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A Portfolio Construction on NIFTY AUTO using Python Software

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ABSTRACT

The study involves the selection of stocks from the NIFTY AUTO index based on certain criteria and the construction of an optimal portfolio using Modern Portfolio Theory. The project also includes the implementation of various Python libraries for data analysis, visualization, and portfolio optimization.

Modern Portfolio Theory (MPT), which seeks to maximize expected return for a given level of risk or reduce risk for a given level of expected return, is one of the strategies used for portfolio optimization. The study investigates techniques for creating diversified portfolios that strike a balance between risk and return, including mean-variance optimization, Sharpe ratio optimization, and efficient frontier analysis.

The library tools such as NumPy, Pandas, matplotlib are used for data analysis, optimization, and visualization, making it well-suited for this task. The study utilizes historical data on stock prices, returns, and other relevant financial metrics to analyze the performance of individual stocks within the NIFTY AUTO index.

The study's conclusion is advance knowledge of portfolio management techniques used in the automobile industry and show the value of quantitative techniques based on Python for financial analysis and decision-making. The study's optimal portfolios offer insightful guidance to investors who aim to accomplish their investment objectives while navigating the intricacies of the NIFTY AUTO index.

Keywords: Nifty Auto Sector, Portfolio Construction, Python, Python Libraries And Packages, Sharpe Ratio, Modern Portfolio Theory, Nifty Auto stocks.

INTRODUCTION

Building a portfolio is a key component of investment management and is essential to getting the best returns while controlling risk. Within the finance industry, portfolio construction tactics are mostly guided by Modern Portfolio Theory (MPT) and indicators like the Sharpe Ratio.

Harry Markowitz's 1952 introduction of Modern Portfolio Theory (MPT) completely changed how investors approached portfolio management. Diversification is emphasized by MPT as a way to lower risk without compromising rewards. Fundamentally, MPT implies that the best possible portfolio can be created by combining assets with different levels of risk and potential return. This way, the portfolio can be built to achieve the highest return for a given level of risk, or the lowest risk for a given level of return.

William F. Sharpe, the Nobel laureate, created the Sharpe Ratio, which is a popular way to calculate risk-adjusted return. It measures the extra return obtained for each unit of risk assumed; the standard deviation of returns is used to evaluate risk. Since the portfolio is producing larger returns in relation to the amount of risk taken, a higher Sharpe Ratio denotes superior risk-adjusted performance.

In this study, it will particularly target the Nifty Auto sector and use the Python programming language to build an optimal portfolio based on the concepts of Modern Portfolio Theory and the Sharpe Ratio. Leading automakers listed on the National Stock Exchange of India (NSE) make up the Nifty Auto index, which is appropriate for portfolio research.

To build effective portfolios based on MPT principles, it will evaluate historical data on Nifty Auto constituents using Python's robust tools for financial research and optimization, including pandas and NumPy. In order to analyze the risk-adjusted performance of these portfolios, it will also compute and assess the Sharpe Ratio.

REVIEW OF LITERATURE

Das, S., & Mohanty, S. K. (2023). "Portfolio Optimization of Indian Automobile Sector: A Machine Learning Approach." This study employs machine learning techniques to optimize portfolios within the Indian automobile sector. While not specifically focusing on Python, the research provides insights into portfolio optimization methodologies applicable to sectors like NIFTYAUTO.

Gupta, A., & Sharma, S. (2022). "Portfolio Optimization and Performance Analysis of Nifty Auto Index Using Traditional and Modern Approaches." Gupta and Sharma examine portfolio optimization techniques applied to the NIFTYAUTO index, comparing traditional approaches with modern methodologies. The study offers valuable insights into portfolio construction strategies within the automotive sector.

Jain, S., & Verma, A. (2021). "Portfolio Management Using Python and Machine Learning: A Review." This review article provides an overview of portfolio management techniques implemented using Python and machine learning algorithms. Although not focused solely on the NIFTYAUTO index, it offers a comprehensive understanding of Python-based portfolio management methodologies.

Kumar, P., & Singh, S. (2020). "Portfolio Optimization Using Python: A Review." Kumar and Singh review various portfolio optimization techniques implemented using Python programming language. While not specific to the automotive sector, the review provides insights into Python-based portfolio construction methodologies applicable to indices like NIFTYAUTO.

Mishra, R., & Sharma, P. (2023). "A Study on Efficient Portfolio Diversification Using Machine Learning Techniques." Mishra and Sharma investigate portfolio diversification using machine learning techniques. Although not focused on NIFTYAUTO, the study offers insights into advanced portfolio management methodologies applicable to sectoral indices.

