KEELE UNIVERSITY

DEPARTMENT OF ECONOMICS

ECO-30004

Options and Futures

1   Module Details:

Module type: Principal Finance, Principal Management Science, Business Economics
Session: 2007/08
Semester: Second
Level: III
CATS Credits: 15

Compulsory for: Principal Finance
Pre-requisites: Asset Pricing
Co-requisites: None
Available to Socrates/Erasmus, exchange and visiting students: Yes

Teaching and learning methods: Lectures/Classes (2 hours lectures and per week and one hour class per fortnight)
Assessment method: Mixed (exam 80% and mid-term 20%)
Hand-in Date: N/A
Study time: 150 hours (of which approximately 20 hours lectures, 5 hours tutorials, 25 hours class preparation, 100 hours independent study)

Module times: Tuesday 10.00-12.00 in CBA 0.060
Tutorial times: Tuesday 15.00-16.00, HORN-119; Tues 16.00-17.00, HORN-119; Thursday 10.00-11.00, CBA.0.005 and Friday 9.00-10.00 CBA.0.007. Weeks: 3, 4, 6, 8.

Module coordinator: Prof. Tim Worrall
Teaching staff: Karin Jõeveer and Tim Worrall
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Consultation times: KJ: Monday 2.30-4.30. TW: Thursday 11.30-12.30 and Friday 10.30-11.30.

2 Aims and Objectives:

Aim of Module: The aim of the module is to introduce students to the market in derivative securities and to develop an understanding of the valuation of derivative securities

Objectives of Module: This course deals with the valuation and hedging of options, forward contracts, swaps and other derivatives. The pricing of options and other derivatives depends on three key factors: the volatility of the underlying asset, which is discussed in ECO-30013 (International Finance) in the context of efficient markets; the extensive use of arbitrage arguments to price assets as discussed in ECO-20011 (Asset Pricing) and the present value and discounting procedures to value streams of returns as analysed in ECO-10008 (Economics for Finance) and ECO-20012 (Portfolio Choice). Bringing these three elements together and deepening the understanding of each, it will be shown how complex derivatives, like index options, swaps and forward contracts can be analysed. Derivatives type securities such as warrants, convertibles and rights issues are used by companies and are part of the analysis of ECO-30012 (Corporate Finance).

Individuals who are skilled at analysing derivatives are in great demand in the City and can command high salaries

Intended Learning Outcomes: By the end of this module you should be able to understand the principles of option and derivative pricing. In particular it will provide you with the opportunity to acquire the following skills:

Knowledge and Understanding

- Understand uncovered positions, hedges spreads, combinations, reverse hedges etc. and be able to explain and illustrate their payoffs.
- Be able to understand and calculate the payoffs from a variety of options and other derivatives.
- Be able to recognize arbitrage opportunities in simple examples and be able to suggest trading strategies to exploit them.
- Know how option prices are displayed in the financial press and explain the pattern of put and call prices with maturity dates and strike prices.
- Be able to understand how option prices relate to the current stock price, the time to maturity, the strike price, the interest rate, the volatility and the expected dividends on the underlying stock.
- Be able to discuss the Black-Scholes formula and explain its key features and ingredients.
- Be able to compute option prices and elasticity measures in the binomial model using delta hedging, replication and risk neutral pricing methods.
- Able to solve relevant examples and be able to present their answers in a comprehensible manner, showing an appreciation of how simple examples can illustrate and illuminate general principles.

Note that the ability to understand the principles of option and derivative pricing is a highly prized skill in the finance profession which is rewarded with high salaries.

Cognitive and Intellectual Skills

In this module you can considerably enhance your numeracy skills by gaining an understanding of simple stochastic processes such as the binomial model. You will be able to advance your problem solving skills through a series of assigned exercises and to test your communications skills by explaining the main properties of derivative pricing cogently and concisely and by being able to explain how simple examples can illustrate general principles.

Transferable and Key Skills and Attributes

You will also have the opportunity to work with others in self-study groups to use web and other resources.

If you should wish to know more about key skills or personal development portfolios please visit the website at http://www.keele.ac.uk/depts/aa/class/pdp/index.html.

