Machine Learning for Quantitative Finance: Fast Derivatives Pricing with Gaussian Process Regression

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Project Description
This project aims to investigate the performance of machine learning methods for pricing financial derivatives. De Spiegeleer et al. (2018) show that one can arrive at pricing speed-ups of several orders of magnitude by deploying machine learning techniques based on Gaussian process regression (GPR). However, this speed-up is obtained with a certain loss of accuracy. An essential focus of this project is a study of the speed-accuracy trade-off for pricing of vanilla (and exotic) options under different models such as i) Gaussian process regression, ii) random forests, and iii) deep neural networks.

Project Objectives

(a) Replicate the main idea of the paper by De Spiegeleer et al. (2018) that employs Gaussian process regression. Extend the approach to different machine learning models, see Anderson and Ulrych (2022), and compare their option pricing accuracy.
(b) Given the linearity of differentiation, a derivative of a Gaussian process is again a Gaussian process. Extend the GPR model in part (a) by incorporating the information about option Greeks to investigate potential improvements in the pricing accuracy.

References

D. Anderson and U. Ulrych. Accelerated American Option Pricing with Deep Neural Networks. *Swiss Finance Institute Research Paper No. 22-03*, 2022.

J. De Spiegeleer, D. B. Madan, S. Reyners, and W. Schoutens. Machine learning for quantitative finance: fast derivative pricing, hedging and fitting. *Quantitative Finance*, 18(10):1635–1643, 2018.