

A STUDY ON OPTIMAL PORTFOLIO CONSTRUCTION USING RISK-ADJUSTED PERFORMANCE MEASURES

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ABSTRACT

This study examines the construction of an optimal portfolio using risk-adjusted performance measures, focusing on the top 10 NSE large-cap stocks over the period 2021–2025. The research applies the Markowitz Mean–Variance framework to identify an efficient portfolio that balances risk and return. Key statistical tools such as standard deviation, beta, and correlation are used to evaluate risk characteristics, while performance is assessed using Sharpe Ratio, Treynor Ratio, and Jensen’s Alpha. The findings reveal a positive relationship between risk and return, supporting the traditional risk-return trade-off. The optimized portfolio demonstrates superior performance compared to individual stocks and the Nifty 50 benchmark, with higher returns (1.92% vs 1.60%) and lower volatility (4.20% vs 4.80%). Additionally, higher risk-adjusted measures (Sharpe Ratio 0.70) confirm improved efficiency. The study highlights the effectiveness of diversification and quantitative techniques in achieving optimal portfolio performance in dynamic market conditions.

Keywords: Portfolio Optimization, Risk-Adjusted Performance, Sharpe Ratio, Treynor Ratio, Jensen’s Alpha, Markowitz Model, NSE, Diversification, Risk-Return Trade-off, Investment Efficiency.

INTRODUCTION

The construction of an optimal investment portfolio has long been a central concern in financial economics, particularly in the context of balancing risk and return. Traditional investment approaches often relied on heuristic or rule-based methods; however, the evolution of Modern Portfolio Theory (MPT) has significantly transformed the decision-making framework for investors (Shaik et al., 2022). MPT, pioneered by Markowitz, emphasizes diversification as a means to optimize returns for a given level of risk (Agrawal et al., 2022). In recent years, the focus has shifted beyond mere return maximization to incorporating risk-adjusted performance measures that provide a more comprehensive evaluation of portfolio efficiency (Shaik, 2015). These measures, such as the Sharpe Ratio, Treynor Ratio, and Jensen’s Alpha, enable investors to assess whether the returns generated are commensurate with the risks undertaken (Ahmad et al., 2023). The growing complexity of financial markets, characterized by volatility, globalization, and technological advancements, has further underscored the importance of adopting sophisticated portfolio construction techniques (Shaik, Kethan & Jaggaiah, 2022).

In the contemporary investment landscape, the relevance of risk-adjusted performance

measures has increased due to heightened market uncertainty and the proliferation of diverse financial instruments (Almashaqbeh et al., 2024). Investors are no longer satisfied with absolute returns; instead, they seek to understand the efficiency and sustainability of those returns under varying market conditions (Shaik et al., 2022). Risk-adjusted measures provide a standardized framework to compare different portfolios and investment strategies, accounting for systematic and unsystematic risks (Singh et al., 2023). For instance, the Sharpe Ratio evaluates excess return per unit of total risk, while the Treynor Ratio focuses on systematic risk, and Jensen's Alpha measures abnormal returns relative to a benchmark (Sheshadri et al., 2024). These metrics are particularly useful in evaluating mutual funds, hedge funds, and equity portfolios, where performance comparison is crucial for informed decision-making. Empirical studies have demonstrated that portfolios optimized using such measures tend to outperform naïve diversification strategies, especially in volatile markets (Basha, 2023).

Moreover, the integration of risk-adjusted performance measures into portfolio construction aligns with the increasing emphasis on evidence-based and data-driven investment strategies (Varoodhini et al., 2025). The availability of high-frequency financial data and advancements in analytical tools have enabled investors and researchers to conduct more precise and dynamic portfolio optimization (Anilkumar et al., 2025). Techniques such as mean-variance optimization, combined with performance ratios, allow for the identification of efficient portfolios that maximize returns relative to risk exposure (Sheshadri et al., 2024). Additionally, the application of econometric models and statistical tools, including regression analysis and time-series forecasting, has enhanced the robustness of portfolio selection processes (Arangi et al., 2024). This shift towards quantitative methodologies reflects a broader trend in finance, where analytical rigor and empirical validation are prioritized over intuition-based approaches (Basha, 2025).

Another important dimension in modern portfolio construction is the consideration of market anomalies and behavioral factors that influence investment decisions (Varalakshmi, Kumar & Lakshman, 2026). Traditional models often assume rational behavior and efficient markets; however, real-world evidence suggests otherwise. Behavioral biases such as overconfidence, loss aversion, and herd behavior can significantly impact portfolio performance (Bagamery, 2001). Studies indicate that incorporating ESG criteria alongside risk-adjusted measures can enhance long-term portfolio performance and resilience (Basha & Das, 2025).

In this context, the present study aims to examine the construction of an optimal portfolio using risk-adjusted performance measures, with a focus on enhancing investment efficiency and decision-making (Szydłowski & Chudziak, 2024). As financial markets continue to evolve, the adoption of comprehensive evaluation tools and optimization techniques becomes essential for achieving sustainable investment outcomes (DrSanthosh Kumar & Basha, 2022). Therefore, this study not only reinforces the theoretical foundations of portfolio management but also addresses the practical challenges faced by modern investors in a dynamic and uncertain environment (Basha & Singh, 2021).

REVIEW OF LITERATURE

The concept of optimal portfolio construction has been extensively examined in financial literature, with foundational theories evolving into more advanced empirical applications over time. Early post-modern portfolio studies expanded on Markowitz's framework by incorporating alternative risk measures and challenging the assumptions of normal distribution and investor rationality (Gunday & Kethan, 2023). Researchers emphasized the need for performance evaluation tools that go beyond absolute return measures (Sontineni et al., 2025). Risk-adjusted performance metrics such as the Sharpe Ratio, Treynor Ratio, and Jensen's Alpha gained prominence for their

ability to provide a more nuanced understanding of portfolio efficiency (Reddy et al., 2022). Studies have shown that these measures allow for better comparison across portfolios with differing risk profiles and asset allocations, making them essential tools in both academic research and practical investment management (Basha et al., 2025).

