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Optimizing Portfolio Construction Using Nifty India Manufacturing Index: A Risk-Return Analysis with Python

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ABSTRACT

This paper presents a comprehensive analysis of portfolio construction strategies aimed at maximizing risk-adjusted returns for investors. Utilizing historical data on stock returns and risks, a meticulous selection process was employed to identify 15 stocks with superior risk-return profiles. These stocks were chosen based on their outperformance relative to the dataset's average measures, prioritizing returns higher than the dataset average and risks lower than average risk levels. The selected stocks, representing a diverse range of manufacturing-related businesses, formed the cornerstone of an optimal portfolio designed to minimize sector-specific risks while maximizing growth potential.

Through rigorous portfolio optimization techniques, including Markowitz's mean-variance optimization, the study identified an optimal portfolio allocation with a return of 50.22% and volatility of 13.33%. Insights from the study offer valuable perspectives for investors seeking realistic and sustainable wealth accumulation strategies. The research also identifies avenues for future exploration, including the integration of alternative asset classes, behavioral finance insights, and advancements in risk management technologies. This study demonstrates the effectiveness of Python in financial analysis and portfolio optimization while furthering the theory of portfolios and providing valuable guidance for making investment decisions.

Keywords*: Returns, Risk, Volatility, Optimal Portfolio Construction, Manufacturing Sector, Markowitz Portfolio Theory,*

Introduction:

India's manufacturing industry has grown at a rate never seen before and has enormous potential to spur economic expansion and employment creation. The importance of this industry is shown by a few important metrics, underscoring its crucial role in India's development as a major global manufacturing hub. India's industrial exports hit a record high of US$ 447.46 billion in the fiscal year 2022– 2023, a stunning increase of 6.03% over the year before. This export boom not only demonstrates the manufacturing sector's tenacity but also highlights its potential to make a significant contribution to India's economic development.

The government is committed to creating an environment that is favorable for the expansion of manufacturing, as seen by programs like the Production Linked Incentive (PLI) plan and 'Make in India' campaigns. The government's efforts to support local industry and improve worldwide competitiveness are demonstrated by the incentives provided to industries such as chemicals, shipping containers, and vaccine ingredients. India's goal to become a worldwide manufacturing powerhouse is reflected in its objective to become an export economy valued at $1 trillion by 2030. India's manufacturing strengths are ideally positioned to take advantage of growing exports, localized production, and contract manufacturing due to their alignment with global value chains and market prospects.

A key component of investment management is portfolio creation, in which investors try to put together a group of stocks that together accomplish their intended financial objectives while skillfully controlling risk. In order to improve portfolio performance, the process entails strategically allocating assets, taking the risk-return trade-off into account, and applying diversification principles. Harry Markowitz developed modern portfolio theory (MPT), which serves as the theoretical foundation for portfolio creation and highlights the significance of diversification in maximizing returns for a particular degree of risk. Python is a great tool for creating and managing investment portfolios because of its extensive libraries for data analysis and optimization.

Statement of the Research Problem:

Limited Knowledge and Expertise: A lot of investors are not well-versed in assessing manufacturing industry equities and comprehending how they affect portfolio management.

Difficulties in Risk Management and Volatility: For investors in the manufacturing industry, market instability, geopolitical unrest, and regulatory changes present serious obstacles. Therefore, effective risk management and portfolio diversification measures are required.

Adoption of Data-Driven Approaches: It's possible that traditional investing approaches fall short in capturing the special dynamics of manufacturing stocks or in revealing new trends and opportunities

Complexity of Manufacturing Sector Dynamics: The manufacturing sector in India is made up of a wide range of industries, from chemicals and cars to consumer durables and medicines. The distinct traits, market patterns, and expansion opportunities exhibited by each industry contribute to the intricacy of portfolio construction.

Review of Literature:

A study by Krishnaprabha and Vijayakumar (2015) examined the risk and return analysis of a few Indian stocks, particularly those in the banking and automotive industries. They stressed how crucial risk and return analysis is in directing people's personal decision-making processes.

Ten pharmaceutical businesses listed on the NSE were chosen, and their risk-return characteristics were examined by Dr. M. Muthu Gopalakrishnan and Amal Vijay A K (2017). They looked at data from 2012 to 2015 using methods including mean, beta, standard deviation, alpha, correlation, and covariance. Their findings emphasized how crucial it is for investors looking for high returns to take risk and return considerations into account.

