

Application of mean-variance modal in four industries

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Abstract. Portfolio optimization is highly valued and used by many people in the financial field. This paper analyzes the asset portfolio allocation of different industries, namely, transportation industry, software industry, semiconductor industry, and insurance industry. This paper selected four representative assets from these four industries, and then used the mean-variance combination model to analyze asset allocation and forecast the return on investment. In order to find the optimal proportion of investment portfolio in these four industries. The results show that "MMC" has the largest weight proportion in the combination of least squares and the maximum Sharpe ratio combination's "MSFT" weight percentage is the highest, while "UPS" has the smallest weight proportion in the combination of least squares and maximum Sharpe ratio. Therefore, in these four industries, the mean-variance model predicts that the insurance industry and software industry can get the maximum rate of return, while the cosmetics and nursing industry cannot get the maximum rate of return.

Keywords: Portfolio optimization; insurance; semiconductor; transportation; software.

1. Introduction

The mean-variance model was put forward by Markowitz, in order to address the issue of how to diversify the investment so as to minimize the risk and maximize the return [1]. Because investors' distributable assets are limited, they are very concerned about hitting a certain predicted return objective in the future and managing asset fluctuations within their own means of affordability [2]. As a result, market investors have pressing challenges in determining how to gauge risk and return on investment and how to balance these two indications for asset allocation [3].

At the initial stage, investors can decide which stocks to buy and how to allocate funds to these stocks by using the mean-variance model and get an optimal combination of asset allocation. It is found that few types of research focus on insurance, software, transportation, insurance, and other industries. At present, the portfolio analysis in the market is mostly the analysis of the whole financial market [4-5]. For example, Evmandact and Kirkpmar used portfolio optimization to analyze the development of the oil market [6]. Zhang built an insurance fund portfolio model based on robust optimization, and then made empirical research on the two models through market data [7].

The objective of this essay is to examine the asset allocation of four sample businesses from four distinct industries: transportation industry, cosmetics and nursing industry, insurance industry and semiconductor industry. The following is a summary of the paper's empirical methodology. First of all, this paper selected four typical companies from the transportation industry, cosmetics and nursing industry, insurance industry, and semiconductor industry as the closing prices from October 1, 2018 to January 1, 2022; Secondly, it arranged all the data in excel, so that the data of four stocks matched the time of financial time series; Thirdly, based on the data of these four stocks, it calculated a covariance matrix. Fourthly, Through the use of the chosen stocks, this paper creates two portfolios: the portfolio with the highest Sharpe ratio and the portfolio with the lowest variance. The findings indicate that the highest weights in these two portfolios are held by the software and insurance industries.

The following is a summary of the rest. Part 2 shows the data, part 3 describes the method, and part 4 and part 5 show the results and conclusions respectively.

2. Data

The data used in this paper comes from Tiger Securities (www.itigerup.com). This paper selects the closing prices of MMC, MSFT, UPS, and TXN from October 1, 2018 to October 1, 2022. In this paper, it considers choosing these companies because they have performed well in their own industries in the past 4 years. In addition, these companies in four completely different fields are chosen to diversify their assets, thus avoiding high correlation, which will lead to data errors.

Table 1. Descriptive statistics of the selected assets.

	MMC	MSFT	UPS	TXN
Expected return	1.565%	1.970%	1.589%	1.578%
variance	0.421%	0.419%	0.921%	0.519%

Through visualizing this table 1, this paper looks that the “MSFT” has the highest average return, while “MMC” has the lowest average return. Seeing the variance, “MSFT” has the lowest ratio, while “UPS” has the highest ratio. Therefore, the “MSFT” has the highest average return and the lowest variance.

3. Method

A technique for asset allocation that aids investors in optimizing expected returns and reducing risk is the mean-variance model analysis.

$$\sum_i \text{Weight}_i = 1 \quad (1)$$

Where Weight_i is the weight of the Asset_i in the portfolio. The following formula can be used to determine a portfolio's return and variance.

$$\text{Portfolio Return} = \sum \text{Weight}_i \times \text{Asset Return}_i \quad (2)$$

Where Asset Return_i is the compound yield of Asset_i 's time series statistics.

$$E [\text{Portfolio Return}] = \sum_i \text{Weight}_i \times E [\text{Asset Return}_i] \quad (3)$$

where $E [\text{Asset Return}_i]$ is the anticipated return of Asset_i . $E [\text{Portfolio Return}]$ is the projected yield of the portfolio.

$$\text{Var} [\text{Portfolio Return}] = \sum_{i,j} \text{Weight}_i \times \text{Weight}_j \quad (4)$$

$$\text{Cov} [\text{Asset Return}_i, \text{Asset Return}_j] \quad (5)$$

Where Cov denotes the variance-covariance between Asset Return_i and Asset Return_j . Var stands for the portfolio return's variance.

The following formula can be used to determine a portfolio's Sharpe ratio,

$$\text{Sharpe Ratio} = \frac{E(R_p) - R_f}{\sigma_p} \quad (6)$$

Where $E(R_p)$ is the expected return of the portfolio, R_f is the risk-free rate, and σ_p is the standard deviation of the portfolio.

4. Result

This paper constructs a covariance matrix of the portfolio, it simply and effectively describes the overall correlation of return on assets (See Table 2).

Table 2. Covariance Matrix.

	MMC	MSFT	UPS	TXN
MMC	0.42%	0.26%	0.34%	0.23%
MSFT	0.26%	0.41%	0.31%	0.27%
UPS	0.34%	0.31%	0.92%	0.28%
TXN	0.23%	0.27%	0.28%	0.52%

This paper constructs certain portfolios shown in the following Table 3 and Table 4. Table 3 is the results of the portfolio construction of the minimum variance portfolio and Table 4 is the results of the portfolio construction of maximizing sharp ratio portfolio.

Table 3. Minimum Variance Portfolio.

	MMC	MSFT	UPS	TXN
MVP weight	40%	34%	0%	26%
portfolio return	1.71%			
standard deviation	5.63%			
sharpe ratio	25.00%			

Looking at the data, we can find that "MMC" has the largest proportion of Minimum Variance Portfolio weight and it can obtain the smallest standard deviation. Since 2010, the assets of the insurance industry have continued to grow steadily. According to data from the China Banking and Insurance Regulatory Commission, the total assets of my country's insurance industry in the first half of this year were 21,979.2 billion yuan [8]. So, this is the reason why insurance accounts for the largest proportion.

Table 4. Maximize Sharpe Ratio Portfolio.

	MMC	MSFT	UPS	TXN
ORP weight	18%	72%	0%	10%
portfolio return	1.86%			
standard deviation	5.92%			
sharpe ratio	26.3%			

Looking at the data, we can find that "MSFT" has the largest proportion of Maximize Sharpe Ratio Portfolio weight and it can obtain the largest sharpe ratio. "MSFT" performance may be because people are optimistic about the software field, which means that people can make excess profits by investing in the software field [9-10].

5. Conclusion

According to the current statistics, most of the research on an investment portfolio is based on the analysis of specific industries and even hot industries. The research in this paper is to help investors make the best investment decisions in the insurance industry, software industry, semiconductor

industry, and transportation industry. The analysis method used in this paper to find the optimal portfolio is mean-variance analysis. The greatest Sharpe ratio portfolio and the minimum variance portfolio are computed in this study, respectively. In the algorithm for the maximum Sharpe ratio, "MSFT" is the stock to which the most money can be invested. "MMC" is the largest stock in the minimum variance portfolio. However, it is undeniable that these methods still have shortcomings, such as some other factors that affect the portfolio may not be included in the mean-variance portfolio.

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