

The optimization model of securities investment risk measurement

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Abstract: With the financial markets to expand unceasingly, more and more investors into the securities market, in pursuit of the interests of the free flow of capital will flow to the economic benefit is high, and the interests of investors in securities investment to pursue higher, need to consider the measure for solving the optimal combination of the risk, so that investors can obtain reasonable returns when get smaller risk. Considering the influence of various factors, a mean-variance portfolio model is established, and a reasonable rate of return is given, and the optimal investment portfolio with the lowest risk is calculated, and a reasonable conclusion is obtained through an example analysis.

Keywords: Investment risk, Mean variance model, Optimization model.

INTRODUCTION

As social economic and scientific economic development, Finance and investment became a part of people's lives. For a rational investor, it is necessary to understand the portfolio risk. So called portfolio risks refer to the risks associated with the investment of a number of assets. The use of multiple assets to invest can reduce the risk of investment, and the magnitude of the risk reduction depends on the degree of correlation between the assets, and the portfolio needs to be determined by the result of some analysis of data, which establishes an mean variance portfolio model and finally obtains the best combination.

Markowitz mean-variance model

Markowitz's mean-variance model [1] means that investors invest a given amount of money in a given period of time. In deciding which securities to buy and how the money is allocated on these securities, investors need to choose the best combination from all possible portfolios. There are two objectives for investors: high yields and low uncertainty risk. The best goal should be to achieve the best balance between these two mutually restricted goals [2].

Assumptions of the model

- Investors estimate the risk of the portfolio according to the expected rate of return of the securities.
- Investors' decisions are based solely on the risks and benefits of the securities.
- At a certain level of income, investors want the least risk.

Establishment and solution of the model**Establishment of portfolio model**

If investors to invest in N kinds of stock, the first of i kind of assets yield with r_i , the standard deviation in σ_i , and set up the first of i kind of assets investment accounted for the proportion of all investment to ω_i , which is based on the gains certain circumstances, the risk is minimum, and we can build the portfolio model, such as type (1).

Under a certain yield:

$$\left\{ \begin{array}{l} \min \sigma^2 = \omega' C \omega \\ r_p = \sum_{i=1}^n r_i \omega_i = \omega' r \\ \sum_{i=1}^n \omega_i = 1 \\ \omega_i \geq 0 (i = 1, 2, \dots, n) \end{array} \right. \quad (1)$$

ω_i is the weight of the i stock, $r_i (i = 1, 2, \dots, n)$ is the rate of return on stock i , and C is the covariance matrix of various stock returns, σ^2 represents the variance of the portfolio return.

Selection of sample data

Risk assets investment choice: samples were randomly selected for a-share market 10 stocks of Shanghai stock exchange were analyzed, and the sample company from eastern wealth network selection of listed companies, and export the latest financial data of listed companies, see chart-1.

Chart-1: Financial data for 10 companies

Name of listed company	Return on equity x_1 (%)	Yield per share x_2 (%)	Name of listed company	Return on equity x_1 (%)	Yield per share x_2 (%)
Pharmablock Sciences	19.38	0.69	Guizhou Gas Group	4.51	0.150
High Technology Computer	16.92	0.55	GUIBAO SCIENCE	7.10	0.2764
Sinonovak	20.09	2.01	Gree Electric Appliances	25.10	2.5600
Langsha Holding	4.44	0.138	SJEC	4.05	0.4024
Iflytek Co	5.74	0.370	ChinaNetCenter	7.63	1.6175

The determination of the return on risk assets: the average yield of the ten stocks selected above is adopted for each risk asset, and the result: $r = 11.496\%$.

Statistical analysis of data

The above data can be used to determine the value of each variable of the portfolio model with the least risk at a certain rate of return. From the 10 stocks samples selected three high growth, high yield, capital stock expansion ability to simulate the stock portfolio investment, selection of stock portfolio is: Gree Electric Appliances (000651), Iflytek Co (002230), ChinaNetCenter (300017), the yield on three stocks is shown in chart-2.

Chart-2: Yields on three stocks

Data	Gree Electric Appliances w_1	Iflytek Co w_2	ChinaNetCenter w_3
	R1	R2	R3
1201	1.1635	1.8334	1.5922
1130	0.8079	0.1343	1.9764
1129	1.241	1.8546	1.4803
1128	0.7196	1.6724	1.867
1127	1.2093	1.3577	0.7276
1124	1.822	0.1253	1.1539
1123	1.593	1.4105	1.1001
1122	1.4588	0.0996	1.1733
1121	1.0221	1.6314	1.7747
1120	1.0263	0.3413	1.4303
1117	1.4578	1.9524	0.6494
1116	1.0943	1.0204	0.9019
1115	1.0525	0.4628	1.7047
1114	1.1116	1.0034	1.3952
1113	1.2425	1.7532	1.6585
1110	1.7349	0.4062	1.699
1109	1.066	1.6972	1.6372
1108	1.3563	1.7586	1.4231
1107	1.4315	0.6491	0.1672
1106	1.5305	0.3521	1.6093

It is known from the Table above: $r_1=1.24%$, $r_2 =1.12%$, $r_3 =1.32%$, $\sigma_1=0.296994$, $\sigma_2=0.704797$, $\sigma_3=0.497015$. The correlation coefficient matrix of three stocks can be obtained by using Eviews software:

$$\begin{pmatrix} 0.084371 & -0.069016 & -0.236828 \\ -0.069016 & 0.475142 & -0.019636 \\ -0.236828 & 0.019636 & 0.236284 \end{pmatrix}$$

Put the above data into the built investment portfolio model:

$$\min \omega' \begin{pmatrix} 0.012646 & -0.01034 & -0.03550 \\ -0.01034 & 0.071215 & 0.002943 \\ -0.03550 & 0.002943 & 0.035414 \end{pmatrix} \omega$$

$$s.t \begin{cases} 1.24\omega_1+1.12\omega_2+1.32\omega_3=0.31 \\ \omega_1+\omega_2+\omega_3=1 \\ \omega_1, \omega_2, \omega_3 \geq 0 \end{cases}$$

According to Lingo's solution to the quadratic programming problem, the investment proportion of three stocks in the portfolio can be determined according to the minimum value problem:

$$w_1 = 4.31\%, w_2 = 10.4\%, w_3 = 85.29\%$$

4.31% of the assets invested in Gree Electric Appliances, 10.4% of the asset investment Iflytek Co, 85.29% of the asset investment China Net Center, which can make the risk to the lowest, and the benefit is more reasonable.

Advantages and limitations of the model

The mean-variance model describes the most basic and complete framework of portfolio selection through mathematical method, which is the mainstream method of current investment theory and investment practice. However, the limitation of this model [3] is that the non-normal distribution of earnings is not taken into account, and most empirical studies show that the yield of securities does not necessarily follow the normal distribution. On the other hand, this method is more complex, especially when applied to the portfolio problem of multiple projects [4].

SUMMARY

Portfolio decisions influenced by personal factors or objective of major factors, decision also needs to consider these factors, the mean variance model is an ideal model, or other factors need to be considered in real life. At the same time, we also want to consider investor appetite for risk, we need to be careful when we enter the securities market, also dare to take risks, don't blindly, rational face.

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