Classification of Economic Regions in Henan Province Based on Cluster Analysis

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Abstract: This paper orientates the economic development degree of Henan provinces through the main indicators of the national economy of 17 cities in 2018. Cluster analysis is carried out for each city at different levels of economic development, thus Henan Province are divided into three economic regions with different levels of economic development, and draws the relevant reasons and conclusions. Finally, it puts forward relevant suggestions and countermeasures for the balanced development of regional coordination in Henan Province.

1. Introduction

Henan Province is an important province in the central region of China. In recent years, its economic development has been rapid. By the end of 2016, its gross domestic product has reached 815.09 billion yuan, ranking fifth only after Guangdong, Shandong, Jiangsu and Zhejiang in all provinces, cities and autonomous regions of the country. Henan's GDP value accounts for 6.4% of the whole country. However, due to resource endowment, geographical conditions and economic conditions, Henan's GDP has reached 6.4%. Influenced by factors such as foundation and national policy, there are obvious differences in development among different cities in the province, and the degree of economic development is very uneven. How to accurately orientate the economic development degree of Henan provinces is an important issue related to the implementation of economic development strategy in Henan province.

Many researchers have analyzed economic development of Henan province. Cai Zuhua et al. [1] used grey fixed weight clustering method to evaluate the level of regional economic development in Henan Province. Liu Xiaoe [2] adopted factor analysis method to conduct comprehensive evaluation and Research on the level of regional economic development in Henan Province. Li Bingjun [3] introduced the convergence theory of regional economic growth, industrial agglomeration theory and growth pole theory to synthesize the economic characteristics and urban-rural disparities of cities in Henan Province. Yang Ming [4] used cluster analysis to quantitatively analyze the economic development level of Henan Province. But few scholars adopt cluster analysis to explore the economic development degree of cities in Henan Province.

2. Material and Methods

2.1 Cluster analysis

With the development of economy and society, the cluster analysis method which combines more powerful mathematical tools has been more and more applied to economic analysis and social work analysis. There are two main methods of cluster analysis, one is "K-Means Cluster Analysis" and the other is" Hierarchical Cluster Analysis", which is employed in this paper.

Hierarchical clustering method is one of the most widely used clustering methods. Its basic idea is:

(1) All samples are considered as one class, i.e. n classes are obtained.

(2) Determine the distance between the sample and the sample and the class.

(3) The distance between different classes are calculated and merge the two closest classes into one class to form a new one.

(4) Repeat step 3. In this way, we start with n classes and merge one class at a time. After n-1 merges, all samples become one class.

(5) Draw all the clustering process of the above merger with an intuitive graph, that is, draw the clustering graph.

(6) Determine the number of classes and get the results of cluster analysis by the above steps.

We use G_{ij} to indicate the distance between the first sample and the first sample, $G_1, G_2, \cdots$ represents classes, and G_{kl} represents the distance between G_k and G_l. In the coefficient clustering method introduced in this section, the distance between classes and samples is the same, i.e. $D_{kl} = d_{kl}$.

2.2 Data collection

The following are the main indicators of the national economy of Henan Province, including X1: GDP (10,000 yuan); X2: Investment in social fixed assets (100 million yuan); X3: Total retail sales of consumer goods (100 million yuan); X4: Disposable income per capital of urban residents (yuan); X5: Net income per capital of rural residents (yuan). All the data in the following comes from Henan Statistical Yearbook.

3. Results and Discussion

We use Ward's Method of Cluster Analysis to process the standardized data. The output results of the software are described in detail below.

Table.1. Summary of Case Processing

Valid		Deficiency		Total	
N	Percentage	N	Percentage	N	Percentage
17	100.00%	0	0.00%	17	100.00%

As is shown in Table 1, 17 samples have entered the cluster analysis, and there is no missing value.

Table.2. Cluster Set Process Table

rank	Cluster combination		coefficient	First appearance of order cluster		Next order
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	2	9	0.173	0	0	11
2	14	15	0.375	0	0	4
3	5	7	0.653	0	0	6
4	14	17	0.937	2	0	8
5	8	10	1.351	0	0	13
6	4	5	1.867	0	3	10
7	3	13	2.585	0	0	13
8	14	16	3.643	4	0	11
9	6	11	4.993	0	0	14
10	4	12	6.608	6	0	12
11	2	14	9.835	1	8	12
12	2	4	14.296	11	10	14
13	3	8	21.952	7	5	15
14	2	6	31.535	12	9	16
15	1	3	43.2	0	13	16
16	1	2	80	15	14	0

In Table 2, the first row of this table indicates that the second sample and the ninth sample are clustered first, and the distance between the samples is 0.173. The result of this clustering will be

used in the eleventh step of clustering later. The second row represents the clustering of the fourteenth sample and the fifteenth sample in the second step of clustering, and the distance between the samples is 0.375. The result of this clustering will be clustered in the fourth step later. Used in. Other lines have similar meanings. It can be seen that after 16 steps of clustering, 17 samples are clustered into a large class.

