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AI-Driven Portfolio Selection for Optimized Financial Management in Corporate Departments

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Abstract

Effective financial management is essential for corporate departments to achieve organizational goals, maintain financial stability, and maximize investment returns. Traditional portfolio selection methods often face challenges in handling market uncertainty, financial risk, changing investment conditions, and multiple financial objectives. To overcome these limitations, this study proposes an AI-Driven Portfolio Selection Framework for Optimized Financial Management in Corporate Departments. The proposed framework integrates Artificial Intelligence (AI), Machine Learning (ML), and Multi-Criteria Decision-Making (MCDM) techniques to support intelligent financial planning and investment allocation. The framework considers multiple financial criteria, including investment returns, risk exposure, liquidity, operational expenses, budget requirements, and financial performance. Machine learning algorithms are employed to analyse historical financial data, predict future financial trends, and estimate investment risks. Furthermore, AI-based optimization techniques are used to identify suitable portfolio allocations among different corporate departments. The proposed approach aims to improve budget distribution, reduce financial risks, enhance resource utilization, and support data-driven managerial decisions. The performance of the framework can be evaluated using prediction accuracy, portfolio return, risk-adjusted performance, investment efficiency, and budget utilization. The proposed model provides an intelligent decision-support mechanism for improving financial planning, investment management, and organizational financial performance.

Keywords: Artificial Intelligence, Portfolio Selection, Corporate Financial Management, Machine Learning, Portfolio Optimization, Risk Management, Decision-Making.

1.Introduction

Financial management plays a significant role in the successful operation and long-term sustainability of corporate organizations. Every corporate department, including Human Resources, Marketing, Research and Development, Production, Information Technology, and Administration, requires effective financial planning and resource allocation to achieve its operational objectives. Organizations must distribute their available financial resources efficiently while maintaining an appropriate balance between investment returns, financial risks, operational expenses, and departmental requirements. Therefore, an effective portfolio selection strategy is essential for improving corporate financial performance and supporting strategic decision-making. Traditional financial portfolio selection techniques primarily depend on historical financial information, statistical models, and managerial experience. Markowitz's Modern Portfolio Theory (MPT) introduced a mathematical approach to portfolio selection by considering the relationship between expected returns and investment risks. Although this approach provides a fundamental framework for financial optimization, traditional methods may have limitations when dealing with complex financial datasets, uncertain market conditions, nonlinear relationships, and rapidly changing corporate investment requirements.

Recent developments in Artificial Intelligence (AI) and Machine Learning (ML) have introduced new opportunities for improving financial decision-making. AI-based techniques can process large volumes of financial information, identify hidden patterns, predict financial trends, and support intelligent investment decisions. Machine learning algorithms such as Random Forest, Support Vector Regression, Artificial Neural Networks, and Long Short-Term Memory (LSTM) networks can be utilized to predict financial performance and estimate potential investment risks. These predictive

capabilities can help corporate managers make more informed decisions regarding financial resource allocation and portfolio selection. In corporate environments, financial portfolio selection is not limited to selecting stocks or other financial securities. It also involves allocating organizational budgets among different departments, projects, investment alternatives, and operational activities. Each department has different financial requirements, expected benefits, risk levels, and resource constraints. Consequently, financial managers need a systematic approach to evaluate competing departmental requirements and determine optimal resource distribution. Integrating AI with mathematical optimization and MCDM techniques can provide a comprehensive mechanism for addressing these challenges.

This research proposes an AI-driven portfolio selection framework to optimize financial management across corporate departments. The proposed framework combines financial data analysis, machine learning-based prediction, risk assessment, and optimization techniques. Initially, historical financial information and departmental budget data are collected and processed. Subsequently, machine learning models predict financial requirements and potential returns. Different departmental alternatives are then evaluated using financial criteria such as expected return, investment risk, liquidity, operational cost, resource utilization, and strategic importance. Finally, an optimization model identifies an appropriate allocation of available financial resources while satisfying organizational budget constraints. The proposed framework aims to improve financial planning accuracy, minimize unnecessary expenditure, enhance departmental resource allocation, and strengthen organizational decision-making. It can also provide management with a systematic and data-driven approach to evaluate financial alternatives under uncertain conditions. Thus, the integration of Artificial Intelligence and portfolio optimization offers a promising approach to developing intelligent and sustainable corporate financial management system

