



Workshop on Stochastic Analysis

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Yuri Saporito
(FGV)

Deep Learning and Elicitability for McKean-Vlasov FBSDEs With Common Noise

Abstract

We present a novel numerical method for solving McKean-Vlasov forward-backward stochastic differential equations (MV-FBSDEs) with common noise, combining Picard iterations, elicibility and deep learning. The key innovation involves elicibility to derive a path-wise loss function, enabling efficient training of neural networks to approximate both the backward process and the conditional expectations arising from common noise – without requiring computationally expensive nested Monte Carlo simulations. The mean-field interaction term is parameterized via a recurrent neural network trained to minimize an elicitable score, while the backward process is approximated through a hybrid feedforward and recurrent network representing the decoupling field. We validate the algorithm on a systemic risk interbank borrowing and lending model, where analytical solutions exist, demonstrating accurate recovery of the true solution. We further extend the model to quantile-mediated interactions, showcasing the flexibility of the elicibility framework beyond conditional means or moments. Finally, we apply the method to a non-stationary Aiyagari–Bewley–Huggett economic growth model with endogenous interest rates, illustrating its applicability to complex mean-field games without closed-form solutions. This is joint work with Felipe Antunes (FGV EMAP) and Sebastian Jaimungal (University of Toronto).