Efficient training of pricing networks using Greeks

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ABSTRACT

The Black-Scholes model is still very popular for option pricing because of its simplicity and existence of the closed formula. However, the model cannot reflect the leverage effect since the assumption of the model is that volatility is constant. To solve this problem, many models have been developed such as CEV, Heston, SABR, etc. But they are computationally expensive since they do not have an analytic closed solution. According to Huh et al. (2021), the computational cost can be significantly reduced utilizing the neural network. [1]

In this study, we trained two types of neural networks to predict the option prices for the Black-Scholes and SABR models, respectively, where the one is obtained using the values only, while the other is obtained using the values and Greeks together. First, we compared the two neural networks for the Black-Scholes model with the well-known closed formula. As a result, the neural network using Greeks achieved much higher accuracy. Next, we compared two neural networks for the SABR model which has no closed formula. Since the Black-Scholes model has the closed formula, there is not any difficulty to generate the Greeks, but the SABR model is not. Therefore, we generate a large number of prices for the SABR model using Monte-Carlo simulation and calculate Greeks using adjoint automatic differentiation (AAD). Same as the previous result, the networks using the Greeks outperformed the other type of network using the values only. Hence, these test results show that the training of the pricing networks considering not only the values but also Greeks can induce an efficient formula regardless of the existence of an analytic closed formula.

REFERENCES