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Capital allocation strategy analysis based on systemic risk perspective

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Abstract: In recent years, with the slowdown of global economic growth and domestic economic growth, systemic risks have gradually increased. The traditional asset allocation based on stocks and bonds has been difficult to meet the needs of asset allocation under the current economic environment. How to effectively control systemic risk under different risk levels has become an important topic in the field of asset allocation. In this context, this paper studies the asset allocation strategies among fund companies under market volatility and systemic risk. The specific problems include: find out the degree of emphasis of different companies on different stocks, then perform cluster analysis according to the degree of emphasis, calculate the degree of similarity of corporate strategies, and finally solve the similarity of asset allocation between Ran companies; After processing the massive and complicated data, the corresponding constraint conditions are given in the calculation of investment utility maximization based on the fundamental data, and the relevant model is established to solve it, and the optimal stock portfolio strategy is obtained. This paper establishes the corresponding model to analyze the fund asset allocation strategy, aiming at obtaining the optimal combination strategy and calculating the data such as value at risk, which has certain reference significance for companies to choose stocks.

1. Introduction

In recent years, with the continuous improvement of the degree of reform and opening up, various risks in China's economic operation are gradually exposed and concentrated in the financial field[1]. The report puts forward the requirement of "holding the bottom line of no systemic financial risks", and regards preventing and resolving major risks as the primary battle to win the three major battles to build a moderately prosperous society in an all-round way[2]. As one of the important components of the financial system, the risk situation of asset management business is also a problem worthy of attention in the process of our country's financial system reform. Therefore, the People's Bank of China issued the Guiding Opinions on Regulating the Asset Management Business of Financial Institutions in 2018, aiming to regulate the asset management business of financial institutions, effectively prevent and control financial risks, guide social funds to flow to the real economy, and better support economic restructuring and transformation and

upgrading[3]. As one of the important components of the financial system, the risk situation of asset management business is also a problem worthy of attention in the process of our country's financial system reform[4]. Therefore, the People's Bank of China issued the Guiding Opinions on Regulating the Asset Management Business of Financial Institutions in 2018, aiming to regulate the asset management business of financial institutions, effectively prevent and control financial risks, guide social funds to flow to the real economy, and better support economic restructuring and transformation and upgrading[5].

Public fund is the most representative form of asset management business[6]. Due to the relative performance appraisal system, the competitive pressure makes the asset allocation of public funds very complicated, and the concentration of shareholding is relatively high, which becomes a potential factor affecting systemic risk[7]. Therefore, how to balance the relationship between the fund investment return and systemic risk is worthy of in-depth exploration. This paper establishes the corresponding model to analyze the fund asset allocation strategy, aiming at obtaining the optimal combination strategy and calculating the data such as value at risk, which has certain reference significance for companies to choose stocks[8].

2. Similarity measurement of asset allocation strategies among fund companies

This problem uses the clustering model to analyze the similarity between the strategies of different companies. Because it is not clear in advance the number of categories to be divided, considering that the hierarchical clustering model does not need to manually determine the number of clusters, which can reduce the error, this paper chooses the hierarchical clustering model[9].

Hierarchical clustering algorithm is a clustering method based on the distance between each node, the size of the distance according to small to large corresponding to the similarity from low to high.

Find the proportion of shares held by different companies in different stocks:

$$x \quad = \frac{a_i}{\sum_{i=1}^{n} a_i} (i = 1,2,\cdots,n) \tag{1}$$

Because the unit is consistent, it can skip the standardization processing and directly Jining analysis. The clustering method between classes uses the average connection method, and the distance between points uses the Minkowski distance method.

