A general framework for building machine learning models for pricing american index options with no-arbitrage and its limitation

Huisu Jang and Jaewook Lee

Department of Industrial Engineering, Seoul National University
1 Gwanak-ro, Gwanak-gu, Seoul 151-744, South Korea
{gmltn7798,jaewook}@snu.ac.kr

Abstract. Since the seminar work by Black and Sholes on option pricing early 1970's, many alternative option pricing models have appeared to address some key stylized facts for option markets such as volatility smile, fat-tail, volatility clustering, and so on. Most of the successful option models are parametric models based on diffusion processes with jumps usually called the Lévy processes and the parameters of the models can be calibrated to fit the model to the market option data. Recently nonparametric models have attracted lots of attention to many researchers for their improved prediction accuracy on pricing financial derivatives mostly for the European options which can be exercised only at its maturities. In the financial market, however, the most frequently traded options are usually of American type, which can be exercised anytime before their maturities and machine learning models suffer from arbitrage opportunities when they are directly applied to pricing real American options. In the present study, we propose a general framework for building a machine learning model that not only satisfies no-arbitrage constraints for pricing American options, but also is stable in its prediction to a specified range of time-varying daily options. We conduct a comprehensive study to verify the predictive performance of the proposed models by applying them to one-year S&P 100 daily American put options and show that the proposed method is significantly better than the state-of arts machine learning models. Also we compare the prediction performance of the machine learning models with parametric jump models when the domain of the in-sample option data is different from the domain of the out-of-sample option data and discuss about their limitations.

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