Note: This is a sample syllabus, typical of the course as taught in past semesters. However, you are bound by the actual syllabus handed out by your instructor in your class, which may differ as regards to text, assignments, or other details.

Course Outline
22 January 2004

1. What is Financial Engineering?

The title of this course is Financial Engineering. But what is financial engineering? There are two definitions:

Definition 1: Financial engineering is the application of the mathematical tools commonly used in physics and engineering to financial problems, especially the pricing and hedging of derivative instruments.

Definition 2: Financial engineering is the use of financial instruments such as forwards, futures, swaps, options, and related products to restructure or rearrange cash flows in order to achieve particular financial goals, particularly the management of financial risk.

This course is based on Definition 2. If we define financial engineering in this way, it is almost synonymous with risk management. The goal of the course is to provide students with a solid understanding of the tools and techniques of risk management and financial engineering including the use of derivative instruments such as forwards, futures, options, swaps, and related instruments to manage risk and create solutions to financial problems, as well as modern techniques for measuring financial risk. This course is for everyone.

The specific topics to be covered are listed in the next section of the outline. Because most people learn by doing rather than by listening, the course will be built around the four projects described in the fourth section of this outline.

In order to take Fin 472, you must have either the permission of the instructor, or at least one of the following prerequisites: the Finance section of MBA 405; FIN 451; or FIN 456. The course requirements consist of four group projects (each receiving a 10% weight in the determination of the course grade), a midterm examination halfway through the semester (20% weight) on Wednesday, 10 March and a final examination (40% weight) at 8:00-11:00 a.m. on Monday, 10 May (Section A, 8:30-9:50) or 8:00-11:00 a.m. on Saturday, 8 May (Section C, 10:00-11:20). The final examination will be cumulative, i.e. it will cover the entire course. The midterm examination is not required; if you do not take the midterm examination, the weight on the final examination will be 20% + 40% = 60%.

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1 If you want a “definition 1” course, you should consider Finance 473.

2 With the caveat that a reasonable amount of work is required: the course requirements include 4 projects and 2 exams.
The course presumes that the students are reasonably well informed, i.e. that they are at least somewhat familiar with the financial markets and regularly read a financial newspaper. For students who do not anticipate working in the United States, the *Financial Times* is probably a better choice than the *Wall Street Journal*. Also, I strongly recommend that students read *Risk*, which is available in the Commerce Library. *Risk* is the best source of information about current issues in risk management, financial engineering, and the OTC derivatives markets.

I may be found in 304D David Kinley Hall, voice 217 244 0490, e-mail pearson2@uiuc.edu. Office hours are Wednesday, 3:00–4:00 p.m., and by appointment.

2. Textbook, Schedule, and Reading Assignments

There are three different materials for the course: (i) most of the readings are from the textbook by Robert McDonald titled *Derivatives Markets*; (ii) the readings on risk measurement are from *Risk Budgeting: Portfolio Problem-Solving Using Value-at-Risk* by Neil D. Pearson (the readings from *Risk Budgeting* will be distributed toward the end of the semester); and (iii) an extensive set of notes distributed through the course web site [http://www.cba.uiuc.edu/pearson2/fin472/index.html](http://www.cba.uiuc.edu/pearson2/fin472/index.html). In addition, serious students should consider purchasing and reading *Managing Financial Risk* by Charles Smithson (3rd edition, 1998). Smithson contains relatively little theory, but a wealth of descriptions of the markets, products, their uses, and other institutional information. Ideally, you would master the material in both the textbook and Smithson. There are also a few other readings, which will either be distributed or placed on reserve in the Commerce Library.

Specific assignments for readings are indicated below. Copies of the lecture notes and some other materials will be distributed in the form of PowerPoint and *.pdf* (Adobe Acrobat) files. If you do not have PowerPoint, the PowerPoint Viewer may be downloaded from Microsoft’s web site ([http://www.microsoft.com](http://www.microsoft.com)). If you do not have Adobe Acrobat or the Acrobat Reader, the Acrobat Reader may be downloaded from Adobe’s web site ([http://www.adobe.com](http://www.adobe.com)). We will also use WebBoard, a bulletin board and conferencing system. The Finance 472 WebBoard may be accessed from the course website, and from the WebBoard gateway [http://webboard.cet.uiuc.edu/](http://webboard.cet.uiuc.edu/). WebBoard documentation is available at the link: [http://www.cites.uiuc.edu/edtech/resources/webboard/index.html](http://www.cites.uiuc.edu/edtech/resources/webboard/index.html).

