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"A Study on Portfolio Management by Markowitz and Sharpe Index Model of Selected Stocks of NASDAQ."

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Abstract

The study explores portfolio management strategies using the Markowitz and Sharpe Index Models, focusing on selected NASDAQ stocks. It delves into methods to optimize asset allocation, balancing risk and returns while ensuring diversification. The Markowitz Model identifies the efficient frontier, enabling portfolios that offer maximum expected return at given risk levels. The Sharpe Index Model evaluates risk-adjusted returns, providing insights into portfolio performance. Through comprehensive analysis, including historical data and statistical tools, the study demonstrates how integrating these models results in portfolios that outperform traditional approaches while minimizing risk. The findings offer investors structured strategies to achieve financial goals amidst fluctuating market conditions.

Key points: Portfolio Management, Markowitz Model, Sharpe Index Model, NASDAQ, Investment, Risk and Return, Diversification, Modern Portfolio Theory (MPT), Portfolio Optimization

Introduction

Portfolio management is both an art and a science, requiring a strategic blend of analytical techniques and personalized decision-making to achieve financial objectives. It involves the careful selection, allocation, and continuous monitoring of investments to balance risk and return effectively. By considering factors such as risk tolerance, market conditions, and asset performance, portfolio managers strive to optimize returns while minimizing potential losses. There are three primary approaches to portfolio management. Active management involves frequently buying and selling assets to outperform the market or a benchmark index. This method requires in-depth research, technical analysis, and continuous market monitoring, offering the potential for higher returns but also carrying greater risk and higher transaction costs. In contrast, passive management focuses on stability by replicating the performance of a market index, such as through index funds or exchange-traded funds (ETFs). This method offers lower costs and is preferred for long-term, consistent returns. Discretionary management, on the other hand, is a personalized approach where professional managers make investment decisions based on individual investor goals, preferences, and risk appetite. It combines elements of both active and passive strategies, offering flexibility and customization.

A key pillar of modern portfolio management is the Markowitz Model, introduced by economist Harry Markowitz in 1952. This model revolutionized investment strategies by promoting diversification as a means of reducing risk. It is based on the principle that combining assets with low or negative correlations can reduce overall portfolio volatility. By constructing an efficient frontier, the model identifies the optimal set of portfolios offering the highest possible return for a given level of risk. Investors can use this frontier to make informed decisions, selecting portfolios that align with their risk tolerance while maximizing potential gains. The risk-return trade-off emphasized by the model helps investors balance their desire for returns against their ability to tolerate market fluctuations.

Complementing the Markowitz Model is the Sharpe Index Model, developed by Nobel Laureate William F. Sharpe. This model provides a framework for evaluating portfolio performance relative to its risk, offering a standardized measure of how effectively a portfolio generates returns in comparison to its volatility. The Sharpe ratio, calculated as the difference between the portfolio return and the risk-free rate, divided by the portfolio's standard deviation, helps investors assess whether they are adequately compensated for the risk they are taking. A higher Sharpe ratio indicates better risk-adjusted returns, while a lower or negative ratio suggests that the portfolio may not be delivering sufficient returns for the level of risk assumed. This metric is widely used to compare portfolios or evaluate the effectiveness of active management strategies.

Together, the Markowitz and Sharpe models form the foundation of effective portfolio management. The Markowitz Model helps construct diversified portfolios that minimize risk while maximizing returns, while the Sharpe Index measures the efficiency of those portfolios by evaluating how well they perform relative to their risk. By integrating these models, portfolio managers can make data-driven, informed decisions, enhancing their ability to

navigate complex financial landscapes. This enables investors to achieve their long-term financial goals with precision and confidence, ensuring that their portfolios are not only optimized for returns but also resilient to market fluctuations.

Literature Review

1. **Gang Hu and Ming Gu (2021):** The paper titled "Markowitz Meets Bellman: Knowledge-distilled Reinforcement Learning for Portfolio Management". The paper combines Markowitz's portfolio theory with reinforcement learning, specifically using the Sharpe Ratio to measure risk-adjusted returns. the paper introduces an advanced framework for portfolio management that bridges the gap between classical financial theory (Markowitz's portfolio theory) and modern machine learning techniques (reinforcement learning). This integration aims to improve the robustness and adaptability of portfolio management strategies in volatile and uncertain financial environments.

2. **Leran Dai (2012):** The paper titled "Portfolio Optimization Using Markowitz Model and Index Model – A Study on 10 Selected Stocks". This study analyses portfolio management using the Markowitz model and Sharpe single index model on ten selected stocks from technology, financial services, and consumer defines industries, highlighting the impact of constraints on portfolio optimization and performance comparison between the models. In essence, the paper compares the effectiveness of the Markowitz Mean-Variance Optimization and Index Model for portfolio construction, highlighting the trade-offs between the complexity and performance of these two popular methods in the context of managing a portfolio of stocks.

