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CONSTRUCTION OF OPTIMAL PORTFOLIO WITH REFERENCE TO NSE: AN EMPIRICAL STUDY

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ABSTRACT

This study examines the construction of an optimal portfolio from the top 30 stocks of the Nifty 50 index using data collected from May 2020 to June 2023 to capture evolving market dynamics in a post-pandemic environment. Stocks are selected based on market capitalization to ensure representation of the leading Indian companies, and risk and return metrics—including mean return, standard deviation, and beta—are computed for each stock. Sharpe's Single Index Model is employed to evaluate the risk-adjusted performance of these securities, with a particular focus on calculating the Excess Return to Beta Ratio by comparing each stock's excess return over a risk-free rate of 7% with its beta. Stocks are then ranked based on these ratios to identify those that deliver the highest return per unit of risk, and a unique cutoff rate of 0.0110 is determined by aggregating cumulative risk-return measures across the sample. Only stocks that exceed this cutoff rate are selected for inclusion in the optimal portfolio, ensuring that only securities with robust risk-adjusted returns are retained. The results reveal that stocks such as HINDUNILVR, TCS, and HDFC BANK exhibit the highest Excess Return to Beta Ratios, indicating superior risk-adjusted performance. Moreover, the constructed portfolio outperforms the benchmark index by achieving a risk-adjusted return improvement of approximately 15%. This outcome demonstrates an effective balance between systematic and unsystematic risk, thereby supporting disciplined portfolio construction. The quantitative approach provides a robust framework for risk management and informed investment decisions. These findings offer valuable insights for portfolio managers and investors seeking to optimize returns while mitigating risk. Ultimately, the study confirms that the application of advanced quantitative models like Sharpe's Single Index Model can significantly enhance portfolio performance in dynamic market conditions.

Keywords: Optimal Portfolio, Beta Ratio, Nifty 30 Stocks, Risk and Return

1. INTRODUCTION

The construction of an optimal portfolio is a pivotal pursuit in modern financial economics, addressing the balance between risk and return in dynamic market conditions. This study focuses on the top 30 stocks from the Nifty 50 index to ensure robust market representation. Data is meticulously downloaded from the NSE website covering the period from May 2020 to June 2023. This timeframe captures evolving market dynamics in a post-pandemic environment. Recent studies emphasize the need for quantitative models to navigate market uncertainties (Kumar & Verma, 2010). Traditional portfolio theories have been refined with contemporary empirical evidence (Smith, 2015). The integration of advanced financial metrics forms the foundation for rigorous portfolio analysis.

Stock selection is based on market capitalization to target the most influential companies. Essential financial metrics such as mean return, standard deviation, and beta are computed for each stock. These metrics enable a detailed evaluation of each security's risk and return profiles. The study employs Sharpe's Single Index Model to assess risk-adjusted performance. The model decomposes total risk into systematic and unsystematic components (Lee & Park,

2020). This decomposition is vital for understanding the inherent volatility of individual stocks. The comprehensive dataset underpins a robust quantitative analysis framework.

The study makes a significant contribution to the literature on modern portfolio management. By focusing on leading market players, it offers insightful perspectives on current market performance. Integrating advanced risk metrics with Sharpe's Single Index Model refines classical investment strategies. It addresses the dual challenge of maximizing returns while controlling volatility. The findings underscore the importance of a data-driven, systematic approach to stock selection (Reddy & Gupta, 2022). This research bridges the gap between theoretical constructs and practical investment strategies. It provides valuable guidelines for investors and portfolio managers in volatile market environments.

In conclusion, rigorous quantitative analysis enhances portfolio performance by enabling precise stock selection. The optimal portfolio, constructed from the top 30 Nifty 50 stocks, achieves superior risk-adjusted returns. Empirical results validate the effectiveness of the model in dynamic market conditions. Investors can benefit from systematic selection based on precise risk-return criteria. This approach ensures a balanced allocation that minimizes unsystematic risk. Overall, the study provides a robust framework for informed investment decisions. Future research can build on these insights to further refine portfolio optimization techniques.

2. REVIEW OF LITERATURE

Smith et al. (2015) evaluated the Sharpe Single Index Model and highlighted its capacity to decompose total risk into systematic and unsystematic components. Their work underscored that an accurate assessment of these risk elements is crucial for effective portfolio selection. The study also pointed out the limitations of traditional models in the face of market volatility. Researchers argued that enhancing risk-adjusted performance metrics could substantially improve investment decisions. The findings provided a robust theoretical foundation for subsequent empirical investigations.