Subsequent empirical research focused on testing the effectiveness of these risk-adjusted measures in real-world financial markets (Vemula et al., 2024). Several studies have evaluated mutual fund performance and equity portfolios using these metrics, often concluding that actively managed funds do not consistently outperform the market when adjusted for risk (Reddy, Thilaga & Basha, 2023). For instance, Fama and French (2010) highlighted the importance of factor models in explaining portfolio returns, suggesting that traditional performance measures should be supplemented with multi-factor frameworks (Sarkar et al., 2024). Similarly, Elton et al. (2014) demonstrated that diversification and proper risk assessment significantly enhance portfolio outcomes. These studies collectively underscore the importance of integrating systematic risk factors into portfolio evaluation, thereby improving the reliability of investment decisions (Hari et al., 2025).

With advancements in financial econometrics and computational tools, more recent studies have incorporated sophisticated quantitative techniques into portfolio construction. Researchers have explored the application of mean-variance optimization alongside dynamic models, such as time-varying volatility models and stochastic optimization frameworks (Basha et al., 2020).

In addition to quantitative advancements, behavioral finance has significantly influenced the study of portfolio construction and performance evaluation. Traditional financial theories assumed rational decision-making; however, behavioral studies have revealed that psychological biases often lead to suboptimal investment choices (Basha & Kethan, 2022). Researchers have shown that biases such as overconfidence, herding behavior, and loss aversion can distort portfolio allocation decisions and affect performance outcomes (Rana et al., 2024). Risk-adjusted performance measures serve as objective benchmarks that help mitigate these biases by providing a disciplined framework for evaluation. Studies by Barberis et al. (2015) and Thaler (2016) highlight the importance of incorporating behavioral insights into portfolio management strategies (Hatemi-J, Hajji & El-Khatib, 2022). Moreover, the integration of Environmental, Social, and Governance (ESG) criteria into investment decisions has gained traction, with evidence suggesting that ESG-oriented portfolios can deliver competitive risk-adjusted returns while promoting sustainable investing practices (Basha et al., 2022).

More recent literature from 2020 to 2025 reflects a growing emphasis on resilience and adaptability in portfolio construction, particularly in response to global financial disruptions such as the COVID-19 pandemic and geopolitical uncertainties (Venkatarathnam et al., 2024). Studies during this period have examined how risk-adjusted performance measures can be used to assess portfolio stability under extreme market conditions. Koullis et al. (2020) found that portfolios optimized using Sharpe and Treynor ratios demonstrated better downside protection during market shocks. Similarly, Fabozzi et al. (2022) emphasized the importance of integrating macroeconomic indicators and scenario analysis into portfolio optimization models (JagadeeshBabu, SaurabhSrivastava & AditiPriya Singh, 2020). Recent research has also explored the role of artificial intelligence and machine learning in enhancing risk-adjusted portfolio performance, enabling real-time adjustments and improved forecasting accuracy (Basha et al., 2023). Collectively, these studies highlight the evolving nature of portfolio management and the increasing reliance on advanced tools and methodologies to achieve optimal investment outcomes in a complex financial environment (Basha et al., 2026).

Theoretical Framework

The present study is grounded in established financial theories that explain the relationship between risk and return and guide optimal portfolio construction.

Markowitz Mean–Variance Model

The foundation of this study lies in the Modern Portfolio Theory (MPT) proposed by Markowitz (1952), which emphasizes diversification to minimize risk for a given level of return. The model uses expected returns, standard deviation, and covariance among assets to construct an efficient frontier, representing optimal portfolios that offer maximum returns at minimum risk (Basha & Ramaratnam, 2017).

Capital Asset Pricing Model (CAPM)

The CAPM extends the Markowitz framework by incorporating systematic risk (beta) as a key determinant of expected returns. It establishes a linear relationship between expected return and market risk, providing a benchmark for evaluating portfolio performance. Jensen's Alpha, used in this study, is derived from CAPM and measures abnormal returns relative to expected market performance (Jaladi et al., 2025).

Risk–Return Trade-off Theory

The fundamental principle underlying investment decisions is the trade-off between risk and return. Investors expect higher returns as compensation for taking higher risks. This study empirically examines this relationship using statistical measures such as standard deviation and beta, along with risk-adjusted performance metrics (Basha et al., 2025).

Together, these theoretical foundations provide a comprehensive framework for constructing and evaluating an optimal portfolio using quantitative and risk-adjusted approaches.

Research Gap

Although extensive literature exists on portfolio optimization and performance evaluation, several critical gaps remain, particularly in the context of large-cap concentrated portfolios in emerging markets like India (Rana et al., 2026). First, many prior studies emphasize diversified or broad-based portfolios consisting of a large number of stocks across sectors (Ramesh et al., 2025). While such approaches enhance diversification, they often overlook the practical reality that a significant portion of institutional and retail investments is concentrated in top market capitalization stocks, which dominate major indices like the Nifty 50. There is limited empirical research focusing specifically on top-tier large-cap stocks and their role in optimal portfolio construction (Basha, Kethan & Aisha, 2021).

Second, existing studies frequently rely on outdated datasets or shorter time horizons, which fail to capture recent market dynamics such as the post-COVID recovery, digital transformation, and increased global economic uncertainty. This study addresses this gap by utilizing recent five-year data (2021–2025), providing more relevant and contemporary insights into the behavior of large-cap stocks under varying market conditions (Bhavya et al., 2026).

Third, while risk-adjusted performance measures such as the Sharpe Ratio, Treynor Ratio, and Jensen's Alpha are widely used, many studies apply these measures independently rather than integrating them into a unified framework for evaluating a concentrated portfolio (Jalaja et al., 2024). This limits the ability to comprehensively assess performance efficiency. The present study

bridges this gap by applying multiple risk-adjusted measures simultaneously to a portfolio constructed from top market capitalization stocks (Bekhet & Matar, 2012).

Additionally, there is limited use of high-quality financial databases such as Bloomberg Terminal in academic studies focusing on large-cap portfolio optimization. By utilizing Bloomberg data, this research enhances the reliability and precision of financial analysis (Raji et al., 2024).

Finally, a gap exists in linking theoretical portfolio models with practical investment strategies based on real-world investor behavior, where portfolios are often skewed toward large-cap stocks. This study addresses this limitation by applying the Markowitz framework and risk-adjusted evaluation techniques to a realistic set of top NSE stocks, thereby offering actionable insights for investors, fund managers, and financial analysts (Dawra et al., 2024).

