

Exploring Optimal Trading Rules and Detecting Anomalous Order Sequences in a High Frequency Trading Context: A Machine Learning Approach

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Abstract

In this talk we discuss two applications using machine learning techniques in the context of high frequency data. In the first part of the talk, we present a collaborative research project with a hedge fund where the objective was to efficiently identify an optimal trading rule in a high frequency portfolio composed of several instruments that were traded at microsecond frequencies. The exercise is to find optimal allocations at the microsecond frequency that optimize for returns under constraints that account for liquidity, latency and trading costs. The solution is given in terms of a computationally intensive objective function for which we propose several methodologies. A benchmark is a brute force grid search algorithm that does not satisfy operational requirements in terms of execution time. Successful alternatives are put forward in terms of simulated annealing mechanisms that perform better and meet time requirements for operation.

In a second application, we present collaborative work with a regulatory arm of a large derivatives exchange whose mission is to detect potentially delinquent orders that include but are not limited to price manipulation and insiders trading. We develop pipelines composed of neural networks trained on auxiliary tasks that then are the basis for anomaly detection mechanisms. Results are promising when compared to benchmarks in terms of detection capabilities and false positive rates. We will discuss in some details some of the most successful architectures and the auxiliary tasks that were used some of which seek to integrate the sequential nature of the anomalous orders via a recurrent neural network architecture.

These two examples allow us to showcase some of the recent successful collaborative research projects with industry that our team has worked on in the past three years. These also illustrate how a combination of traditional and new methods in statistics prove to be successful on high frequency data contexts when cleverly implemented via machine learning approaches.

These results are to be published in the following working papers [1] and [2].

Keywords: High Frequency Trading, Limit Order Book Data, Anomaly Detection, Artificial Neural Networks, Portfolio Optimization, Simulated Annealing

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References

- [1] Cedric Poutre and Manuel Morales (2018), “Exploring Optimal Trading Rules in a High Frequency Portfolio.” *Working Paper*, **University of Montreal**.
- [2] Cedric Poutre and Manuel Morales (2022), “Anomaly Detection Models for Potentially Delinquent Order Sequences in Limit Order Book Data.” *Working Paper*, **University of Montreal**.