An Achievable Portfolio Trading Strategy

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Abstract. This research outlines an advanced investment strategy for a diversified 20-stock U.S. portfolio, leveraging Yahoo Finance data for optimization. Utilizing a momentum strategy, the study refines stock weights based on historical performance, incorporating dual moving averages for precise trading signals. A novel approach introduces Exponential Moving Averages (EMAs) and risk-adjusted scores to enhance decision-making, striking a balance between returns and associated risks. In the past one year period from February 1, 2023 to February 1, 2024, the annual return rate can be achieved according to this method of 36.81%, the strategy showcases the effectiveness of data-driven, technical analysis in financial mathematics. It demonstrates the utility of sophisticated investment techniques for market performance optimization, contributing valuable insights into portfolio management.The study highlights the potential of leveraging advanced algorithms and financial indicators to outperform traditional market strategies. This innovative approach provides a comprehensive framework for achieving superior returns, emphasizing the importance of technical analysis and risk adjustment in modern investment strategies.

Keywords: Exponential Moving Averages (EMA); momentum score; returns.

1. Introduction

A trading strategy could be conceptualized as a structured set of directives aimed at realizing specific asset allocations at predetermined moments [1]. At the same time, in the context of the rapid development of data, the integration of data and computer technology into the framework of trading strategies has become a direction that needs to be considered. A systematic data analysis system can use a large number of historical data analysis possibilities, and ensure that there is no personal bias [2]. In this paper, the python computer language is used to obtain historical stock data, an analytical exploration is conducted on the formulation and refinement of an investment strategy, concentrating on a meticulously selected portfolio comprising 20 diversified U.S. stocks. These stocks, emanating from an array of industries including consumer electronics, software development, e-commerce, social media, financial services, and healthcare, were selected based on their commendable performance metrics in preceding years. The empirical data for this study was meticulously extracted from Yahoo Finance, providing a robust foundation for the ensuing analysis.

The methodology employed in this investigation is structured around three pivotal aspects: (1) the allocation of optimal weights to each constituent stock within the portfolio, predicated on a momentum strategy. This involves the computation of a momentum score for each stock, with an emphasis on reallocating the portfolio towards those stocks exhibiting the most pronounced positive momentum over a 12-month horizon. (2) The adoption of a dual moving average technique to generate actionable trading signals. This methodological approach leverages a short-term and a long-term moving average, utilizing their crossovers as precursors for potential buy or sell decisions. This technique is instrumental in delineating prevailing market trends, thus facilitating informed trading decisions. (3) The assessment of the theoretical annual returns to quantitatively evaluate the efficacy of the devised strategy.

A distinctive aspect of this research is the integration of a risk-adjusted score in the portfolio optimization process. This adjustment serves to recalibrate the portfolio's composition, ensuring a judicious balance between the pursuit of high returns and the mitigation of associated volatilities. Additionally, Exponential Moving Averages (EMAs) are employed to refine the trading strategy further. This involves identifying 'golden crosses' and 'death crosses' as indicators for prospective

buying or selling opportunities, respectively. Such a dynamic investment strategy is poised to leverage short-term market fluctuations while adhering to a structured investment paradigm.

The findings from this research delineate a compelling annual return of 36.81% for the period spanning February 1, 2023, to February 1, 2024, contingent upon strict adherence to the trading strategy outlined. This outcome not only corroborates the strategy's potency but also underscores the potential of sophisticated, data-driven investment strategies to transcend traditional investment paradigms significantly. Through a rigorous analysis of market trends, a recalibration for risk, and the strategic timing of trades, this paper furnishes profound insights into the domain of investment management and strategy optimization within the field of financial mathematics.

2. Data Collection

The data collection process for this study aimed at assembling a diverse and resilient investment portfolio by selecting 20 U.S. stocks from a variety of industries. Diversification can diversify unsystemic risks by means of diversification. Therefore, diversification by choosing stocks as many as possible can minimize or even ignore the unsystemic risks [3]. These stocks have demonstrated commendable performance over recent years, highlighting their potential for stable returns. The selection criterion was designed to mitigate sector-specific risks, ensuring the portfolio's robustness against industry-wide downturns. This diversification strategy is pivotal for maintaining a stable return ratio, as it cushions the portfolio from the volatility characteristic of single-sector investments.