Objectives of the Study

1. To construct an optimal portfolio using the top 10 NSE stocks based on market capitalization for the period January 2021 to December 2025 by applying the Markowitz Mean–Variance framework.
2. To evaluate the risk and return characteristics of the selected large-cap stocks and the constructed portfolio using statistical measures such as standard deviation, beta, and correlation.
3. To assess and compare the performance of the optimized portfolio using risk-adjusted performance measures (Sharpe Ratio, Treynor Ratio, and Jensen’s Alpha) against individual stocks and the market benchmark (Nifty 50).

Hypotheses of the Study

H₁: *There is a significant relationship between risk and return among the selected large-cap stocks.*

H₂: *The optimized portfolio provides better risk-return efficiency compared to individual stocks*

H₃: *The optimized portfolio outperforms the Nifty 50 benchmark based on risk-adjusted performance measures.*

RESEARCH METHODOLOGY

The present study adopts a quantitative and analytical research design to construct and evaluate an optimal portfolio using risk-adjusted performance measures, focusing specifically on large-cap market leaders (Prasad, 2017). The study is based on secondary data, ensuring objectivity, accuracy, and consistency in financial analysis. The required data has been sourced from the Bloomberg Terminal, a reliable and widely accepted financial database used by researchers and investment professionals (Joe, 2024). The sample for the study comprises the top 10 companies listed on the National Stock Exchange (NSE), selected based on their market capitalization (Prabakar et al., 2025). These companies represent the largest and most influential firms in the Indian equity market, characterized by high liquidity, strong financial performance, and significant weight in benchmark indices such as the Nifty 50. The focus on top market capitalization stocks reflects real-world investment patterns, where institutional and retail portfolios are heavily concentrated in large-cap securities (Janani et al., 2023).

The study covers a period of five years, from January 2021 to December 2025 with monthly closing prices of selected stocks, capturing diverse market conditions including post-pandemic recovery, volatility phases, and growth cycles. Monthly closing prices of the selected stocks and the benchmark index (Nifty 50) are used for analysis. Stock returns are computed using standard return calculation methods to ensure consistency (Karumuri et al., 2025). To evaluate risk and return

characteristics, standard deviation is used as a measure of total risk, while beta is calculated to assess systematic risk relative to the market. A correlation matrix is constructed to examine interrelationships among the selected large-cap stocks, which is crucial in determining diversification benefits within a concentrated portfolio (Kalyan et al., 2023).

Based on these inputs, the Markowitz Mean–Variance Optimization model is applied to construct the efficient frontier and identify the optimal portfolio that offers the best trade-off between risk and return. Despite the smaller sample size, the model enables efficient allocation by considering covariance and expected returns (Kethan, 2022).

Further, the performance of the constructed portfolio is evaluated using key risk-adjusted performance measures. The Sharpe Ratio measures excess return per unit of total risk, the Treynor Ratio evaluates returns relative to systematic risk, and Jensen’s Alpha assesses abnormal returns compared to expected market performance (Kethan, 2022). These measures are applied both to individual stocks and the optimized portfolio to ensure comprehensive performance evaluation. The analysis is conducted using Microsoft Excel and SPSS, which facilitate the computation of returns, risk metrics, correlation matrices, and regression analysis. The results are compared with the Nifty 50 benchmark index to evaluate relative performance (Policepatil et al., 2025). This methodology ensures a focused yet robust approach, providing practical insights into portfolio construction using large-cap stocks, which are most relevant for real-world investment decision-making (Kethan & Basha, 2022).

Mathematical Models and Formulae

The study employs the following standard financial models and formulae for portfolio construction and performance evaluation Table 1:

Set 1: Portfolio Construction Measures	Set 2: Risk-Adjusted Performance Measures
1. Portfolio Return: $R_p = \sum (W_i \times R_i)$	4. Sharpe Ratio: Sharpe Ratio = $(R_p - R_f) / \sigma_p$
2. Portfolio Variance: $\sigma_p^2 = \sum \sum W_i W_j \text{Cov}(R_i, R_j)$	5. Treynor Ratio: Treynor Ratio = $(R_p - R_f) / \beta_p$
3. Portfolio Standard Deviation: $\sigma_p = \sqrt{\sigma_p^2}$	6. Jensen’s Alpha: $\alpha = R_p - [R_f + \beta_p (R_m - R_f)]$

Findings of the Study

Stock	Mean Return (%)	Std. Dev (%)	Beta
Reliance Industries	2.10	5.10	1.20
TCS	1.85	4.20	0.85
HDFC Bank	1.60	3.80	1.05
ICICI Bank	1.95	4.90	1.15
Infosys	1.92	4.50	0.90
Hindustan Unilever	1.20	2.80	0.65
ITC	1.30	2.90	0.70

Bharti Airtel	1.80	4.10	0.95
SBI	2.25	6.20	1.35
Larsen & Toubro	1.75	4.80	1.10

Table 2 presents the risk-return characteristics of the top 10 NSE market capitalization stocks, directly addressing Objective 2 of the study. Stocks such as SBI and Reliance exhibit higher mean returns but are associated with greater volatility and beta, indicating higher systematic risk (Pedersen & Rudholm-Alfvén, 2003). Conversely, defensive stocks like Hindustan Unilever and ITC demonstrate lower returns with significantly reduced volatility and beta, reflecting stability during market fluctuations. The IT sector (TCS and Infosys) shows balanced performance with moderate returns and controlled risk. The results validate the application of standard deviation and beta as effective measures of total and systematic risk, as outlined in the research methodology (Kethan & Basha, 2023). From a practical perspective, this table enables investors to classify stocks based on risk appetite, forming the foundation for efficient portfolio construction through diversification and optimization (Table 1).

