- Assessing the Resilience of Trading Strategies in the Bristol Stock Exchange System: Developing a Resilience Index for Robust Trading Strategies -.

- **Yousef Khalil** -
School of Computer Science
Faculty of Science and Engineering
University of Nottingham
Malaysia

I hereby declare that this dissertation is all my own work, except as indicated in the text:

Signature _____Yousef Khalil_____

Date _16__/_05__ /_2023__

Abstract

In this study, the aim is to evaluate the resilience of different trading strategies in the Bristol Stock Exchange system under varying levels of noise and uncertainty. By simulating market conditions using stochastic models, various trading strategies were implemented such as moving average crossover, mean reversion, and momentum trading. A resilience index that considers the impact of noise and uncertainty on the performance of trading strategies is developed. This approach helps identify robust trading strategies that can perform well under various market conditions, thus minimising the risk of losses for investors.

Introduction

Financial markets are inherently complex, noisy, and uncertain, which makes it challenging for investors to develop and implement reliable and effective trading strategies (Dacorogna et al. 2019). To make informed decisions on what to buy and sell, investors employ a variety of trading strategies such as value investing, mean reversion, and momentum trading (Khandani & Lo, 2011). However, these strategies often have limitations, and their performance may be adversely affected by noise and unpredictability in the financial markets. Moreover, the impacts of noise and uncertainty on the effectiveness of trading strategies are frequently overlooked by current evaluation techniques, potentially leading to suboptimal investment decisions (Bouchaud et al., 2018).

The primary goal of this study is to develop a novel approach to evaluate the resilience of trading strategies in the Bristol Stock Exchange system under varying levels of noise and uncertainty. By simulating market conditions using stochastic models, the aim is to assess the performance of various trading strategies and develop a resilience index that considers the impact of noise and uncertainty. This approach will help identify robust trading strategies that can perform well under diverse market conditions, minimise the risk of losses for investors, and provide a more accurate evaluation framework for trading strategies in a noisy environment.

Literature Review

Developing and evaluating trading strategies have been a significant area of interest for researchers and practitioners in finance and computer science. In this section, some of the most relevant studies on trading strategies and their evaluation methods in noisy and uncertain financial markets are reviewed.

Trading strategies have been explored in the study, including value investing, momentum trading, and mean reversion. Each strategy has its own set of strengths and weaknesses, with some performing better under certain market conditions (Chong et al., 2021). However, the performance of these strategies can be affected by noise and uncertainty in the financial markets (Cont, 2020).

Efforts have been made to develop methods to evaluate the performance of trading strategies under different market conditions (Sandoval & Hernández, 2020). For instance, some studies have proposed the use of stochastic models to simulate underlying market dynamics and assess the resilience of trading strategies under varying levels of noise and uncertainty (Zhang et al., 2019). Other studies have focused on the development of risk-adjusted performance metrics such as the Sharpe ratio to assess the robustness of trading strategies (Lo, 2020).

Machine-learning techniques have also been applied to the development and evaluation of trading strategies (Liu et al., 2021). These approaches typically involve training algorithms to recognise patterns in historical market data and predict future price movements. Recent studies have explored the use of deep learning techniques, such as recurrent neural networks (RNNs) and long short-term memory (LSTM) networks, to model and predict market behaviour (Tsantekidis et al., 2020). However, the performance of these methods remains sensitive to noise and uncertainty in financial markets.

Despite a substantial body of research on trading strategies and their evaluation, there is still a need for more robust methods that can effectively assess the resilience of trading strategies under varying market conditions. The proposed approach aims to address this gap by developing a resilience index that considers the impact of noise and uncertainty on the performance of trading strategies in the Bristol Stock Exchange system.

Experiment

Firstly, three widely studied trading strategies were selected for this study: value investing, momentum trading, and mean reversion. These strategies were chosen due to their popularity and distinct characteristics, which allow for a comprehensive evaluation of their resilience under varying market conditions.

Secondly, to simulate market conditions with different levels of noise and uncertainty, stochastic models were employed, as they have proven effective in representing the underlying dynamics of financial markets (Cont, 2020; Zhang et al., 2019). These models were parameterized to generate a range of market scenarios, enabling the testing of trading strategies under various conditions.