$$D(x,y) = \frac{d_1 + d_2 + d_3 + d_4}{4} \tag{2}$$

(D(x, y) is the distance between x and y, and D 1, D 2, D 3, and D 4 are the distances between the two clusters, respectively)

$$D(p,q) = \left(\sum_{i=1}^{n} |x_p - x_q|^p \right)^{\frac{1}{p}} \tag{3}$$

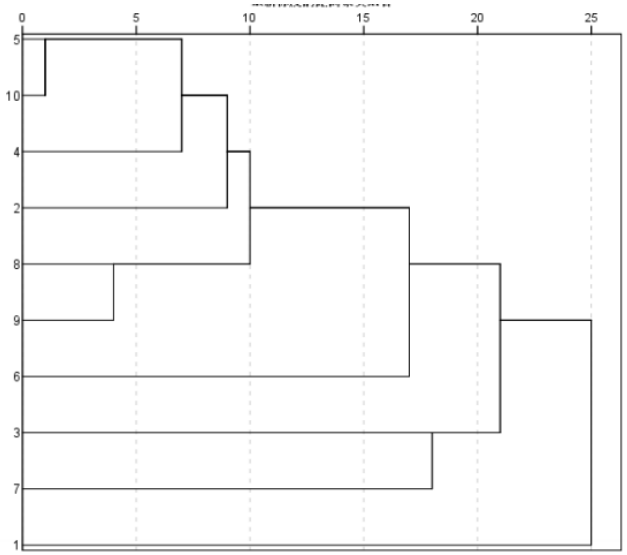

Figure 1: Pedigree diagram

As can be seen from Figure 1, ten companies can be divided into different types according to different criteria. The elbow rule is used to estimate the number of clusters, and Ck is used to denote the KTH cluster. The distortion degree of the KTH cluster is as follows: $\sum_{i\in C_k}\left|x_i - x_j\right|^2$. Total distortion for all classes (aggregation coefficient): $J = \sum_{K=1}^{K}\sum_{i\in C_k}\left|x_i - x_j\right|^2$. The results obtained are made into a graph using excel as follows:

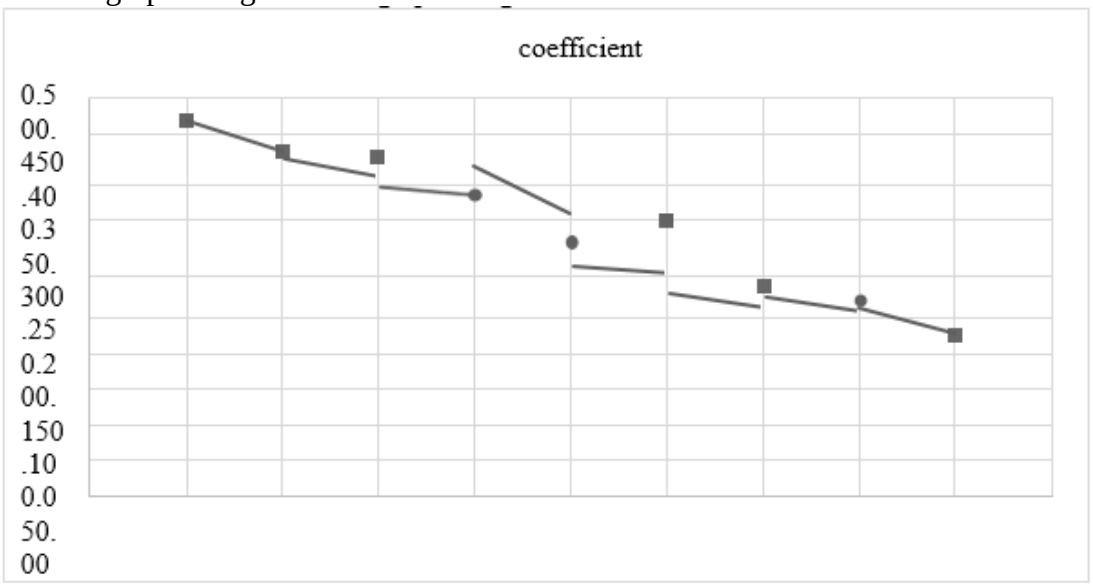

Figure 2: Relationship between the aggregation coefficient and the number of clusters k

As can be seen from Figure 2, when the value of k is from 1 to 5, the change of distortion degree is the largest, and the change of distortion degree decreases after 5, so the elbow is 5, so the number of categories can be set to 5.

