

The Wharton School  
Financial Engineering(392)

Mr Krishna Ramaswamy  
Spring, 2016

## Financial Engineering

FNCE 892  
Wednesdays, 3-5:45pm

*Registration is via a proforma application that you can email to us. Please read through the Course Description and Pre-requisites below; if you wish to apply, follow the instructions that are at the end of this description.*

Who should take the course?

- 1. Juniors and Seniors among Undergrads, MBAs and those grad students in the sciences and engineering who have strong finance interests, who wish to explore financial products in depth, and whose intellectual curiosity is unaccompanied by fear of some elementary calculus and algebra! This is a necessary prerequisite!*
- 2. All UGs with finance concentration and MBAs who are finance majors, who have taken Financial Derivatives and Fixed Income, were comfortable with that material, are certainly eligible; but see Item 1! The coverage in this class will be oriented towards equities and corporate securities, and the use of derivatives by banks, hedge funds, and corporate treasurers; you may have seen some of the basic products and concepts in earlier electives, but our coverage will at once dig deeper and go further in complexity and in applications. I will even pick some topics and applications of interest to students, after I meet you all. I will not cover the basics of fixed income products and credit products, or of the basic (binomial) model applied to pricing puts and calls.*
- 3. If you have taken Financial Derivatives but not Fixed Income (or vice versa) – then I expect you will be motivated enough to catch up by on material which I will direct you to read; my TA and I will be on hand to help you to do so, but see Item 1! I haven't yet had a student who felt that having taken BOTH courses is a necessary condition! Having had neither, though is trickier, but if you've read this far you should have satisfied yourself that Item 1 applies to you, from prior exposure to finance!*
- 4. If you have taken some advanced stat and math courses, you will be ready to tackle the math level of the class; if you have taken only the required math and stat classes, you will have to work a bit harder (read the text coverage I prescribe to all, PLUS some targeted coverage for you in a easier text book) – but see Item 1!*
- 5. Juniors are advised to take it in the Spring of their senior years; if, however, you have already had both Derivatives and Fixed Income and meet the requirement in Item 1, please do apply. I encourage sophomores to please wait until their junior years..*

## 1 Course Description

Many financial products are introduced each year; some are designed to meet the needs of a particular clientele, and others are really strategies and related implementations. A common feature of the successful products is the careful attention to their design, and more importantly, the technical preparation that entered into its valuation, its hedging, and its benefits to users. Innovations in financial markets are rapidly imitated because even complex contracts and strategies that use existing securities or they are seen as equivalent to dynamically-adjusted positions in other securities. A strong foundation in the technical tools and statistical methods is invaluable in this process of financial engineering.

The objectives in this course are twofold.

- First, to provide the student with the necessary skills to design or reverse-engineer, to value, and to hedge these products.
- Second, to enable the student to absorb the analytical arguments in the (increasingly) technical publications that deal with innovations in these contracts — now in the in-house research notes of financial institutions and in practitioner-oriented journals — and to apply them.

We will have a few lectures where technical, foundational material is covered; that will be followed by reading and discussion of (academic & practitioner) journal articles — these readings will be substantially more difficult than in most electives — as well as a few guest lectures. We may use case studies but only as quick examples in each topic, because our coverage will be deeper than is expected in a case-oriented course.

This is an advanced course, where a deep knowledge of the pricing of futures and options (especially backward-recursion with binomial trees, as well as the institutional setting of exchange-traded futures and options — covered in detail in Finance 206 and perhaps in other Finance electives) will be taken for granted. Basic ideas from probability and statistics, as well from the calculus (especially partial derivatives) will be assumed.

Students who have taken this course in the past have had a strong interest in analytical material and a willingness to work hard. Most of them have gone on to the principal financial institutions and chosen to work in functional areas that demand knowledge of financial markets and modelling methods. Almost all who have taken the course felt they wanted more rigorous analytical coverage than was available or possible in the typical finance elective. These students are self-starters and have in group projects examined existing products and strategies and collected the relevant data and conducted the statistical analyses that enable us to evaluate them.

Topics: The Maths of Financial Derivatives, Valuation and Hedging in practice; simulation methods; canonical products beyond common options, including swaps, swaptions, fixed income and currency-translated options, a few Exotic Options, Credit Products, and Securitised Products, pretty much in that order. I try to sprinkle examples as I go in the first part of the course.

*The attendance of the first class is mandatory. The course will have at least 9 lectures and one or two guest lectures. I will make myself available to student groups – you will pick a product or market, study its use and hedging in depth, and write a brief report and make a brief presentation to the class for several hours each week. I keep open office hours.*

## 2 Software Readiness

Knowledge of spread-sheet programming, eg Excel, is expected; the ability to program in Visual Basic or use software like Crystal Ball or Matlab is desirable but easily picked up, and will serve you well later. You might need to access some large databases (some available at Wharton, others on the web) – so if you have some experience that will enable you to download and manipulate data, so much the better. Statistical Packages: it's great if you're acquainted with them; Excel and VBA are powerful enough for the tasks in this course.

### 3 Books

Recommended:

1. *A Course in Derivative Securities: Introduction to Theory and Computation*, by Kerry Back, Springer Finance. This is an ideal book for our course; I will follow it for the first 5-6 weeks. Its usefulness lies in its tight mathematical progression, and it is replete with VBA code that is downloadable from the author's website – you will find it of considerable use in the course and later in your careers.
2. *Option Theory*, by Peter James, Wiley Finance. This has excellent intuition especially in the context of exotic options.
3. *Options, Futures & Other Derivatives*, by J Hull, Prentice Hall. It is more comprehensive in its coverage of the canonical derivatives products; unhappily, it supplies little by way of intuition.

The textbooks in derivatives act as a decent source for models; they will leave us with little by way of guidance on how well they work, and which one is in practical use! Sometimes they fail to give us ballpark estimates of the model's parameters. For this reason, I will supplement the material w Lecture Notes and Supplementary Readings.

I am setting up a CANVAS site for our collective convenience, even though the number of students will be small. You will find supplementary readings there; I may be forced to distribute material in class, although I will try to be as paper free as I can.

### 4 Course Requirements

I will have (a) 4 individual Problem Sets, (b) one group project (to be fully described in the first class – hence a must attend!), and (c) a midterm exam to be held in the 9th or 10th week, after we have learned the basic material. This is an advanced elective, so grades should not be your prime focus. Students who are organised and work hard almost never get a grade south of A-minus in this course.

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The next page provides a simple application procedure: it is in PDF form, so please EITHER enter your answers in the space provided as best you can and email it to me, OR simply type in all the answers in stream into your email taking care to answer all the questions!

Please answer the following questions in the space provided, and use additional space if necessary. Then email your app to me at [krishna@wharton.upenn.edu](mailto:krishna@wharton.upenn.edu), and please remember to include FNCE892: APPLICATION in the subject line!

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**NAME:**  
**email:**  
**Student ID:**

**Status**

Undergrad? Are you a junior/senior? Concentrating in Finance/  
 Other(indicate)

GRAD STUDENT? School, Field (major), and Years at Penn

**Relevant ELECTIVE Courses Taken**

Here please enter those elective classes you've taken that you feel were relevant. These should include the most advanced of the maths ELECTIVES in Calculus, Probability, Differential Equations, Stochastic Processes you have taken; grad students can include courses taken elsewhere.

Course Title	When Taken (Semester/Year)	Indicate Grade Received
Derivatives (717)		
Fixed Income (725)		

**Please indicate briefly any other relevant information, including your prior exposure to the field.**