The relevance of risk-return analysis, especially in portfolio management, is emphasized by Satyaprasad and Anusha in the financial industry. The authors examine the correlation between equity share risk and return, emphasizing the necessity of conducting regular portfolio assessments grounded in investor risk-return standards. The writers discuss the relationship between systematic risk and equity returns as well as the risk-return trade-off in stocks, highlighting the value of making well-informed decisions while managing a portfolio.

Wang and Aste present a unique use of the Inverse Covariance Clustering (ICC) technique for dynamic portfolio optimization. They outperform conventional approaches by incorporating market conditions found through ICC into the portfolio optimization procedure.

Zhang uses Python to carry out an extensive empirical investigation of financial data analysis and portfolio optimization. Zhang uses Python-based approaches to select six equities from the Chinese stock market that make up the FTSE A50, and then creates optimal portfolios with the maximum Sharpe ratio and the shortest variance. The performance of various portfolios is compared and examined in the study, offering valuable insights into efficient portfolio creation techniques.

Research Objectives:

1. To Analyze Historical Risk and Return Profiles and To Construct Efficient Portfolios.
2. To Identify Optimal Portfolio Allocations using Python.

Data Analysis:

Historical Returns Analysis: To comprehend the performance dynamics over a certain time period, historical returns of manufacturing sector companies from the Nifty India Manufacturing Index were examined. Calculating the daily, monthly, and annual returns of individual companies as well as the index itself was part of this investigation.

Risk Measures Calculation: To assess the degree of risk connected to specific stocks and the portfolio as a whole, risk measures like beta, Sharpe ratio, and standard deviation (volatility) were computed. The risk-adjusted returns of stocks and portfolios were assessed with the use of the Sharpe ratio.

Correlation Analysis: The degree of a linear relationship between the returns of the various manufacturing sector companies that are part of the index was investigated using correlation analysis. This study aided in portfolio diversification and risk management by pointing out equities that move in unison and those that show diverging price fluctuations.

Efficient Frontier Construction: To determine the best portfolios that deliver the highest projected returns for a given level of risk or the lowest risk for a specified level of return, the efficient frontier was built using the principles of Modern Portfolio Theory (MPT). This involved calculating the expected returns and standard deviations of each portfolio and simulating alternative combinations of portfolios by assigning weights to individual stocks. The most efficient allocations were represented by portfolios that lay on the efficient frontier, which visually represented the trade-off between risk and return.

Research Outcome and Findings:

The data used for analysis in this study comprises historical stock price information of 77 stocks included in the Nifty India Manufacturing Index. These stocks represent various sectors within the manufacturing industry, such as automobile and auto components, capital goods, chemicals, consumer durables, healthcare, metals & mining, oil gas & consumable fuels, telecommunications, and textiles.

Industry	No of Companies
Automobile and Auto Components	16
Capital goods	20
Chemicals	12
Consumer durables	7
Healthcare	8
Metals and Mining	7
Oil Gas &Consumable fuels	3
Telecommunication	1
Textiles	3

Combined table showing the Returns and Risk of the portfolio stocks.

The final list of 15 equities was chosen on the basis of their outstanding risk-return profiles, which outperformed the dataset's average performance measures. This made sure that the equities that were selected would be profitable given their respective risk profiles.

Stock	Return	Risk
CGPOWER.NS	374.4564	20.24876
TEJASNET.NS	221.3745	17.85324
HAL.NS	218.2252	10.96079
SOLARINDS.NS	186.1679	9.97503
BEL.NS	180.3261	8.95914
POLYCAB.NS	173.4325	9.799291
ESCORTS.NS	156.7973	10.16163
TVSMOTOR.NS	148.9407	9.039276
SUPREMEIND.NS	141.4217	10.10535
NAVINFLUOR.NS	135.6657	10.21178
TIMKEN.NS	131.2193	8.090142
ABB.NS	130.5591	10.19503
SRF.NS	129.7664	9.888776
CARBORUNIV.NS	126.6858	10.22421

SCHAEFFLER.NS	125.8348	8.667868.

Source: python output.

