Kellogg Graduate School of Management
Northwestern University

Finance 467, Derivatives Markets II

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This course is a follow-up to *Derivatives Markets I*, Finance 465. Familiarity with the material in that course is a prerequisite; in particular, I assume familiarity with the Black-Scholes model and working knowledge of binomial pricing. I also assume very good facility with Excel, and we will do some VBA programming (Appendix D in my text is a VBA tutorial).

The material in this course is more mathematical than in the average course at Kellogg. We will use calculus in class, though I will not expect you to do sophisticated mathematical derivations on exams. (Ryan (2003) might suffice for those needing a calculus refresher.) I do presuppose that you are interested in being able to read "advanced practitioner" literature, such as *Risk* magazine, and technical reports published by the investment banks.

1 Resources

1.1 Required Readings

- McDonald (2006)
- Case packet and selected articles, available online (via online syllabus)
- First Assignment: Review the binomial model, the Black-Scholes model, and the Greeks.

1.2 Excel

We will make extensive use of Excel (Office 97 or later) and Visual Basic for Applications (VBA), Excel's built-in macro language. An introduction to VBA is in the case packet. If you're not familiar with VBA, you should work through the VBA tutorial, which is an appendix in the book and is also on the web. The spreadsheet *OptAll2.xls* is included with the second edition of my book.

1.3 Of Interest (not required for the course)

- Hull (2003) This is a widely-used text and reference which (in my opinion) is not really aimed at an MBA-level audience. It does have good coverage of some advanced topics, in particular interest rate derivatives.
- Wilmott (1998) (and later books, with considerable overlap among them.) Wilmott views derivatives as an applied mathematician: once you've written down the partial differential equation and boundary conditions for a particular problem, you're done. It's not for everyone, but this is an excellent book, more advanced than Hull. (Two

comments: 1. don't worry if you don't know what a partial differential equation is. I don't expect that you know. 2. By the end of the course, you *will* understand the appeal of Wilmott's approach!)

- Geman (2005) This is a serious academic book on commodities, with a lot of institutional detail.
- Glasserman (2004) This admirable book offers an excellent and exhaustive treatment of Monte Carlo. Glasserman is clear and concise.
- Joshi (2003) This book goes into the mathematics of financial models relatively carefully but without being excessively formal.
- Neftci (2000) This is an informal treatment of derivatives mathematics, assuming very little prior knowledge. It's patient and fairly thorough.
- Ryan (2003) An entertainingly written (yes, really) calculus book if you need a refresher. As a bonus, you may bump into the author at Peet's.
- Jackson and Staunton (2001) This book builds spreadsheets for analyzing bonds, equities, and options, and has some very nice VBA examples.
- London (2007) This is a new book that looks good, based on a quick perusal.

1.4 Data

For the course project we have several data sources:

- **Bloomberg** There is a terminal in the student labs. Unfortunately our license does not permit downloading of data; you can just view it on the screen and print the screen.
- **Datastream** There is a Datastream machine in the student labs.
- **WRDS** This is a source for historical stock, bond, company, and option data. The link is `http://wrds.wharton.upenn.edu`; the username is *fin465* and the password is *OptionsR2Fun* (case sensitive).

2 Requirements

2.1 Grading

2.1.1 Problem Sets

These may be handed in as group assignments, with a maximum of **four** to a group. See the "Honor Code" and "Written Assignments" notes below. I drop the low homework grade.

2.1.2 Quizzes

This will be three brief (30-minute or less) in-class quizzes, on these dates:

- Jan 22
- Feb 12

- Mar 4

The purpose of these quizzes is to encourage you to keep up with the material. I drop the low quiz grade.

2.1.3 Final Exam

March 18. This will be in-class and will cover the entire class.

2.1.4 Final Project

Due Friday, March 14. The final project will give you the opportunity to apply the tools of the course to a practical problem. We will discuss this more in class. This may be handed in as a group project. The grade will reflect the number of participants (i.e. I expect a better project from a larger group.) *You must have a bibliography, and citations in the paper to your research references.*

You should discuss your project with me before you begin in-depth work.

2.1.5 Class Participation

I expect you to bring namecards to class and to display them. I will reward thoughtful comments and contributions that enlighten others or me. This grade is determined entirely by the *quality* of your participation, not its quantity. Here are things that will count as class participation:

- Comments and questions in class which are instructive and helpful for the class as a whole.
- Active, helpful participation in the newsgroup.
- Direct feedback to me which helps me do a better job of teaching. This could include letting me know if particular material or a problem set is confusing, suggesting ways to improve presentation of the material, and suggesting different applications of a concept in the course.
- Copies of articles or materials which are useful to me or to the class.

2.1.6 Grading Formula

Your grade will be determined by the following formula:

$$0.05 \times X_P + 0.10 \times X_{PS} + 0.2 \times X_J + 0.65 \times \max(0.5X_Q + 0.5X_F, X_F)$$

where X_Q is the participation grade, X_{PS} the problem set grade (low grade dropped), X_J the project grade, X_Q the quiz grade (low grade dropped), and X_F the final.

