CIME Course on

From a Microscopic to a Macroscopic Description of Complex Systems

Bedlewo (Poland) - September 4-9, 2006

Stochastic Processes and Stochastic Differential Equations and their Applications

Lecturer: Vincenzo Capasso

Outline:

1. Stochastic processes
   - 1.1 Processes with independent increments
   - 1.2 Martingales
   - 1.3 Markov Processes
   - 1.4 Brownian motion and Wiener process
   - 1.5 Counting, Poisson, Levy Processes
2. Ito Integral
   - 2.1 Ito Formula
   - 2.2 Martingale representation theorem
3. Stochastic differential equations
   - 3.1 Markov property
   - 3.2 Transition semigroups
   - 3.3 Girsanov theorem
   - 3.4 Kolmogorov and Fokker Plank equations
   - 3.5 Dynkin formulae
   - 3.6 Feynman-Kac formula
4. Applications to Biology and Medicine
   - 4.1 Population Dynamics: models discrete in space - continuous in time
   - 4.2 Population Dynamics: continuous approximation of jump processes
   - 4.3 Population Dynamics: Individual based models - ant colony systems
   - 4.4 Neurosciences

Reference

V.Capasso, D. Bakstein, *An Introduction to Continuous-Time Stochastic Processes. Theory, models, and applications to Finance, Biology and Medicine*, Birkhauser, Boston, 2004.