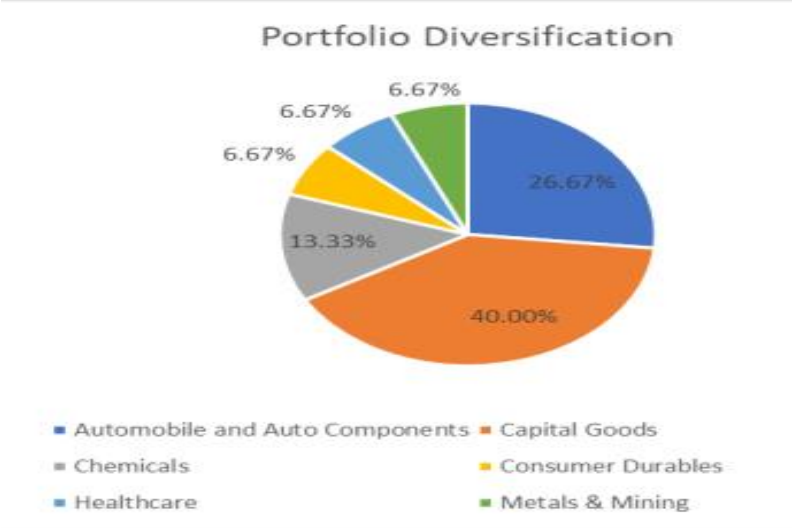

Fig 1

Correlation Matrix:

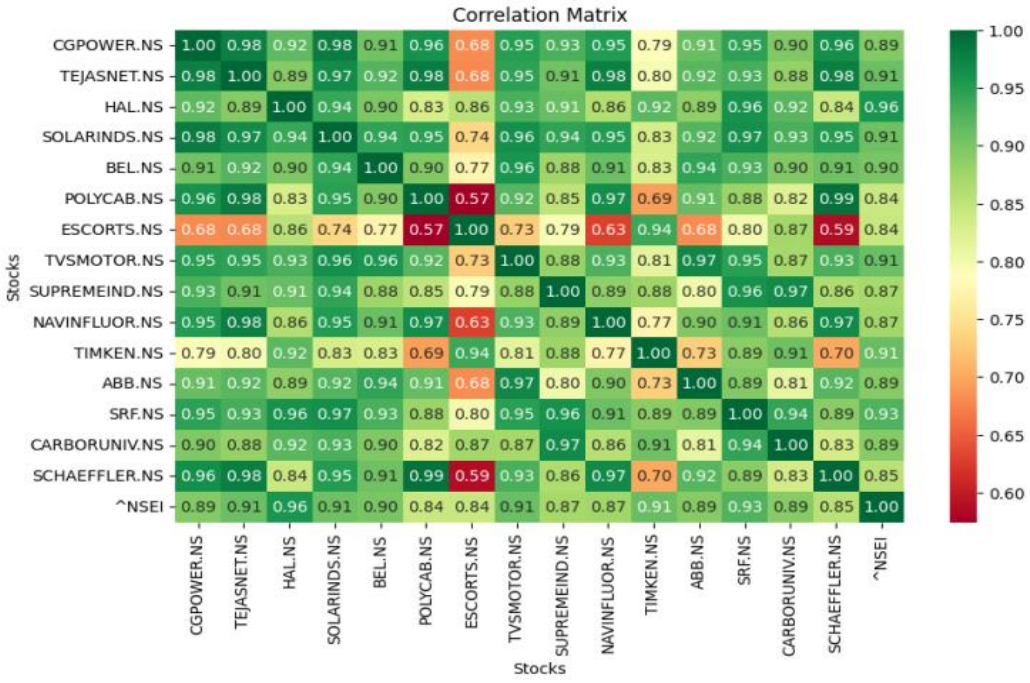

Fig: 2 Correlation Matrix (Source: python output.)

Certain equities, like CGPOWER.NS and SOLARINDS.NS, have a high positive correlation, indicating a tendency to move in tandem. When diversifying their portfolio, investors should take this into account to prevent becoming overexposed to similar fluctuations.

As a hedge against correlated risks, stocks with weaker correlations, such as ESCORTS.NS and POLYCAB.NS, may not move in lockstep with one another, offering potential diversification benefits.

Investors can determine how sensitive their portfolio is to general market movements by knowing the correlations between individual stocks and the market index (\NSEI). During market swings, stocks that have stronger correlations to the market index could become more volatile

Optimal portfolio allocation:

Stocks	Optimal allocation
CGPOWER.NS	9.63%
TEJASNET.NS	0.09%
HAL.NS	10.72%
SOLARINDS.NS	15.72%
BEL.NS	13.87%
POLYCAB.NS	6.40%
ESCORTS.NS	3.25%
TVSMOTOR.NS	14.34%
SUPREMEIND.NS	4.47%
NAVINFLUOR.NS	0.38%
TIMKEN.NS	0.82%
ABB.NS	6.63%
SRF.NS	2.88%
CARBORUNIV.NS	1.22%
SCHAEFFLER.NS	9.59%

Source: python output.