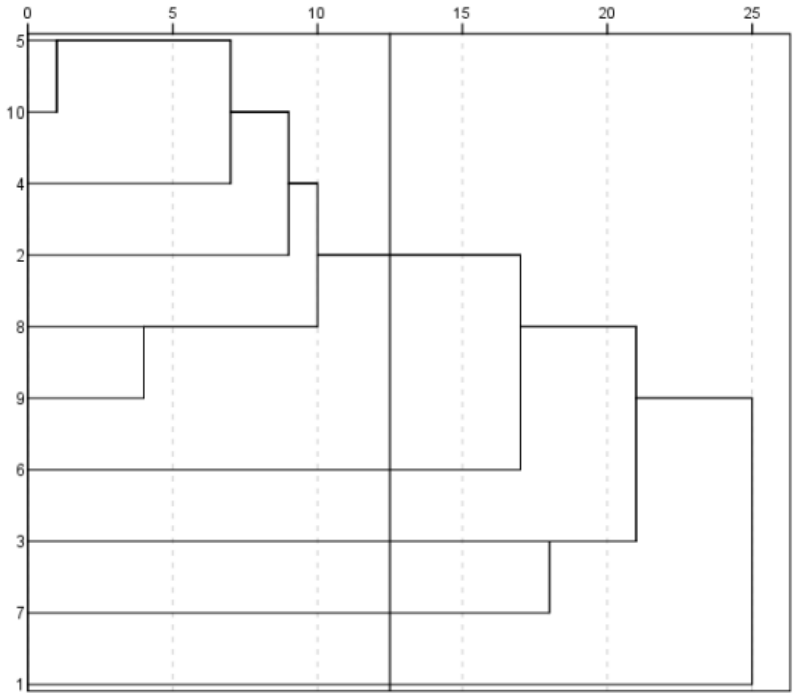

Figure 3: Clustering results

As can be seen from Figure3, dividing the genealogy graph according to the five categories, it can be obtained that company E, Company J, Company D, Company B, company H and company I are in the same category, that is, the asset allocation strategies of these companies are highly similar, and company F, Company C, company G and Company A are in the same category respectively. That is, there is no high similarity of asset allocation strategy with other companies.

3. Model building and analysis

In case of missing data, it is necessary to fill the data first. Because the cubic spline interpolation has the advantages of simple calculation, good stability and convergence, and accuracy, this problem chooses the cubic spline interpolation algorithm to solve the missing data, which can be directly solved by using software MATLAB. The result is as follows:

Table 1: Missing data

	Stock 1	Stock 2	Stock 3	Stock 57
2019-1-2	8.28	25.65	11.5	59.8
2019-1-3	7.94	25.32	11.27	56.98
2019-1-4	8.08	25.91	11.47	57.1
2019-1-5	8.2575	26.5799	11.616	57.304
...	...	...	...	...
2019-1-31	10.26	30.03	12.34	54.5

It can be seen from Table 1, the improved mean-variance model is used to solve the optimal portfolio strategy. Since the final portfolio strategy has little relationship with the initial wealth, it is only related to the investment proportion of different stocks, so the initial wealth can be analyzed differently first[10], and the return rate of the ith stock on the t day Rit is:$R_u = \frac{p_{it}-p_{i(t-1)}}{p_{it}}$

The return rate Ri of the ith stock is: $R_i = \frac{1}{T}\sum_{t=1}^{T} r_{it}$, (T=30)

The expectation Ri of ri is as follows:$r_i = E(R_i)$

The covariance matrix G is given as follows:

$$G = (\sigma_{ij})_{n\times n}$$
$$\sigma_{ij} = COV(R_i, R_j)$$
$$COV(R_i, R_j) = E[R_i R_j] - E[R_i]E[R_j] \quad (4)$$

Let xi represent the proportion of investment for the i type of stock, as follows:

$$x_i \le 1, \sum_{i=1}^{n} x_i = 1 \quad (n = 57) \quad (5)$$

Let e be an n-dimensional column vector with all 1 components, then:$e^T x = 1$
Therefore, the return rate Rt on day t after all the portfolios is as follows:$R_t = \sum_{i=1}^{n} x_i R_{it}$
The expected return rate of the portfolio, Rp, is :$R_p = \sum_{i=1}^{n} x_i r_i v$
Its mean rp is as follows:$r_p = R^T x$
The variance is:$\sigma^2 = x^T G x$
Build the mean-variance model for the case where short selling is not allowed:

$$\min \frac{1}{2} x^T G x, s.t. \begin{cases} r^T x \ge r^0 \\ e^T x = 1 \\ x \ge 0 \end{cases}$$
(Among them r^0 represents the minimum standard expected) (6)

