

A Cluster Analysis of Stock Market from Perspective of Complex Network

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Abstract

In nature, a large number of complex systems can be described by complex networks. In this paper, we build a stock market network using the complex network tools. Then we analyze the characters of the stock network and obtain interesting cluster structures. We found some interesting results of the cluster structure of the stock market network. These results are interesting in finance data analysis field and will potentially contribute to the stock network management. From the class, I learned some method to analysis a market, so I want to use those method to analysis cluster market.

Keywords

Cluster Analysis, Stock Market, Network.

1. Introduction

In nature, a large number of complex systems can be described by complex networks. In the network, the vertices are elements in the system and the lines between each vertices are relationship of the two elements. Such as social network in figure 1.

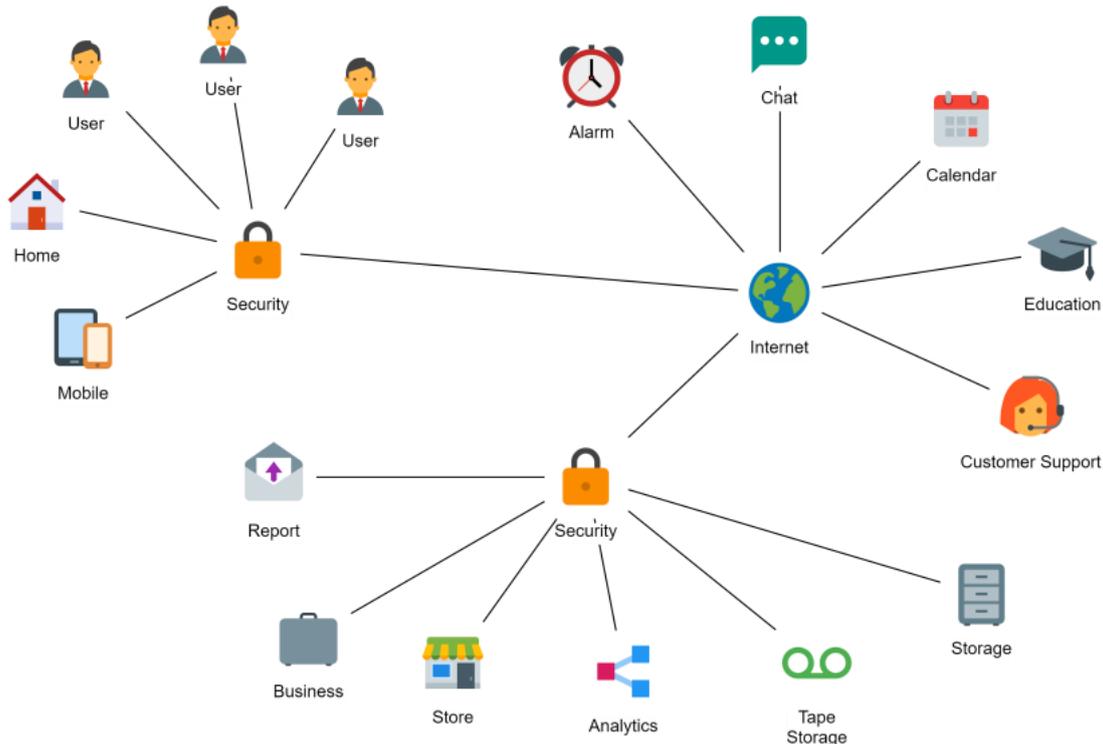


Figure 1: An example of the social network

In essence, the stock market is a complex system. There are many companies which experience interactions with each other. In the stock market, we could establish a network according to the price fluctuations using certain method [1]. In the stock market network, each vertex represents a public company, and lines represent a relationship between the public companies. Since the stock price correlations are widely used in the stock market analysis, the studies of dynamic correlations and relationships become crucial for constructing the stock market network and analyzing the economic features of the stock market [2-5]. So in this article, we first build a stock network using the correlation method. Then we use this model to analyze the stock market.