In the third step, the selected trading strategies were implemented as agents using Python. These agents interact with the simulated market environment and are designed to follow the rules of their respective trading strategies. They make buy-and-sell decisions based on historical price data and other relevant market information.

Subsequently, the performance of each trading strategy was evaluated under simulated market conditions using established metrics such as the percentage of profitable trades, maximum drawdown, and Sharpe ratio. Additionally, a resilience index that considers the impact of noise and uncertainty on the performance of trading strategies was developed. This index will be used to assess the robustness and adaptability of the strategies under various market conditions.

Lastly, the results of the experiments were analysed, focusing on the performance of each trading strategy under different market conditions. The resilience index served as a key metric for identifying robust trading strategies. This analysis aims to enhance understanding of the factors that contribute to the resilience of trading strategies and provide insights into the development of more effective strategies that can perform well under various levels of noise and uncertainty.

Result

In this section, the results of the experiments evaluating the resilience of the moving_average_crossover, mean_reversion, and momentum strategies under varying noise levels in the simulated Bristol Stock Exchange system are presented. The performance metrics, including profitable trades, maximum drawdown, Sharpe ratio, and resilience index, are shown below.

Noise Level	Profitable Trades	Max Drawdown	Sharpe Ratio	Resilience Index
0.01	8.145353e+18	0.995834	0.031615	2.575160e+17
0.05	8.252205e+18	0.995834	0.032199	2.657144e+17
0.10	-3.557183e+17	0.995834	-0.042754	1.520837e+16
0.20	3.989297e+21	0.995834	0.031639	1.262161e+20

Fig.1. Evaluating moving_average_crossover strategy:

Noise Level	Profitable Trades	Max Drawdown	Sharpe Ratio	Resilience Index
0.01	7.629154e+11	0.995834	0.031506	2.403612e+10
0.05	2.415563e+11	0.995834	0.053525	1.292936e+10
0.10	1.849577e+15	0.995834	0.031853	5.891546e+13
0.20	2.299399e+11	0.995834	0.033180	7.629462e+09

Fig.2. Evaluation of mean_reversion strategy

Noise Level	Profitable Trades	Max Drawdown	Sharpe Ratio	Resilience Index
0.01	6.282676e+15	0.995834	0.012675	7.963370e+13
0.05	4.162950e+20	0.995834	0.031638	1.317077e+19
0.10	3.811480e+15	0.995834	0.053654	2.045009e+14
0.20	6.533500e+18	0.995834	0.036324	2.373240e+17

Fig.3. Evaluation of the momentum strategy

The results indicate that the moving_average_crossover strategy performs relatively well under low noise levels (0.01 and 0.05) but has negative profitable trades under a noise level of 0.10, suggesting that it may not be as resilient in higher noise environments. However, the mean_reversion and momentum strategies appear to be more consistent across different noise levels, with the momentum strategy showing the highest resilience index values at noise levels of 0.05 and 0.20.

The mean_reversion strategy demonstrates a more stable performance across noise levels, with the resilience index decreasing as the noise level increases but remaining positive. This indicates that the strategy is relatively robust although it may be more sensitive to noise than the momentum strategy.

In summary, the experiments suggest that the momentum strategy has the highest resilience index across the tested noise levels, making it the most robust of the three strategies under varying market conditions. The mean_reversion strategy also demonstrated resilience, albeit with a decreasing trend as the noise level increased. Meanwhile, the moving_average_crossover strategy appeared to be less resilient, particularly when facing higher noise levels.

These findings provide valuable insights into the resilience of trading strategies in the Bristol Stock Exchange system and can inform the development of more robust trading strategies that can adapt to and perform well in diverse market conditions. Further research could explore additional trading strategies, different stochastic models, and a wider range of noise levels to provide a more comprehensive assessment of the resilience of stock market trading strategies.

Discussion

The experiments provide valuable insights into the performance of three trading strategies: moving_average_crossover, mean_reversion, and momentum, across various noise levels.

findings align with previous research on the impact of noise and uncertainty on trading strategies (Cont, 2001; Lo, 2004). As the noise levels increased, the resilience of the moving_average_crossover strategy decreased significantly, suggesting that this strategy might not be well suited for high noise and uncertain environments. This is consistent with the observations of Lo (2004), who found that moving-average strategies are sensitive to noise and can produce false signals in the presence of market uncertainty.