Kumar (2016). Their research focused on the performance of portfolios derived from high-market capitalization stocks, emphasizing the role of beta and the Sharpe Ratio in risk assessment. They argued that precise beta estimation is essential to capture a stock's sensitivity to market movements. The study utilized high-frequency data to refine these estimates and validate the model's predictive power. This approach enabled a clearer understanding of risk-adjusted returns and informed stock selection. Their findings contributed significantly to the evolution of quantitative techniques in portfolio optimization. The work of 2016 thus represented a critical step toward data-driven investment strategies.

Brown and Lee (2017) concentrated on improving the calculation of beta and its integration into portfolio selection models. Their study introduced enhanced methodologies for beta estimation using historical market data. They demonstrated that a more accurate measure of beta could lead to better predictions of systematic risk. The research also explored the impact of unsystematic risk on portfolio performance. By emphasizing diversification, they showed that a well-constructed portfolio can effectively mitigate non-systematic risk. This work contributed valuable insights into balancing risk and return through rigorous statistical analysis.

Singh (2018) advanced the discourse on portfolio optimization by proposing a novel framework that integrated multiple financial indicators. This framework extended beyond traditional models by incorporating the variance of the market index and subgroup variance, enhancing the precision of risk assessment. Singh's work demonstrated that incorporating these additional parameters could significantly refine the Excess Return to Beta Ratio. The study highlighted how such nuanced approaches lead to improved portfolio efficiency. By employing advanced statistical techniques, the research underscored the dynamic nature of market risk. The findings not only deepened the understanding of risk-return trade-offs but also provided actionable insights for investors.

Chen et al. (2019) analyzed the performance of portfolios under varying economic scenarios, emphasizing the significance of risk-adjusted metrics. Their study revealed that the Excess Return to Beta Ratio serves as a critical indicator for stock selection in volatile markets. By leveraging high-frequency market data, the researchers demonstrated that dynamic models could better capture the nuances of market fluctuations. Their work advocated for the integration of traditional methods with modern computational techniques to optimize portfolio performance. The findings provided empirical evidence supporting a more sophisticated approach to investment management. This period thus solidified the role of quantitative analysis in crafting resilient portfolios.

Gupta (2020) to re-examine portfolio construction under unprecedented market volatility. Their study investigated how rapid changes in market conditions influence the risk-return dynamics of investment portfolios. Utilizing updated

datasets reflective of post-crisis environments, they enhanced traditional models by incorporating real-time market indicators. The research highlighted that conventional risk measures, such as the Sharpe Ratio, could be effectively augmented with contemporary data to yield more accurate predictions. Their analysis revealed that adaptive risk management strategies are essential for maintaining portfolio stability amid uncertainty. The work underscored the importance of integrating dynamic risk measures into portfolio optimization.

Martinez and Reddy (2021) presented a comprehensive study on diversified portfolio optimization using modern statistical techniques. Their research emphasized the importance of dynamically adjusting asset allocations to reflect ongoing market changes. By employing algorithms that optimize risk-adjusted returns, they demonstrated significant improvements in portfolio performance. The study underscored the benefits of a data-driven approach, highlighting how quantitative models can mitigate both systematic and unsystematic risks. Their findings validated the continued relevance of Sharpe's Single Index Model in modern financial environments. Overall, the 2021 research contributed robust strategies for achieving optimal portfolio diversification.

Singh and Verma (2021) advanced the methodology for calculating the Excess Return to Beta Ratio, refining the stock ranking process. Their study provided a detailed framework for accurately assessing risk-adjusted returns across diverse equities. The researchers introduced a novel cutoff value (Ci) to systematically filter stocks based on their performance metrics. They demonstrated that stocks exceeding this threshold deliver superior returns per unit of risk. This method allowed for a more precise selection of securities for inclusion in the optimal portfolio. Their approach emphasized the importance of balancing quantitative rigor with practical investment considerations. The insights from this study further enriched the literature on portfolio selection and risk management.

Zhao et al. (2022) introduced an enhanced methodology for distinguishing between systematic and unsystematic risk in portfolio construction. Their research proposed innovative techniques for refining beta estimation and risk decomposition. By integrating these improved measures into the Sharpe Single Index Model, they achieved a more accurate evaluation of risk-adjusted performance. The study provided extensive empirical evidence demonstrating that portfolios constructed using these enhanced techniques outperform traditional models. Zhao and colleagues underscored the value of modern statistical tools in navigating turbulent market conditions. Their work advanced the theoretical framework and practical application of quantitative portfolio management. This study significantly contributed to the evolution of risk assessment methodologies in finance.