2.1. Source of Data

The primary source for the stock performance data was Yahoo Finance, a reputable platform known for providing comprehensive financial information, including historical price data, financial statements, and market analysis. This data was crucial for evaluating the selected stocks' past performance and forecasting future trends. Yahoo Finance's extensive database offered a reliable foundation for quantitative analysis, enabling a thorough examination of stock trends, volatility, and sectoral performance. The existence of yahoo finance has made it easier for many stock traders to access stock information, and some companies have set up message boards, which, according to research, have increased daily trading volumes [4].

2.2. Selection of Criteria

The stocks were chosen based on their historical performance, market capitalization, and sector diversity. This selection included giants like Apple Inc., Microsoft Corporation, and Amazon.com Inc., representing sectors from consumer electronics to e-commerce and cloud computing. The rationale behind selecting stocks from different industries was to create a portfolio that could withstand market fluctuations. By including companies like Tesla Inc., which focuses on electric vehicles and renewable energy, alongside traditional powerhouses like JPMorgan Chase & Co. in financial services, the portfolio aimed to balance innovation with stability. The stock symbol and profiles of the 20 US stocks selected first are shown in table 1.

Table 1. 20 US stocks and profiles.

Stock Symbol	Company Name	Primary Business
AAPL	Apple Inc.	Consumer electronics, computer software, and online services
MSFT	Microsoft Corporation	Software development, computer hardware, cloud computing
AMZN	Amazon.com, Inc.	E-commerce, cloud computing, artificial intelligence
GOOGL	Alphabet Inc. (Google's parent company)	Internet-related services and products, including search, advertising, and cloud computing
META	Meta Platforms (Formerly Facebook)	Social media, virtual reality

TSLA	Tesla, Inc.	Electric vehicles, solar energy generation, and energy storage
BKR	Baker Hughes	Oil services and equipment
JPM	JPMorgan Chase & Co.	Financial services
JNJ	Johnson & Johnson	Pharmaceuticals, medical devices, and consumer goods
V	Visa Inc.	Payment technology
WMT	Walmart Inc.	Retailing
PG	Procter & Gamble Co.	Consumer goods
MA	Mastercard Incorporated	Payment technology
UNH	UnitedHealth Group	Health insurance and healthcare services
BAC	Bank of America Corp.	Banking and financial services
HD	The Home Depot, Inc.	Home improvement retailer
NVDA	NVIDIA Corporation	Visual computing technology
ADBE	Adobe Inc.	Software and services focused on creative and document management
PYPL	PayPal Holdings, Inc.	Digital payment
DIS	The Walt Disney Company	Media and entertainment

3. Method

This paper employs a multifaceted methodology to verify a trading strategy, comprising three main components. First, it calculates the appropriate weight of each stock in the portfolio based on a momentum strategy, which assesses stocks' past performances to predict future gains. Secondly, it utilizes two moving averages—one short-term and one long-term—to generate trading signals, where a buying signal is indicated when the short-term average crosses above the long-term average, and a sell signal is signified when it crosses below. Lastly, the paper evaluates the portfolio's performance by calculating its theoretical returns over the past year, thereby providing a comprehensive assessment of the strategy's effectiveness.

3.1. Momentum strategy

The momentum strategy was pivotal in determining the weight of each stock in the portfolio. Stocks were scored based on their momentum, a measure of their recent performance relative to the past. High-momentum stocks were presumed to continue their upward trajectory, making them attractive investments. This approach aligns with the momentum effect in finance, which suggests that assets that have performed well in the past will continue to perform well in the near future. In the Century City Life stock trade, analysts will choose momentum indicators as a signal to buy or sell a stock [5]. The stocks were then ranked, and only the top performers were selected for inclusion in the final portfolio, ensuring a focus on growth potential.