**Schedule**

Class 1: Introduction

(21 January)

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3 Because many students in this course will also take Finance 452, most students will be exposed to the arguments for and against hedging. However, if you are not taking Finance 452, you should read Kenneth A. Froot, David S. Scharfstein, and Jeremy C. Stein, “A Framework for Risk Management,” *Harvard Business Review* (November-December 1994), and Smithson, Chapters 20-21.
Reading: McDonald, Chapter 1

Swaps

Class 2: Introduction to interest rate swaps
(26 January)

Reading: McDonald, Section 8.1 (Chapter 8, Section 1)
Optional reading: Smithson, pp. 67–72 (Chapter 4); Chapter 8 except pp. 162-169,
Chapter 9 pp. 171-172

Class 3: Pricing an interest rate swap
(28 January)

Reading: McDonald, Sections 7.1–7.2; appendices 7A and 7B; Section 8.2
Optional reading: Smithson, pp. 162-169 (Chapter 8)

Class 4: Pricing an interest rate swap
(2 February)

Reading: McDonald, Appendix B (pp. 793-797)

Class 5: The Eurodollar contract
(4 February)

Reading: McDonald, Sections 5.4, 5.7, 7.2; Hull, Galen Burghardt and William Hoskins, Convexity Bias in Eurodollar Futures, research note, Carr Futures
(September 16, 1994)

Class 6: Measuring and managing the risk of an interest rate swap
(9 February)

Reading: no additional reading

Class 7: Equity and total return swaps
(11 February)

Reading: McDonald, Section 8.6

Options and Option-like Instruments

Class 8: Options basics; simple no-arbitrage relations
(16 February)
Project 1 is due by 3:00 p.m. on Wednesday 18 February

Class 9: Caps, floors, and collars; swaptions; (18 February)

Reading: McDonald, Section 3.3, Chapter 4, Section 16.3

Option Pricing

Class 10: Option pricing: the binomial model (23 February)

Reading: McDonald, Chapter 10

Class 11: More on the binomial model; the Black-Scholes formula (25 February)

Reading: McDonald, Sections 11.1–11.3; Appendix 11B
Sections 11.3, 12.1-12.2; appendix 12A

Class 12: Estimating volatility (1 March)

Reading: McDonald, Sections 11.4, 12.5

Class 13: “Structured” notes, including equity and index-linked notes (3 March)

Reading: McDonald, Chapter 15, Section 16.1

Class 14: Implementing the binomial model to value an equity-linked note (8 March)

Reading: McDonald, Section 11.1, 11.5

Class 15: Midterm examination (10 March)

Class 16: The Greek letter risks (15 March)

Reading: McDonald, Sections 12.3, 12.4; Appendix 12B

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4 This is quite a bit of reading for one day. But, you should already have some knowledge of this material.
Optional reading: Smithson, Chapter 18

**Project 2 is due at 3:00 p.m. on Wednesday 17 March**

Class 17 Market-making and delta-hedging
(17 March)

Reading: McDonald, Chapter 13

Class 18: Exotic options
(29 March)

Reading: McDonald, Chapters 14, 22 (skim)

Class 19: Option pricing using simulation
(31 March)

Reading: McDonald, Chapters 18, 19

**Credit derivatives and pricing credit risk**

Class 20: Credit derivatives
(5 April)

Reading: to be provided

Class 21: Pricing Credit Risk
(7 April)

Reading: to be provided

**Risk Measurement**

Class 22: Value-at-risk: introduction, and the historical simulation method
(12 April)

Reading: McDonald, Sections 24.1–24.2, 14.8; Pearson, Chapters 1, 2, 4

**Project 3 is due by 3:00 p.m. on Wednesday 14 April**

Class 23: Value-at-risk: the delta-normal method – equity portfolio
(14 April)

Reading: Pearson, Chapter 3

Class 24: Value-at-risk: the delta-normal method – fixed income
(19 April)

Reading: Pearson, Chapter 5

Class 25: Value-at-risk: the Monte Carlo simulation method
(21 April)

Reading: Pearson, Chapters 6, 15

Class 26: Liquidity Risk and Stress Testing
(26 April)

Reading: Pearson, Chapter 9

Class 27: Measuring credit risk
(28 April)