2. Method for Building a Stock Market Network

2.1 Original Data

The Data Set in this experiment is from CSMAR, including the closing price fluctuations of 3605 public companies of Chinese stock market from 2016/3/1 to 2018/3/1 (489 trading days). The data sample is in table 1.

In the table 1, we could see that different companies (stock symbol) has different close price in different days. We described one sample close price fluctuations of 489 trading days in figure 2. As far as we can see, the closing price fluctuates violently.

Table 1. Close price of data sample(unit:Yuan)

stock symbol	2016/5/13	2016/5/16	2016/5/17	2016/5/18
000010	8.03	8.14	8.15	7.67
000529	6.72	6.77	6.88	6.67
000744	10.4	10.64	10.52	10.29

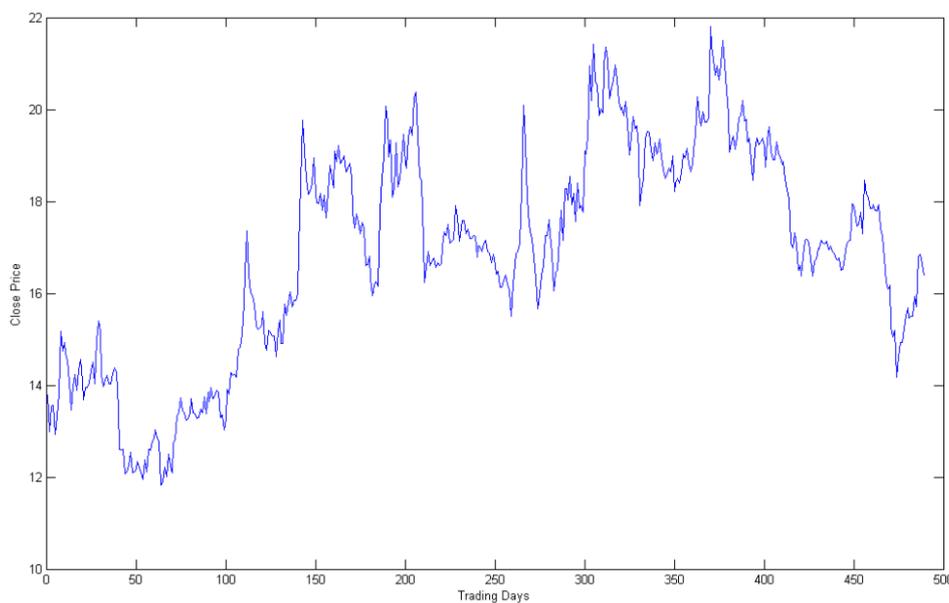


Figure 2 Close Price of one stock company

2.2 Building a Stock Market Network

Here we apply the return correlation method to build a market network in [6-10].

First, we calculate the return price of each stock, as follows.

$$r_i(t) = \ln \left[\frac{p_i(t+1)}{p_i(t)} \right] \tag{1}$$

Where p represents the closing price of company i, and there are T companies.

Second, we calculate correlation coefficient of each company i and j .

$$C_{ij} = \frac{\sum_{t=1}^T r_i(t)r_j(t) - \sum_{t=1}^T r_i(t)\sum_{t=1}^T r_j(t)}{\sqrt{\sum_{t=1}^T (r_i(t) - \bar{r}_i)^2 \sum_{t=1}^T (r_j(t) - \bar{r}_j)^2}} \tag{2}$$

Third, we establish edges of the company i and j using threshold θ as follows:

$$E = \begin{cases} e_{ij} = 1, & i \neq j \text{ and } w_{ij} > \theta \\ e_{ij} = 0, & i = j \end{cases} \tag{3}$$

If $C_{ij} > \theta$ we establish a edge from company i to company j , if not there is no edge from j to j . here we choose $\theta=0.7$. And the stock network is as follows in figure 3:

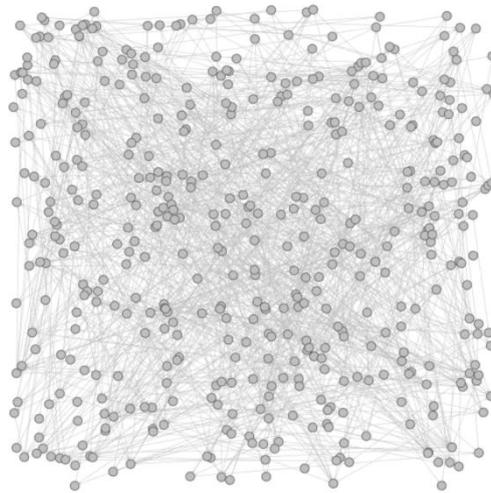


Figure 3: A general view of the stock market network

3. Clustering Analysis of the Stock Network

Here we do clustering Analysis using clustering algorithm in [3]. There are 4 steps to cluster the vertices in the network, the specific algorithm was described in figure 4. The detail of the algorithms could be obtained in research [4].

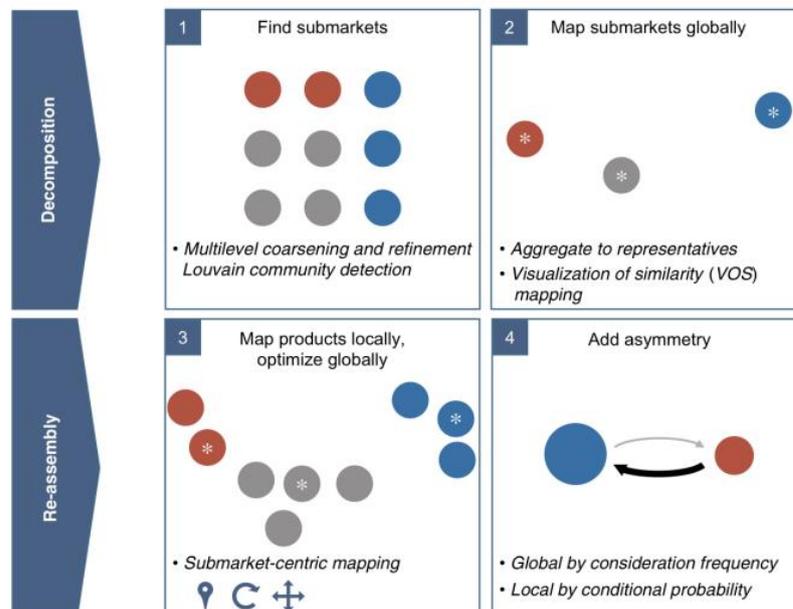


Figure 4: 4-step of clustering vertices [4]

As a result, we got a stock network which is classified by the algorithm, which is shown in figure 5.

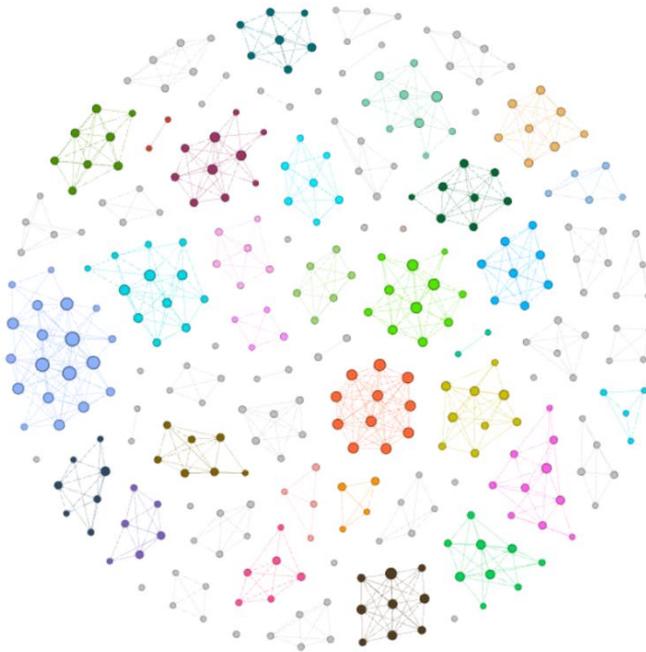


Figure 5: Cluster Analysis of Stock Market Network

In figure 5, we describe different clusters with different colors. We can see that, some vertices stayed together as they have bigger correlation coefficient, which means that some companies influence each other [11,12].

