

Description for the general public

The aim of the project is to study the so-called backward stochastic differential equations. These equations were introduced in 1990 by E. Pardoux and S. Peng. Since then the theory of such equations has been intensively developed, mainly due to their numerous and interesting applications, for instance to the theory of nonlinear partial differential equations, problems of mathematical finance (for instance to option pricing) and problems of mathematical economics (for instance in problems of optimal stopping or optimal switching of processes, say processes of production from “on” to “off” mode).

Most existing papers devoted to backward equations concern the so-called equations with Brownian filtration. Intuitively, such equations appear when we want describe physical phenomena with local interactions or describe economic processes which are continuous. However, to describe nonlocal physical phenomena or economic processes, which may be discontinuous (for instance, in the economic model we allow the stock prices to jump) one needs to generalize the existing theory to equations with more general nonBrownian filtration. The theory of such more general equations has been developed for some 5-6 year. The members of the research group also contributed to the theory.

In the project we want concentrate on several topics. They can be classified as follows.

- Backward stochastic differential equations with general, nonBrownian filtration and their applications to partial differential equations with nonlocal operators, for instance to equations with the so-called fractional Laplacian.
- Reflected backward stochastic differential equations with general filtration. Applications to so-called problems with obstacles and to problems of optimal stopping, especially to so-called Dynkin games. Dynkin games appear for instance in valuing Israeli options, i.e. contacts that can be exercised both by the buyer and by the seller at any time.
- Reflected backward stochastic differential equations with irregular trajectories. Equations with such trajectories appear naturally in modeling of some real processes.