

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

ENMG 624 Financial Engineering I

Spring 2017, CRN 20459 , TTh 5:30 PM - 6:45 PM - Bechtel 208

Instructor

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Course Description and Objectives

Financial Engineering is the tailoring of cash flows over time to be as desirable as possible. This involves the scientific design of financial products which are traded in the financial markets. Examples of financial products (also known as financial instruments or securities) include bonds, stocks, futures, and options. This course aims to (i) introduce students to the investment process and financial markets; and (ii) explain how Financial Engineering is applied to structure an important class of financial securities. Specifically, the course will focus on portfolio management and valuation of financial instruments modeled as single-period random cash flows (e.g. stocks) and will introduce the student to the pricing of a basic class of financial derivative securities (forwards, futures and options) using discrete-time tools (i.e., the underlying asset prices is assumed to change at discrete time points). This study has many direct applications in the financial market and provides insights that can be extended to handle more complex financial instruments with continuous-time analysis. (These will be covered in ENMG 625 Financial Engineering II.) The course will also provide the students with a good exposure to areas such as mathematical modeling, optimization, probability, and, more generally, to finance, and operations research.

Course Prerequisites

Basic concepts of engineering economy. A training equivalent to INDE 301 is required.

Textbook

Luenberger, D. G. (2013). *Investment Science*, 2nd Edition, Oxford University Press.

Additional References

1. Bodie, Z., K. Alex and A. J. Marcus (2005). *Investments*, McGraw-Hill.
2. Bernstein, P. L. (2005). *Capital Ideas: The Improbable Origins of Modern Wall Street*. Wiley.
3. Bernstein, P. L. (2009). *Capital Ideas Evolving*. Wiley.
4. Derman, E. (2004). *My Life as a Quant*, Wiley.
5. Elton, E. J. and M. J. Gruber (1991). *Portfolio Theory and Investment Analysis*, Wiley.

6. Malkiel, B. (2003). *A Random Walk down Wall Street*, Norton.
7. Ross, S. M. (2002). *Introduction to Probability Models*, Academic Press.
8. Sharpe, W. F., G. J. Alexander and J. V. Bailey (1999). *Investments*, Prentice-Hall.
9. Sullivan, W. G., E. Wicks and J. Luxhoj (2003). *Engineering Economy*, Prentice-Hall.
10. Taleb, N. N. (2007). *The Black Swan: The Impact of the Highly Improbable*, Random House.

Topics Covered

We will cover Chapters 6 to 14 of the textbook (with a cursory coverage of Chapters 11 and 13). Students will also present selected topics from Bodie et al. (2005, BAM) book.

1. Review. The basic theory of interest. Present and future value of streams, internal rate of return. Probability primer. Basic probability theory, random variables, distribution functions, joint distributions. (Chapter 2, Luenberger and Ross).
2. Mean-variance portfolio theory. Portfolio mean and variance, feasible set, efficient frontier, the Markowitz model, the two-fund theorem, inclusion of a risk-free asset, the one-fund theorem (Chapter 6, Luenberger).
3. The capital asset pricing model. Market equilibrium, the capital market line, the pricing model, performance evaluation, project choice. (Chapter 7, Luenberger).
4. Pricing Models. Factor models, the CAPM as a factor model. Arbitrage pricing theory. Projection pricing. (Chapters 8 and 9, Luenberger)
5. Data and Statistics. Estimation of parameters. Mean blur. Effect of estimation error (Chapter 10, Luenberger).
6. General principles. Utility functions, risk aversion, linear pricing, portfolio selection based on utility maximization. (Chapter 9, Luenberger).
7. Risk measures. Value at risk. Computation of VaR. Conditional Value at Risk. (Chapter 11, Luenberger).
8. Forward contracts, forward prices, future contracts, future prices, swaps, minimum variance and optimal hedging. (Chapter 12, Luenberger)
9. Basic option theory. Models of asset dynamics: Binomial lattice model, geometric Brownian motion. Option concepts, option values, option combinations, put-call parity, single- and multi-period binomial option theory, real options, risk-neutral pricing. (Chapters 13 and 14, Luenberger)

Grading

Midterm Exam	32%
Final Exam	33%
Homework Assignments	15%
Presentation	20%

Homework

Homework problems will be assigned and graded frequently. Students are encouraged to spend plenty of time working on the homework problems and to discuss their solution with each other and the instructor. However, *each student should write and submit the homework individually. Do not type the homework. But do staple it. Doing the homework is the best way to excel in this course.*

In-Class Presentations

Selected readings from BAM book will be assigned to each student. Each student will present the assigned reading within 20 minutes of class time, during the last week of classes. The presenters are *required* to go beyond the assigned chapters and enrich the presentation with “colorful” material from the web and other sources. To guarantee the quality of the presentation, the presenters must send me their presentation slides one week before the presentation and be ready to incorporate my feedback. To stimulate the class interest in the presentations, 15% of the final exam will cover basic concepts from the presentations. Non-presenting students are encouraged to read the chapter before coming to class and to ask the presenters “good” questions.

The list of reading material includes

1. The investment environment (Chapter 1, BAM).
2. Financial instruments (Chapter 2, BAM).
3. How securities are traded (Chapter 3, BAM).
4. Mutual funds and other investment companies (Chapter 4, BAM).
5. History of Interest Rates and Risk Premiums (Chapter 5, BAM).
6. Market efficiency and behavioral finance (Chapter 12, BAM).
7. Empirical evidence on security returns (Chapter 13, BAM).

Attendance Policy

Attendance will be noted.

Course Website

<http://www.aub.edu.lb/~bm05/FEI/>

Look for assignments and other class related material there.