4. Results and Discussion

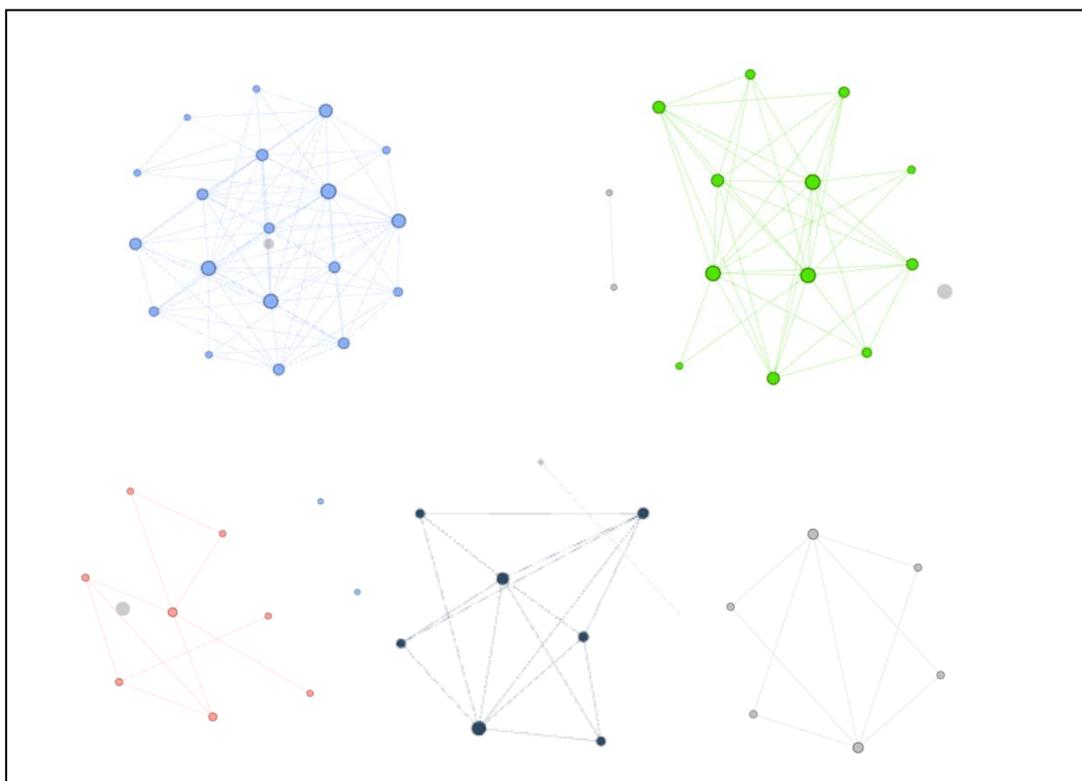


Figure 6 Different Styles of Different Clusters

In addition, we find that different clusters differ in certain way. They have different sizes and different connection sizes. And I draw them in Figure 6. As is shown in Figure 6, some of the clusters (the blue one and the green one) have the most number of vertices and the closest connections, which means that some of the stock companies have a closer relationships with each other in this cluster. And some cluster such as the grey one, there are fewer vertices and connections with each other, which means that the companies in this cluster are less influential in the whole stock market.

5. Conclusion

In this small project, I have learned how to make a network of a stock and how to do some cluster analysis with certain algorithms. In addition, I found different patterns in the stock market network. The result could have some contributions to the stock market in reality. We adopt the complex network and cluster algorithm to analyze the properties.

In this paper, threshold method was applied to construct the stock market network, which may filter some information of the stock network more or less. For further study, we are going to attempt some new methods. From the class, I feel the power of data analysis. It can make the complex structures become clear and helping us find the most general rule.

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