MPYHS PROJECT PROPOSAL

ALGORITHMIC TRADING STRATEGIES WITH MACHINE LEARNING TECHNIQUES DURING THE COVID-19 MARKET CRASH

Abstract

Algorithmic trading is a method of executing market orders using computer programs which make decisions based on variables such as price, volume and liquidity. It has been increasingly adopted by large institutions like investment banks or hedge funds, who recruit mathematicians and physicists to employ such strategies, in an attempt to give them an edge in the market. The advantages include accuracy, reduced overhead and, most notably speed, with algorithms being able to capitalise on market opportunities in fractions of the time that it would take a human trader. Ultimately, this has made markets far more efficient.

These algorithms account for around 80% of modern trading. Despite this, they need constant updating by programmers and quant strategists as sentiment about markets change. This results in algorithms becoming increasingly more complex and tedious to work with. To combat this, firms such as JP Morgan have begun utilising machine learning (ML) to update their algorithms with no human intervention. Additionally, traditional algorithms struggle to react to external news which might affect the market. Most recently, the COVID-19 pandemic sparked a global market crash. It is possible that ML algorithms will be able to adjust to the surge in volatility precipitated by these events to reduce negative market impact on portfolios.

Aims and objectives

In this project we hope to study and build some simple algorithms, then analyse their damping effects on negative market movements sparked by external events. Initially, we would attempt to program a simple algorithm, most likely something like a long-short equity strategy, using an open source IDE, like the one provided by Quantopian, and financial data from the likes of Morningstar. To do this we first define a trading universe and create an alpha factor using a Pipeline API. The predictiveness of any alpha factor will be assessed using a module like Alphalens. This can then be used to create our trading strategy in the IDE before back testing. The long-short equity strategy in question uses a ranking system to order securities before going long in the top equities and shorting the bottom ones. We will back test the algorithm during previous market crashes and bear markets, such as the 2008 financial crisis, and see how it performs against a benchmark such as the SPY. The recent COVID-19 data will be saved for out of sample testing. We then hope to go onto study the advantages of machine learning and how it is applied to such algorithms. This can be studied from multiple angles. It should be possible to train our trading algorithm using ML techniques such as the random forest. We could also investigate other strategies such as pairs trading. This strategy considers two historically correlated equities and searches for a temporarily weakened correlation. Under the statistical assumption that correlated equities undergo mean reversion, the strategy bets on the ‘spread’ between the two converging. We could investigate the applications of ML to this strategy in an attempt to find profitable pairs. A working knowledge of Python would be required for this project. Background knowledge in finance would prove useful but should not be essential.

We feel there is a lot of potential to extent this to the full academic year and focus on more advanced algorithmic trading techniques or consider more complex securities. We would also be interested in researching the more pure mathematical aspect of finance. For example, many problems rely on the computation of particular integrals or solving PDEs like the Black-Scholes equation. Numerical techniques such as Monte-Carlo are often employed to solve such problems and ultimately value financial derivatives like European options.

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