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**Sector-wise portfolio diversification and optimization on the NYSE: adaptive clustering framework**

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This research investigates the application of K-means cluster analysis to create diversified and optimized stock portfolios within the New York Stock Exchange (NYSE). Diversification is a crucial strategy for mitigating risk and achieving optimal returns in the stock market. Different stocks belonging to various industrial sectors exhibit diverse memory dependencies in their price profiles, particularly in volatility profiles. Therefore, general clustering approaches do not provide a stable clustering customized to each industrial sector. An advanced memory adaptive clustering method has to be utilized in order to have a stable clustering in a given industrial sector. The available methods often neglect sector-specific characteristics, leading to potentially suboptimal portfolio construction. This study proposes a novel approach that incorporates sector-wise analysis of historical data to determine the optimal number of clusters within each sector. By considering these sector-specific characteristics, the proposed methodology aims to create robust and diversified portfolios. The study uses historical closing price data for NYSE stocks from January 2020 to December 2023. To capture risk characteristics, quarterly volatility values are used as a key clustering variable. The formed clusters are then considered to represent stable risk groupings within the NYSE. Furthermore, to incorporate return potential, a similar clustering process is applied using the Sharpe Ratio, a risk-adjusted return metric. By analyzing the centroids of these return-based clusters, three distinct return levels are defined. The companies are assigned risk and return classes based on their cluster membership resulting in volatility and Sharpe Ratio analyses. This classification is used for the formulation of five portfolio strategies. Modern Portfolio Theory (MPT) is then employed to optimize a set of randomly generated portfolios for each strategy. The Sharpe Ratio serves as the optimization criterion, and the five portfolios with the highest Sharpe Ratios are selected for further analysis. The performance of these top-performing portfolios is then compared to a benchmark of ten randomly generated portfolios formed by using S&P 500-indexed companies. Evaluation based on the Sharpe Ratio demonstrates the existence of optimized cluster-based portfolios that outperform the benchmarks. In conclusion, this study offers a comprehensive framework for investors to identify and invest in companies with the potential to deliver greater profitability.

**Keywords:** Portfolio Diversification, K-means Clustering, Investment Strategies, Risk-Adjusted Returns, Optimized Portfolio Formation