2. Literature Review

The integration of Artificial Intelligence (AI), machine learning, portfolio optimization, and multi-criteria decision-making has attracted considerable attention in financial management research. Traditional portfolio selection approaches mainly focus on maximizing investment returns while minimizing financial risks. However, modern corporate financial management requires more comprehensive approaches that consider investment performance, budget allocation, operational expenses, liquidity, and departmental financial requirements. This literature review examines important contributions in portfolio theory, machine learning-based financial prediction, intelligent portfolio optimization, and risk-based decision-making. Markowitz (1952) introduced Modern Portfolio Theory (MPT), which established a mathematical foundation for selecting investment portfolios based on expected returns and associated risks. The mean–variance optimization approach enables investors to identify efficient portfolios by minimizing risk for a given expected return. This theory remains an important foundation for modern investment management. However, its dependence on historical returns and covariance estimates creates challenges under changing financial market conditions. Further developments in portfolio optimization have focused on improving the accuracy and reliability of financial allocation decisions. Kaczmarek and Perez (2022) investigated machine learning-based stock selection combined with Markowitz mean–variance and Hierarchical Risk Parity optimization. Their findings demonstrated the potential of combining predictive models with portfolio construction techniques to improve risk-adjusted investment performance. This study highlights the importance of integrating financial prediction and mathematical optimization.

Machine learning techniques have become increasingly important in financial forecasting and investment portfolio management. These techniques can identify nonlinear relationships, process historical financial information, and predict future investment performance. Novykov et al. (2023) presented a systematic literature review of deep learning applications in investment portfolio management. Their study identified reinforcement learning as an important approach for dynamic portfolio management, while Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) demonstrated potential for financial time-series forecasting. The authors also highlighted the need for improved risk-return balancing and reliable model evaluation. Kaczmarek and Perez (2022) applied Random Forest techniques to predict expected excess stock returns and integrated the predictions with portfolio optimization models. Their research considered different portfolio construction strategies, including mean–variance optimization, Hierarchical Risk Parity, and equal-weighted allocation. The findings indicated that machine learning-based stock selection can support improved portfolio construction and risk-adjusted performance. Ślusarczyk and Ślepaczuk (2025) investigated the integration of time-series forecasting and machine learning models with the Markowitz portfolio framework. Their research employed ARIMA-GARCH and XGBoost models to forecast stock returns and construct optimized portfolios. The results indicated that

forecast-based portfolio selection could improve investment performance compared with relying exclusively on historical returns, although the outcomes depended on model parameters and market conditions. Deep learning techniques provide advanced capabilities for analysing complex financial datasets and identifying hidden patterns in investment performance. Rezaei and Nezamabadi-Pour (2025) reviewed deep reinforcement learning applications in portfolio management and evaluated several algorithms, including Advantage Actor-Critic (A2C), Deep Deterministic Policy Gradient (DDPG), Proximal Policy Optimization (PPO), Soft Actor-Critic (SAC), and Twin Delayed DDPG (TD3). Their research demonstrated the potential of reinforcement learning for adaptive portfolio management and risk-aware investment decisions. Santos et al. (2023) investigated investment portfolio management using reinforcement learning techniques. Their research compared reinforcement learning strategies with traditional investment approaches and examined their ability to optimize portfolio performance. The study contributed to understanding how intelligent learning algorithms can support automated investment decisions and dynamic portfolio management.

Song et al. (2025) proposed a reinforcement learning-based portfolio optimization approach using deterministic state transitions. Their research explored the use of reinforcement learning for improving portfolio allocation and financial decision-making. This direction provides opportunities for developing adaptive investment strategies under changing market conditions. Financial risk assessment is an important component of portfolio management because investment decisions must consider both expected returns and potential financial losses. Traditional optimization approaches frequently use variance and standard deviation to measure investment risk. However, advanced approaches incorporate additional risk measures, including Value at Risk (VaR), Conditional Value at Risk (CVaR), maximum drawdown, and risk-adjusted performance indicators. López de Prado et al. (2025) discussed the integration of machine learning techniques into Markowitz's portfolio selection framework. Their study examined how machine learning can support financial signal generation, risk management, and portfolio optimization. The authors emphasized that machine learning can process complex financial datasets and improve portfolio construction strategies. Gollart and Okhrin (2025) investigated a reinforcement learning approach to dynamic portfolio optimization. Their research addressed the allocation of investments between risky and risk-free assets over multiple periods. This study demonstrates the relevance of adaptive learning methods for portfolio decisions involving changing financial conditions and investor preferences.

