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Strategic Asset Allocation Optimization: Enhancing Portfolio Performance Through PCA-Driven Multi-Objective Modeling

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Abstract : Asset allocation, which affects the long-term profitability of portfolios by distributing assets to fulfill a range of investment objectives, is the cornerstone of investment management in the dynamic and complicated world of financial markets. This paper offers a technique for optimizing strategic asset allocation with the goal of improving portfolio performance by addressing the inherent complexity and uncertainty of the market through the use of Principal Component Analysis (PCA) in a multi-objective modeling framework. The study's first section starts with a critical evaluation of conventional asset allocation techniques, highlighting how poorly they are able to capture the intricate relationships between assets and the volatile nature of the market. In order to overcome these challenges, the project suggests a PCA-driven methodology that isolates important characteristics influencing asset returns by decreasing the dimensionality of the investment universe. This decrease provides a stronger basis for asset allocation decisions by facilitating a clearer understanding of market structures and behaviors. Using a multi-objective optimization model, the project builds on this foundation by taking into account a number of performance metrics at once, including risk minimization, return maximization, and the accomplishment of predetermined investment goals like regulatory compliance or sustainability standards. This model provides a more comprehensive understanding of investor preferences and portfolio performance in comparison to conventional single-objective optimization techniques. While applying the PCA-driven multi-objective optimization model to historical market data, aiming to construct portfolios better under different market situations. As compared to portfolios produced from conventional asset allocation methodologies, the results show that portfolios optimized using the proposed method display improved risk-adjusted returns, more resilience to market downturns, and better alignment with specified investment objectives. The study also looks at the implications of this PCA technique for portfolio management, including the prospect that it might give investors a more advanced framework for navigating financial markets. The findings suggest that by combining PCA with multi-objective optimization, investors may obtain a more strategic and informed asset allocation that is responsive to both market conditions and individual investment preferences. In conclusion, this capstone project improves the field of financial engineering by creating a sophisticated asset allocation optimization model that integrates PCA with multi-objective optimization. In addition to raising concerns about the condition of asset allocation today, the proposed method of portfolio management opens up new avenues for research and application in the area of investment techniques.

Keywords : asset allocation, portfolio optimization, principle component analysis, multi-objective modelling, financial market
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