incisivetraining

Risk

Marcello Minenna

on Advanced derivative pricing and model calibration

Practical approaches to pricing derivatives with jumps and when volatility and interest rates are stochastic

London

8 & 9 June 2010

Risk

About the course

Over the last few years a number of sophisticated and realistic models for pricing derivatives have been developed that go a long way to capturing the complexities of market behavior. However, the recent financial turmoil has demonstrated that banks need to have in place careful and effective calibration procedures that properly take into account abrupt movements of price, rates and volatilities in order to avoid a complete model's failure. This in-depth course will focus on the theoretical and practical aspects of pricing and hedging derivatives, with an extensive focus on models implementation and calibration.

Course highlights

- Analysing models beyond the Black-Scholes paradigm
- Fourier analysis in derivative pricing
- Fast implementations of advanced pricing models
- Calibration techniques, robust procedures and error control

Learning outcomes

By the end of the course you will have a better understanding of how to address the significant challenges that lie behind the implementation and calibration of derivative pricing models with specific knowledge about:

- The stochastic nature of interest rates
- Numerical solutions to the pricing problem in a levy setting
- How to price and hedge in discrete and continuous time
- Implementing fast routines for stochastic volatility and interest rate models
- Investigating the nature of jumps: Poisson process and the stochastic time hypothesis
- The theory and practice of calibrating levy models to market data

Who should attend?

This course is designed for those who are responsible for ensuring that the models used to price interest rate, equity and FX derivatives are validated and calibrated correctly. It is particularly appropriate to those working in the areas of:

- Quantitative Analytics
- Financial engineering
- Options pricing
- Derivatives risk
- Risk analysis
- Derivatives research
- Interest rate modelling
- Equity derivative modelling

Pre course reading:

Produced in consultation with the course tutor, every delegate will receive a comprehensive pre-course reading pack to ensure they obtain maximum benefit from the course. Each article has been selected based upon its relevance to the topics covered within the presentations.

Course Tutors:

Marcello Minenna is the Head of the Quantitative Analysis Unit at CONSOB (the Italian Securities and Exchange Commission). In charge of what Risk magazine addressed as the "quant enforcement", he analyses and develops quantitative models for surveillance and supports the enforcement units in their activities.

His last research in this field regards the development of synthetic risk indicators for qualifying inside the prospectus the risk profile of non-equity investment products; this approach includes the estimate of the likely performance of the product and is at the centre of a pan-European debate. Marcello has taught mathematical models for finance in several Italian and foreign universities and is presently teaching Topics in quantitative finance at the universities of Milano Bocconi. He received his PhD and MA in mathematics for finance from the State University of Brescia and from Columbia University. He is the author of several publications including the bestselling book A Guide to Quantitative Finance published by Risk Books.

Teaching Assistant

Paolo Verzella is a Senior Analyst at the CONSOB Quantitative Analysis Unit. He was Assistant Professor in Mathematical Finance at Milano Bicocca University and has taught courses in mathematics and finance in Italian Universities namely Bocconi and Politecnico of Milano. Paolo received his Phd in Mathematics for Financial markets from Milano Bicocca University. His research interests focus mainly on Numerical Methods for Option Pricing, Optimisation Problems and Applied Harmonic Analysis and also includes more general areas of finance such as Structured Products and Monte Carlo methods.

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Day one

Tuesday 8 June 2010

08.30 **Registration and coffee**

09:00 **Beyond the Black Scholes paradigm: the rationale**
- The stochastic nature of interest rates
- The stochastic nature of volatility
- Modelling prices and rates discontinuities with jumps
- Correlations between state variables in a complete model

10:30 **Morning break**

11:00 **Derivative pricing via partial differential equation for jump diffusion models**
- The partial differential equation approach
- Replicating and quasi-replicating portfolios
- Price representation "a là Black-Scholes"
- Examples: analytical PDE's for affine and non affine jump diffusion models

12:30 **Lunch**

13:30 **Derivative pricing via Fourier transform**
- The Fourier transform and the discrete Fourier transform
- Convergence theorems for Fourier transform
- Price representations for jump diffusion models via Fourier transform
- Price representations for jump diffusion models via discrete Fourier transform

15:00 **Afternoon break**

15:30 **Numerical solutions to the pricing problem in a jump diffusion setting**
- Integrating via quadrature: numerical schemes
- Newton–Cotes schemes and numerical representations of jump diffusion pricing formulas
- Gauss schemes and numerical representations of jump diffusion pricing formulas
- Excel and MATLAB implementation

17:00 **End of day one**

Day two

Wednesday 9 June 2010

08:30 **Registration and coffee**

09:00 **Fast numerical solutions for jump diffusion models: the standard fast Fourier transform approach**
- Fast Fourier transform approach
  - Fast Fourier transform vs discrete Fourier transform: computational costs
  - Danielson-Lanczos representation
  - Cooley-Tuckey algorithm
  - Implementation

10:30 **Morning break**

11:00 **Fast numerical solutions for jump diffusion models: the fractional and non uniform discrete Fourier transforms**
- The generalised discrete Fourier transform
  - Generalised convergence theorems for DFT
  - The fractional fast Fourier transform algorithm
  - The non uniform fast Fourier transform algorithm
  - Excel and MATLAB implementation

12:30 **Lunch**

13.30 **Calibration to market data of jump diffusion models: the theory**
- The calibration problem
  - An ill-posed problem: dimensions, local minima and operative solutions
  - Local optimizers vs global algorithms
  - The optimal choice of the starting point
  - The optimal choice of the fit measure

15:00 **Afternoon break**

15.30 **Calibration to market data of jump diffusion models: the practice**
- Some MATLAB examples of real time calibration of jump diffusion models
  - Stability assessment: resilience of the calibrated parameters to price shocks
  - Error control: analysis of the fitting quality
- Calibrating jump diffusion models on illiquid markets data: operative solutions

17:00 **Close of course**