

American University of Beirut  
Faculty of Engineering and Architecture  
Engineering Management Program

---

## ENMG 625 Financial Engineering II

Summer 2009

CRN 30139. TTH 5:00 - 8:00 PM in Bechtel 537

### **Instructor**

Bacel Maddah, Ph.D.

Office: Bechtel 519A

E-mail: [bacel.maddah@aub.edu.lb](mailto:bacel.maddah@aub.edu.lb).

Office phone: 3551.

Webpage: [www.aub.edu.lb/~bm05/](http://www.aub.edu.lb/~bm05/)

Office hours: Th 12:30 - 3:30 PM

### **Course Description and Objectives**

Financial Engineering involves scientific tailoring of financial products. In ENMG 624 Financial Engineering I, we studied pricing and portfolio structuring of fixed-income securities (e.g. bonds) and securities characterized by a single-period random cash flows (e.g. stocks). In this course, our main focus is on *derivative securities*. A derivative security is a financial instrument whose value depends on another “underlying” financial (or tangible) asset. Derivative securities are used (i) to *hedge* against the risk of the underlying asset; or (ii) to make money by *speculators* anticipating a price change (ignoring market efficiency). Specifically, we will study futures, forwards and *options*. The study of options in the last three decades has fueled the interest of the scientific community in Finance. The theoretical and practical success on the options front is among the main reasons for the emergence of Financial Engineering. Among the most prominent success stories is the development of the options pricing technique by Black and Scholes, which continues to serve as the main tool for pricing options and other securities. This well-known technique is based on arbitrage pricing and on modeling the stock price as a geometric Brownian motion. We will also study techniques for maximizing a *portfolio growth* over time. The main objectives of the course is for the student to acquire familiarity with derivative securities and the ability to apply Black-Scholes and other techniques for pricing these securities. A secondary objective is to expose the student to stochastic processes and their applications in Finance.

### **Course Prerequisites**

ENMG 624.

### **Textbook**

Luenberger, D. G. (1998). *Investment Science*, Oxford University Press.

## Additional References

1. Bodie, Z., K. Alex and A. J. Marcus (2005). *Investments*, McGraw-Hill.
2. Bjork, T. (1998) *Arbitrage Theory in Continuous Time*, Oxford University Press.
3. Derman, E. (2004). *My Life as a Quant*, Wiley.
4. Hull, J. C. (2006). *Options, Futures and Other Derivatives*, Prentice Hall.
5. Malkiel, B. (2007). *A Random Walk down Wall Street*, Norton.
6. Sharpe, W. F., G. J. Alexander and J. V. Bailey (1999). *Investments*, Prentice Hall.
7. Ross, S. M. (2003). *An Elementary Introduction to Mathematical Finance*, Cambridge University Press.
8. Wilmott, P. (2007). *Paul Wilmott Introduces Quantitative Finance*. Wiley.

## Topics Covered

We will cover mainly Chapters 10 to 15 from Luenberger's book. In addition, the students will read Malkiel's book (and will be expected to answer short questions on this reading in the exams). Specifically, the following topics will be covered from Luenberger's book.

1. Forward contracts, forward prices, future contracts, future prices, swaps, minimum variance and optimal hedging. (Chapter 10)
2. Models of asset dynamics: Binomial lattice model, additive and multiplicative models, random walk, Wiener (Brownian motion) and Ito processes, stock price process, Ito's lemma. (Chapter 11)
3. Basic option theory: Option concepts, option values, option combinations, put-call parity, single- and multi-period binomial option theory, real options, risk-neutral pricing. (Chapter 12)
4. Advanced option theory: Black-Scholes equation, call option formula, risk-neutral valuation, delta, replication, synthetic options, portfolio insurance, computational methods, storage costs and dividends, Martingale pricing. (Chapter 13)
5. Exotic options, Non-standard American options. Shout, binary, forward start, chooser, compound, Asian, barrier, lookback, and exchange options.
6. Interest rate derivatives: Binomial approach, pricing applications, leveling, adjustable-rate loans, forward equation, matching the term structure, immunization, CMOs, continuous time solutions. (Chapter 14)
7. Portfolio growth: Log-utility approach to growth, power utilities, continuous-time growth, mean-variance, log-optimal pricing. (Chapter 15)

## Grading

Midterm Exam	35%
Final Exam	35%
Homework	20%
Paper	10%

**Homework**

Homework problems will be assigned frequently. Students are encouraged to spend plenty of time working on the homework problems and to discuss their solution with each other. However, each student should write the final version of the homework *individually*.

**Paper**

Students (in groups of 2) will choose with the assistance of the instructor a paper on a relevant topic. Each group will (i) write a summary, with a critique of the paper, (ii) receive and incorporate instructor's feedback, and (iii) present their findings to the class.

**Attendance Policy**

Attendance will be noted. A student is allowed four unexcused absences at most.

**Course Website**

<http://staff.aub.edu.lb/~bm05/FEII/>

Look for assignments and other class related material there.

---

Students are advised to review all relevant university rules and regulations including those related to attendance, cheating, plagiarism, misconduct, and academic integrity, among many others. It shall be expected that strict enforcement of these rules and regulations will be exercised.