**Overview**

Financial Engineering is a multidisciplinary field drawing from finance and economics, mathematics, statistics, engineering and computational methods. The emphasis of **FE & RM** **Part I** will be on the use of simple stochastic models to price derivative securities in various asset classes including equities, fixed income, credit and mortgage-backed securities. We will also consider the role that some of these asset classes played during the financial crisis. A notable feature of this course will be an interview module with **Emanuel Derman**, the renowned ``quant'' and best-selling author of "My Life as a Quant". We hope that students who complete the course will begin to understand the "rocket science" behind financial engineering but perhaps more importantly, we hope they will also understand the limitations of this theory in practice and why financial models should always be treated with a healthy degree of skepticism. The follow-on course **FE & RM** **Part II** will continue to develop derivatives pricing models but it will also focus on asset allocation and portfolio optimization as well as other applications of financial engineering such as real options, commodity and energy derivatives and algorithmic trading.

**Requirements/Prerequisites**

Students should at some point have taken intermediate to advanced undergraduate courses in: (i) probability and statistics (ii) linear algebra and (iii) calculus. With regards to programming, we have designed the course so that all required "programming" questions can all be completed within Excel. That said, students are welcome to complete the assignments using their software / programming languages of choice.

**Course Structure**

The course consists of the following:

* *Videos*. The lectures are delivered via video modules which will typically have a duration of anything from five minutes to twenty minutes. There will be an average of approximately two hours of video content per week but this number will vary. You may watch the lecture videos at your convenience. Lower-resolution videos are also available for those with slow internet connections.
* *Slides*. Pdf files of all the lecture slides will be made available at the start of each week. We will also make Excel spreadsheets available.
* *In-Module Quizzes*. Most of the video modules will feature one or more "in-module quizzes". Such a quiz consists of a short multiple choice question that appears at an appropriate time in the video.
* *Problem Sets*. There will be approximately n= 6 problem sets and students will need to "pass" n-1 of them in order to obtain a certificate of completion for the course. A score of 70% or higher on an assignment will constitute a "pass". Students can submit up to 100 times and only the best score will be counted towards the grade.
* *Exams*. There are no exams!

**Suggested Readings**

The course is intended to be self-contained but the following text does provide more detailed coverage of some of the course material.

* [Investment Science](http://books.google.com/books?id=luD5jwEACAAJ&dq=investment+science+luenberger&hl=en&sa=X&ei=o9AbUY3XJILp0gGxnYGgDw&ved=0CEYQ6AEwAg), by David G. Luenberger; Oxford University Press, 2013.

**Grading Policy**

As stated above, students will obtain a certificate of completion if they score 70% or higher on n-1 or more of the problem sets. You will have 10 days to complete a problem set and meet the problem set's "soft" deadline. After the soft deadline has passed, there will be a base penalty of -10% along with an additional penalty of -2% per day. The "hard" deadline for an assignment will be an additional 10 days after the soft deadline. However, you will be given a total of 10 "late days" to use, and each time you use a late day there will be no penalty applied for that day. Note that if you submit an assignment on the hard deadline (without using any late days), then your maximum score will be 100 - 10 - 10 x 2 = 70%. It is therefore still possible to pass an assignment by submitting on the hard deadline and obtaining a perfect score. Note that it is not possible to pass an assignment after the hard deadline has passed. (This is because "late days" cannot be applied after the hard deadline.) For the individual assignment grades, the submission with the highest score will be taken.

**Questions**

If you have any questions, please *do not* contact the professors directly. With tens of thousands of enrolled students it is not feasible for us to respond to individual requests. The course includes on-line Q&A forums where students can post and respond to questions. This will go live in parallel with the first lectures. In these forums students can rank questions and answers so that the most important questions and the best answers rise to the top. The course instructors and teaching assistant(s) will monitor these forums so that important questions not already answered by other students will be addressed.

**Tentative Course Outline**

|  |  |  |
| --- | --- | --- |
| **Release Dates** | | **Problem Set Due Date** |
| Oct 28 | **Week 1: Course Overview and Introduction to Basic Fixed Income Securities**  Course overview, review of interest and basic fixed income securities; introduction to arbitrage pricing.  **PSet 1 Released** | Wed 6 Nov 2013 (soft deadline)  Sat 16 Nov 2013 (hard deadline) |
| Nov 4 | **Week 2: Introduction to Derivative Securities**  The mechanics of forwards, futures, swaps and options. Option pricing in the 1-period binomial model.  **PSet 2 Released** | Wed 13 Nov 2013 (soft deadline)  Sat 23 Nov 2013 (hard deadline) |
| Nov 11 | **Week 3: Option Pricing in the Multi-Period Binomial Model**  Derivatives pricing in the binomial model including European and American options; handling dividends; pricing forwards and futures; convergence of the binomial model to Black-Scholes.  **PSet 3 Released** | Wed 20 Nov2013 (soft deadline)  Sat 30 Nov2013 (hard deadline) |
| Nov 18 | **Week 4: Term Structure Models I**  Binomial lattice models of the short-rate; pricing fixed income derivative securities including caps, floors swaps and swaptions; the forward equations and elementary securities.  **PSet 4 Released** | Wed 27 Nov2013 (soft deadline)  Sat 7 Dec 2013 (hard deadline) |
| Nov 25 | **Week 5: Term Structure Models II and Introduction to Credit Derivatives**  Calibration of term-structure models; the Black-Derman-Toy and Ho-Lee models. Limitations of term-structure models and derivatives pricing models in general. Introduction to credit-default swaps (CDS) and the pricing of CDS and defaultable bonds.  **PSet 5 Released** | Wed 4 Dec 2013 (soft deadline)  Sat 14 Dec 2013 (hard deadline) |
| Dec 2 | **Week 6: Introduction to Mortgage Mathematics and Mortgage-Backed Securities**  Basic mortgage mathematics; mechanics of mortgage-backed securities (MBS) including pass-throughs, principal-only and interest-only securities, and CMOs; pricing of MBS; MBS and the financial crisis.  **PSet 6 Released** | Wed 11 Dec 2013 (soft deadline)  Sat 21 Dec 2013 (hard deadline) |