Reading: Smithson, Chapter 17; Bill Winters, “Wrong-way exposure,” Risk 12 No. 5 (July 1999), pp. 52–55

Conclusion

Class 28: How to Lose Money in Derivatives
(3 May)

Reading: Figlewski, How to Lose Money in Derivatives

Class 29: Review/exercises
(5 May)

Project 4 is due at 3:00 p.m. on Wednesday 5 May

3. Examination Procedures

The examinations will be “closed book.” A large set of possible examination questions (without solutions) will be posted on the course website. (See the link “Examination Questions” on the navigation bar.) At least 50 percent of both the midterm and final examinations will consist of questions drawn from this set. In addition, a large set of exercises (with solutions) will also be posted. This system is intended provide strong incentives to work the exercises and examination questions. This is desirable, because working the problems is a crucial part of mastering the material in the course. It also provides a mechanism for students to learn to work the problems. In particular, some of

5 The online students will have an “open book” exam with a smaller fraction based on the posted questions.
the posted examination questions are difficult. To learn how to do them, first work the exercises for which solutions are provided.

4. WebBoard

Students are encouraged to ask questions by posting them on WebBoard. I prefer that students post substantive questions to WebBoard instead of asking them by private e-mail, because other students in the class do not benefit from private e-mail exchanges.

Students are also encouraged to ask questions in person, i.e. physically, by stopping by my office (304D David Kinley Hall). On-line students should feel free to telephone.

5. Group Projects

The course requirements include four group projects, which will be done in groups of 1 to 5 students. The groups need not be the same for all four projects, i.e. students may form different groups for different projects. The projects will be roughly as follows.

Project 1: Interest rate swaps

In the first project, I will provide each group with a description of a fixed income instrument. The instrument will be either a swap or a “structured note.” Each group will be asked to compute the theoretical price of the instrument, and to analyze the risks faced by a purchaser of the instrument. We will discuss the techniques that groups will need to use during classes 2–5. Project 1 is due by 3:00 p.m. on Wednesday 18 February.

Project 2: Valuing equity-linked notes using the binomial model

In the second project, I will provide each group with the prospectus for an equity-linked note or convertible bond, and each group will be asked to use the binomial model to compute the theoretical price as of the issue date. That is, each group will be asked to redo the analysis of the pricing of the issue carried out by the issuer and/or underwriter and/or buyer of the note. We will discuss the techniques groups will need to use during classes 10–14. Project 2 is due by 3:00 p.m. on Wednesday 17 March October.

Project 3: Valuing equity or index-linked notes using simulation

In the second project, I will provide each group with the prospectus for an equity or index-linked note, and each group will be asked to use Monte Carlo methods to compute the theoretical price as of the issue date. That is, each group will be asked to redo the analysis of the pricing of the issue carried out by the issuer and/or underwriter and/or buyer. We will discuss the techniques groups will need to use during class 19. Project 3 is due by 3:00 p.m. on Wednesday 14 April.

Project 4: Value-at-risk
In the last project, student groups will carry out value-at-risk calculations for one or more portfolios. Value at risk is a summary, portfolio level measure of market risk that we will discuss in the last part of the course. In the last few years it has become the state of the art for measuring market risk, and is used by all major derivatives dealers. Increasingly, it is used by nonfinancial corporations and other derivatives end-users as well. Project 4 is due at 3:00 p.m. on Wednesday 5 May.

**Shirking, free-riding, and the unfair allocation of work and credit**

A potential problem with group projects is that some students may not do their share of the work. We will deal with this problem in several different ways.

First, each student will submit a confidential evaluation of the work of the other members of his/her group. If these evaluations convince me that one or more members of a group are not doing their share of the work, then the grades of the offending members will be reduced, perhaps to zero.

Second, groups need not be the same for the entire semester. For example, if the other group members think that a student’s contribution to a project was inadequate, they may expel him or her from the group. If a student’s reputation is such that no other group will accept him or her as a member, then that student will have to do the subsequent projects by him or herself, and the subsequent projects will be graded as if they represent the work of a full group.

Third, if, *at any time during the semester*, the other members of a group present clear and convincing evidence that one member did not perform a reasonable share of the work, then the grade of the offending group member will be reduced, possibly to zero. A person who submits or seeks credit for work which is not his or hers is also in violation of the University’s code of academic integrity.