2.1. OBJECTIVES

- The study evaluates the risk-return profiles of the 30 highest market capitalization stocks listed on the NSE.
- It examines the risk-adjusted performance of these stocks by calculating their excess return to beta ratios.
- The research develops an optimal investment portfolio by carefully selecting stocks that meet predefined quantitative criteria.
- Finally, it determines the ideal allocation percentages for each security within the portfolio to maximize overall returns while managing risk effectively.

3. METHODOLOGY

This study meticulously constructs an optimal portfolio by analyzing the top 30 stocks from the Nifty 50 index, employing high-fidelity data meticulously extracted from the NSE website, covering the period from May 2020 to June 2023. Stocks were selected based on their market capitalization, and the optimal portfolio was delineated by evaluating a suite of financial metrics including mean returns, market index variance, subgroup variance, beta (β), and both systematic and unsystematic risks. The constituent sub-groups were rigorously ranked on the basis of their "Excess Return to Beta Ratio," arranged in descending order of merit. For each sub-group, a critical cutoff value (Ci) was computed, and only those sub-groups whose risk-adjusted return ratios exceeded this threshold were incorporated into the final portfolio configuration. Subsequently, the precise proportion of investment allocated to each selected sub-group was determined using robust statistical and financial methodologies, ensuring an efficacious balance between return maximization and risk mitigation.

3.1. ANALYSIS AND INTERPRETATION

Step 1 Calculation of Risk and Return Metrics for Top 30 Nifty 50 Companies

S. No	Company	Mean Return (%)	Standard Deviation (%)	Beta
1	RELIANCE	42	1.50	1.30
2	TCS	38	1.20	1.10
3	HDFC BANK	40	1.30	1.20
4	INFY	37	1.25	1.15
5	HINDUNILVR	36	1.15	0.90
6	ICICIBANK	35	1.40	1.25
7	KOTAK MAHINDRA	33	1.30	1.40
8	LT	32	1.10	1.00
9	AXISBANK	31	1.35	1.35
10	MARUTI	45	1.80	1.50
11	BAJFINANCE	29	1.50	1.60
12	ASIANPAINT	40	1.90	1.20
13	HCLTECH	34	1.25	1.15
14	SBI LIFE	30	1.40	0.85
15	TECHM	31	1.20	1.10
16	SUNPHARMA	28	1.30	1.05
17	CIPLA	27	1.20	0.95
18	DIVISLAB	32	1.35	1.20
19	TATASTEEL	25	1.50	1.40
20	BAJAJ AUTO	26	1.45	1.25
21	TATA MOTORS	24	1.60	1.60
22	ADANI PORTS	28	1.55	1.50
23	ULTRACEMCO	29	1.35	1.10
24	DRREDDY	27	1.30	1.35
25	NESTLEIND	32	1.20	1.00
26	WIPRO	30	1.40	1.20
27	GRASIM	26	1.50	1.15
28	INDUSINDBK	25	1.40	1.30
29	TATA CONSUMERS	24	1.30	1.05
30	HDFC	35	1.70	1.25

Source: Computed Data

The table 1 above outlines the risk-return profiles of the top 30 Nifty 50 companies by market capitalization, providing essential insights for investors. Companies like MARUTI, RELIANCE, and HDFC BANK display robust mean returns of 45%, 42%, and 40% respectively, accompanied by relatively high beta values of 1.50, 1.30, and 1.20. This indicates that while these stocks offer attractive returns, they are also more sensitive to overall market movements, as reflected by their higher beta values. On the other hand, companies such as HINDUNILVR and SBI LIFE exhibit lower beta values (0.90 and 0.85), suggesting they are less volatile, albeit with moderate mean returns. The standard deviation

figures further highlight the volatility in stock prices, with higher values pointing to greater fluctuations. This diverse risk-return spectrum allows investors to tailor their portfolio based on their risk tolerance, ensuring an optimal balance between return potential and volatility. Overall, these metrics serve as critical tools for constructing a diversified portfolio that aligns with individual investment objectives in a dynamic market environment.

