment as both the Professor and TA have other responsibilities to juggle.

Suggestions: Below are some suggestions that can help you to succeed in this course. In addition, the Warren College website has some helpful tips on class strategies at http://warren.ucsd.edu/prospective/freshmen_tips.php. (Although this is on the Warren College site and labelled for Freshmen students, it has generally helpful tips for all students.)

1. *Spend sufficient time and keep up with the course.* The course uses a variety of abstract mathematical notions from probability and geometric linear algebra. It is important to spend enough time absorbing the theoretical material in addition to working on the homework problems. Keeping up with the reading and homework will enable you to follow the course in real time.

2. *Notetaking and reading.* It is strongly recommended that you take notes in class and diligently do the assigned readings from the summary notes. If possible, try to read a bit ahead of the class; you can then have in mind any aspects that you find particularly challenging when the topic is discussed in class. (As Louis Pasteur said: “Chance favors the prepared mind”.) After each class, read through your class notes and compare them with the summary notes that relate to the class. Try to do this as soon after the class as possible while the memory of the lecture is still fresh in your mind.

3. *Homework.* Start the homework as early as possible. In particular, try to do the relevant homework problems as soon as the related lecture has been given. This will help you to keep up with the material and make subsequent lectures easier to comprehend. Furthermore, it will allow you time to get help from the Professor or TA, if needed. When seeking help from the Professor or TA on a problem, it is important that you have tried hard to work on the problem, to have reviewed the relevant lectures and summary material, and to have tried to pinpoint the difficulty you are having with the problem. Coming prepared with specific questions will enable the Professor or TA to give you more targeted assistance. Neither the Professor nor the TA will solve the problem for you before the homework is due. They may give you hints if you are stuck on a particular point or they may work through a related problem to help you in understanding the general approach. After your homework is returned to you, make sure you understand how to solve all of the problems and if need be, see the Professor or TA for an explanation of how to solve the problem.

Class and section etiquette: The following expectations are to enhance your ability to learn in this course, to avoid disruption and distraction, and to improve the quality of the learning experience.

Entering/exiting class/section: Please arrive on time to class/section and stay for the entire class/section period. If, despite your best effort, you arrive late, please try to enter through the rear and please quietly take a seat near where you enter. Similarly, in the rare event that you must leave early (e.g., for a medical appointment), please sit close to the rear door (if there is one) and leave as unobtrusively as possible.

Noise and common courtesy: When class/section begins, please stop your conversations. Wait until class/section is over before putting your materials away in your backpack, standing up, or talking to friends. Do not disturb others by engaging in disruptive behavior. Disruption interferes with the learning environment and impairs the ability of others to focus, participate, and engage.

Electronic devices: Please turn off cell phones, PDAs, CD or MP3 players, IPODs etc. while in class/section and wait until after class/section to use such devices. Please do not use laptops in class/section without explicit permission of the Professor/TA. No taping, filming, or photography is allowed in class/section without prior permission of the Professor (whether by camera, cell phone, or other means).

Email etiquette: You are expected to write as you would in any professional correspondence. Email communication should be courteous and respectful in manner and tone. Do not send emails that are curt or demanding.

Academic integrity: Academic integrity is a fundamental value. It is essential that all students adhere to the UCSD policy on academic integrity (see <http://www-senate.ucsd.edu/manual/Appendices/app2.htm>). In addition to this general policy, for this course, the following apply.

Exams: On exams, students may only use the items (such as calculators) that are explicitly indicated in the instructions given on the course webpage. Of course, looking at other students’ answers or communicating during the exam with anyone (other than the Professor or TA proctoring the exam) is prohibited.

Homework: Students may consult other students, the Professor, or the TA, while working on homework assignments. However, the following rules apply:

1. You must write up your final solutions independently.
2. You may not copy solutions from another student or from any other source.
3. If you consult any resources other than your class notes or the notes on the class webpage, or discuss the problems with anyone other than the Professor or TA, you must acknowledge this on your homework, indicating on which problems you received help and the extent of the help.
4. You may look up general course topics in books or on the Internet, but you may not look for, nor use, solutions to specific homework problems from such resources.