3. **Tianhao Guo and Jinxuan Wang (2021):** The paper titled "Elaborative Research between Markowitz Model and the Index Model". The paper analyses portfolio management using the Markowitz and Index models on ten selected stocks, revealing similar results favouring Travelers Companies Inc and SPX, highlighting the stability and long-term returns of insurance companies due to low variance. In summary, Guo and Wang's paper provides a thorough comparative study of the Markowitz Mean-Variance Optimization Model and the Index Model in the context of portfolio optimization. It highlights the trade-offs between computational complexity, diversification, and ease of implementation, offering insights into the practical application of these models in real-world portfolio management.

4. **Haowen Tan (2017):** The paper titled "An Empirical Study on the Markowitz Portfolio". The paper empirically demonstrates the Markowitz portfolio model using Apple Inc., Alphabet Inc., and Microsoft Corporation, evaluating performance through the Sharpe ratio. It highlights the model's effectiveness and limitations, particularly during periods of negative expected returns due to macroeconomic factors. focuses on analysing the practical application of the Markowitz Portfolio Theory, which is a foundation of modern portfolio management. The theory emphasizes optimizing the risk-return trade-off in investment portfolios through diversification.

5. **Janki Mistry, Ritesh, and Ashok Khatwani (2017):** The paper titled "Examining the superiority of the Sharpe single-index model of portfolio selection: A study of the Indian mid-cap sector". The paper focuses on the efficacy of Sharpe's single-index model for portfolio optimization in the Indian mid-cap sector, demonstrating that it outperforms the benchmark Nifty mid-cap 100 index with higher returns and lower risk over a five-year period. In conclusion, the study supports the use of the Sharpe Single-Index Model for portfolio selection in the Indian mid-cap sector. It finds that the model provides an effective, efficient, and simpler approach to constructing optimal portfolios, particularly in a market where data complexities and computational challenges are present.

Research Methodology

This study employs secondary data sourced from websites, books, and publications related to portfolio management, while primary data collection is not utilized. The research focuses on securities from ten companies across three industries—computer software (Adobe Inc., IBM, SAP SE), finance (Bank of America, Citigroup, Wells Fargo, Travelers Companies Inc.), and airlines (Southwest Airlines, Alaska Air Group, Hawaiian Airlines)—using historical monthly data from April 2015 to December 2024. The Markowitz and Sharpe index models serve as analytical tools for identifying high-return, low-risk securities, analyzing asset allocation through variance-covariance matrices, and formulating diversified portfolios based on risk-return trade-offs. Historical stock prices over a nine-year period are analyzed in Excel using techniques like variance-covariance analysis and standard deviation calculations. However, the study is limited by its time frame, its inclusion of only ten companies, and its specific context, restricting broader generalizations. The research aims to monitor portfolio performance aligned with market trends, incorporate investor objectives and constraints, and revise portfolio strategies for optimized returns.

Data Interpretation

The analysis of the portfolio data reveals key differences between the equally weighted portfolio and the optimal risky portfolio. the optimal risky portfolio demonstrates a higher expected return (21%) compared to the equally weighted portfolio (12%). This indicates that the portfolio optimization process effectively selected assets with stronger return potential. Notably, this higher return was achieved with a slightly lower standard deviation (risk) of 20%, compared to the 21% standard deviation of the equally weighted portfolio. This suggests that the optimal risky portfolio not only offers enhanced returns but also provides improved risk management. A critical metric highlighting this improvement is the Sharpe ratio, which measures risk-adjusted return.

The optimal risky portfolio boasts a Sharpe ratio of 0.80, significantly outperforming the equally weighted portfolio's ratio of 0.35. This substantial difference underscores the optimal portfolio's superior efficiency in generating returns relative to the risk undertaken.

Variance Co-variance Matrix

This table illustrates the variance and co-variance between the assets in the portfolio. Variance measures the degree of variation of a single asset's return, while co-variance measures how the returns of two assets move in relation to each other.

	ADBE	IBM	SAP SE	BAC	C	WFC	TRV	LUV	ALK	HA
ADBE	8%	2%	4%	3%	4%	2%	1%	3%	2%	-5%
IBM	2%	5%	3%	3%	4%	2%	2%	3%	4%	0%
SAP SE	4%	3%	7%	3%	4%	3%	2%	3%	3%	-1%
BAC	3%	3%	3%	9%	8%	7%	3%	6%	7%	3%
C	4%	4%	4%	8%	10%	7%	4%	6%	8%	3%
WFC	2%	2%	3%	7%	7%	6%	3%	5%	5%	1%
TRV	1%	2%	2%	3%	4%	3%	4%	3%	3%	-2%
LUV	3%	3%	3%	6%	6%	5%	3%	10%	7%	1%
ALK	2%	4%	3%	7%	8%	5%	3%	7%	9%	2%
HA	-5%	0%	-1%	3%	3%	1%	-2%	1%	2%	15%

Equally Weighted Portfolio Analysis

The equally weighted portfolio serves as a baseline for comparison. In this portfolio, each stock is given the same weight, regardless of its individual risk or return profile. This approach is simple to implement but does not consider the complex interactions between assets.
As shown in Table 7, the equally weighted portfolio has an expected return of 12% and a standard deviation of 21%. The Sharpe ratio for this portfolio is 0.35.