The ideal distribution of capital among the chosen stocks shows what proportion of each stock ought to be in the portfolio. To attain the ideal portfolio balance, for instance, 9.63% of CGPOWER.NS, 0.09% of TEJASNET.NS, 10.72% of HAL.NS, and so on, should be purchased.

Return: This shows the portfolio's anticipated percentage gain over a certain time frame. The projected return in this instance is rather high at 50.22%, indicating the possibility of a sizable profit.

Volatility: Volatility, which is sometimes expressed as standard deviation, is a measure of how much the returns on a portfolio vary. Less variation in returns and, thus, less risk are indicated by reduced volatility. The 13.33% volatility in this case implies that the returns on the portfolio are rather steady.

Efficient Frontier:

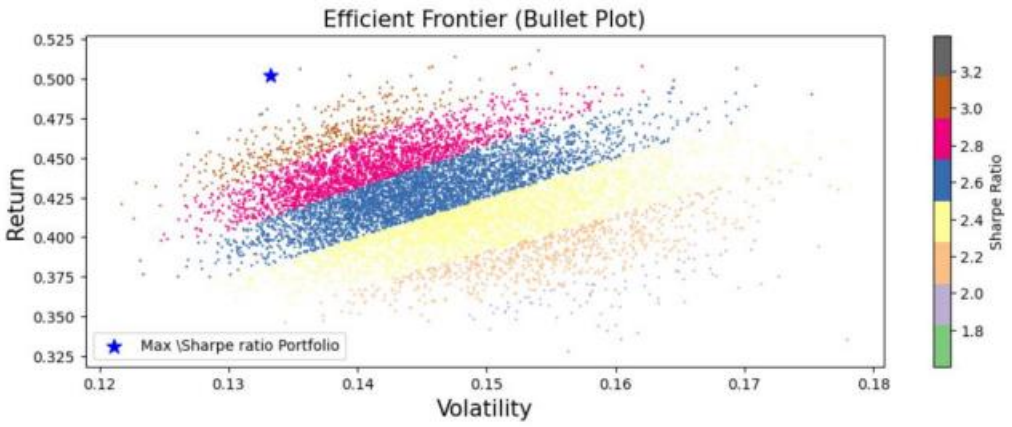

Fig: 3 Efficient Frontier

Source: python output.

The risk-adjusted return, or Sharpe ratio, was maximized to determine the portfolio allocation. The best portfolio is one that effectively balances risk and return, as shown by the highest Sharpe ratio. With a volatility of 13.33%, the Markowitz optimal portfolio return in this scenario is 50.22%.

The efficient frontier is shown visually by the scatter plot, which displays alternative return and volatility combinations for various portfolio allocations. The ideal portfolio is the one with the blue star; it is the best possible trade-off between risk and return and is located on the efficient frontier.

Scope for Future Research:

- Examine the effects of implementing alternative asset classes into portfolio allocation techniques, such as commodities, cryptocurrencies, or REITs.
- To learn how psychological biases affect investing decisions, investigate the behavioral facets of portfolio decision-making and investor preferences.
- Examine how technology, including blockchain and artificial intelligence, can transform the way that portfolio management is done.
- Investigate how portfolio management for sustainable investing methods incorporates environmental, social, and governance (ESG) factors.
- Examine the effects of geopolitical events and legislative changes on risk management and portfolio development techniques.

Conclusion:

In our analysis, we carefully chosen 15 equities to serve as the foundation of an effective portfolio. These companies were selected on the basis of their outstanding risk-return profiles, which outperformed the dataset's average performance metrics. Our portfolio design technique prioritizes equities with returns higher than the average for the dataset and risks lower than the average risk. This helps to optimize growth potential while limiting exposure to volatility and downside risk. The portfolio attains a well-rounded composition by incorporating a wide variety of manufacturing-related enterprises, which lowers sector-specific risks and increases stability against market changes. Our research offers insightful information to investors, including practical viewpoints on building portfolios in line with their risk tolerance and investing objectives. In addition, our research advances the theoretical knowledge of portfolio optimization techniques by illustrating how Modern Portfolio Theory (MPT) can be used to create diversified portfolios. With recommendations on how to build and manage portfolios to improve performance and satisfy their clients' financial goals, this research has applications for financial advisers and portfolio managers. The study's limitations, such as data restrictions and model assumptions, must be acknowledged even if our findings provide insightful information and may affect the conclusions' generalizability and robustness.

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