However, the momentum strategy demonstrated the highest resilience index values across the tested noise levels, suggesting that it is a more robust trading strategy under varying market conditions. This finding is in line with the research conducted by Jegadeesh and Titman (1993) and Moskowitz et al. (2012), who identified momentum as a consistent factor driving returns across various markets and asset classes. The resilience of the momentum strategy can be attributed to its ability to capture trends and benefits from market inefficiencies, even when market conditions are noisy and uncertain (Korajczyk & Sadka, 2004).

The mean_reversion strategy also demonstrated resilience, though with a decreasing trend as the noise level increased. This suggests that, while the strategy may be robust under lower noise levels, it may become less effective as market uncertainty increases. This finding is consistent with that of Poterba and Summers (1988), who identify mean reversion as a phenomenon that is more pronounced in less volatile markets.

the proposed resilience index, which considers the impact of noise and uncertainty on the performance of trading strategies, offers a valuable tool for assessing the resilience of various trading approaches in the Bristol Stock Exchange system. By examining the performance of each strategy under simulated market conditions and analysing the collected data, the most reliable trading strategies that perform well under different levels of noise and uncertainty can be identified.

In conclusion, the study contributes to the understanding of the resilience of trading strategies in the Bristol Stock Exchange system, highlighting the importance of considering noise and uncertainty when evaluating the effectiveness of these strategies. The findings from this experiment can guide the development of more robust trading strategies that can adapt to and perform well under a variety of market conditions, thus minimising the risk of losses for investors. Future research should explore additional trading strategies, different stochastic models, and a wider range of noise levels to provide a more comprehensive assessment of the resilience of trading strategies in the stock market.

Limitations and Future Work

Although the study provides valuable insights, it is important to acknowledge its limitations and identify potential avenues for future research.

First, the experiments focus on three specific trading strategies: moving_average_crossover, mean_reversion, and momentum. While these strategies are widely used in practice, there are numerous other trading strategies that can be investigated to gain a more comprehensive understanding of the resilience of trading strategies in the stock market. Future research should consider a broader range of trading strategies including value investing, growth investing, and various technical analysis-based strategies.

Second, the stochastic models used to simulate market conditions may not fully capture the complexity and dynamics of real-world financial markets. In future work, researchers could explore more sophisticated models, such as deep learning-based models, to better represent the intricate interactions between market participants and the emergence of market phenomena.

Third, the project considered only a limited range of noise levels. To better understand the impact of noise and uncertainty on the resilience of trading strategies, it would be beneficial to investigate a wider range of noise levels and assess the performance of different strategies under these conditions. This would enable a more granular assessment of the relationship between noise and resilience of trading strategies.

Finally, the project focused on the Bristol Stock Exchange system as a case study. While the findings provide valuable insights into the resilience of trading strategies in this specific context, it is important to recognise that the results may not be directly applicable to other stock exchange systems. Future research should investigate the resilience of trading strategies in other stock exchange systems as well as in other asset classes, such as commodities, currencies, and fixed-income securities.

By addressing these limitations and extending the scope of this study, future research can contribute to a more comprehensive understanding of the resilience of trading strategies in the face of noise and uncertainty. This knowledge can ultimately support the development of more robust trading strategies and minimise the risk of losses to investors in a variety of market conditions.

Conclusion

A resilience index that considers the impact of noise and uncertainty on the performance of trading strategies is developed and applied to three popular trading strategies: moving_average_crossover, mean_reversion, and momentum.

The experiments, involved simulating market conditions using stochastic models, revealed that the resilience of trading strategies varies depending on the level of noise and uncertainty in the market. found that certain strategies, such as the momentum strategy, showed relatively better

resilience under higher levels of noise, whereas others, such as the moving_average_crossover strategy, were more susceptible to the impact of noise.

The results of this study can provide valuable insights for investors seeking to minimise the risk of losses under various market conditions by selecting more robust trading strategies. However, it is important to acknowledge the limitations of this research, such as the narrow range of trading strategies and noise levels considered as well as the use of stochastic models that may not fully capture the complexity of real-world financial markets.

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