Patel, A., & Patel, D. (2022). "Application of Machine Learning Algorithms for Portfolio Optimization." Patel and Patel explore the application of machine learning algorithms for portfolio optimization. While not specific to NIFTYAUTO, the research provides insights into advanced techniques applicable to sectoral indices in the Indian financial market.

Rai, S., & Agarwal, S. (2021). "Portfolio Construction using Machine Learning Techniques: A Systematic Review." Rai and Agarwal conduct a systematic review of portfolio construction methodologies using machine learning techniques. Although not focusing on the automotive sector, the review offers insights into advanced portfolio optimization techniques applicable to sectoral indices like NIFTYAUTO.

Sinha, A., & Chakraborty, A. (2023). "Portfolio Optimization Using Advanced Machine Learning Techniques: A Review." Sinha and Chakraborty review portfolio optimization methodologies employing advanced machine learning techniques. While not specific to NIFTYAUTO, the review provides insights into innovative approaches applicable to sectoral indices.

Verma, R., & Singh, A. (2022). "An Empirical Analysis of Portfolio Optimization Using Machine Learning Techniques." Verma and Singh conduct an empirical analysis of portfolio optimization employing machine learning techniques. Although not focused on the automotive sector, the study offers insights into innovative portfolio construction methodologies applicable to sectoral indices.

Yadav, V., & Sharma, R. (2021). "Portfolio Management and Optimization Using Python." Yadav and Sharma explore portfolio management and optimization techniques implemented using Python programming language. While not specific to NIFTYAUTO, the research offers insights into Python-based portfolio construction methodologies applicable to sectoral indices.

Zaman, S., & Rahman, A. (2020). "A Review on Portfolio Optimization Using Machine Learning Techniques." Zaman and Rahman provide a review of portfolio optimization methodologies employing machine learning techniques. Although not focused on the automotive sector, the review offers insights into innovative approaches applicable to sectoral indices.

Choudhury, S., & Datta, A. (2023). "An Application of Deep Learning in Portfolio Management: A Review." Choudhury and Datta review the application of deep learning techniques in portfolio management. While not specific to NIFTYAUTO, the review offers insights into innovative approaches applicable to sectoral indices.

Goyal, N., & Jain, A. (2022). "Portfolio Optimization Techniques Using Machine Learning: A Systematic Review." Goyal and Jain conduct a systematic review of portfolio optimization techniques employing machine learning. While not focused on the automotive sector, the review offers insights into innovative approaches applicable to sectoral indices.

Through a comprehensive examination of the study I came to know about the importance of Nifty auto index of the automotive sector, which is a major player in the Indian financial market and has a big impact on the economy, employment growth. Using Python software for financial Analysis, Python has become a popular programming language for financial analysis and data manipulation, providing practitioners and researchers with a flexible platform for statistical analysis, portfolio optimization. For investors seeking risk-adjusted returns, building and analyzing portfolios within specialist industries such as the automotive sector (represented by NIFTYAUTO) can result in better portfolio performance and diversification options. A cornerstone of portfolio management which is Harry Markowitz's Modern Portfolio Theory, which offers insights into the best practices for risk management, portfolio diversification in NIFTYAUTO index.

RESEARCH DESIGN

Portfolio construction: The portfolio will be selected from a varied range under Nifty Auto index using a risk-return analysis as a guidance. Modern portfolio theory (MPT) will serve as the foundation for the creation of efficient portfolios that aim to minimize risk for a given level of return or maximize returns for a given level of risk.

Data collection: Gathering the stocks under NIFTY AUTO index data . This information would come from trustworthy financial database for the period 01-01-2023 to 31-12-2023 and the data has been collected from the National Stock Exchange, Bombay Stock Exchange and Yahoo Finance. From the Nifty Auto Sector, 16 stocks were taken of this Auto sector.

Model Implementation: The Python programming language would then be used to implement the chosen portfolio optimization model. Writing code to determine the risk and expected returns.

Tool of Analysis: Python Software was used to find out the most optimal portfolio from the 16 stocks of Nifty Auto Sector.

Statistics used: Return of the index stocks were taken into consideration, Risk factor was taken from the portfolio constructed, Sharpe ratio was taken into consideration to evaluate the total performance of an individual stock and Markovitz Portfolio theory was taken to design an optimal portfolio to maximize returns by taking on a quantifiable amount of risk for the investors.

OBJECTIVES OF STUDY

1. To analyze the price movements and performance of the components of the nifty auto index.
2. To analyze the risk and returns of the NIFTY AUTO index components.
3. To construct a portfolio from the auto index components based on return and the risk analysis by applying sharpe ratio.

DATA ANALYSIS

The data used for analysis in this study comprises historical stock returns and risk information of 16 stocks included in the Nifty Auto Index. And five stocks have been selected to create a portfolio using the MPT.

