Mathematics, Statistics, and Computer Science **@ UIC**

Statistics and Data Science Seminar

Cubature method and machine learning to solve Path Dependent PDE(PPDE)

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Abstract: The classical models for asset processes in math finance are SDEs driven by Brownian motion of the following type $X_t = x + \int_0^t b(s, X_s)ds + \int_0^t \sigma(s, X_s) \circ dB_s$. Then $u(t, X_t) = \mathbb{E}[g(X_T)|\mathcal{F}_t^X]$ is a deterministic function of X_t and $u(t, x)$ solves a parabolic PDE. The cubature formula is first constructed to numerically compute functionals like $\mathbb{E}^{\mathbb{P}}[g(X_T)]$, which can be seen as a discrete approximation of the infinite dimensional Wiener measure (denoted as $\mathbb{P}$). In this talk, we will consider that the asset process follows a rough volatility model. For example, in the rough Heston model, the process X_t is the solution of Volterra type SDEs. In this case, X itself is non-Markovian, then $u(t, X_t)$ will depend on the whole path of $(X_s)_{0\leq s\leq t}$ and $u(t, X_{[0,t]})$ solves the so-called Path Dependent PDE (PPDE). We propose a new algorithm to numerically solve PPDE by using cubature type formulas for Volterra SDEs. The cubature formula for Volterra SDEs is solved by using machine learning method. In the end, I will show some numerical examples. The talk is based on a joint work with Jianfeng Zhang.

Wednesday, March 4 at 3:00 PM in 636 SEO