Processus à sauts, applications en finance et simulation (32h)

Eva Löcherbach, PU à Dpt. Math. UCP

PROGRAM

After recalling basic facts concerning Brownian motion and the Black-Scholes formula, we turn to processes having jumps and introduce the concept of Lévy processes. A first part of the course is devoted to the investigation of basic properties of Lévy-processes (Lévy-Khintchine formula, the Lévy-Itô decomposition). Then we turn to questions that are at the heart of mathematical finance: the Girsanov theorem and the Itô formula for Lévy processes. We show how to apply these concepts for option pricing. The course is supplied by exercises.

Detailed program

1. Processes in continuous time and Brownian motion.
2. General definition of Lévy processes, examples: Poisson process, compound Poisson process.
3. Poisson random measures (PRM) and integrals with respect to PRM
4. Lévy-Itô decomposition
5. Properties of sample paths of Lévy processes: finite/infinite activity, bounded/unbounded variation. Subordinators.
6. Lévy measures and moments
7. Margingales and Lévy measures
8. Girsanov's theorem and Esscher transform
9. Itô formula for Lévy processes
10. Option pricing: Lévy driven Market models, incompleteness, Fourier transform method for option pricing.
11. Simulation of Lévy processes

References

[1] Sato, K. (1999) "Lévy processes and infinitely divisible distributions", Cambridge University Press.

[2] Papapantoleon, A. (2008) "An introduction to Lévy processes with applications in finance". http://arxiv.org/abs/0804.0482.

[3] Cont, R., Tankov, P. (2004) "Financial Modelling with Jump Processes". Chapman & Hall.

[4] Carr, P., Geman, H., Madan, D.B., Yor, M.(2002) "The fine structure of Asset returns: An empirical investigation". Journal of Business vol 75.

[5] Voltchkova, E.(2005) "Integro-differential evolution equations: numerical methods and applications in finance", PhD thesis, http://tel.archives-ouvertes.fr/tel-00010842.