SYLLABUS DEL CORSO

Derivatives

2223-1-F1601M051-F1601M056M

Learning objectives

1) Knowing the simplest types of derivatives instruments and understanding their meaning and financial uses

2) Understanding the concept of model of a financial market and its use in valuing derivative instruments

3) Knowning in full details the various models studied and the derivations of the various pricing formulas

4) Being able to apply the various models to the pricing of a generic contingent claim

5) Using Bloomberg Terminal and understanding the basic equity derivatives functions OMON, OV, OSA, SKEW.

Contents

- Preliminaries on options

- Multiperiod Binomial model

- General one-period model

- Continuous time models

- Black Scholes model

- Vasicek model

- Merton model

- Monte Carlo method

- The VIX Index

- The most important Bloomberg functions for equity derivatives: OMON, OV, OSA, SKEW.

Detailed program

Introduction to derivatives
Forward, futures, options. Payoffs and replication of the forward contract. Forward price and spot-forward parity. Put-call parity. Payoffs of combinations (spread, butterfly, strangle, straddle), convexity of the call price as a function of the strike. Superreplication and subreplication. Merton bounds. American options and value of early exercise. Qualitative discussion of the factors affecting option prices.

Binomial models
Pricing a generic payoff in the one-period binomial model. Two-period binomial models and american options. Multiperiod binomial models: valuation of a generic payoff and formula for a call option. Choice of the parameters u and d and historical volatility matching.

One period models
One period models. Payoff matrix. Replicability, completeness, sufficient condition for completeness. Definition of arbitrage opportunity. State price vectors and first fundamental theorem of valuation. Second fundamental theorem of valuation. Superreplication and subreplication as linear programming problems. Dual formulation.

Continuous-time models
Brownian motion: definition and first properties. Ito processes: definition and examples. Ito formula: drift and volatility of a transformed process. Geometric Brownian motion, lognormal distribution.

Black-Scholes model
Derivation of the Black-Scholes differential equation. Elementary solutions, linearity and superposition principle. Derivation of the Black-Scholes formula as the risk neutral discounted expected value of the payoff. First properties of the BS formula; sensitivities with respect to the parameters and computation of the greeks. First extensions of the BS model; dividends. Approximation of the BS formula for ATM short maturity options. Empirical fit of the BS formula. Implied volatility and volatility smile.

Vasicek model
Short rate dynamics. Stochastic integral of a deterministic function with respect to the Brownian motion. Derivation of the distribution of the short rate. Derivation of the yield curve and example of calibration.

Merton model
Credit risk. Merton model: equity as a call option on the asset value. Determination of the risk neutral probability of default. Determination of the spread curve for a defaultable bond.

Montecarlo method
Random number generation. Simulating stochastic processes. Pricing a derivative and computing his greeks with the Montecarlo method.

The VIX Index.

The most important Bloomberg functions for equity derivatives: OMON, OV, OSA, SKEW.

Prerequisites

The basic notions of Mathematics, Statistics and Finance required for the access to ECOFIN.

Teaching methods

Spiegazioni basate su slides messe a disposizione degli studenti, assegnazione di esercizi di compito il cui svolgimento autonomo da parte degli studenti costituisce parte integrante del corso, discussione in aula dello svolgimento degli esercizi assegnati, utilizzo di un forum per eventuali richieste ulteriori di chiarimento.

Assessment methods

Written exam with oral integration. Bonus points will be attributed to students attending a class on Bloomberg Terminal based on Bloomberg for Education materials. Further information will be delivered at the beginning of the course.

Textbooks and Reading Materials

- Lectures notes and slides
- J. Hull "Opzioni e futures"
- J. Cox, M. Rubinstein "Option markets"

Semester

First Semester

Teaching language

Italian

Sustainable Development Goals