Portfolio Algorithm Based on Correlation of Accounting Information Systems

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Abstract: This paper analyzes the corporate investment portfolio based on the correlation of accounting information system, and proposes a portfolio algorithm to facilitate the analysis results. In the process of research, this paper gradually implements a system based on various steps such as system architecture, modeling, model optimization and training, and then implements a portfolio algorithm based on the correlation of accounting information system, and puts it into application. Experimental results show that after applying the algorithm, the annual return of the optimized portfolio increases by 10% and the overall volatility decreases, which proves that the method is effective. The final conclusion shows that the portfolio algorithm based on the correlation of accounting information system,It can significantly improve the balance between return and risk, and provide a sufficient and powerful basis for the company to formulate long-term investment strategies.

1 INTRODUCTION

In recent years, the market environment faced by various companies has become increasingly complex, and how to maximize investment returns while controlling risks has become a hot topic in the field of investment management. Some researchers use traditional portfolio theories, such as the Markowitz mean-variance model, to optimize asset allocation, but this method is slower to respond to market fluctuations and more difficult to adapt to complex and volatile financial market environments. Some researchers have proposed a portfolio optimization method based on genetic algorithm, which is effective in some scenarios, but still shows the problems of overfitting and inefficient calculation. Some researchers have proposed that investment portfolios can be optimized by using artificial neural networks, but this method relies on a large amount of historical data and is easily affected by data quality in practical applications. This paper is based on the correlation of accounting information systems combined with intelligent algorithms to improve the balance of return and risk of investment portfolios. This approach is based on dynamically adjusting investment ratios, which can effectively respond to market volatility and improve the overall performance of the portfolio. Based on this research, this paper hopes to verify the advantages of the portfolio algorithm based on the correlation of accounting information systems, so as to provide effective support for the company's investment decision-making.

2 RELATED WORKS

2.1 Factor Analysis Theory

Factor analysis theory is a statistical method that is based on extracting a set of potential common factors to explain the intercorrelation between multiple variables. In financial and investment analysis (Hu, Tang, et al. 2024), factor analysis is used to extract various key financial factors that affect investment returns, such as earnings growth rate, asset-liability ratio, etc. (Kuroki, 2024). It reduces redundant information and simplifies complex financial data sets, while improving the explanatory power and predictive power of algorithmic models. In portfolio optimization, based on the correlation between analytical factors and market performance, investors can identify the key variables that affect returns, so as to make more accurate asset allocation, and achieve a balance between risk control and return enhancement (Laichuk, Maksym, et al. 2023).

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2.2 Portfolio Theory

Portfolio theory is the core theory used in finance to optimize asset allocation, and its goal is to maximize returns at a given level of risk (Long, 2024). The classical portfolio theory was proposed by Harry · Markowitz, the mean-variance model. Based on the calculation of the expected return and risk of the asset, and the covariance between each asset, the theory emphasizes that the optimal portfolio can be constructed. From the current practice, modern portfolio theory has introduced multi-factor models and behavioral finance research results (Moreira, Araujo, et al. 2023), which can play a role in improving the methods of asset pricing and risk management. The portfolio theory is based on diversification to effectively reduce unsystematic risks, which provides a more scientific and reasonable basis for investors to formulate reasonable investment strategies in a complex market environment (Ning, 2023).

