January 13, 2023
Zoom Meeting
3:30pm-4:30pm

Dr. Zachary Bezemek
(Boston University)

Large Deviations and Importance Sampling for Weakly Interacting Diffusions

Abstract: We consider an ensemble of N interacting particles modeled by a system of N stochastic differential equations (SDEs). The coefficients of the SDEs are taken to be such that as N approaches infinity, the system undergoes Kac's propagation of chaos, and hence is well-approximated by the solution to a McKean-Vlasov Equation. Rare but possible deviations of the behavior of the particles from this limit may reflect a catastrophe, and computing the probability of such rare events is of high interest in many applications.

In this talk, we design an importance sampling scheme which allows us to numerically compute statistics related to these rare events with high accuracy and efficiency for any N. Standard Monte Carlo methods behave exponentially poorly as N increases for such problems. Our scheme is based on subsolutions of a Hamilton-Jacobi-Bellman (HJB) Equation on Wasserstein Space which arises in the theory of mean-field control. This HJB Equation is seen to be connected to the large deviations rate function for the empirical measure on the ensemble of particles. We identify conditions under which our scheme is provably asymptotically optimal in N in the sense of log-efficiency. We also provide evidence, both analytical and numerical, that with sufficient regularity of the solution to the HJB Equation, our scheme can have vanishingly small relative error as N increases.

Zoom Link: USC Math Finance Colloquium
Time: Jan 13, 2023 3:30 PM Pacific Time (US and Canada)

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