Commodity Market Risk Management with Generative Artificial Intelligence

Master thesis in cooperation with Lytica GmbH

Description

The generation of artificial time series of financial prices plays an integral role in several fields. For instance, these serve as a valuation tool for complex derivatives or are utilized in risk management for investment portfolios.
In recent years, there have been significant advancements in the field of machine learning, particularly in the area of deep learning. However, these developments have primarily been driven by the need to address challenges in other application domains.
The objective of this thesis is to generate time series for oil, gasoline, and heating oil using the subgroup of deep learning known as "generative adversarial networks." To this end, a review of the existing literature on this topic will be conducted. Based on this, individual models will be implemented and trained with price data. In the next step, time series can then be generated from the model and compared with the real data. In the final step, the model can be adapted so that the prices for oil/gasoline/heating oil are trained simultaneously.

Industry partner

The master's thesis is offered in collaboration with Dr. Paschke of Lytica GmbH. Lytica offers consulting services for life reinsurance companies, with a particular emphasis on pricing and risk management. Effective risk management is a crucial competency for insurance companies, particularly those engaged in life insurance. Traditionally, such companies have relied on a range of techniques, including scenario analysis, simulations, and what-if analyses, to inform their daily decision-making processes. The potential for generative artificial intelligence to generate realistic price scenarios represents a promising avenue for innovation in the financial industry. However, it is essential to conduct a thorough examination of this approach to ascertain its suitability and potential benefits for the industry.

Literature

Quant GANs: Deep Generation of Financial Time Series; M Wiese, R Knobloch, R Korn, P Kretschmer; Quantitative Finance, 2020

Fin-GAN: forecasting and classifying financial time series via generative adversarial networks; Milena Vuletić, Felix Prenzel & Mihai Cucuringu; Quantitative Finance, 2024

Coding

Python with Tensorflow or PyTorch; access to servers with GPUs can be provided if required.

The codes/elements provided by the authors of the above references can be used and adapted

Prerequisite

In addition to the knowledge gained from the financial economics lectures, proficiency in the Python programming language is required. Prior experience with the implementation of deep learning models is highly desirable.