2.1. Research Gap and Motivation

The reviewed studies demonstrate significant developments in machine learning, deep learning, reinforcement learning, and mathematical portfolio optimization. However, most existing research primarily concentrates on selecting financial securities, predicting stock returns, and optimizing investment portfolios. Comparatively less attention has been given to integrating these techniques into a unified financial management framework that considers the different requirements of corporate departments. In particular, corporate financial management requires the simultaneous consideration of departmental budgets, operational expenditures, expected financial benefits, resource utilization, liquidity, and financial risks. A model that focuses exclusively on stock returns may not adequately address these organizational requirements. Therefore, the present research proposes an AI-driven portfolio selection framework that combines machine learning-based financial prediction, risk assessment, multi-criteria decision-making, and mathematical optimization. The framework aims to support intelligent financial allocation among corporate departments while considering organizational objectives and budget constraints.

3.Literature Review

The development of portfolio selection and financial management has progressed significantly through mathematical optimization, statistical modelling, artificial intelligence, and machine learning. Since the 1980s, researchers have concentrated on improving investment decisions by considering financial risk, expected returns, resource allocation, and multiple decision-making criteria. Traditional portfolio selection models primarily focused on balancing investment risk and returns, whereas recent developments have introduced intelligent prediction techniques and automated optimization approaches. The following literature review discusses the evolution of portfolio selection and financial optimization from 1980 to 2027, with particular emphasis on their applications in corporate financial management.

During the 1980s, portfolio selection research concentrated on extending classical portfolio theory to accommodate investor preferences, uncertainty, and multiple financial objectives. Markowitz (1952) established the foundation of Modern Portfolio Theory (MPT) through the mean–variance optimization approach, which evaluates investment alternatives based on expected returns and associated risks. During this period, researchers increasingly investigated the application of

mathematical programming and decision-support techniques to financial resource allocation. Saaty (1980) introduced the Analytic Hierarchy Process (AHP), which provided a systematic approach for evaluating alternatives using multiple criteria and hierarchical decision structures. This technique subsequently became useful in financial investment selection and resource allocation problems. Research during this period also emphasized the importance of combining quantitative financial analysis with managerial preferences. Multi-criteria optimization techniques enabled decision-makers to consider different financial objectives simultaneously rather than concentrating exclusively on investment returns. These developments established the foundation for integrating mathematical decision-making techniques into corporate financial planning. During the 1990s, portfolio optimization received considerable attention through the development of advanced statistical and mathematical models. Black and Litterman (1992) introduced an innovative portfolio allocation framework that combined market equilibrium returns with investors' views to generate more practical investment decisions. Their model improved traditional portfolio allocation by incorporating subjective expectations into quantitative financial analysis.

Fama and French (1993) developed a three-factor asset pricing model by incorporating market, size, and value factors to explain stock returns. Their research contributed to a broader understanding of financial risk and investment performance. Elton and Gruber (1997) reviewed the development of Modern Portfolio Theory and discussed the practical considerations involved in portfolio construction, optimization, and performance evaluation. During this period, researchers also investigated goal programming and multi-criteria decision-making techniques for evaluating financial alternatives. These developments provided important foundations for corporate organizations to evaluate competing investment opportunities and allocate limited financial resources according to multiple organizational objectives. Between 2001 and 2010, researchers increasingly concentrated on integrating multi-criteria decision-making with financial portfolio management. Xidonas and Psarras (2009) examined equity portfolio management within the multi-criteria decision-making framework and discussed the importance of evaluating investment alternatives using several financial criteria. Their work demonstrated that portfolio selection could be treated as a multi-dimensional decision-making problem rather than a simple return-maximization process.