3 METHODS

3.1 Introduction to the Base Portfolio Algorithm

Specifically, the core task of the data collection module is to obtain investment portfolio-related accounting and market data based on various external data sources, including financial statements, macroeconomic indicators, market conditions, etc., and update them regularly based on automated processes. The data is accessed based on external APIs to ensure the integrity and consistency of the collected data, and the cleaned data needs to be converted to a format, so that the model can obtain high-quality data in real time (Penman, 2024). The function of the data processing and preprocessing module is to standardize the data imported by the data collection module, process the data in different formats based on unified rules, and ensure that the data quality meets the standards. All processed data is stored in a structured database for efficient access and recall for subsequent steps. The Factor Analysis module extracts key financial factors, such as return on equity and debt-to-asset ratio, based on statistical methods and machine learning techniques to predict portfolio performance. Based on correlation and regression analysis, the accounting information is converted into factor inputs to the model. Factor weights are dynamically adjusted with market changes to ensure that the model can accurately and timely reflect new market signals. At the same time, the module also supports a variety of statistical tools for factor screening and regression analysis to ensure the accuracy of the analysis results. Based on the results provided by the factor analysis module, the portfolio construction module combines with the classical portfolio algorithm to automatically calculate the weight distribution of various assets, and carries out personalized adjustments according to investors' preferences and risk tolerance. The model balances returns and risks based on an optimization algorithm to ensure the stability of the portfolio in the face of market fluctuations. This module requires periodic dynamic adjustment of asset weights (Purwanti, 92023) to keep the portfolio in step with market conditions. The risk management and monitoring module is mainly used to monitor the risk status of the portfolio in real time, such as the risk caused by market fluctuations and the abnormal fluctuations of individual assets. By setting risk thresholds and using a risk budget model, potential investment risk signals can be automatically identified. Moreover, the system will issue timely warnings based on different market scenarios and automatically adjust the risk exposure of the portfolio. In addition, the algorithm in the module can adjust the allocation of the portfolio based on historical data and market trends, so that investors can get real-time risk management tips when the market fluctuates violently. The backtesting and performance evaluation module is responsible for simulating the performance of investment strategies in historical market data to verify the reliability and stability of the model. Evaluate the performance of data from different economic cycles in various market environments based on the input of data from different economic cycles. In addition, the module needs to provide feedback content for the factor analysis and risk management module based on the backtest results to help optimize parameter settings and algorithm adjustments. The evaluation results also provide a reference for the optimization of the investment portfolio and ensure the long-term stable return performance of the model.

3.2 Portfolio Algorithm Design

The collection of data is the basis of the model construction, which mainly includes comprehensive accounting information system data related to the investment portfolio, such as balance sheet, income statement, cash flow statement, etc., as well as macroeconomic data in the market, such as GDP

growth rate, inflation rate, etc., to ensure the diversity and comprehensiveness of the data. These raw data, when unprocessed, often contain missing values, outliers, and even different units for different accounts, so they need to be standardized to eliminate dimensional differences between data and eliminate abnormal data points. The purpose of this step is to ensure the uniformity of data quality and the training effect of the model. See Eq. (1) for details.

$$X' = \frac{X - \mu}{\sigma} \tag{1}$$

In this formula, the X is original accounting data, such as net assets per share, operating income, etc., is the μ is mean of the data set, the σ is standard deviation of the data set, and X' is the normalized data for subsequent model training.

Correlation analysis based on accounting information system is the core link of the whole model construction. At this stage, based on statistical analysis methods such as factor analysis and principal component analysis, the key factors that can significantly affect the return of the portfolio are selected, such as the asset-liability ratio, return on equity, operating profit margin, etc., which are relatively common accounting and financial indicators. At the same time, macroeconomic variables, such as interest rate level and market volatility, can be introduced to effectively ensure the robustness and accuracy of the model. Multiple regression analysis is then used to quantify these factors and analyze their impact on the expected return of the portfolio. See Eq. (2) for details.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + L + \beta_n X_n \tag{2}$$

In this formula, the Y is expected rate of return representing the portfolio , $X_1, X_2, \ldots, X_n$ is the screened accounting information system factors, such as asset-liability ratio, gross profit margin, etc., $\beta_1, \beta_2, \ldots, \beta_n$ is the regression coefficient of each factor, that is, the weight of its contribution to the portfolio return, which β_0 is the constant term of the model, which is reflected in the basic return of the portfolio when the factors are zero.

After selecting the investment factors, it is necessary to construct the objective function and constraints of the portfolio. The objective function is usually to maximize the return of the portfolio and minimize its risk. This can be achieved based on maximizing the Sharpe ratio, based on Markowitz's mean-variance model, which allows the portfolio to balance risk and return. Because it is necessary to truly meet the market demand in actual operation, it is necessary to introduce constraints, such as the asset allocation ratio cannot exceed a certain upper limit, industry concentration, etc., to ensure the rationality and safety of investment. See Eq. (3) for details.

$$Maximize \ \frac{E[R_p] - R_f}{\sigma_p} \tag{3}$$

In this constraint, $E[R\_p]$ is represents the expected return of the portfolio, R_f is the risk-free rate, σ_P is the standard deviation of the portfolio and reflects the volatility of the portfolio. It is used to measure excess returns per unit of risk, optimizing the return-to-risk ratio of a portfolio based on maximizing the Sharpe ratio.

3.3 Portfolio Algorithm System Training for Relevance

The training process of the model usually relies on the backtesting of historical accounting information and market data, and the data segmentation training is carried out based on the method of rolling window, and the parameters of the model are dynamically updated and optimized. In this step, different optimization algorithms can be used to adjust the weight coefficients in the model to ensure that the prediction effect is the best. In order to improve the generalization ability of the model, cross-validation and other problems can be used to prevent overfitting, so that the portfolio algorithm can have high adaptability in different market environments.