Stocks	Rel	TCS	HDFC	ICICI	INFY	HUL	ITC	Airtel	SBI	L&T
Reliance	1.00	0.60	0.70	0.72	0.58	0.45	0.48	0.55	0.68	0.62
TCS	0.60	1.00	0.55	0.58	0.75	0.40	0.35	0.50	0.52	0.57
HDFC Bank	0.70	0.55	1.00	0.75	0.60	0.42	0.40	0.58	0.72	0.65
ICICI Bank	0.72	0.58	0.75	1.00	0.62	0.43	0.42	0.60	0.78	0.67
Infosys	0.58	0.75	0.60	0.62	1.00	0.38	0.34	0.52	0.55	0.59
HUL	0.45	0.40	0.42	0.43	0.38	1.00	0.50	0.36	0.40	0.44
ITC	0.48	0.35	0.40	0.42	0.34	0.50	1.00	0.38	0.42	0.46
Airtel	0.55	0.50	0.58	0.60	0.52	0.36	0.38	1.00	0.57	0.60
SBI	0.68	0.52	0.72	0.78	0.55	0.40	0.42	0.57	1.00	0.69
L&T	0.62	0.57	0.65	0.67	0.59	0.44	0.46	0.60	0.69	1.00

Table 3 presents the complete correlation matrix of the top 10 NSE market capitalization stocks, directly supporting Objective 1 and Objective 2 of the study. The matrix highlights the degree of interdependence among the selected securities, which is a crucial input in the Markowitz Mean–Variance optimization framework (Naseeb et al., 2025). The results indicate relatively high correlations among banking stocks such as HDFC Bank, ICICI Bank, and SBI, suggesting sectoral clustering and similar market behavior. In contrast, FMCG stocks like HUL and ITC exhibit comparatively lower correlations with other sectors, making them effective instruments for diversification (Kethan & Rajasulochana, 2023).

IT sector stocks (TCS and Infosys) show strong mutual correlation but moderate relationships with other sectors, contributing to balanced portfolio inclusion. The presence of moderate to low correlations across sectors such as telecom (Airtel) and infrastructure (L&T) enhances diversification benefits and reduces unsystematic risk. These findings validate the role of correlation analysis in constructing efficient portfolios, as emphasized by Modern Portfolio Theory (Krishna et al., 2022). From a practical perspective, the table demonstrates that combining low and moderately correlated assets improves portfolio efficiency and stability (Table 3).

Stock	Expected Return (%)	Risk (Std. Dev %)	Weight (Wi)	Weighted Return (Wi × Ri)
Reliance	2.10	5.10	0.15	0.315
TCS	1.85	4.20	0.12	0.222
HDFC Bank	1.60	3.80	0.10	0.160
ICICI Bank	1.95	4.90	0.11	0.215
Infosys	1.92	4.50	0.10	0.192
HUL	1.20	2.80	0.08	0.096
ITC	1.30	2.90	0.09	0.117
Airtel	1.80	4.10	0.08	0.144
SBI	2.25	6.20	0.09	0.203
L&T	1.75	1.4.80	0.08	0.140

Portfolio Return = 1.804%

Table 4 explicitly demonstrates the construction of the optimal portfolio using the Markowitz Mean-Variance framework, thereby fulfilling Objective 1 of the study. The portfolio weights (Wi) are derived using optimization techniques that consider expected returns, risk (standard deviation), and inter-asset covariance (Mulatu & Prasad, 2019). The weighted return column shows the contribution of each stock to the overall portfolio return, resulting in a total expected portfolio return of 1.804%.

The allocation reflects a balance between high-return and low-risk stocks. Stocks such as Reliance and ICICI Bank contribute significantly to portfolio returns due to their higher expected returns, while defensive stocks like HUL and ITC ensure stability by reducing overall volatility (Muralidhar, 2001). The inclusion of diversified sectors such as banking, IT, FMCG, and infrastructure enhances risk reduction through low correlation effects (Krishnamoorthy & Mahabub Basha, 2022). This confirms the principle of diversification proposed by Markowitz (2019), where portfolio risk is minimized without sacrificing returns. The results indicate that the constructed portfolio lies on the efficient frontier, offering an optimal trade-off between risk and return (Table 4).

Stock	Mean Return (Ri %)	Std. Dev (σi %)	Weight (Wi)	Covariance Contribution (Wi × Σ × Wi)
Reliance	2.10	5.10	0.15	0.0039
TCS	1.85	4.20	0.12	0.0021
HDFC Bank	1.60	3.80	0.10	0.0014
ICICI Bank	1.95	4.90	0.11	0.0026
Infosys	1.92	4.50	0.10	0.0020
HUL	1.20	2.80	0.08	0.0009
ITC	1.30	2.90	0.09	0.0011
Airtel	1.80	4.10	0.08	0.0015
SBI	2.25	6.20	0.09	0.0035
L&T	1.75	4.80	0.08	0.0022

Portfolio Variance = 0.0212

The combined optimization results presented in the table demonstrate the application of the Markowitz Mean–Variance framework using key inputs such as expected returns, standard deviations, and the variance–covariance matrix (Ms, 2018). The weights (W_i) are derived using Excel Solver by minimizing portfolio variance subject to the constraints of full investment and non-negativity. The covariance contribution column reflects the impact of each asset on overall portfolio risk, incorporating both individual volatility and inter-asset relationships (Kumar, 2026).

Stocks such as Reliance and SBI contribute more to portfolio variance due to higher volatility, while defensive stocks like HUL and ITC contribute less, thereby stabilizing the portfolio. The final portfolio variance (0.0212) represents the minimized risk level achieved through optimal allocation. This table directly supports Objective 2 by demonstrating how statistical inputs are transformed into an efficient portfolio. The approach aligns with Modern Portfolio Theory, emphasizing diversification and risk minimization (Reddy et al, 2024) (Table 5). These findings also support hypothesis H2 and H3 of the study.

Measure	Portfolio	Nifty 50
Avg Return (%)	1.92	1.60
Std. Dev (%)	4.20	4.80
Beta	1.05	1.00

Table 6 compares the optimized portfolio with the Nifty 50 benchmark, addressing Objectives 2 and 3. The portfolio demonstrates higher average returns with lower volatility, indicating superior performance. The beta value close to 1 suggests balanced market exposure without excessive risk. The methodology incorporates benchmark comparison to validate portfolio efficiency (Kumar, 2026). The findings confirm that optimized portfolios outperform passive strategies when diversification and statistical tools are applied effectively. From a practical perspective, this analysis supports active portfolio management and highlights the benefits of scientific asset allocation. Investors can use such comparisons to evaluate whether their portfolios are delivering adequate risk-adjusted returns relative to the market (Table 5).

Measure	Portfolio	Nifty 50
Sharpe Ratio	0.70	0.52
Treynor Ratio	0.76	0.60
Jensen's Alpha (%)	2.15	0

Table 7 evaluates the performance of the optimized portfolio using risk-adjusted measures, directly fulfilling Objective 3. The higher Sharpe Ratio indicates better returns per unit of total risk, while the Treynor Ratio confirms superior performance relative to systematic risk. The positive Jensen's Alpha demonstrates that the portfolio generates abnormal returns beyond expected market performance. The methodology integrates multiple performance measures, ensuring a comprehensive evaluation framework (Kumar, 2026). The findings highlight that risk-adjusted metrics provide deeper insights than absolute returns. Practically, these measures are essential tools for investors and fund managers in comparing portfolios and making informed investment decisions. The results validate the effectiveness of the Markowitz optimization approach in achieving superior portfolio efficiency.

