Università Commerciale
Luigi Bocconi
Graduate School

Master of Quantitative Finance and Risk Management

TOPICS IN QUANTITATIVE FINANCE
Marcello Minenna

1. COURSE OUTLINE/OBJECTIVES

The course is aimed to offer an extensive understanding of financial analytics. Models and topics are chosen in order to offer tools and techniques that can be tailored to face whatever issue in derivative pricing and hedging.
Section 1 moves beyond the Black-Scholes-Merton paradigm and explores the analytic machinery that makes possible to use and reconstruct market implied probability distributions. Sections 2 and 3 deal with several classes of stochastic processes in the Lévy framework explored through the mathematical tools of Fourier and Laplace Transforms. Numerical methods based on Newton-Cotes and Gauss quadrature schemes are also fully explored and derived in these sections. Section 4 offers an extensive overview of term structure models by detailing the dynamics of the core stochastic processes in terms of relationship between different probability measures.

MATLAB applications of all these approaches will be shown.

2. DETAILED PROGRAMME AND SCHEDULE

I. BEYOND BLACK-SCHOLES-MERTON PARADIGM
- The CEV process and its applications
- Modelling market implied distributions in continuous and discrete time

II. PURE JUMP MODELS: WHEN TIME IS A STOCHASTIC PROCESS
- The original idea: Barndorff-Nielsen Normal Inverse Gaussian process
- A remarkable improvement: Madan-Seneta Variance Gamma process

III. AFFINE JUMP DIFFUSION MODELS: MIXING CONTINUOUS TIME ANALYTICS WITH JUMPS
- The seminal Merton Jump Diffusion process
- An all-purpose model: Heston Stochastic volatility model

IV. TERM STRUCTURE MODELLING AND PROBABILITY MEASURES
- Short rate dynamics and no arbitrage under equivalent probability measures
- Concrete application to Gaussian and Square Root processes

3. COURSE MATERIALS

- A Guide to Quantitative Finance, Marcello Minenna, Risk Books
- Option Pricing Via Quadrature, Minenna-Verzella, Risk Books
- Notes distributed by the Course Tutor.

4. EXAM

Homework assignments
Final written + oral exam