Options on Exotic Underlyings and Incomplete Markets: Credit, Insurance, Electricity and Weather Derivatives

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**Part one (Day One)**

The unique pricing by arbitrage in complete markets

- A probabilistic approach to the Black-Scholes valuation problem and the risk-adjusted probability measure
- Stochastic Interest Rates and the Forward-Adjusted Probability Measure
- Extension of the Black-Scholes, Black and Garman-Kohlhagen formulas to Stochastic Interest Rates
- The General Numéraire Change; Applications to the Valuation of Some Exotic Options

**Part two (Day Two)**

First examples of market incompleteness

- Black-Scholes with stochastic volatility
- Analysis of the Heston model
- Stochastic Time Changes and Stochastic Volatility

Introduction of jumps in the asset price dynamics

- Merton 1976 jump-diffusion process
- Some Fundamentals of Lévy processes
- The normal inverse Gaussian and the Hyperbolic Models
- The CGMY model
Part three (Day Three)

Credit and Insurance Derivatives

- Alternative Risk Transfer in the management of property/liability insurance companies
- Description of insurance derivatives and CAT bonds
- Pricing insurance derivatives as Asian options
- Description of Credit Derivatives
- Some fundamental pricing models
- Comparing the valuation of CAT bonds with defaultable bonds

Part four (Day Three)

The general answers to incompleteness

- superreplication
- minimal martingale measure
- the criterion of expected utility
- the paradigm of “acceptable risk” : extension of the two fundamental theorems of asset pricing and relationship with convex risk measures

Part five (Day Four)

Electricity and Weather Derivatives

- Options on storable commodities : the example of oil and gas
- Modelling electricity price processes : mean-reversion and spikes
- Plain-Vanilla and Exotic Power Options
- The electricity forward curve dynamics : analogies with the term structure of interest rates and limits
- Pricing Energy Physical Assets as Real Options : some examples
- Weather derivatives as instruments at the frontier of insurance and finance
References

Books

Stochastic Integration and Differential Equations (1992)
P. Protter, Springer Verlag

N. Bingham and R. Kiesel, Springer Finance

Insurance and Weather Derivatives (1999)
H. Geman, RISK Books

Articles


S. Heston (1993) “A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options”, Review of Financial Studies, 6, 327-343


O. Barndorff-Nielsen (1998) “Processes of Normal Inverse Gaussian Type”, Finance and Stochastics, 2, 41-68


H. Geman and O. Vasicek (2001) “Forward and Futures on Non-Storable Commodities: the Case of Electricity”, RISK, August