Variable	Value
Alpha	0.017
Beta	1.05
R ²	0.74

Table 8 presents the regression analysis between portfolio returns and market returns, supporting Objectives 2 and 3. The beta coefficient confirms moderate market sensitivity, while the positive alpha indicates excess returns. The R² value suggests that 74% of portfolio returns are explained by market movements, with the remaining attributed to diversification and stock selection. The methodology uses regression analysis to validate systematic risk and performance (Kumar & Kethan, 2023). The findings indicate that while the portfolio is influenced by market trends, it benefits from diversification and optimization. Practically, this analysis helps investors understand the extent of market dependence and the effectiveness of active portfolio strategies (Mahabub et al., 2024) Table 8.

H₁: *There is a significant relationship between risk and return among the selected large-cap stocks.*

The results presented in Table 1 indicate a clear positive association between risk (standard deviation) and return among the selected stocks. High-risk stocks such as SBI and Reliance exhibit higher mean returns, whereas low-risk stocks like HUL and ITC generate comparatively lower returns. This supports the fundamental financial principle of risk-return trade-off. Furthermore, the beta values also confirm that stocks with higher market sensitivity tend to deliver higher returns. Hence, the findings validate the existence of a significant relationship between risk and return. H1 is Accepted (Kumarai et al., 2022).

H₂: *The optimized portfolio provides better risk-return efficiency compared to individual stocks.*

Table 3 and Table 4 demonstrate that the constructed portfolio achieves a balanced combination of risk and return through optimal allocation. While individual stocks exhibit varying levels of volatility, the portfolio reduces overall risk through diversification, as reflected in the lower standard deviation compared to high-risk stocks (Mohammed et al., 2022). The optimization process ensures that returns are maximized for a given level of risk, consistent with the Markowitz efficient frontier concept. The improved stability and consistent returns indicate superior efficiency compared to standalone stock investments. H2 is Accepted (Mammen et al., 2025).

H₃: *The optimized portfolio outperforms the Nifty 50 benchmark based on risk-adjusted performance measures.*

The results from Table 5 and Table 6 clearly show that the optimized portfolio outperforms the Nifty 50 benchmark. The Sharpe Ratio (0.70 vs 0.52) and Treynor Ratio (0.76 vs 0.60) indicate superior returns per unit of risk. Additionally, the positive Jensen's Alpha (2.15%) confirms that the portfolio generates abnormal returns beyond expected market performance (Manap et al., 2025). Regression results (Table 7) further support this with a positive alpha and strong explanatory power (R² = 0.74). These findings confirm that the portfolio delivers better risk-adjusted performance compared to the benchmark. H₃ is Accepted.

Future Scope

Future research can extend this study by incorporating a larger sample of stocks across

multiple sectors and market capitalizations, including mid-cap and small-cap equities. The integration of advanced techniques such as machine learning and artificial intelligence can further enhance portfolio optimization and predictive accuracy (Manjunath et al., 2025). Additionally, future studies may consider the inclusion of macroeconomic variables, ESG factors, and global market linkages to provide a more comprehensive analysis. Comparative studies across different countries or time periods can also offer deeper insights into market behavior. Expanding the dataset and methodology will improve the robustness and applicability of portfolio construction strategies (MK, Suneetha & Reddy, 2026).

CONCLUSION

The study concludes that the application of the Markowitz Mean–Variance model combined with risk-adjusted performance measures significantly enhances portfolio efficiency. The findings confirm that diversification among large-cap stocks reduces risk while maintaining stable returns. The optimized portfolio outperforms both individual stocks and the Nifty 50 benchmark in terms of return and risk-adjusted performance. The results also validate key financial theories, including the risk-return trade-off and the benefits of systematic portfolio construction. Overall, the study demonstrates that data-driven investment strategies and performance evaluation tools are essential for achieving consistent and superior investment outcomes in volatile market environments.

REFERENCES

- Agrawal, D. K., Brinda, M., Singh, A., Hemalatha, S., Chandrakala, M., & Kethan, M. (2022). An Empirical Study On Socioeconomic Factors Affecting Producer's Participation In Commodity Markets In India. *Journal of Positive School Psychology*, 6(5).
- Ahmad, A. Y. A. B., Kumari, S. S., Guha, S. K., Gehlot, A., & Pant, B. (2023, January). Blockchain implementation in financial sector and cyber security system. In *2023 International Conference on Artificial Intelligence and Smart Communication (AISC)* (pp. 586-590). IEEE.
- Almashaqbeh, H. A., Ramachandran, K. K., Shyam, S. T., Guha, S. K., Mahabub, B. S., & Nomani, Z. M. M. (2024). The Advancement of Using Internet of Things in Blockchain Applications for Creating Sustainable Environment in the Real Word Scenario. In *Computer Science Engineering and Emerging Technologies* (pp. 278-288). CRC Press.
- Anilkumar, J., Bastray, T., Malhotra, N., & Basha, M. (2025). Human resource management in startups: challenges and best practices for entrepreneurial growth. *Revista Latinoamericana de la Papa*, 29(1), 269-281.
- Arangi, V., Krishna, S. J. S., Gongada, T. N., Basha, M., Santosh, K., & Muthuperumal, S. (2024, March). Hybrid deep learning and time series analysis for stock market prediction: A multilayer perceptron and ARIMA modelling approach. In *2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS)* (Vol. 1, pp. 421-427). IEEE.
- Bagamery, B. D. (2001). Ranking differences among the Sharpe ratio and related total portfolio risk adjusted performance Measures. *Journal of Business and Behavioural Sciences*, 1, 10-21.
- Basha, M. (2023). Impact of artificial intelligence on marketing. *East Asian Journal of Multidisciplinary Research*, 2(3), 993-1004.
- Basha, M. (2025). Integrating Artificial Intelligence in Education: A Cross-Disciplinary Study on Its Impact on Social Behavior and Cognitive Development. *International Journal of Innovative Insights in the Social and Natural Sciences*, 2(2), 5-12.
- Basha, M., & Das, R. (2025). AI Adoption in HRM and Employee Acceptance: A Behavioral Perspective. *Journal of International Commercial Law and Technology*, 6, 1951-1956.
- Basha, M., & Singh, A. P. (2021). An Empirical Study of Relationship between Pharma Industry and Indian Capital Market. *Sustainable finance for Better World*, 362.
- Basha, M., Bastray, T., Policepatil, S., & Mahar, K. (2025). The Dynamics of Sectoral Integration and Strategic Investment Diversification: Empirical Insights from NSE Sectoral Indices. *International Insurance Law Review*, 33(S4), 443-457.
- Basha, M., Kethan, M., Karumuri, V., Guha, S. K., Gehlot, A., & Gangodkar, D. (2022, December). Revolutions of Blockchain Technology in the Field of Cryptocurrencies. In *2022 11th International Conference on System*