3.2. Exponential Moving Averages and Trading Signals

The application of moving averages — both short-term and long-term — was instrumental in generating buy and sell signals. This technical analysis tool helps smooth out price data over a specific period, making trends easier to spot. A short-term moving average crossing above a long-term moving average signals an uptrend, suggesting a buying opportunity. Conversely, a short-term average dipping below the long-term average indicates a downtrend, prompting a sell. In academic discussions, it is established that an effective method for smoothing involves calculating averages of the sequential closing prices. Within the scholarly literature, both moving averages and exponential moving averages are identified as viable options for this purpose [6].The moving average (MA) and exponential moving average (EMA) both aim to smooth out price volatility to identify trends. However, the EMA's emphasis on recent price data makes it more sensitive to recent market changes, reducing the lag effect seen in the moving average. This method is widely used in stock trading for its simplicity and effectiveness in identifying potential entry and exit points.

3.3. Risk-Adjusted Scores

In optimizing the portfolio, risk factors were meticulously considered through the reintroduction of risk-adjusted scores. Typically, investors take more risk to earn higher returns [7]. These scores helped recalibrate the weights of the stocks in the portfolio, taking into account their volatility. The aim was to achieve a balance between high returns and manageable risk, ensuring that the portfolio's performance remained robust under different market conditions.

The main methods used in this paper are mainly divided into three parts: 1) Calculate the appropriate weight of each stock based on the momentum strategy. 2) Use two moving averages (one short term and one long term) to generate trading signals. When the short term moving average crosses the long-term moving average from below, it is considered a buying signal. When the short-term moving average crosses the long-term moving average from above, it is considered a sell signal. 3) Finally, the portfolio's theoretical return over the past year are calculated to verify the strategy.

3.4. Theoretical Returns

Theoretical returns were calculated based on the strategy of buying at "golden crosses" (when the short-term moving average crosses above the long-term average) and selling at "death crosses" (the opposite scenario). This method provided a practical framework for evaluating the strategy's effectiveness, with the annual return serving as a direct measure of its success.

3.5. Process

3.5.1. Decide on the appropriate weights

First of all, 20 American stocks have been selected, so the momentum formula (1) is used first to calculate the momentum score of each stock. Where M_t represents the momentum at time point t, P_t represents the current price, and P_{t-n} represents the price before the n period. And the weight value based on momentum score is calculated according to formula (2).

$$M_t = \frac{P_t}{P_{t-n}} \tag{1}$$

$$\text{weights} = \frac{\text{momentum scores}}{\sum \text{momentum scores}} \tag{2}$$

The obtained momentum score and corresponding weights are shown in table 2.

Table 2. Momentum score & weights.

Stock Symbol	Momentum score	weights
NVDA	1.937831	0.310694
META	1.547936	0.248182
ADBE	0.609137	0.097664
MSFT	0.573017	0.091872
AMZN	0.475987	0.076315
GOOGL	0.395002	0.063331
AAPL	0.267964	0.042963
JPM	0.249087	0.039936
MA	0.200893	0.032209
V	0.183456	0.029414
WMT	0.142255	0.022808
PG	0.097423	0.015620
HD	0.075802	0.012153
TSLA	0.032413	0.005197
UNH	0.029658	0.004755
JNJ	-0.036503	-0.005852
BAC	-0.053174	-0.008525
BKR	-0.109097	-0.017492
DIS	-0.121949	-0.019552
PYPL	-0.260041	-0.041693

Considering that a small momentum score means that the stock has underperformed over the past 12 months, only the top 10 stocks are kept in the final portfolio. The momentum score of the remaining 10 stocks was calculated again and the corresponding weight distribution was obtained. The top 10 stocks' momentum score and corresponding weights are shown in table 3.

Table 3. Top 10 stocks' Momentum score & weights.

