Digital Finance (2023) 5:1–2
https://doi.org/10.1007/s42521-023-00080-2

EDITORIAL

Deep Learning in Finance

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Published online: 31 March 2023

JEL Classification C00 · G00

1 Introduction

As the field of finance continues to evolve and embrace new technologies, the integration of deep learning has proven to be a valuable tool for financial problems. The use of deep learning algorithms has facilitated the development of novel financial products and services, while enabling firms to manage their risk and compliance obligations, and to perform fraud detection and prevention more effectively.

The success of deep learning in finance has been driven by its ability to process vast amounts of complex data with speed and precision, and to represent high-dimensional complex functions without suffering from the curse of dimensionality. This enables firms to extract valuable insights and make more informed decisions. From fraud detection and credit scoring to portfolio management and algorithmic trading, deep learning has become a key enabler of innovation in the financial industry.

However, the adoption of deep learning in finance is not without its challenges. As the complexity of models and algorithms increases, so does the need for robust testing and validation procedures, and better theoretical underpinning. Quite a few crucial problems still need to be understood, for example, theories on why deep learning algorithms work in financial problems, interpretability and instability of the outputs by deep learning algorithms, and the risks brought by deep learning into finance. Additionally, the use of deep learning in finance requires a deep understanding of the financial markets in which it is applied.

As we move forward, it is important that we continue to explore the potential of deep learning in finance while remain vigilant about the risks and challenges associated with its use. We hope, by leveraging the power of this transformative

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technology, we can solve more fundamental problems in financial mathematics, and create a more efficient, secure, and inclusive financial ecosystem that benefits individuals and organizations alike.

In this special issue on *Deep Learning in Finance*, we have brought together leading experts and researchers to share their insights and experiences in the field. Through their contributions, we hope to spark a deeper conversation about the opportunities and challenges of this emerging interdisciplinary field and its potential to transform the financial industry.

2 Contents of this special issue

The seven papers in this special issue include aspects of deep learning algorithms, applications in finance, and fundamental theories.

A. Max Reppen, H. Mete Soner and Valentin Tissot-Daguette used deep learning to solve free-boundary problems related to American and Bermudan option pricing. William Lefebvre, Grégoire Loeper and Huyên Pham proposed a deep differential learning methods for fully nonlinear PDEs with applications to option pricing under market impact and to the portfolio selection problems. Xiaofei Shi, Daran Xu and Zhanhao Zhang developed efficient deep learning algorithms for optimal hedging with market frictions such as transaction costs. Ming Min and Tomoyuki Ichiba proposed a novel convolutional neural network model combined with signature from rough path theory to efficiently process time series classification and natural language processing tasks with high-dimensional financial data. Mario Figueiredo and Yuri F. Saporito used machine learning to forecast the term structure of commodities' future prices. Huei-Wen Teng and Yu-Hsien Li performed an extensive comparative analysis of deep neural networks' ability in stock returns prediction with asset-pricing factors, compared to traditional regression and tree-based algorithms. Georgios Fatouros, Georgios Makridis, Dimitrios Kotios, John Soldatos, Michael Filippakis and Dimosthenis Kyriazis designed a framework for portfolio risk assessment via probabilistic deep neural networks to monitor the Value at Risk.

We hope that the insights shared in this issue will be of great value to anyone interested in the intersection of deep learning and finance, from researchers and academics to practitioners and policymakers. We look forward to the continued evolution of this field and the exciting new possibilities that deep learning will bring to the financial industry.