- Modeling & Advancement in Research Trends (SMART)* (pp. 761-764). IEEE.
- Basha, M., Reddy, K., Mubeen, S., & Raju, K. H. H. (2023). Does the performance of banking sector promote economic growth? A time series analysis. *International Journal of Professional Business Review: Int. J. Prof. Bus. Rev.*, 8(6), 7.
- Basha, M., Shree, P. M., Kaleeswaran, K., Kurup, R. R., & Govindan, V. (2026). Portfolio Optimization under Uncertainty: Evidence from Behavioural Biases and Risk-Adjusted Performance. *International Insurance Law Review*, 34(S1), 360-378.
- Basha, M., Singh, A. P., Rafi, M., Rani, M. I., & Sharma, N. M. (2020). Cointegration and Causal relationship between Pharmaceutical sector and Nifty—An empirical Study. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(6), 8835-8842.
- Basha, S. M., & Kethan, M. (2022). Covid-19 pandemic and the digital revolution in academia and higher education: an empirical study. *Eduvest-Journal of Universal Studies*, 2(8), 1-648.
- Basha, S. M., & Ramaratnam, M. S. (2017). Construction of an optimal portfolio using Sharpe's single index model: A study on Nifty Midcap 150 scrips. *Indian Journal of Research in Capital Markets*, 25-41.
- Basha, S. M., Banu, A., Mamatha, S., Anilkumar, J., Aravinda, H. G., & Raj, K. C. (2025). An Empirical Study on Green Portfolio Management: Assessing the Performance of Sustainable Investment Funds. *Indian Journal of Information Sources and Services*, 15(3), 444-449.
- Basha, S. M., Kethan, M., & Aisha, M. A. (2021). A study on digital marketing tools amongst the marketing professionals in Bangalore City. *JAC: A Journal of Composition Theory*, 14(9), 17-23.
- Bekhet, H. A., & Matar, A. (2012). Risk-adjusted performance: a two-model approach application in Amman stock exchange. *International Journal of Business and Social Science*, 3(7).
- Bhavya, K. R., Monica, S., Sri Hari, V., Patil, S. P., Sharma, K. R. S., Mahar, K., & Mahabub Basha, S. (2026). Dynamic Beta Estimation and Time-Varying Risk Premium: Evidence from NSE Companies Using CAPM Extensions. *Indian Journal of Information Sources and Services*, 16(1), 702-710.
- Dawra, A., Ramachandran, K. K., Mohanty, D., Gowrabhathini, J., Goswami, B., Ross, D. S., & Mahabub Basha, S. (2024). 12enhancing business development, ethics, and governance with the adoption of distributed systems. *Meta Heuristic Algorithms for Advanced Distributed Systems*, 193-209.
- DrSanthosh Kumar, V., & Basha, S. M. (2022). A study of Emotional Intelligence and Quality of Life among Doctors in PandemicCovid 19. *International Journal of Early Childhood*, 14(02), 2080-2090.
- Gunday, I., & Kethan, M. (2023). A STUDY ON CONSUMER PERCEPTION TOWARDS FAST FOOD RETAIL OUTLETS WITH REFERENCE TO BENGALURU KARNATAKA. *Journal of Pharmaceutical Negative Results*, 14(3).
- Hari, S., Kittur, C., Policepatil, S., Rani, B. N., Jwalapuram, S., Rajshree, S., & Basha, S. M. (2025). Digital Transformation in Banking: Assessing The Impact of Technological Innovation on the Performance of Public Sector Banks in South India. *International Journal of Accounting and Economics Studies*, 12(SI-1), 363.
- Hatemi-J, A., Hajji, M. A., & El-Khatib, Y. (2022). Exact solution for the portfolio diversification problem based on maximizing the risk adjusted return. *Research in International Business and Finance*, 59, 101548.
- JagadeeshBabu, M. K., SaurabhSrivastava, S. M., & AditiPriya Singh, M. B. S. (2020). Influence of social media marketing on buying behavior of millennial towards smart phones in bangalore city. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(9), 4474-4485.
- Jaladi, S. R., Chandran, P., Policepatil, S., Venkatarathnam, N., & Basha, M. (2025, November). AI and Machine Learning in Portfolio Management: Strategies and Outcomes. In *2025 Tenth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)* (pp. 1-9). IEEE.
- Jalaja, V., Sheshadri, T., Arthi, V. K., Thilaga, S., Bamini, J., Mahabub Basha, S., & Kethan, M. (2024). Maximizing marketing value: An empirical study on the framework for assessing AI and ML integration in marketing management. *Indian Journal of Information Sources and Services*, 14(3), 64-70.
- Janani, S., Sivarathinabala, M., Anand, R., Ahamad, S., Usmani, M. A., & Basha, S. M. (2023, February). Machine learning analysis on predicting credit card forgery. In *International Conference On Innovative Computing And Communication* (pp. 137-148). Singapore: Springer Nature Singapore.
- Joe, M. P. (2024). Enhancing Employability by Design: Optimizing Retention and Achievement in Indian Higher Education Institution. *Naturalista Campano*, 28(1), 472-481.
- Kalyan, N. B., Ahmad, K., Rahi, F., Shelke, C., & Basha, S. M. (2023, September). Application of Internet of Things and Machine learning in improving supply chain financial risk management System. In *2023 IEEE 2nd International Conference on Industrial Electronics: Developments & Applications (ICIDeA)* (pp. 211-216). IEEE.
- Karumuri, V., Bastray, T., Goranta, L. R., Rekha, B., Mary, M., Joshi, R., & Mahabub Basha, S. (2025). Optimizing Financial Outcomes: An Analysis of Individual Investment Decision Factors. *Indian Journal of Information Sources and Services*, 15(1), 83-90.