To optimize the model, it is necessary to select the appropriate optimization algorithm, such as gradient descent method, L-BFGS, genetic algorithm, etc., to iteratively optimize the key parameters in the model, so that the value of the objective function is gradually close to the optimal solution. Based on the backtest of the historical data of the accounting information system,

In this paper, we choose to apply the gradient descent algorithm to repeatedly update the weight coefficient of the model, and adjust the optimization path according to the feedback of errors, so that the

desired convergence effect can be achieved in a small number of iterations. For details, see Eq. (4).

$$\theta_{t+1} = \theta_t - \eta \nabla J(\theta_t) \tag{4}$$

In this formula, θ is the set of parameters representing the model, such as factor weights, η is the learning rate, and the main task is to control the step size of parameter updates, $\nabla J(\theta_t)$ is representing the gradient value of the objective function at the current iteration, and its value reflects the direction and magnitude of the error of the model at that point.

Based on the correlation analysis of the accounting information system, the risk management of the investment portfolio can be optimized, and the risk of each asset in the portfolio can be quantitatively analyzed by using Markowitz's mean-variance theory and other risk models. In addition, a risk budget model can be introduced to set risk limits for each asset, thereby ensuring the volatility of a single asset without affecting the overall portfolio. For this, see Eq. (5) for details.

$$\min\left(\sum_{i=1}^{n} \omega_i^2 \sigma_i^2\right) \tag{5}$$

In this optimization formula, ω_i is the weight of the first i asset in the portfolio σ_i is the standard deviation of the asset, that is, its risk level, and the balance between risk and return can be achieved by minimizing the total risk of the portfolio.

In actual investment, transaction costs and liquidity will directly affect the performance of the portfolio. Therefore, the optimization process also needs to take into account the minimization of transaction costs, which can be achieved based on the cost function of introducing transaction fees into the buying and selling decisions to maximize the net return of the portfolio. In addition, liquidity issues also need to be taken into account, so it is necessary to maintain sufficient liquidity to cope with sudden market changes, and then ensure that the investment strategy of the portfolio is adjusted without affecting market liquidity. See Eq. (6) for details.

$$C = \sum_{i=1}^{n} T_i \cdot c_i \tag{6}$$

In this formula, C is the total transaction cost, T_i is the trading volume of the first i is asset, and c_i is its unit transaction cost, and this step is used to calculate the transaction fee that the portfolio will pay for each adjustment, ensuring that the transaction cost minimization strategy balances the benefits and costs.

3.4 Portfolio Algorithm System Optimization

System integration requires the integration of individual modules through seamless integration. The data collection module uses APIs and data interfaces to transmit real-time data to its data processing module (Sabac, and Tian, 2023)10 and after the data processing module is cleaned and standardized, the data will be passed to the factor analysis module for further processing. Subsequently, the investment factor generated by the factor will pass the investment factor to the portfolio building module, and the optimization algorithm will be used to generate the optimal investment plan. Next, the risk management module is responsible for continuously monitoring market conditions and portfolio risks, and is connected to the backtesting module based on the feedback mechanism to finally complete the closed-loop management process of the system (Zhong, Ren, et al. 2023).

4 RESULTS AND DISCUSSION

4.1 Introduction to Portfolio Algorithm Cases

A large company plans to optimize its existing investment portfolio to enhance overall investment returns and reduce investment risk. The company's current portfolio spans a variety of asset classes such as equities, bonds, and cash, and in order to better manage risk and return, this paper uses a portfolio based on:

Accounting Information System Correlation Portfolio Analysis System (EAS) is a portfolio analysis system designed to maximize investment performance based on balancing returns and volatility. A total of 30 million US dollars were invested in this investment case, 4 types of assets were invested, held for 4 years, and 300 people participated.

Table 1 shows the percentage of the company's current portfolio by asset allocation. The initial results of information investment are shown in Figure 1.

Table 1: Analysis of the current situation and returns of the portfolio

Asset class	Investment Ratio (%)	Current Market Cap (USD millions)	Expected Rate of Return (%)	Historical Volatility (%)
Stocks	50	200	8.0	15
Bonds	30	120	4.5	5
Cash	20	80	2.0	1

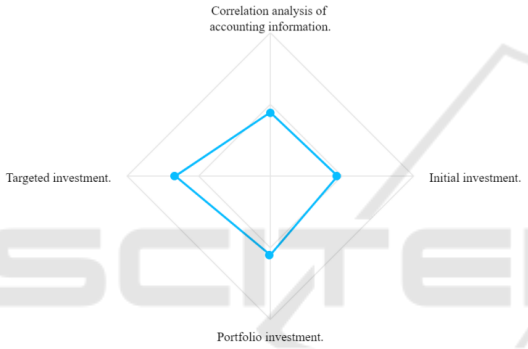

Figure 1: The initial result of information investment.

