Deep Learning in Finance: Mathematical Foundations and Applications

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Research Group: Probability & Applications

Project description:

The recent rise of machine learning has generated a large interest from companies as well as in academia. In mathematical finance, the use of deep neural networks allows us to efficiently solve high-dimensional problems, which were frequently infeasible. Examples are derivative pricing and risk management, for example quantifying counterparty credit risk. Growing regulatory demand amplifies the need for computational methods of the highest efficiency.

In this project we follow up on the exciting results presented in the article currently under review:

- K. Glau, L. Wunderlich, The Deep Parametric PDE Method: Applications to Option Pricing, https://arxiv.org/pdf/2012.06211.pdf

To deepen the mathematical understanding of the method, we will look at the numerical stability of the method and the best-approximation properties of neural networks. By extending approximation results for functions to include the second derivative, we obtain estimates suitable for the PDE formulation.

Methodologically, we will extend the formulation from the Black-Scholes model to more complex models of practical interest. This includes the Heston model and the Merton Jump Diffusion model, where a partial integro-differential equation is solved. With an implementation of the model already available, we can also investigate practical applications for the financial industry and for financial regulators. The instant availability of option prices for all parameters of interest allows for the evaluation of more complex and accurate risk metrics.

The applicant requires both a strong mathematical background and solid programming experience in python. Experience with machine learning, especially through Tensorflow is desirable. Prior knowledge of the field of computational finance would be useful, but not required. A sample implementation of the method is available on GitHub:

https://github.com/LWunderlich/DeepPDE

Further information:

How to apply

Entry requirements

Fees and funding