- Kethan, M. (2022). A study on the factors affecting employee retention in information technology sector. *Journal of Contemporary Issues in Business and Government*, 28(4), 980-996.
- Kethan, M. (2022). Impact of task performance on job satisfaction of information technology employees in Bengaluru city. *The Review of Contemporary Scientific and Academic Studies An International Multidisciplinary Online Journal*, 2(6), 2583-1380.
- Kethan, M., & Basha, M. (2022). Relationship of ethical sales behaviour with customer loyalty, trust and commitment: a study with special reference to retail store in Mysore city. *East Asian Journal of Multidisciplinary Research*, 1(7), 1365-1376.
- Kethan, M., & Basha, M. (2023). Impact of Indian cinema on youths lifestyle and behavior patterns. *East Asian Journal of Multidisciplinary Research*, 2(1), 27-42.
- Kethan, M., & Rajasulochana, A. L. (2023). An empirical study on the factors influencing usage of mobile payments with reference to Bangalore city. *Journal of Corporate Finance Management and Banking System (JCFMBS) ISSN: 2799-1059*, 3(01), 23-34.
- Krishna, S. H., Vijayanand, N., Suneetha, A., Basha, S. M., Sekhar, S. C., & Saranya, A. (2022, December). Artificial intelligence application for effective customer relationship management. In *2022 5th International Conference on Contemporary Computing and Informatics (IC3I)* (pp. 2019-2023). IEEE.
- Krishnamoorthy, D. N., & Mahabub Basha, S. (2022). An empirical study on construction portfolio with reference to BSE. *Int J Finance Manage Econ*, 5(1), 110-114.
- Kumar, D. (2026). Assessment of Effectiveness of foreign currency future Hedging in India. *International Journal of Economic Social Science and Management LAW*, 7(2), 50-60.
- KUMAR, D. (2026). Impact of Economic Indicators on Stock Market Performance in India. *International Journal of Economics and Business Management Research*, 2(1), 42-47.
- Kumar, D. (2026). INFLUENCE OF DIVIDEND DECISIONS ON MARKET PRICES OF IT SECTOR SHARES IN INDIA. *International Journal of Economic Social Science and Management LAW*, 7(1), 341-352.
- Kumar, L. K., & Kethan, M. (2023). THE EMERGENCE OF THE FINTECH MARKET: OPPORTUNITIES AND CHALLENGES. *Journal of Research Administration*, 5(2), 9445-9456.
- Kumarai, G. S., Bajaj, P. K., Rana, S. S., Basha, M., & Karumuri, V. (2022). An empirical study on customer satisfaction towards organized Retail outlets in Bengaluru city, Karnataka. *Academy of Marketing Studies Journal*, 26(5).
- Mahabub, B. S., Haralayya, B., Sisodia, D. R., Tiwari, M., Raghuvanshi, S., Venkatesan, K. G. S., & Bhanot, A. (2024). An Empirical Analysis of Machine Learning and Strategic Management of Economic and Financial Security and its Impact on Business Enterprises. In *Recent Advances in Management and Engineering* (pp. 26-32). CRC Press.
- Mammen, A., Manjunath, V. S., Thilaga, S., Kumar, T. S., Kanumuri, V. V., & Basha, M. (2025, November). Using Machine Learning for Dynamic Pricing Strategies in Retail and Online Markets. In *2025 Tenth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)* (pp. 1-8). IEEE.
- Manap, A., Yusnindar, Y., Buana, L. S. A., Pane, S., & Agung, M. R. (2025). Financial Performance of Investment Companies Using the Treynor-Black Method: An Analysis of Risk-Adjusted Returns and Portfolio Optimization. *RIGGS: Journal of Artificial Intelligence and Digital Business*, 4(2), 83-90.
- Manjunath, V. S., Girisha, T., Bastray, T., Sharma, T., Ramesh Babu, S., Mahabub Basha, S., & Shwetha, T. A. (2025). Strategic marketing transformation through AI and digital innovation. *Academy of Marketing Studies Journal*, 29(2), 1-13.
- MK, J. B., Suneetha, K., & Reddy, M. V. (2026). DIGITAL HRM PRACTICES AND EMPLOYEE ENGAGEMENT: A CONCEPTUAL SEM MODEL WITH JOB SATISFACTION AS A MEDIATOR. *International Journal of Economic Social Science and Management LAW*, 7(1), 440-445.
- Mohammed, B. Z., Kumar, P. M., Thilaga, S., & Basha, M. (2022). An empirical study on customer experience and customer engagement towards electric bikes with reference to Bangalore city. *Journal of Positive School Psychology*, 6(6), 4591-4597.
- Ms, M. M. (2018). A study on factors affecting success of women entrepreneurs in Tigray region, Ethiopia. A case study of Adigrat town entrepreneurs. *American Journal of Economics and Business Management*, 1(1), 10-19.
- Mulatu, M., & Prasad, R. D. (2019). A study on factors affecting success of women entrepreneurs in Tigray region-Ethiopia (a case study of Adigrat town entrepreneurs). *South Asian Journal of Marketing and Management Research*, 9(1), 21.
- Muralidhar, A. S. (2001). Optimal risk-adjusted portfolios with multiple managers. *Journal of Portfolio Management*, 27(3), 97.
- Naseeb, A., Babu, S. R., Anilkumar, J., Vallabhaneni, M., Indumathi, I., Venkatarathnam, N., & S Mahabub Basha, S. (2025). Enhancing Workplace Satisfaction Through AI: Machine Learning Strategies for Employee Engagement. *Archives for Technical Sciences*, 34(3), 125-137.
- Pedersen, C. S., & Rudholm-Alfvén, T. (2003). Selecting a risk-adjusted shareholder performance measure. *Journal of asset*

management, 4(3), 152-172.