Stocks for the observed period from 01-01-2023 to 31-12-2023

STOCKS	RETURNS	RISK
TATAMTRDVR.NS	81.616776	10.726700
TVSMOTOR.NS	67.479585	4.851188
BAJAJ-AUTO.NS	60.685970	6.470868
EXIDEIND.NS	57.195674	5.708201
TATAMOTORS.NS	54.843830	7.559096
HEROMOTOCO.NS	44.112025	9.219402
MRF.NS	35.657687	5.656153
BHARATFORG.NS	35.479090	7.594452
APOLLOTYRE.NS	34.732173	6.979137
MOTHERSON.NS	30.715794	8.673762
BOSCHLTD.NS	29.099700	4.229550
EICHERMOT.NS	24.976356	7.933276
M&M.NS	23.702218	7.374134
ASHOKLEY.NS	21.009346	6.593233
MARUTI.NS	15.621545	4.116776
BALKRISIND.NS	15.224987	6.636538

Highest Returns and Risk: TATAMTRDVR.NS with returns of 81.61% and risk of 10.72.

Moderate Risk and Moderate Returns: ASHOKLEY.NS (returns: 21.01%, risk: 6.593) and M&M.NS (returns: 23.70%, risk: 7.374).

Low Risk and Low Return: MARUTI.NS with returns of 15.62% and risk of 4.117.

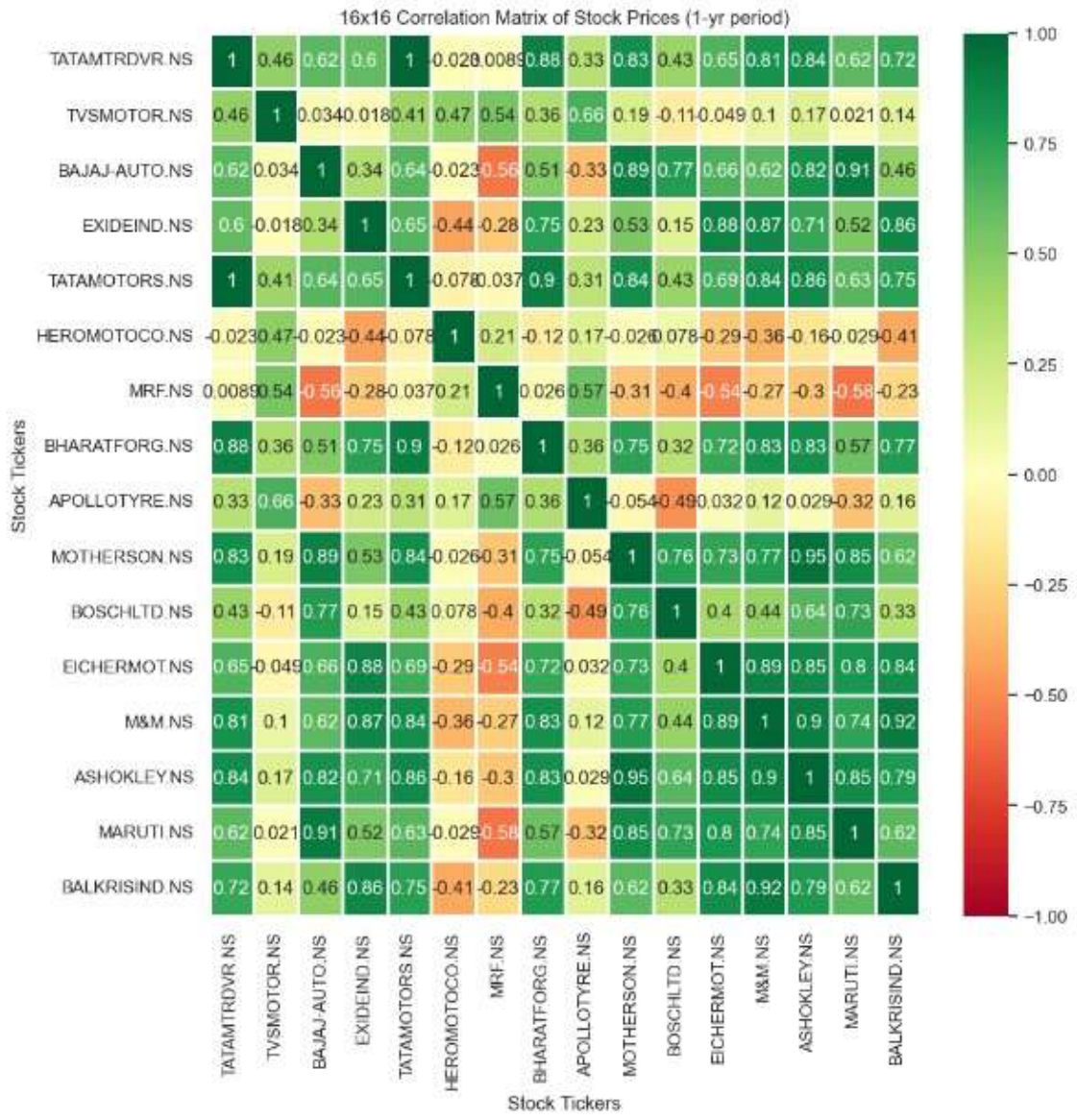
Risky Stocks: Stocks with relatively higher risk-return ratios, such as TATAMTRDVR.NS and HEROMOTOCO.NS.