2.2 The Honor Code

In addition to the usual expectations created by the honor code, there are four aspects I want to interpret and emphasize for this class:

- *You must have a full understanding of any written material you submit with your name on it.* I encourage you to work in groups as I believe this is the best way to learn. You may hand in group problem sets. However, it is an honor code violation if you are not completely familiar with the contents of a document bearing your name.

- *You may not use any material from previous offerings of this course in preparing material to be graded.* For example, you may not look at problem set answers from previous quarters.
- *You may not collaborate on exams.* (Yes, I know this sounds silly but I was advised by a GMA honor code rep that I need to say this explicitly!)
- *You must cite your sources.* In written work you must
  - provide complete citations for all your sources
  - place in quotation marks any non-trivial portion that is taken directly from a source
  - offer citation for any graphs or tables that are taken from another source.

  Failure to adhere to these standards is a potential violation of the honor code and may be deemed plagiarism.

2.3 Written Assignments and E-mail

Except in unusual and pre-approved circumstances, assignments are to be submitted on paper, not electronically. Prinouts of spreadsheets must be clearly documented, indicating the formulas and calculations. Unless I explicity state otherwise, there is no need to turn in pages of random numbers.

E-mail is the best way to get in touch with me. I ask that you please not send attachments without a good reason to do so.

3 Course Outline

The following is a *tentative* outline of the course. If you miss a class, it is your responsibility to check with someone to find out what happened.

A "*" after a reading means that the material is available in the case packet.

3.1 Introduction and Review (Jan 8)

- Overview of Course.
  - Merton (1995)*
- The Black-Scholes Formula, the Black formula, and variants
  - McDonald (2006, Sections 12.1–12.2 and 14.6)
- Delta-Neutral Hedging and the Link to Pricing.
  - McDonald (2006, Chapter 13, Section 11.3);
- Programming in Excel. (We will compute most everything in the course using Excel's macro language. Feel free to use Matlab or some other language.)
  - McDonald (2006, Appendix D).

3.2 Lognormality (Jan 15)

- The Lognormal Distribution.
  - McDonald (2006, Chapter 18); Surdell (1999)*.
- Are Stock Prices Lognormal?
  - Campbell et al. (1997, pp. 9-24)*;
    Campbell et al. (2001, link)

3.3 Monte Carlo (Jan 22)

- Review of the Binomial Formula
  - McDonald (2006, Chapter 10, Section 11.3)
- Why does Risk-Neutral Pricing Work?
  - McDonald (2006, Section 19.1 and Appendix 11.B)
- Monte Carlo Methods
  - McDonald (2006, Chapter 19); Bodie and Crane (1999)*; Baubonis et al. (1993)*
- American Option Pricing
  - Broadie and Glasserman (1997, link), Longstaff and Schwartz (2001, link)

3.4 Brownian Motion and Itô's Lemma (Jan 29)

- Brownian Motion.
  - McDonald (2006, Chapter 20.1–20.5)
- Ito's Lemma
  - McDonald (2006, Chapter 20.6–20.9)

3.5 The Black-Scholes Equation (Feb 5)

- The Black-Scholes Derivation
  - McDonald (2006, Chapter 21.1–21.3, Appendix 21.A)
- Solutions to the Black-Scholes Equation
  - McDonald (2006, Chapter 21.4–21.5, Appendix 21.C)
- Stochastic Volatility
  - McDonald (2006, Chapter 23); McDonald (draft of Chapter 23, 2006, link), Chicago Board Options Exchange (2003, link), Heston (1993, link), Bakshi et al. (1997, link), Duffie et al. (2000, link), Coval and Shumway (2001, link), Bakshi and Kapadia (2003)

3.6 Non-Standard Options (Feb 12– Feb 19)

- Digital and Barrier Options.
  - McDonald (2006, Sections 14.3, Chapter 22)
- Supershares
  - Hakannson (1976, link)
- Quantos
  - McDonald (2006, Chapter 22)
- Other Exotics
  - McDonald (2006, Chapter 14, Chapter 22); Meulbroek (2002)*
- Advanced Binomial Pricing
  - McDonald (2006, chapter 22);

3.7 Fixed Income: Static Models (Feb 26)

- Basic Concepts.
  - McDonald (2006, Chapters 7, 8, 15), Fleming and Garbade (2003, link)

3.8 Fixed Income: Dynamic Models (Mar 4)

- Short-rate models
  - McDonald (2006, Chapter 23); Black et al. (1990, link)
- Binomial Trees
- The LIBOR Market Model

3.9 Risk Assessment and Corporate Applications (Mar 11)

- Value at Risk
  - McDonald (2006, Chapter 24); Lowenstein (2000, Chapter 3)*; Pearson (2002, Chapters 8, 16)*, Srivastava (1999)*,
    Fleming and Garbade (2002, link)*,
- Credit Risk
  - McDonald (2006, Chapter 26), McDonald (draft of Chapter 26, 2006, link), Campbell and Taksler (2003, link)
- Corporate applications
  - Schwartz and Moon (2000, link); Schwartz and Moon (2001, link)

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