Stock Symbol	Momentum score	Weights
NVDA	1.937831	0.300891
META	1.547936	0.240351
ADBE	0.609137	0.094582
MSFT	0.573017	0.088973
AMZN	0.475987	0.073907
GOOGL	0.395002	0.061333
AAPL	0.267964	0.041607
JPM	0.249087	0.038676
MA	0.200893	0.031193
V	0.183456	0.028486

In the process of continuous optimization, attention to risk factors still needs to be paid. Therefore, risk adjusted score is re-introduced as factor and the corresponding weight is recalculated. The formula for calculating the annual volatility is shown in (3), where daily volatility represents the daily volatility, which represents the standard deviation of the price fluctuation of the asset in one day. $\sqrt{252}$ Represents the conversion factor that converts daily volatility into annualized volatility. In this formula 252 is the average number of trading days in a year. Since volatility (standard deviation) increases proportionally with the square root of time, the use of $\sqrt{252}$ is based on the assumption that asset price movements follow a random walk model, which means that daily volatility needs to be multiplied by $\sqrt{252}$ to estimate one-year volatility. The risk adjusted score is calculated as (4).

$$\text{annual volatility} = \text{daily volatility} \times \sqrt{252} \tag{3}$$

$$\text{risk adjusted scores} = \frac{\text{momentum scores}}{\text{annual volatility}} \tag{4}$$

Finally, the adjusted rounded weighted value is shown in table 4.

Table 4. Stocks' volatility & Adjusted weights.

Stock Symbol	Annual volatility	Weights	Rounded weights (%)
AAPL	0.201515	0.065512	6.6
ADBE	0.314416	0.095448	9.5
AMZN	0.317514	0.073856	7.4
GOOGL	0.302991	0.064228	6.4
JPM	0.204247	0.060082	6.0
MA	0.160564	0.061641	6.2
META	0.392953	0.194073	19.4
MSFT	0.238494	0.118371	11.8
NVDA	0.462831	0.206275	20.6
V	0.149359	0.060514	6.1

3.5.2. Calculate EMAs

Roberts first proposed the exponentially weighted moving average (EWMA) in 1959, also known as the exponentially moving average (EMA) [8] that showed as (5). is a trend indicator used for technical analysis. It is calculated by weighted average of price data over a certain period of time, which makes EMA more sensitive to price changes than SMA and can reflect the latest market trends and price movements more quickly. Where EMA_ts the exponential moving average of the current

time point t. Value_t is the price or other observation at the current point in time t, and N represents the number of time periods, such as days, weeks, or months, used to calculate the EMA. EMA_{t-1} Is the exponential moving average of $t-1$ at the previous point in time?

$$EMA_t = \left(\text{Value}_t \times \frac{2}{N+1}\right) + EMA_{t-1} \times \left(1 - \frac{2}{N+1}\right) \tag{5}$$

Based on the data of the past year, the dates corresponding to the golden and death crosses can be obtained, where the short-term EMA is 9 trading days, and the long-term EMA is 25 trading days. This is a choice based on relatively short-term investors. As for the long term, it could be choosen 50-200 trading days as units [9]. In theory, buying the stocks of the portfolio when the gold fork appears and selling the stocks of the portfolio when the death fork appears basically completes the implementation of the trading strategy over the past year, the performance of the portfolio and the crosses is shown in figure 1.

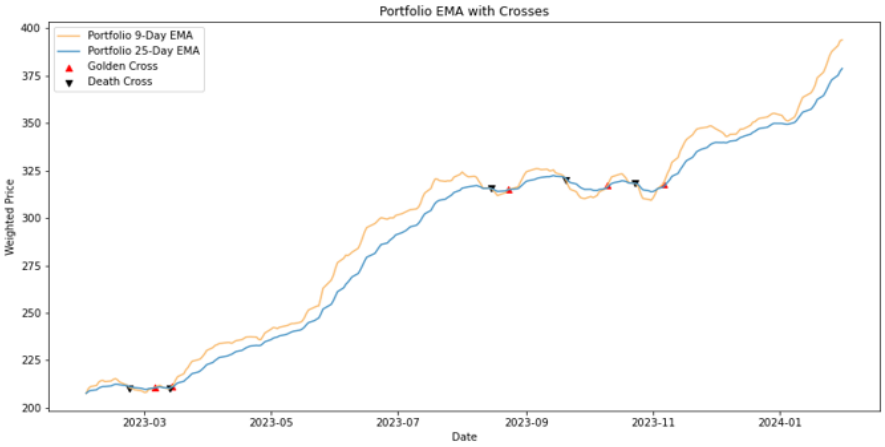

Fig 1. Portfolio EMA with Crosses.