Equation 6 is a convex quadratic programming problem, and the Kuhn-Tucker (K-T) condition that should be satisfied is as follows.

$$\begin{cases} \sigma_{i1}x_1 + \cdots + \sigma_{in}x_n - \mu_1 x_n + \mu_2 \ge 0, (i = 1, \cdots, n) \\ r_1 x_1 + \cdots + r_n x_n \ge r_0 \\ x_1 + \cdots + x_n = 1 \\ x_i \ge 0, (i = 1, \cdots, n), \mu_1 \ge 0 \\ (r_1 x_1 + \cdots + r_n x_n)\mu_1 = 0 \\ (\sigma_{i1}x_1 + \cdots + \sigma_{in}x_n - \mu_1 r_i + \mu_2)x_i = 0 (i = 1, \cdots, n) \end{cases} \quad (7)$$

For this model the rotation algorithm can be used to calculate: the initial basic inequality set is given by: $x_i \ge 0, (i = 1, \cdots, n), \mu_1 \ge 0, \mu_2 \ge 0$ composition.The initial fundamental solution is given by, $y^0 = (0, \cdots, 0)^T (n + 2 \uparrow 0), a_i = (\sigma_{i1}, \cdots, \sigma_{in}, -r, 1), (i = 1, \cdots, n), a_{n+1} = (r_1, \cdots, r_n, 0, 0), a_{n+2} = (1, \cdots, 1, 0, 0)$ .The deviation is, $\sigma_i = 0, (i = 1, \cdots, n), \sigma_{n+1} = -r_0, \sigma_{n+2} = -1$,The initial table of the model can be obtained by substituting the desired data into the following table2:

Table 2: Initial table

	e1	…	en	en+1	en+2	σi
	0.0006	…	-0.0007		1	0
a1				−r1		
…	… -0.0007	… …	… 0.0042	…	… 1	… 0
an		…		−rn 0	0	
an+1	r1		rn			−r0
an+2	1	…	1	0	0	-1

Two rotations are performed so that a1 enters the base en+2 and an+2 enters the base e1, and then the column where the base vector an+2 resides and the row where the base vector en+2 resides are deleted. The non-fundamental inequality is exchanged with the fundamental inequality until the deviation of all non-fundamental vectors is non-negative, and the optimal solution of the model is the sum of the initial fundamental solution and the deviation, namely $y = y^0 + \sigma_i$.

Given $r_0 = 0.05$ the optimal solution obtained is as follows:

Table 3: Optimal solution of combination strategy

	Stock 3	Stock 3	Stock 10	Stock 22	Stock 27	Stock 41
0.0722	0.0722	0.3514	0.1746	0.2832	0.0625	0.0561

It can be seen from the above table3 that when the investment utility is maximized, the optimal stock portfolio strategy is to invest in stock 3, stock 7, stock 10, stock 22, stock 27 and stock 41, accounting for 7.22%, 25.14%, 17.46%, 28.32%, 6.25% and 5.61%, respectively. Do not invest in other stocks.

4. Conclusion

This paper studies the strategic problem of asset allocation under the intervention of systemic risk in several years, and constructs the solution of hierarchical clustering model, mean-variance model, dynamic programming model and rotation algorithm. By analyzing the relationship between fund asset allocation and market changes in the corresponding scenario, a model is established, and the coping strategies under different error backgrounds are discussed.

The research shows that the model constructed in this paper has been tested as the optimal analysis model, which can effectively deal with the fund asset allocation under the system risk, and ensure the accuracy of analysis and stability in operation. In the process of establishing and solving the model, this paper considers the possible influence of the measurement error, and puts forward the corresponding mathematical calculation and error treatment methods to ensure the reliability of the analysis results.

The hierarchical clustering model used in this paper relies less on prior information, which is more suitable for solving the problem of incomplete information, and can judge the clustering chain by synthesizing various feature influencing factors without considering the setting of the feature threshold. In the hierarchical clustering, we can choose the calculation method of multiple types and classes, and the distance between points. Constraints can be added to the mean-variance model to make the model more accurate. When calculating value at risk, a more complex and practical model can be built to further improve its efficiency and reliability.

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