4.2 Correlation Analysis of Accounting Information

Table 2: Portfolio Optimization Scenarios and Profitability Analysis

Asset class	Adjusted Investment Ratio (%)	Adjusted Expected Rate of Return (%)	Adjusted expected annual earnings (US$ millions)
Stocks	40	7.5	240 * 7.5% = 18.0
Bonds	35	5.0	210 * 5.0% = 10.5
Cash	15	2.0	90 * 2.0% = 1.8
Real Estate	10	6.5	60 * 6.5% = 3.9

Table 2 shows the portfolio rebalancing based on optimization Correlation analysis of accounting investments, the specific results are shown in Figure 2.

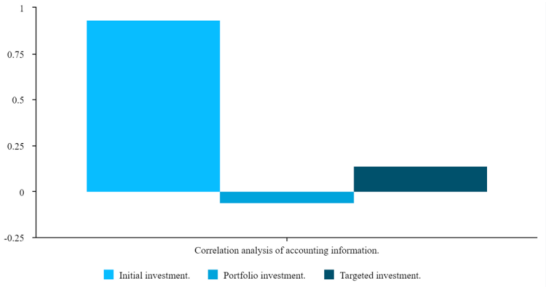

Figure 2: Correlation analysis of these investments

4.3 The Investment Portfolio Results of Accounting Information

As can be seen from the above examples, the optimized portfolio has increased the overall expected annual return to US$34.2 million, which is about 10% higher than the annual return of the original portfolio. Based on the reduction of the proportion of equity assets and the increase of bonds and real estate assets, the company has achieved a better risk-return balance, and the overall volatility and risk have been significantly reduced.

Table 3: Risk and Reward Balance Analysis

Asset class	Adjusted Standard Deviation (%)	Adjusted Sharpe ratio	Maximum Drawdown (%)
Stocks	12	0.65	-15
Bonds	4	0.60	-7
Cash	1	0.50	-1
Real Estate	8	0.62	-10

Table 3 shows the balance between risk and return of the optimized portfolio. The adjusted Sharpe ratio has increased significantly, from 0.60 to 0.65 for equity assets and slightly for bond assets, making the overall portfolio more balanced. Based on risk reduction, the portfolio's performance in market volatility is more stable and the maximum drawdown is reduced. The numerical combination result is shown in Figure 3.

Based on 3 years of simulated historical data, the optimised portfolio is more robust in different market conditions, with a 5% increase in total return. Especially in the economic downturn, the optimized portfolio shows stronger risk resistance, showing the

effectiveness and feasibility of the strategy. Based on the optimized portfolio, the company achieves an increase in returns while controlling risk. The addition of real estate assets provides good risk diversification for the portfolio while optimizing the overall rate of return.

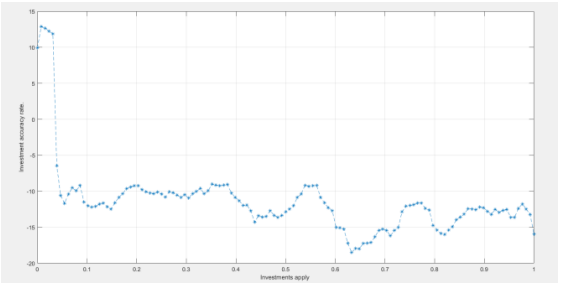

Figure 3: Judgment of accounting investment portfolio results.

5 CONCLUSIONS

This paper studies the portfolio algorithm based on the correlation of accounting information system, and builds a complete system, integrates the algorithm, and then implements the application. Judging from the data results, the optimization method used in this time has significant results. Based on the correlation of accounting information systems, combined with intelligent algorithms, such as factor analysis and gradient descent methods, this paper successfully identifies the key financial factors that have an impact on investment returns, and then balances returns and risks in asset allocation. Through the effective application of this system, the optimized portfolio has a very strong anti-risk performance, and at the same time, the overall return is good. This proves that the portfolio algorithm based on the correlation of accounting information system is effective and can provide reliable decision support for the long-term investment strategy of enterprises. In short, the research in this paper will provide a good foundation for improving the financial management efficiency and investment decision-making ability of enterprises. Although the data collection in this paper is very complete, its data coverage is still very limited, so there are still many deficiencies in this paper, which need to be further optimized.

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