

LEARNING THE RANDOM VARIABLES: COMBINING MONTE CARLO SIMULATIONS WITH
MACHINE LEARNING

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In recent years, there has been a tremendous amount of research activity aimed at developing new deep learning-based methods for scientific computing problems. While many of these methods are promising, they often do not fully utilize existing numerical approaches and theory. In this talk, we introduce a novel method that merges machine learning techniques with problem-specific knowledge to tackle high-dimensional parametric stochastic approximation problems. Our strategy is based on the idea of combining Monte Carlo (MC) algorithms (e.g., standard MC or multilevel MC) with stochastic gradient descent (SGD) optimization methods by treating the realizations of random variables in the MC approximation as trainable parameters for the SGD optimization method. In other words, our approach focuses on learning the random variables appearing in MC approximations rather than training standard artificial neural networks. We present numerical results for this Learning the Random Variables (LRV) strategy applied to the pricing of financial options in the Black-Scholes model. In the considered examples, the LRV strategy produces highly convincing numerical results when compared with standard numerical methods (such as MC and Quasi-MC) and other machine learning-based methods.

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