Table.3. Cluster members

Case	1: ZhengZhou	2: KaiFeng	3: Luoyang	4: Pingdingshan	5: Anyang	6: Hebi	7: Xinxiang	8: Jiaozuo	9: Puyang	10: Xuchang	11: Luohe	12: Sanmenxia	13: Nanyang	14: Shangqiu	15: Xinyang	16: Zhoukou	17: Zhumadian
3 cluster	1	2	3	2	2	2	2	3	2	3	2	2	3	2	2	2	2

Table.3 exhibits the classification table of samples when clustering analysis of sample system is clustered into three classes. We can see that Zhengzhou is a city of one kind; Kaifeng, Pingdingshan, Anyang, Hebi, Xinxiang, Puyang, Luohe, Sanmenxia, Shangqiu, Xinyang, Zhoukou and Zhumadian are clustered into one group; Luoyang, Jiaozuo, Xuchang and Nanyang are clustered into one group.

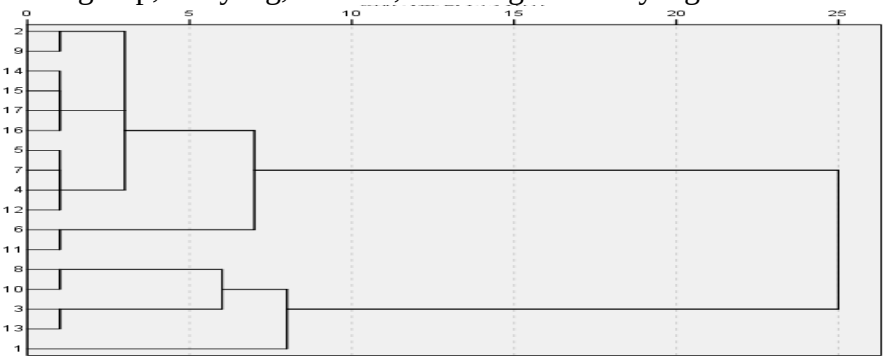

Figure 1. WARD Tree

Figure 1 is a dendrogram of cluster analysis. As can be seen from Figure 1, the distance between the classes is within 25 coordinates. By this way, the whole clustering process can be visually displayed. The results of the pedigree and the number of the cities represented by the pedigree are consistent with those in Table 3.

4. Conclusion

Based on the above cluster analysis, we divide the current economic development level of Henan Province in 2018 into three economic regions:

(1) More developed cities: Zhengzhou.

(2) Medium-developed cities: Luoyang, Jiaozuo, Xuchang and Nanyang.

(3) Developing cities: Kaifeng City, Pingdingshan City, Anyang City, Hebi City, Xinxiang City, Puyang City, Luohe City, Sanmenxia City, Shangqiu City, Xinyang City, Zhoukou City and Zhu Madian City.

From the clustering results, we can find that Zhengzhou as a developed city is the capital of Henan Province because of its location as a transportation hub. It has a large scale and rapid economic development, so it is classified as an economically developed city. And the medium-developed cities, Luoyang, Jiaozuo, Xuchang and Nanyang are relatively large. Luoyang, which is an ancient capital of 11 dynasties, can develop tourism and is close to many cities. Therefore, the economy and trade with other cities are relatively frequent, and the economy is relatively developed. The infrastructure construction of Kaifeng, Pingdingshan, Anyang, Hebi, Xinxiang, Puyang, Luohe, Sanmenxia, Shangqiu, Xinyang, Zhoukou and Zhumadian are relatively backward, the industrial structure is not reasonable enough and the financial revenue is small, so the economy will be relatively backward.

5. Policy Recommendations

Cluster analysis shows that the overall economic development of Henan Province is more

coordinated, but the regional economic development level gap still exists. In a certain period of time, the economic development among regions is unbalanced, which is a normal phenomenon. However, if the gap is too large and the problem is ignored, there will be polarization, which is not conducive to the sustainable development of regional economy. Therefore, we must gradually narrow the gap between regional economic development levels, give full play to the advantages of each region, and realize the coordinated development of Henan's economy. Here, the following suggestions are made:

(1) Improving the policy system of regional coordinated development and defining the policy orientation. We should attach importance to the economic development of developing cities and adopt certain policies and measures, such as increasing investment in infrastructure construction of developing cities, improving the basic living conditions of urban residents in developing countries, and creating a good environment for attracting investment.

(2) Give full play to regional advantages and develop characteristic economy. Municipalities have different advantages in resources, so they can give full play to their advantages, develop characteristic industries and strengthen the division of labor and cooperation among regions according to their characteristics. For example, Anyang and Kaifeng, as well known historical and literary cities, should learn from Luoyang and attach importance to the development of tourism in order to make tourism an important driving force for regional economic development. All regions should seek their own development advantages and enhance their competitiveness by developing characteristic industries.

(3) Combining market mechanism with government intervention mechanism to regulate economic development. The coordinated development of regional economy is not equal to the complete balanced development. We should adhere to the principle of "giving priority to efficiency and giving consideration to fairness". All regions should make full use of regional advantages to absorb radiation from surrounding areas. As an important economic center of Henan Province, Zhengzhou should seize the opportunity to achieve a new leap and play a leading role in the economic center.

(4) Constructing regional innovation system. Science and technology are the primary productivity, and innovation is an important factor in the development of regional economy and strong competitiveness. The construction of regional innovation system helps to improve regional competitiveness and promote regional economic development. Therefore, we must increase investment in science and technology, accelerate the innovation of science and technology knowledge, focus on training innovative talents, and pay attention to the innovation of system and mechanism. Through the establishment of new industrial organizations, the construction of a reasonable financial transfer payment system, the establishment and improvement of the development of underdeveloped areas.

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