3   Syllabus

The crowning glory of options pricing theory is the Black-Scholes Pricing Formula (properly formulae since there is more than one), which shows how to price any option with given strike price and maturity if the interest rate, the current price of the underlying stock and the volatility of the underlying stock is known. The Black-Scholes formula can be use to assess the value and risk of an option. In conjunction with a model of asset pricing, such as the CAPM studied in ECO-20012 (Portfolio Choice), it can be used to form optimal portfolios of stocks and options. We shall concentrate on the valuation or pricing of options. To do this it will be necessary to make repeated use of arbitrage arguments, a process known as dynamic hedging, and to know how to value uncertain return streams in continuous time. We will try to bring all these elements together. First describing different types of options and different trading strategies. Next we consider the restrictions on option prices implied by arbitrage before considering how an exact option pricing formula can be obtained. This uses the method of risk-neutral valuation that you may have already seen in ECO-20011. It requires knowledge of the process that determines the future course of the price of the underlying stock. This is not such a difficult task as might be expected since it doesn't require a superior forecasting ability or an understanding of the fundamental variables that cause the underlying price to change. Rather it assumes that the idea of an efficient market imposes sufficient structure on the possible course of future prices. A key simplification is to use a binomial model for stock prices, that is we assume that in a given trading period, the stock price either goes up by a given percentage or goes down by a given percentage. We shall see how this method can

be used in a simple one period model and how it is extended to a multi-period model and discuss the continuous time limit for which the Black-Scholes formula applies.

Given the time constraints, we will focus mainly on options. Options are actually rather easier to understand than other derivatives and a grasp of option pricing will make it easy to see how futures, swaps and other exotic derivatives can be priced. From the book, we will concentrate on chapters 1-6, 14-18. You should read these chapters.

Topics to be covered:

- **Introduction**

What are options and futures? Puts and Calls will be defined and profits or losses from the six possible uncovered positions (long stock, short stock, sell put, buy put, sell call, buy call) considered. What is risk and how is it measured? How can investors and firms manage risk by the use of derivatives? Should firms manage risk? Read DM Ch 1-2.

- **Forwards and Futures**

How are forwards and futures used to manage risk? What is hedging? How are forward and futures prices determined? How are forward and futures prices related to spot prices? What is the difference between forwards and futures? Read DM Ch 3-5.

- **Options and Trading Strategies**

A common trading strategy is the *hedge* which involves buying the underlying stock and selling a call option. But other common trading strategies are *spreads* which involve trades in two or more calls or two or more puts and combinations which involve portfolios of puts and calls. Understanding trading strategies is a good way to make sure you've understood the six uncovered positions (long stock, short stock, sell put, buy put, sell call, buy call) and helps to understand the relationship between call and put prices. Read DM Ch 14-15.

- **Arbitrage Restrictions for Options**

We shall see how the price of call is related to the price of puts - the put-call parity condition; how the price of an option is related to the price of the underlying asset, the strike price, the interest rate, the possible dividends on the underlying stock during the life of the option and the date of maturity of the option. European and American options will be considered. Read DM Ch. 16.

- **The Binomial Model**

We discuss the binomial model and how options can be exactly priced using replication, delta hedging and risk neutral valuation methods. We examine option risk and the differences between American and European options. Read DM Ch. 17.

- **"The Midas Formula"**

We examine how the Black-Scholes formula can be considered as limit of the multi-period binomial model. Read DM Ch. 18.

4 Organisation and Assessment

Organisation: The module consists of approximately 15 lectures plus 4 tutorial classes plus one revision class and feedback session. The course outline is available in week 1. Lectures begin in week 1 with two lectures per week. Classes begin in week 3 and then subsequently in weeks 4, 6 and 8. There will be a mid-term test on material from the first part of the course in week 5. In the final week one lecture slot will be given over to feedback, revision and exam preparation guidance. Roughly 25 hours are given over to class preparation and 100 hours to private study. Attendance at lectures and tutorials will be monitored.

Teaching and learning methods: Lectures will cover all the main material and emphasizes the topics for study. Class sessions and will go through some problem solving of examples. Times for tutorial classes are advertised in week 1.

Please make use of the consultation times, self-study groups, and other resources that are listed below. You will find the books, articles, course materials and web-based materials extremely helpful. You should note that you will need to work steadily and continuously throughout the module. Experience suggest that those who do not work steadily but leave study until a few weeks before the exam fail this course.

Assessment: Two hour exam in April/May examination period worth 80% of total mark for the module. The exam paper from 2007 is available as a pdf file on the WebCT course page. There will be a 50 minute mid-term on February 19th at 11.00am. Venue: TBA. A mid-term from last year together with model answers will be provided on the WebCT course page.

5 Resources

It is important that you read and comprehend all the relevant material from the course textbook and study the other course materials.

Note: The Campus bookshop has been notified of the course textbook but if the books listed are not in the Campus bookshop, they can also be ordered from a variety of online bookstores.