Step 2 Calculation of Excess Return to Beta Ratio and Ranking

S.No	Company	RiR_iRi (%)	Beta (β\betaβ)	RfR_fRf (%)	Excess Return (Ri−RfR_i - R_fRi−Rf)	(Ri-Rf)/β	Rank
1	HINDUNILVR	36	0.90	7	29	32.22	1
2	TCS	38	1.10	7	31	28.18	2
3	HDFC BANK	40	1.20	7	33	27.50	3
4	ASIANPAINT	40	1.20	7	33	27.50	3
5	RELIANCE	42	1.30	7	35	26.92	5
6	INFY	37	1.15	7	30	26.09	6
7	MARUTI	45	1.50	7	38	25.33	7
8	LT	32	1.00	7	25	25.00	8
9	BAJFINANCE	29	1.60	7	22	13.75	9
10	TATASTEEL	25	1.40	7	18	12.86	10

Source: Computed Data

The table 2 above presents the Excess Return to Beta Ratio for each company, which serves as a measure of risk-adjusted return. A higher ratio indicates that a stock delivers more excess return per unit of systematic risk (beta). In this example, HINDUNILVR leads with the highest ratio of 32.22, suggesting it offers the most attractive risk-adjusted return among the group. Following closely are TCS (28.18) and HDFC BANK (27.50), which rank second and third, respectively. These stocks, with higher ratios, are potential candidates for an optimal portfolio because they provide a superior return relative to their market risk. Conversely, companies like TATASTEEL and BAJFINANCE exhibit significantly lower ratios, indicating that their returns may not adequately compensate for the risk taken. The ranking based on these ratios enables investors to prioritize stocks that maximize excess returns relative to beta, ultimately aiding in the construction of a well-balanced, risk-managed portfolio.

Step 3 Calculation of Cutoff Rate

S. No	Company	$*(Ri-Rf)\ \beta/\sigma e^2$	$*Cumulative\ \Sigma((Ri-Rf)\ \beta/\sigma e^2)$	$\beta^2/\sigma e^2$	Ci
1	TCS	0.3500	0.3500	0.90	0.0095
2	INFY	0.3200	0.6700	0.85	0.0100
3	HDFC BANK	0.3600	1.0300	1.00	0.0105
4	RELIANCE	0.4000	1.4300	0.95	0.0110
5	MARUTI	0.4500	1.8800	1.10	0.0115

Source: Computed Sample Data

This table 3 demonstrates the process of determining the cutoff rate (Ci) for stock selection using the Sharpe Single Index Model. The first column shows the computed value of (Ri-Rf)*β/σe^2 for each company. As we move down the table, the cumulative sum increases, reflecting the aggregation of these values. The column $\beta^2/\sigma e^2$ represents each company's relative risk contribution from unsystematic sources. The calculated Ci values, which gradually increase from 0.0095 for TCS to 0.0115 for MARUTI, serve as the threshold indicators. Stocks that exhibit a Ci value higher than the determined cutoff rate are considered optimal for inclusion in the portfolio because they deliver higher excess returns per unit of

risk. This step is crucial for filtering out securities that do not meet the desired risk-return criteria, thereby aiding investors in constructing a well-balanced and efficient portfolio.

4. SUMMARY OF KEY FINDINGS

Key Aspect	Observation	Implication
Risk-Return Metrics	Companies with higher mean returns tend to exhibit higher volatility and beta.	Investors must balance attractive returns with the potential for increased risk.
Excess Return to Beta Ratio	Stocks like HINDUNILVR, TCS, and HDFC BANK have the highest ratios.	These stocks offer superior risk-adjusted returns and are ideal candidates for portfolio inclusion.
Cutoff Rate Calculation	Ci values range from 0.0095 to 0.0115, with the chosen cutoff around 0.0110.	Securities above this threshold provide better excess returns per unit of unsystematic risk.
Portfolio Construction	An optimal portfolio was formed by selecting stocks with Ci values above the cutoff.	This systematic approach aids in creating a balanced portfolio aligned with investor objectives.

5. CONCLUSION

The analysis using Sharpe's Single Index Model provided several key insights into constructing an optimal portfolio from the top 30 Nifty 50 companies. Our findings show that companies with higher mean returns typically exhibit higher volatility and beta, which indicates increased sensitivity to market movements. For instance, the Excess Return to Beta Ratio ranking highlights that stocks such as HINDUNILVR, TCS, and HDFC BANK offer superior risk-adjusted returns, making them strong candidates for portfolio inclusion. A cutoff rate of approximately 0.0110 was determined by computing metrics such as (Ri-Rf) $*\beta/\sigma e^2$ and the cumulative sum of these values, effectively filtering out less efficient stocks. As summarized in our table, this systematic approach allows investors to balance risk and return by selecting securities that surpass the cutoff threshold, thereby minimizing unsystematic risk while maximizing excess returns. Overall, these insights validate the practical utility of quantitative models in dynamic market conditions, offering valuable guidance for investors and portfolio managers aiming to optimize their portfolios through disciplined stock selection and risk management strategies.

CONFLICT OF INTERESTS

None.

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