During this period, financial decision-support systems were increasingly used to evaluate investment performance, financial stability, and organizational investment requirements. Mathematical optimization methods such as linear programming, nonlinear programming, and goal programming became important tools for allocating limited financial resources. These methods enabled decision-makers to consider budget limitations, financial priorities, and competing investment requirements. The development of these approaches created opportunities for applying portfolio selection principles to corporate departments, project investments, and operational financial planning. Between 2011 and 2020, the growth of computational intelligence and data analytics significantly influenced financial portfolio management. Researchers increasingly applied artificial neural networks, genetic algorithms, support vector machines, and evolutionary optimization techniques to financial prediction and investment selection. These methods provided improved capabilities for identifying nonlinear relationships and analysing complex financial datasets. Kalayci et al. (2019) presented a comprehensive review of deterministic models and applications for mean–variance portfolio optimization. Their research examined 175 studies published between 1998 and 2018, emphasizing mathematical formulations, computational techniques, and practical investment constraints. The study demonstrated the continued importance of mathematical optimization in financial portfolio construction. Ozbayoglu et al. (2020) reviewed deep learning applications in financial portfolio management and highlighted the potential of neural networks and reinforcement learning for financial prediction, automated trading, and investment allocation. Their research indicated that deep learning techniques could improve the analysis of complex financial market information. During this period, machine learning became increasingly relevant to financial management because it enabled organizations to process large datasets and identify patterns that were difficult to capture using conventional statistical techniques. Recent research has increasingly focused on integrating Artificial Intelligence (AI) and Machine Learning (ML) into financial portfolio selection. Kaczmarek and Perez (2022) investigated machine learning-based stock return predictions and their integration with portfolio construction techniques. Their research demonstrated the potential of predictive models for improving investment selection and risk-adjusted portfolio performance.

Sutiene et al. (2024) presented a comprehensive literature review entitled *Enhancing Portfolio Management Using Artificial Intelligence: Literature Review*. The authors investigated the applications of AI across portfolio planning, execution, and feedback processes. Their research discussed machine learning, reinforcement learning, deep learning,

natural language processing, and explainable AI for financial portfolio construction. The study also highlighted the importance of transparency, fairness, and explainability in AI-based financial decision-making. Salo et al. (2024), in their study *Fifty Years of Portfolio Optimization*, examined the historical development of portfolio optimization and presented an integrated perspective covering financial asset allocation, multiple objectives, decision-maker preferences, and real-asset selection, including research and development projects. Their work is particularly relevant to corporate financial management because portfolio optimization can support both financial investment and organizational resource allocation. These developments demonstrate that AI-based financial management can extend beyond traditional stock selection. Corporate organizations can use intelligent analytical systems to forecast departmental financial requirements, evaluate investment alternatives, and improve resource distribution. Between 2025 and 2026, research increasingly explored deep reinforcement learning for adaptive portfolio management. Rezaei and Nezamabadi-Pour (2025) presented a comprehensive review of deep reinforcement learning applications in portfolio management. Their study examined algorithms such as Advantage Actor-Critic (A2C), Deep Deterministic Policy Gradient (DDPG), Proximal Policy Optimization (PPO), Soft Actor-Critic (SAC), and Twin Delayed DDPG (TD3). The authors also evaluated these algorithms using a portfolio consisting of 30 Dow Jones Industrial Average stocks. Their research demonstrated the potential of reinforcement learning for adapting investment strategies to changing market conditions.

Furthermore, recent developments in AI-based financial analytics have emphasized predictive accuracy, automated decision-making, financial risk assessment, and portfolio rebalancing. Machine learning models can analyse historical financial performance, identify investment patterns, and estimate future financial requirements. Deep learning models, particularly Long Short-Term Memory (LSTM) networks, are useful for analysing sequential financial information, while Random Forest and Support Vector Regression can support financial forecasting and risk classification. The increasing use of intelligent optimization techniques provides opportunities for corporate departments to improve financial planning. Departments such as Human Resources, Marketing, Research and Development, Production, and Information Technology have different expenditure patterns, budget requirements, and expected financial contributions. Therefore, AI-based prediction combined with mathematical optimization can help management identify appropriate financial allocations while satisfying organizational constraints.

3.1.Research Gap

The reviewed literature indicates that portfolio selection has evolved from conventional mathematical optimization to intelligent financial prediction and automated decision-making. Although several researchers have investigated machine learning-based investment prediction, deep reinforcement learning, and multi-criteria portfolio optimization, most studies primarily concentrate on selecting financial securities and maximizing investment returns. However, corporate financial management requires a broader perspective involving departmental budget allocation, operational expenditure, financial risk, liquidity, resource utilization, and organizational performance. There is a need for an integrated framework that combines AI-based financial prediction with multi-criteria evaluation and mathematical optimization. To address this research gap, the present study proposes an AI-driven portfolio selection framework that integrates Random Forest, LSTM, Fuzzy AHP, TOPSIS, and Linear Programming. The proposed framework aims to predict financial requirements, evaluate departmental priorities, assess financial risks, and optimize available resources across corporate departments. This integrated approach is expected to improve financial planning, enhance budget utilization, and support intelligent corporate decision-making.