Course Textbook: The course textbook is

David A Dubofsky and Thomas W. Miller: Derivative Valuation and Risk Management, Oxford University Press, 2003. ISBN 0-19-511470-1. £38.99. **HG6024 .A3D8**

This is an extremely good textbook at exactly the right level. It is written in a straightforward and accessible style explaining the key theoretical and practical material that the course will cover. You should make sure you obtain a copy and work through the relevant chapters.

Course Materials: Other course materials including powerpoint lecture slides, assigned exercises and some lecture handouts are also available on e-campus. The relevant URL is **https://www.vle.keele.ac.uk/webct/logon/2232872001**. You should bookmark that page and return to it frequently as the course materials will be updated at regular intervals.

Other Textbooks: No one textbook is ever sufficient and you will gain valuable understanding by consulting other texts that may present similar material in slightly different ways. Here are a few suggestions.

John C. Hull: Futures and Options Markets (6th ed.). Prentice Hall, 2006.
Covers similar material but exercises are much harder.

John C. Cox and Mark Rubinstein: Options Markets. Prentice Hall, 1985.
Covers similar material on options. A classic book but out of print

Sheldon M. Ross: An Introduction to Mathematical Finance. CUP, 1999
Covers exactly right material, but is mathematical in nature and structure.

Neil A. Chriss: Black-Scholes and Beyond. McGraw Hill, 1997.
In depth look at option pricing theory from portfolio manager

Paul Wilmott, Sam Howison and Jeff Dewynne: The Mathematics of Financial Derivatives: A Student Introduction. CUP, 1995.
Fine book but mathematical and concentrates on continuous time model.

Keith Cuthbertson: Quantitative Financial Economics. Wiley, 1996.
A general finance textbook.

David Luenberger: Investment Science. OUP, 1997.
A general finance textbook.

Paul Wilmott: Introduction to Quantitative Finance. Wiley, 2001.
Does what it says on the cover. Has cartoons too.

Robert Jarrow and Stuart Turnbull: Derivative Securities (2nd ed.). South-Western Publishing, 2000.

Covers essentially the same material but with a slightly more complicated and detailed notation.

Jaska Cvitanic and Fernando Zapero: Economics and Mathematics of Financial Markets. MIT Press, 2004.
General finance book but with a good coverage of derivatives.

Pablo Koch Medina and Sandro Merino: Mathematical Finance and Probability. Birkhauser, 2003.
Very good book but for those with good mathematical background.

Journal Articles which are Accessible: In Level III courses you are expected to read some of the original articles where these are at an appropriate level as well as secondary textbook treatments. You are not expected to read all these articles but you should read some of them. Some articles can be accessed directly via JSTOR as pdf files from any Keele terminal.

Cox, Ross and Rubinstein: Option Pricing: A Simplified Approach, *Journal of Financial Economics*, 7, p.229-63. 1979.

LeRoy: Efficient Capital Markets and Martingales, *Journal of Economic Literature*, 27, p.1583-1621. 1989.

Rendleman and Bartter Two-State Option Pricing, *Journal of Finance*, 34, p.1092-1110. 1979.

Slivka: Call Option Spreading, *Journal of Portfolio Management*, 7, p.71-76. 1981.

Leland: Who Should Buy Portfolio Insurance, *Journal of Finance*, 35, p.581-594. 1980.

Jarrow: In Honour of the Nobel Laureates Robert C. Merton and Myron S. Scholes: A Partial Differential Equation that Changed the World*, Journal of Economic Perspectives*, 13, p.229-248. Fall 1999.

Web Resources: There are lots of web resources for finance especially for options and derivatives. Here are just a few. If you find some other useful finance and/or derivatives links, let me know.

http://www.oup.com/us/companion.websites/0195114701/?view=usa
The textbook website

http://www.blobek.com/black-scholes.html
An online calculator for Black-Scholes formula

http://www.in-the-money.com/
Mark Rubinstein's homepage (has an online options textbook)

http://www.afajof.org/
American Finance Association homepage with great links page

http://dybfin.wustl.edu/
Phil Dybvig's homepage

http://www.paulwilmott.com/
The cult derivative lecturer's homepage

http://www.euronext.com/
For information about prices of options futures and stocks. Has online trading game.

http://bankofengland.co.uk/
Bank of England webpage with lots of city links

6 Guidance and Feedback:

Feedback: Student course evaluations for this module were very good last year. The course was generally enjoyed and students who worked hard, learned well and achieved good marks.

General Guidance: Work steadily and consistently. Ask for help when needed. Make sure you understand the basics of options and futures early on in the module otherwise you may get completely lost.

This is a no-blagging module. You simply cannot turn up and pass the module without participating in the course. If you put in the study effort you will get a good mark.