According to the image data, after November 6, 2023, the short-term EMA is higher than the long-term EMA, which can be regarded as a buy signal. The portfolio has an EMA differential of about 5.2 on average, which means the portfolio is performing well. After November 6, 2023, the EMA spread is large, so the decision to buy this portfolio can be made.

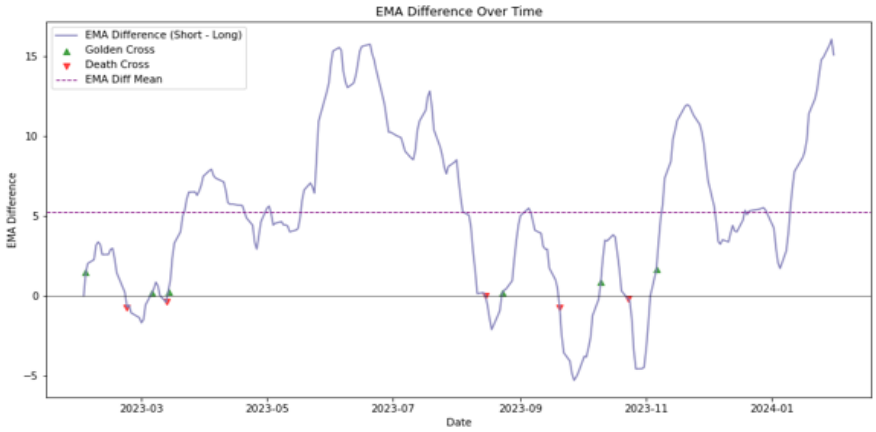

Fig 2. EMA Difference over Time.

Finally, according to the calculation, the portfolio in the past year from February 1, 2023 to February 1, 2024, if strictly follow the trading strategy of buying at the gold fork and selling at the dead fork, its annual return can reach 36.81% . Formula (6) shows the return calculation formula for each trading day (each period, represented by i) [10] the final figure is then obtained by accumulating returns for each trading day (each period).

$$R_i = \frac{P_{\text{sell},i} - P_{\text{buy},i}}{P_{\text{buy},i}} \tag{6}$$

$$R_{\text{total}} = \sum_{i=1}^{n} R_i \tag{7}$$

$$R_{\text{total, percentage}} = R_{\text{total}} \times 100\% \tag{8}$$

4. Conclusion

The culmination of this research affords a compelling narrative on the viability of employing a data-driven investment strategy in navigating the complexities of the financial markets. By methodically selecting a diversified portfolio of 20 U.S. stocks from various sectors and applying an innovative combination of momentum strategies, moving averages, and risk adjustment measures, the study demonstrates a remarkable capacity to achieve substantial returns. The strategic integration of momentum scores and Exponential Moving Averages (EMAs) to guide trading decisions—highlighted by the identification of 'golden' and 'death' crosses—underscores the efficacy of technical analysis in predicting market movements and optimizing portfolio performance.

Remarkably, the study's findings reveal an annual return of 36.81% from February 1, 2023, to February 1, 2024, a testament to the strategy's potency and the potential of sophisticated investment approaches to significantly outperform traditional market strategies. This success is not merely a reflection of market volatility exploitation but also an affirmation of the prudent risk management and strategic foresight embedded in the chosen methodology. The research eloquently navigates through the intricate balance between risk and return, offering profound insights into the realm of investment strategy optimization within the ambit of financial mathematics.

In essence, this paper not only validates the effectiveness of the proposed trading strategy but also enriches the discourse on investment management by demonstrating how data-driven decisions can transcend conventional investment paradigms, offering a robust framework for achieving superior returns. As such, it contributes invaluable knowledge to the field, providing a solid foundation for future explorations into the dynamic interplay between financial theory and practical market operations.

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