3.2. Proposed Work

The proposed research develops an AI-driven portfolio selection framework for optimizing financial management across corporate departments. The framework integrates Artificial Intelligence (AI), Machine Learning (ML), Fuzzy Analytical Hierarchy Process (FAHP), TOPSIS, and Linear Programming techniques to improve financial planning and resource allocation. Initially, historical financial data, departmental budget details, operational expenses, investment returns, and financial risk information are collected and preprocessed to ensure data quality and consistency. Random Forest and Long Short-Term Memory (LSTM) algorithms are employed to predict future financial requirements, expenditure patterns, and expected investment returns. Subsequently, Fuzzy AHP is applied to determine the relative importance of financial criteria such as expected returns, investment risk, liquidity, operational cost, resource utilization, and departmental priorities. The TOPSIS method is then used to evaluate and rank the financial alternatives based on their overall performance. Finally, Linear Programming is incorporated to identify the optimal allocation of available financial resources while satisfying

departmental budget constraints and organizational objectives. The proposed framework aims to minimize financial risks, reduce unnecessary expenditure, improve budget utilization, and enhance the overall financial performance of corporate organizations through intelligent and data-driven decision-making.

3.3Objectives of the Proposed Work

1. To develop an AI-based financial prediction model for corporate departments.
2. To estimate future departmental financial requirements using Random Forest and LSTM.
3. To evaluate financial criteria using Fuzzy AHP.
4. To rank departmental investment alternatives using TOPSIS.
5. To optimize financial resource allocation using Linear Programming.
6. To evaluate the proposed framework using financial performance indicators.

