

Markovian switching systems: conditional McKean-Vlasov backward and forward-backward equations and their applications

Esteban J Rolón Gutiérrez,
esteban.rolon@upr.edu
Department of Mathematics, UPR-RP.

January 8, 2024



DISSERTATION
DEPARTMENT OF
MATHEMATICS

Abstract

In recent years, forward-backward stochastic differential equations (FBSDE) have been extensively studied because of their numerous applications in many areas such as control and game theory, mathematical economics, and mathematical finance. Due to the pressing need of treating large-scale systems, there has been increasing effort of dealing with mean-field interactions, systems with mean-field interactions, and related control problems, and games. To deal with large-scale switching systems, the mean-field types of FBSDEs with Markovian switching naturally come into play when one needs to treat the mean-field control problems.

In this work we derive useful estimates for the solutions of the backward stochastic differential equations (BSDE) with Markovian switching. We also work on the FBSDEs with regime-switching and FBSDEs with mean-field and regime-switching, providing sufficient conditions for the existence and uniqueness of the solutions. Then we consider a nonzero-sum game problem with N players in which the dynamics and cost functionals of each player depend on conditional mean-field terms and a regime-switching process, presenting conditions on the coefficients such that a Nash equilibrium point of the differential game exists and the relationship of the existence of the Nash equilibrium point and the solution of the conditional mean-field FBSDE with regime switching.