Advanced derivatives

Academic Year: (2018 / 2019)   **Review date: 15/03/2018 13:27:30**

Department assigned to the subject:

Coordinating teacher: MORENO MUÑOZ, JESUS DAVID

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Students are expected to have completed the basic course of Fixed Income (First Term) and Derivatives (Second Term).

Professor:
Javier Fernández Navas (Universidad Pablo de Olavide) - jfernav@upo.es

OBJECTIVES

This course consists of three parts. The first part generalizes the Black-Scholes-Merton option pricing framework for pricing warrants on the shares of the own issuer (corporate warrants). In this way, there is a natural transition between from the previous course "Derivatives" to this more complicated one. The second part studies the pricing of exotic options (path-dependent and path-independent) and their use to design structured products (turbo warrants, guarantee funds, etc.). To this end, special techniques such as Monte Carlo simulation are explained and used. The third part covers interest-rate derivatives: swaps, caps, and swaptions. To price these securities, a solid knowledge of the construction of term structure of interest rates is needed.

DESCRIPTION OF CONTENTS: PROGRAMME

1. An application of standard option pricing: The valuation of warrants
- Valuation of warrants as shares on common stock
- Taking dilution into account
- Valuation of warrants as shares on total equity
- Valuation of warrants using observable variables

2. Exotic Options and Monte Carlo Simulation
- Review of Monte Carlo simulation
- Path-dependent options: Valuation with Monte Carlo simulation: Lookback options, Barrier options, Asian options
- Path-independent options: Valuation with analytical formula: Digital options, Paylater options, Compound options, Chooser options, Structured products

3. Valuation of swaps
- Review of Forward Rate Agreements (FRAs)
- Review of Interest Rate Swaps (IRS)
- Valuation of IRS using forward rates
- Valuation of deferred IRS

4. Introduction to Interest Rate OTC derivatives
- Options on FRAs
- Description of Caps, floors, and collars
- Description of Swaptions
- Valuation os swaptions as bond options
- Valuation of caps and swaptions with Black (1976) model

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LEARNING ACTIVITIES AND METHODOLOGY

Students will work with Excel or more sophisticated computer program (Matlab, C++, Fortran) if they wish. They will be asked to solve different problems during the course. Firstly, they will have to price corporate warrants using only market data. They will have to use Solver (or the equivalent routine) to look for the correct price of this derivative product. The second practical exercise will be to price exotic path-dependent options using Monte Carlo simulation. Students will be asked to price barrier options (turbo-warrants and turbo-pro-warrants), lookback options and/or Asian options. They will have the opportunity to apply variance reduction techniques, such as the use of antithetic variables. A third activity will be the design of a real structured product (a guarantee investment fund really offered by an investment company). To this end, the students will have to combine and price different path-independent options (digital options, asset-or-nothing options, gap options, etc.) with standard options. They will be asked to present in class their solution for the construction of the proposed structured product. In the same way, students will also be asked to price swaps, caps and swaptions similar to the ones really traded on the market.

Students will be allowed to work on these activities alone, although it will be encouraged to work in small teams (2 or 3 people). Previously to each activity, the professor will explain in class the theoretical background needed to perform each task and will provide hints to work on the activities in an efficient way. After handing-in each exercise, in a weekly basis, it will be discussed in class the difficulties that students have found to do the activity and the correct way to do it.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

The grade will be based on a final exam (60% of the final grade; minimum punctuation 4/10), homework (40%)
The final exam will be taken with the help of only a calculator in a standard classroom (that is, not in a computer room).

BASIC BIBLIOGRAPHY

 - Hull, J.C. Options, Futures, and other Derivative Securities, 9th Edition, Prentice-Hall, Englewood Cliffs, New Jersey., 2015

- Hull, J.C. Options, Futures, and other Derivative Securities, 9th Edition, Prentice-Hall, Englewood Cliffs, New Jersey., 2015

ADDITIONAL BIBLIOGRAPHY

- Chance, D.M. and R. Brooks An Introduction to Derivatives and Risk Management, 8th Edition, Thomson South-Western, Mason, Ohio., 2010

- Jarrow, R. and S. Turnbull Derivative Securities, 2nd Edition, South-Western College Publishing, Cincinnati., 1999