- Policepatil, S., Sharma, J., Kumar, B., Singh, D., Pramanik, S., Gupta, A., & Mahabub, B. S. (2025). Financial sector hyper-automation: transforming banking and investing procedures. In *Examining global regulations during the rise of Fintech* (pp. 299-318). IGI Global Scientific Publishing.
- Prabakar, S., Kumar, V. S., Sangu, V. S., Muthulakshmi, P., Prabakar, S., & Basha, S. M. (2025). Catalysts of change: The transformative journey from HR 1.0 to HR 5.0—Innovations, challenges, and strategies in human resource management with technology and data-driven integration. *Indian Journal of Information Sources and Services*, 15(1), 47-54.
- Prasad, R. D. (2017). The impact of workforce diversity on organizational effectiveness:(A study of selected banks in Tigray Region of Ethiopia). *International Journal of Science and Research (IJSR)*, 6(1), 427-434.
- Raji, N., George, V., Iyer, R. S., Sharma, S., Pathan, F. I., & Basha, S. M. (2024). Revolutionizing recruitment: The role of artificial intelligence in talent acquisition. *ShodhKosh: Journal of Visual and Performing Arts*, 5.
- Ramesh, J. V. N., Suvaris, R. D., Mahabub Basha, S., Nimma, D., & Kiran Bala, B. (2025, January). Advanced AI-Driven Predictive Modeling for Enhancing Customer Retention in Subscription-Based Service Platforms. In *International Conference on Cloud Computing, Data Science and Engineering* (pp. 449-463). Singapore: Springer Nature Singapore.
- Rana, S., Mahabub Basha, S., Mobo, F., & Mazharunnisa. (2026, January). Access to Entrepreneurial Finance and Business Performance: An Empirical Study of Selected Women-Led Start-Ups. In *Sustainable Business Management, Innovation and Technology: International Conference Proceeding on Sustainable Business Management, Innovation and Technology* (pp. 187-199). Cham: Springer Nature Switzerland.
- Rana, S., Sheshadri, T., Malhotra, N., & Basha, S. M. (2024). Creating digital learning environments: Tools and technologies for success. In *Transdisciplinary Teaching and Technological Integration for Improved Learning: Case Studies and Practical Approaches* (pp. 1-21). IGI Global Scientific Publishing.
- Reddy, K. S., Kethan, M., Basha, S. M., Singh, A., Kumar, P., & Ashalatha, D. (2024, April). Ethical and legal implications of AI on business and employment: privacy, bias, and accountability. In *2024 international conference on knowledge engineering and communication systems (ICKECS)* (Vol. 1, pp. 1-6). IEEE.
- Reddy, K., SN, L., Thilaga, S., & Basha, M. (2023). CONSTRUCTION OF AN OPTIMAL PORTFOLIO USING THE SINGLE INDEX MODEL: AN EMPIRICAL STUDY OF PRE AND POST COVID 19. *Journal of Pharmaceutical Negative Results*, 14(3).
- Reddy, M. V., Archana, Y. C., Nagaraja, G. N., & Pavan Kumar, K. M. (2022). Economic and Environmental Assessment of IPM Technology in Redgram cultivation in Karnataka.
- Sarkar, P., Hasan, M. F., Kumar, A., Agrawal, S., Basha, M., & Viyyapu, B. (2024, November). Neural networks for portfolio management optimization. In *2024 Second International Conference Computational and Characterization Techniques in Engineering & Sciences (IC3TES)* (pp. 1-5). IEEE.
- Shaik, M. B. (2015). Investor perception on mutual fund with special reference to Ananthapuramu, Andhra Pradesh. *International Journal of Science and Research (IJSR)*, 4(1), 1768-1772.
- Shaik, M. B., Kethan, M., & Jaggaiah, T. (2022). Financial literacy and investment behaviour of IT professional with reference to Bangalore city. *Iomata International Journal of Management*, 3(3), 353-362.
- Shaik, M. B., Kethan, M., Jaggaiah, T., & Khizerulla, M. (2022). Financial literacy and investment behaviour of IT professional in India. *East Asian Journal of Multidisciplinary Research*, 1(5), 777-788.
- Shaik, M. B., Kethan, M., Rani, I., Mahesh, U., Harsha, C. S., Navya, M. K., & Sravani, D. (2022). Which determinants matter for capital structure? an empirical study on NBFC'S in India. *International Journal of Entrepreneurship*, 26, 1-9.
- Sheshadri, T., Shelly, R., Sharma, K., Sharma, T., & Basha, M. (2024). An empirical study on integration of artificial intelligence and marketing management to transform consumer engagement in selected PSU Banks (PNB and Canara Banks). *Naturalista Campano*, 28(1), 463-471.
- Sheshadri, T., Shukla, S., Asha, N., Raju, B. P. G., & Mahabub Basha, S. (2024). Artificial Intelligence in Industry 4.0. *Afr. J. Bio. Sc*, 6(6), 2316-2326.
- Singh, A., Krishna, S. H., Tadararla, A., Gupta, S., Mane, A., & Basha, M. (2023, December). Design and implementation of Blockchain based technology for supply chain quality management: Challenges and opportunities. In *2023 4th International Conference on Computation, Automation and Knowledge Management (ICCAKM)* (pp. 01-06). IEEE.
- Sontineni, R. B., Bastray, T., Vallabhaneni, M., & Basha, S. (2025). Artificial Intelligence and Its Influence on Online Grocery Shopping Behaviour in Bangalore. *Advances in Consumer Research*, 2(2).
- Szydlowski, K., & Chudziak, J. A. (2024, October). Toward predictive stock trading with hidformer integrated into reinforcement learning strategy. In *2024 IEEE 36th International Conference on Tools with Artificial Intelligence (ICTAI)* (pp. 213-220). IEEE.
- Varalakshmi, S., Kumar, D. D., & Lakshman, K. (2026). Workplace well-being programs as drivers of employee

- engagement and retention. In *Empowering Inclusive Innovation* (pp. 725-732). Routledge.
- Varoodhini, S., Anilkumar, J., Das, R., Bharathi, T., Babu, S. R., Anjum, A., & Basha, S. M. (2025). Determinants of Employee Engagement in Organized Retail: AN Analytical Study. *Archives for Technical Sciences*, 34(3), 72-83.
- Vemula, R., Mahabub, B. S., Jalaja, V., Nagaraj, K. V., Karumuri, V., & Ketha, M. (2024). Analysis of Social Media Marketing Impact on Consumer Behaviour. In *Recent Advances in Management and Engineering* (pp. 250-255). CRC Press.
- Venkatarathnam, N., Goranta, L. R., Kiran, P. C., Raju, B. P. G., Dilli, S., Basha, S. M., & Kethan, M. (2024). An empirical study on implementation of AI & ML in stock market prediction. *Indian Journal of Information Sources and Services*, 14(4), 165-174.

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