

## ISE 563 FINANCIAL ENGINEERING - Summer 2016 (July 1 – Aug 8)

MF 11:30 a.m. – 2:40 p.m.

Professor: Cesar Acosta, Ph.D.  
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### Textbooks

Hull J., *Options, Futures, and Other Derivatives*, 9<sup>th</sup> ed., Prentice Hall, 2014  
Davison M., *Quantitative Finance*, Chapman and Hall/CRC, 2014

**Pre-requisites:** Required, ISE 220 Probability Concepts in Engineering or equivalent. Recommended ISE 460 or 560 Engineering Economy, or equivalent.

**Course Objectives:** To familiarize students with investment problems and the mathematical tools needed to solve them. Investment problems such as assets pricing, portfolio selection and optimization, hedging, and optimization of financial strategies. In particular the use of derivative instruments to reduce investments risk. To attain this objective the knowledge of some mathematical tools is required. This course will familiarize the students with stochastic processes and stochastic calculus as they are useful to price derivative assets.

Week	Topic	EXAMS
1	Portfolio Optimization	
2	Derivatives & the Arbitrage Theorem	
3	The Binomial model & Black-Scholes Formula	
	Midterm	July 22
4	Monte Carlo simulation of Exotic Options	
5	Martingales	
6	Portfolio hedging	
6	Stochastic Calculus, Ito's lemma	
7	Final Exam	Aug TBD

**Grading Policy:** homework assignments 30%, midterm exam 30%, final exam 40%.

**Software:** R, will be the main computational finance tool for portfolio optimization and simulation. Real data will be downloaded, manipulated and analyzed (analytically and graphically) using R. It is a powerful open source platform for statistical analysis.

**Academic Integrity.** The Viterbi School of Engineering adheres to the University's policies and procedures governing academic integrity as described in SCampus ([www.usc.edu/dept/publications/SCAMPUS/](http://www.usc.edu/dept/publications/SCAMPUS/)). Students are expected to be aware of and to observe the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course.

**Students with Disabilities.** Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301and is open 8:30 a.m. – 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776

**Desire2learn.** For general instructional support assistance please contact the Instructional Support Center office at [denisc@usc.edu](mailto:denisc@usc.edu) or (213) 821-1421. For any other technical support issue please contact the Technical Support Center at [dentsc@usc.edu](mailto:dentsc@usc.edu) or (213) 821-1321.

Financial Engineering - Study guide

- Risk free and risky assets
- Estimating volatility and correlations
  - geometric averages
  - the EWMA model
  - the GARCH model
  - ◆ R application
- Portfolio Optimization
  - two risky assets
  - $n$  risky assets
  - including a risk free asset
  - R application
- Value at risk
  - Probability of a loss
  - Conditional value at risk (CVaR)
  - R application
- Financial Derivatives (Forwards, Futures, Options)
  - Arbitrage Principle
  - Forwards
  - Options (call and put options)
  - Portfolios including options
- Discrete time models for pricing derivatives
  - Binomial Tree models
  - Options on stocks paying dividends
  - R application

MIDTERM EXAM

- The Black and Scholes formula
- American options
- Models for stock prices
  - Brownian motion
  - Martingales
  - R application
- Exotic Options
  - Binomial tree models
  - Monte Carlo Simulation
  - R application
- Hedging risk positions
  - Derivatives of the option price (the greeks)
  - Portfolio hedging
  - R application

FINAL EXAM