FALL 2016

BEM 105 "OPTIONS"

Instructor: Jakša Cvitanić; 203 Baxter, (626) 395-1784,
cvitanic@hss.caltech.edu
Office Hours: Mo 2:00-2:30, or by appointment

T.A.: TBA

Disclaimer: The syllabus is subject to change.

Class meetings: Mo Wed 2:30-3:55PM

Prerequisites: A basic knowledge of calculus based probability/statistics. Some exposure to stochastic processes and partial differential equations is helpful, but not mandatory.

Grading: 10% in-class presentation, 10% class attendance (pro-rated according to the attendance percentage), 15% homework assignments, 30% midterm exam, 35% final exam. For those taking the course on Pass/Fail: you must pass the final exam and the midterm and you must receive at least 50% of the grade for each homework to pass the course. Penalty for late submission of homework: 10% per day. Penalty for late submission of the final exam: 33% per day. Some of the problems in the homeworks and the exams will be easier to solve if you attend the class. Moreover, I may assign extra work for the students not attending classes on a regular basis.

Starting from 2015/2016: I use the **flipped classroom** approach to learning. By moving passive learning experiences outside of class, we will be able to use in-class time to engage in activities such as small group problem solving and experiential learning activities. The students will have to watch the lectures and solve problems online, before we address that material in class, by participating in my MOOC "Pricing Options with Mathematical Models" available on edX. In class, we will work together on solving harder problems and discussing lectures, and we will have group presentations of case studies and scientific articles on the topic of derivatives. Each time another group will be invited to discuss the given presentation, and present their comments/questions on the presentation to the whole class. At the end of the term each student would be asked to do a short self-evaluation and also comment on how the group functioned.

While this approach requires additional activities such as watching lectures outside of the classroom, it will significantly reduce the amount of time

needed to do the homework assignments, because we will be solving in class problems very similar to the ones assigned.

Collaboration Policy: Discussions of class material are allowed; fellow students can give hints on homework assignments; no collaboration allowed on the exams. The homeworks and exams are open-book, open-notes. You are not allowed to consult others on the exams. You may consult outside reference materials, other students, the TA, or the instructor. You may not consult any prepared solutions for the problems, whether they are from this year or from previous years, from Caltech or external sources, and you must cite any use of material from outside references. All solutions that are handed in should be written up individually and should reflect your own understanding of the subject matter at the time of writing. Software produced scripts and plots are considered part of your write-up and should be done individually (you can share ideas, but not code). For group presentations, each individual should contribute approximately the same amount of effort.

As a general guideline for the collaboration policy, you should be able to reproduce any solution you hand in without help from anyone else. It is possible to achieve high scores on the HW but still fail the exams. This indicates poor adherence to the collaboration policy: the object of the HW problems and the collaboration policy is to help you learn the material.

Course Material:

The required textbook is:

J. Cvitanić and F. Zapatero: Introduction to the Economics and Mathematics of Financial Markets.

There are many good more advanced books on the subject, such as

S. Shreve: Stochastic Calculus for Finance II : Continuous-Time Models

T. Bjork: Arbitrage Theory in Continuous Time

K.Back: A Course in Derivative Securities: Introduction to Theory and Computation

Topics (subject to change):

(Numbers in parentheses refer to chapters/sections in the textbook.)

1. Main ideas: hedging and no-arbitrage; Financial Markets; options (1, 9.2)

2. Interest rates and dividend yields (2)

3. & 4. Model probabilities and state price probabilities (a.k.a. Equivalent Martingale Measure or risk-neutral probabilities): binomial model (3.1, 3.2, 3.6.1, 3.6.2, 3.6.4, 3.6.5, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.4, 7.1.1)

5. Forward and futures contracts (6.2, 6.3.9, 9.1)

6. Bounds on options prices (6.1)

7. & 8. Stochastic Calculus (3.3 except 3.3.6, 3.3.7)

9. The Black-Scholes(-Merton) model (3.3.6, 3.6.6, 7.2, 7.9)

11. More on Black-Scholes model (3.6.3, 3.6.6, 6.3.6, 6.3.7, 6.3.8, 7.1.2, 7.6.1)

12. American options; dividends; exotic options (7.3, 7.4, 7.5)

13. & 14. Stochastic volatility (7.2.4, 7.6.3, 7.6.4, 7.8)

15. Portfolio risk; Hedging (5.2, 9.3, 11.2)

16. Models with jumps/Incomplete markets (7.6.5, 7.7)

17. Interest rate models (3.4.2, 8.2.1, 8.2.2)

18. Forward rate models: Heath-Jarrow-Morton (8.2.3)

19. Risk management with bonds (10)

20. Numerical methods