Proceedings of the 4th International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/2024.26931

Deep Learning Approaches for Pricing Options in Stochastic Volatility Models

Yang Zheng

Poole College of Management, North Carolina State University, Raleigh, USA
koroly1119@gmail.com

Abstract. Efficient computation of option prices is essential for making quick trading decisions. This paper investigates the use of deep learning to expedite the accurate calculation of European option prices within a local volatility framework that utilizes five parameters. We compared the predictions of the deep neural networks against results obtained from the Monte Carlo method across various scenarios. Our numerical experiments indicate that the approximation network achieves satisfactory accuracy. The network performs exceptionally well within the core region of the parameter domain.

Keywords: Local volatility model, European call option, Finite difference method, Monte Carlo simulation, Deep learning

111

References

[1] Bayer C, Friz P, Gatheral J. Pricing under rough volatility [J]. Quantitative Finance, 2016, 16(6): 887-904.
[2] Wilmott P, Howison S, Dewynne J. The mathematics of financial derivatives: a student introduction [M]. Cambridge university press, 1995.
[3] Lipton A. Mathematical methods for foreign exchange: A financial engineer's approach [M]. World Scientific, 2001.
[4] LeCun Y, Bengio Y, Hinton G. Deep learning [J]. nature, 2015, 521(7553): 436-444.
[5] Cox, J. Notes on Option Pricing I: Constant Elasticity of Diffusions. Unpublished draft, Stanford University, 1975.
[6] S.L.Heston. A closed-form solution for options with stochastic volatility with applications to bond and currency options. The review of financial studies, 6(2): 327{343, 1993}.
[7] Jichao Zhao, Matt Davison, Robert M. Corless Compact finite difference method for American option pricing, Journal of Computational and Applied Mathematics, 206, 2007, 306-321.
[8] Bayer C, Horvath B, Muguruza A, et al. On deep pricing and calibration of (rough) stochastic volatility models [J]. Preprint.
[9] Horvath B, Muguruza A, Tomas M. Deep learning volatility [J]. arXiv preprint arXiv: 1901.09647, 2019.
[10] Hornik K, Stinchcombe M, White H. Universal approximation of an unknown mapping and its derivatives using multilayer feedforward networks [J]. Neural networks, 1990, 3(5): 551-560.
[11] Emanuel D C, MacBeth J D. Further results on the constant elasticity of variance call option pricing model [J]. Journal of Financial and Quantitative Analysis, 1982, 17(4): 533-554.
[12] Schroder.M, Computing the constant elasticity of variance option pricing formula, Journal of Finance, 1989: 44, Mar., 211-219.
[13] Gatheral, J., The Volatility Surface: A Practitioners Guide, 2006, NewYork, NY: John Wiley & Sons.