UC3M–ICMAT Seminar – 2014/2015

Applied Probability and Statistics

Optimal control of stochastic Volterra equations and applications to financial markets with memory

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Friday, March 20, 2015
12h00, *ICMAT, Aula Gris I*

Stochastic Volterra equations appear naturally in many areas of mathematics such as integral transforms, transport equations, functional differential equations and so forth, and they also appear in applications in biology, physics and finance. There are also examples in economics (which also applies to population dynamics) and examples stemming from Newtonian motion in a random environment. Stochastic Volterra equations can also be derived from stochastic delay equations. More generally, they represent interesting models for stochastic dynamic systems with memory. In view of this, it is important to find good methods to solve optimal control problems for such equations. Solutions of stochastic Volterra (integral) equations are not Markov processes, and therefore classical methods, like dynamic programming, cannot be used to study optimal control problems for such equations. However, we show that, by using Hida–Malliavin calculus, it is possible to formulate a modified functional type of maximum principle suitable for such systems. This principle also applies to situations where the controller has only partial information available to base her decisions upon. We present both a sufficient and a necessary maximum principle of this type, and then we use the results to study some specific examples. In particular, we solve an optimal portfolio problem in a financial market model with memory.

The presentation is based on joint work with Nacira Agram, University Med Khider, Biskra, Algeria.

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