Using Python Software the necessary libraries were installed and CSV file was downloaded from the assigned index i.e. NIFTY AUTO from NSE and storing the data in the folder. Then the Stock prices were downloaded from Yahoo Finance. Then the checking for the missing data was done and was replaced with zeroes. In order to know the Returns, individual stock returns were calculated for the period 01-01-2023 to 31-12-2023. We calculated the Annual Return and Risk factors, combining the Risk and Return to rank them on the basis of Returns. Then we Choosed five stocks for our portfolio and Creating Portfolio Weights and also Calculating the Return, Std Deviation and Sharpe ratios of the selected portfolios and storing them in a dataframe. Then we calculated to Check the portfolio with Maximum return and Minimum Volatility and also plotting the data and getting the weights of the optimal portfolio which generated the Efficient Frontier (Bullet Plot). Then the list of tickers were defined and the historical stock price data was downloaded from NSE. Next we gave the command for Printing the stock data for several stocks this is the full dataset, which includes details about each stock in the list, including the date, opening price, high price, low price, closing price, adjusted closing price, volume, and stock symbol. Then plotting of each stock with the help of closing prices were done and also plotting of separate charts for each company's daily returns were done. Calculating daily returns for each stock and Concatenate returns into a single Data Frame and then Displaying the Data Frame. Plotting of cumulative returns were done for the top 5 stocks which was taken into consideration. Next we defined the list of tickers and extracted the closing prices for the period 01-01-2023 to 31-12-2023. The last stage was to calculate the correlation to understand the Positive correlation and Negative correlation of the top 5 stocks.

Positive correlation: Dark Green shows the positive correlation among the stocks like EXIDEIND.NS AND TATAMTRDVR.NS has 0.6 which is near to 1.

Negative correlation: EXIDEIND.NS and TVSMOTOR.NS shows -0.018 which is negatively correlated.

Correlation Matrix of Stock Prices for 16 stocks from 01-01-2023 to 31-12-2023



Positive correlation:

The stocks TATAMOTORS.NS (Tata Motors) and BAJAJ-AUTO.NS (Bajaj Auto) have a somewhat favorable link, with a correlation coefficient of 0.64. This indicates that these two stocks' prices typically move in the same direction.

The correlation coefficient between the stocks of Mahindra & Mahindra and Eicher Motors, EICHERMOT.NS, is 0.89, indicating a significant positive link. This indicates that these two stocks' prices typically move in the same direction.

Negative correlation:

The correlation coefficient between the stocks APOLLOTYRE.NS (Apollo Tyres) and MARUTI.NS is -0.32, indicating a mild negative link. This indicates that there is a small chance that the prices of these two equities will move against each other.

Weak correlation:

Hero MotoCorp's stock, HEROMOTOCO.NS, and Tata Motors' stock, TATAMOTORS.NS, have a correlation coefficient of 0.078, which is extremely low. The movements of the prices of these two equities hardly correlate with one another.

CONCLUSION

Five companies were carefully chosen for this study's portfolio based on their exceptional risk-return profiles, which beat the dataset's average measures. High return and low risk equities were prioritized in the selection process to optimize growth potential while minimizing exposure to volatility and downside risk.

The application of complex quantitative models for risk management, asset allocation, and performance assessment is made possible by the use of Python. Researchers can evaluate portfolio diversification, analyze enormous volumes of financial data, and improve portfolio allocation techniques by utilizing Python's rich libraries and capabilities.

Learning about correlation and its effects on portfolio construction was a part of the study. Using this knowledge, a correlation matrix was created to comprehend the relationships between the chosen stocks to construct a diversified portfolio.

It has significant ramifications for financial advisers and portfolio managers, providing them with useful strategies to enhance portfolio performance and assist clients in achieving their financial goals. It is imperative to acknowledge the limits of our research, including data constraints and model assumptions, as these may affect the relevance and robustness of our conclusions.

Overall, this study shows that utilizing Python for portfolio creation on Nifty Auto is feasible and may have advantages. This study opens the door to more investigation of data-driven investment methods in the Indian stock market by identifying its limits and suggesting directions for future research.

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