

**OR688/SYST688: Financial Engineering -  
Introduction to Derivatives and Risk Management**

Fall 2015

George Mason University  
Department of Systems Engineering and Operations Research

**Instructor:** KC Chang

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Class hour: Wednesday 4:30-7:10 PM, Eng. #2241

Office Hour: Wednesday 1:00-3:00 PM, or by appointment

**Course Description:** This course introduces derivatives and risk management in financial engineering. Financial engineering is a cross-disciplinary field which relies on mathematical finance, numerical methods, and computer simulations to make trading, hedging, and investment decisions, as well as facilitating the risk management of those decisions. This course will introduce basic concepts of options, futures, and financial derivatives markets. It will also cover a broad range of derivatives products and discuss how risks are managed in financial institutions. While mathematics is indispensable in financial engineering, this course will try best to focus on the concepts and ideas of finance, while limiting the math within a scope acceptable to most students in engineering.

**Prerequisites:** Graduate standing (Undergraduate engineering math: Calculus, probability theory, and some basic computer programming skills. Some background in financial markets would also be helpful, but not necessary.)

**Textbooks:**

**Required:**

1. John. C. Hull, “*Options, Futures, and Other Derivatives*,” 9<sup>th</sup> edition, Prentice-Hall, 2014.

**Recommended References:**

2. John. C. Hull, “*Risk Management and Financial Institutions*”; Prentice-Hall, 2nd edition, 2010.
3. Mark S. Joshi, “*The concepts and practice of mathematical finance*,” Cambridge University Press, 2004.
4. David G. Luenberger, “*Investment Science*,” Oxford University Press, 1997.
5. Salih N. Neftci, “*Principles of Financial Engineering*,” Academic Press, 2004.

### **Optional Readings:**

6. Emanuel Derman, “*My Life as a Quant: Reflections on Physics and Finance*,” Wiley, 2004.
7. William Poundstone, “*Fortune’s Formula*,” Hill and Wang, 2006.
8. Burton G. Malkiel, “*A Random Walk Down Wall Street: The Time-Tested Strategy for Successful Investing*,” Norton, 2011.
9. Michael Lewis, “*The Big Short*,” Norton, 2010.
10. Nassim Taleb, “*The Black Swan: The Impact of the Highly Improbable*,” Random House, 2010.

### **Assignments and Exams:**

There will be five hand-in assignments during the semester, a mini term project, as well as a mid-term exam and a final exam, both in-class. The exams will not be open book. However, you will be permitted a two-sided “cheat sheet” with notes and/or formulae.

### **Grading:**

The assignments, mini project, and two exams constitute 25%, 20%, 25% and 30% of the grades respectively.

### **Schedule:**

- Unit #1: Introduction; Chapters 1-3
- Unit #2: Interest rates and future prices; Chap. 5-7, Credit crisis; Chap. 8
- Unit #3: Properties of Options; Binomial Trees; Chapters 9-10, 12, 20
- Unit #4: Review of standard products and models; Chapters 13-14,16-17,19
- Unit #5: Value at Risk; Chapters 21
- Unit #6: Estimating volatilities and correlations; Chapter 22
- Unit #7: Mid-term exam
- Unit #8: Credit risk; Chapter 23
- Unit #9: Credit derivatives; Chapter 24
- Unit #10: Interest Rate Risk; Chapters 28-29
- Unit #11: Market Risk; Notes and Handouts
- Unit #12: Other Risks; Notes and Handouts
- Unit #13: Energy and commodity derivatives; Chapter 33
- Unit #14: Real options; risk and return; Chapter 34
- Unit #15: Review of Course; Project presentation
- Unit #16: Final exam