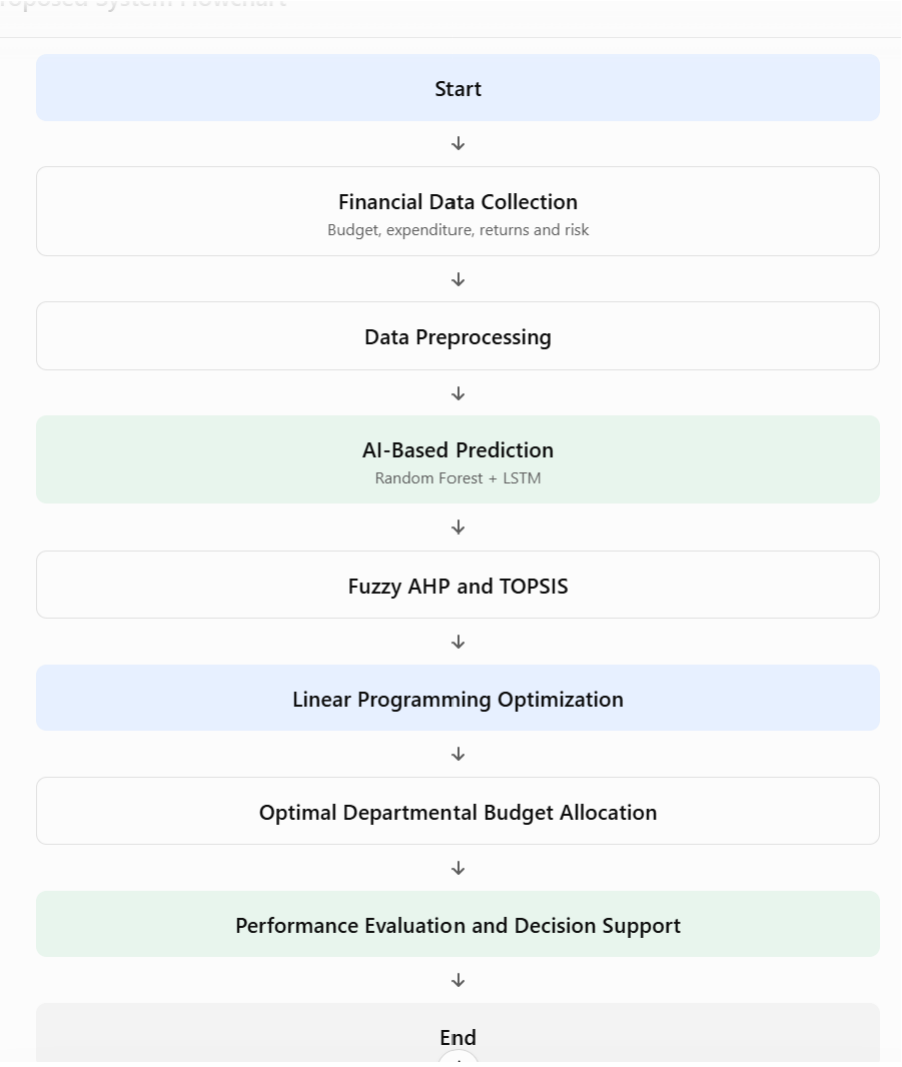


Fig.1.Proposed System Flowchart

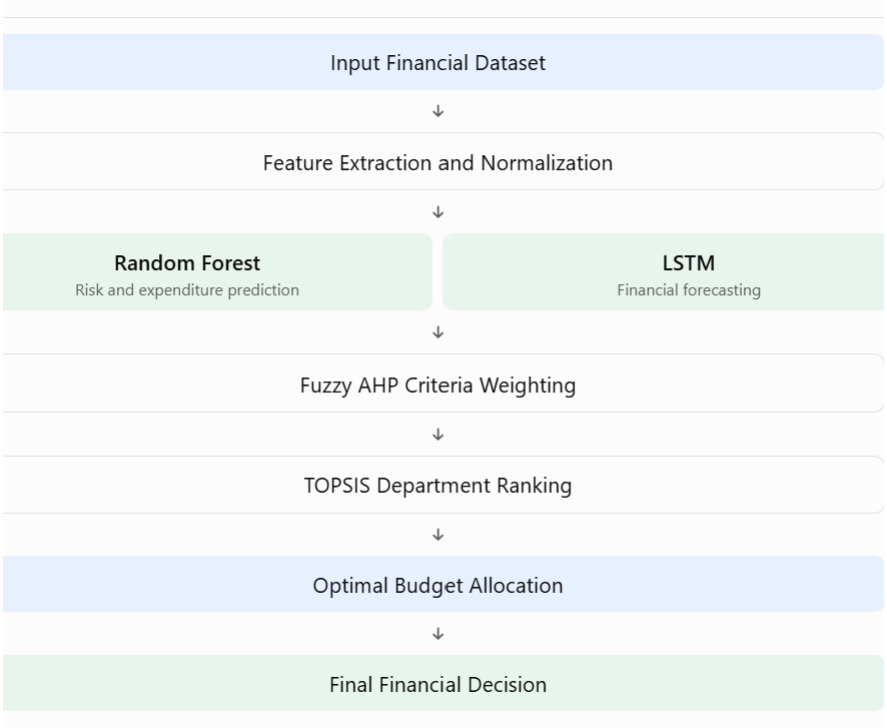


Fig.2.AI Based Proposed work Flowchart

3.4. Results and Discussion

The proposed AI-driven portfolio selection framework is designed to improve financial management and optimize resource allocation across corporate departments. The integration of Random Forest and Long Short-Term Memory (LSTM) algorithms provides a mechanism for predicting future financial requirements, expenditure patterns, and expected investment returns using historical financial data. Fuzzy AHP determines the relative importance of financial criteria, while TOPSIS ranks departmental financial alternatives according to their overall performance. Furthermore, Linear Programming identifies an appropriate allocation of available financial resources while satisfying organizational budget constraints. The combined framework is expected to support better financial planning, improve departmental budget utilization, and minimize unnecessary expenditure. The performance of the proposed model can be assessed using Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Return on Investment (ROI), Sharpe Ratio, and budget utilization percentage. Overall, the proposed approach provides an integrated decision-support mechanism for improving financial efficiency, reducing investment risks, and strengthening strategic financial management in corporate organizations.

4. Conclusion and Future Work

This research proposes an AI-driven portfolio selection framework for optimized financial management in corporate departments by integrating machine learning, fuzzy multi-criteria decision-making, and mathematical optimization techniques. The proposed framework combines Random Forest and LSTM algorithms for financial prediction, Fuzzy AHP for determining financial criteria weights, TOPSIS for ranking departmental alternatives, and Linear Programming for optimal budget allocation. The integrated approach provides a systematic mechanism for evaluating financial requirements, assessing risks, and distributing organizational resources effectively. It aims to improve financial forecasting, reduce unnecessary operational expenditure, enhance budget utilization, and support intelligent managerial decision-making. In future research, the proposed framework can be extended by incorporating deep reinforcement learning, explainable artificial intelligence, real-time financial data, and blockchain-based financial monitoring. Furthermore, the model can be validated using real-world corporate financial datasets and compared with existing financial optimization techniques to evaluate its effectiveness, reliability, and practical applicability.

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