- **Expected Return:** The 12% expected return indicates the average return anticipated from this portfolio.
- **Standard Deviation:** The 21% standard deviation reflects the portfolio's volatility or risk. A higher standard deviation implies greater fluctuations in returns.
- **Sharpe Ratio:** The Sharpe ratio of 0.35 measures the risk-adjusted return. A lower Sharpe ratio suggests that the portfolio is not generating sufficient return relative to its risk.

Optimal Risky Portfolio Analysis

The optimal risky portfolio is constructed using the Markowitz model and Sharpe ratio to maximize return for a given level of risk. This portfolio intentionally concentrates investments in assets that offer the best risk-adjusted returns.
As detailed in Table 7, the optimal risky portfolio has an expected return of 21%, a standard deviation of 20%, and a Sharpe ratio of 0.80.

- **Expected Return:** The optimal risky portfolio significantly outperforms the equally weighted portfolio, with an expected return of 21%. This demonstrates the effectiveness of portfolio optimization in selecting high-return assets.
- **Standard Deviation:** The standard deviation is slightly lower at 20% compared to the equally weighted portfolio's 21%. This reduction in risk, despite the higher return, indicates an efficient risk management strategy.
- **Sharpe Ratio:** The Sharpe ratio of 0.80 is substantially higher than that of the equally weighted portfolio (0.35). This higher ratio confirms that the optimal risky portfolio provides a much better risk-adjusted return.

Comparative Analysis and Implications

The comparison between the two portfolios highlights the benefits of optimal portfolio construction:

- **Return Enhancement:** The optimal risky portfolio offers a considerably higher expected return (21%) than the equally weighted portfolio (12%). This demonstrates that active portfolio management, guided by models like Markowitz, can effectively boost returns.
- **Risk Management:** Despite the higher return, the optimal risky portfolio maintains a lower or similar level of risk (20%) compared to the equally weighted portfolio (21%). This indicates that optimization techniques can help in managing and even reducing risk.
- **Efficiency:** The Sharpe ratio, a measure of risk-adjusted return, is significantly higher for the optimal risky portfolio (0.80) than for the equally weighted portfolio (0.35). This highlights the superior efficiency of the optimized portfolio in generating returns relative to the risk taken.

Asset Allocation

The optimal risky portfolio is concentrated in specific assets. Assets such as ADBE, TRV, and HA receive the largest weights, suggesting that these assets offer the most attractive risk-adjusted returns. The exclusion of other assets implies that they do not contribute effectively to the portfolio's risk-return profile.

Comparison of Equally Weighted Portfolio and Optimal Risky Portfolio

Metric	Equally Weighted Portfolio	Optimal Risky Portfolio
Expected Return	12%	21%
Standard Deviation	21%	20%
Sharpe Ratio	0.35	0.80

Conclusion

"The analysis of individual stock performance revealed significant variations in return and risk. Notably, ADBE demonstrated the highest return (25%) among the companies studied, indicating a strong growth potential. Conversely, LUV exhibited the lowest return (4%). In terms of risk, Hà Bank presented the highest volatility (76%), suggesting a higher degree of uncertainty in its returns, while TRV showed the lowest risk (4%), indicating relative stability. Evaluating portfolio-level performance, the equally weighted portfolio yielded a return of 12% with a risk of 21%. In contrast, the optimal risky portfolio, constructed using the Markowitz and Sharpe models, achieved a higher return of 21% with a slightly reduced risk of 20%. This optimal portfolio also exhibited a superior Sharpe ratio (0.80) compared to the equally weighted portfolio (0.35). This substantial difference in Sharpe ratios highlights the optimal risky portfolio's enhanced risk-adjusted return, reaffirming the efficacy of the Markowitz and Sharpe models in constructing efficient portfolios. While these models are valuable tools for maximizing returns relative to risk through diversification and asset selection, it is crucial to acknowledge their limitations. These include assumptions such as the normal distribution of returns and reliance on historical data, which may not always accurately predict future market behavior. Therefore, while these models offer robust frameworks for portfolio construction, investors should integrate them with a comprehensive understanding of prevailing market conditions and individual risk tolerance for more informed decision-making. The insights derived from this analysis can be instrumental for technical analysis, aiding in trend identification, investment potential assessment, and understanding broader market dynamics influencing the selected companies."

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