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On County Economic Development in Baoding City:

Application of Fuzzy Clustering Method

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Abstract: Based on statistics in 2009 and fuzzy cluster analysis, 22 counties and county-level cities in Baoding were ranked and classified according to their economic development level. It shows that each class has its own respective advantages and characteristics of development, so each country may take actions that suit local circumstances and to promote overall development of the city's economy.

Key words: Fuzzy clustering analysis; Fuzzy equivalent matrix; Regional economy

INTRODUCTION

County economy is the regional economy within the country zone, who is supervised by countryship government and based on rural area development. It optimizes the allocation of resources across the whole county, and has the characteristics of an open regional economy

County economy is the basic unit and an important part of the national economy. It is related not only to the local political stability and economic prosperity, but also to the economic quality and long-run development of the province and city where it locates, even to the sustainable development of the entire national economy and the process of building a moderately prosperous society. The Sixteenth CPC National Congress clearly proposed "boosting the county economy," and the Third Plenary Sessions of its Sixteenth Central Committee further emphasized the necessity "to develop the county economy." So we may say that it is of great significance to do researches on county economy.

1. REVIEWS OF RECENT LITERATURE

1.1 Reviews of Abroad

There is no concept of county economy abroad. Regional economy is close to county economy in the meaning, so we sort out researches on regional economy. Among typical theories are Circular and Cumulative Causation Theory, Economic Balanced Development Theory, Imbalanced Development Theory, invert "U" theory, growth pole theory, Center-external theory. Martine oncluded that regions with geographic advantage win more attraction, and enterprises may benefit from the process of industrial agglomeration. Venables drew a conclusion that trade mode depends on resource endowment, factor intensity and transportation cost on base of new economic geography model. Waitz shows that integration of regional economics leads to increasing return to scale and regional clustering of innovative products, which move forward to bring about productivity growth and regional economic growth.

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1.2 Reviews at Home

Though it is in the 1980s that Chinese scholars first advanced the conception of the county economy, there are very little studies on it until the end of the 20th century. Stepping into the 21st century, domestic research on development of county economy enjoys a boom.

According to Zhan Zhaolei (2010), Chinese county economic development mode may be classified into location-oriented, resource-oriented, capital-oriented, market-oriented, by classification characteristics and evolutionary path, whose common path lies in characterized development and sustainable development.

Li Kun (2010) concludes that county economy of china has comparative advantage in reallocate resources, late-development advantage and geographic advantage.

Tan Fuzhu (2009) pays more attention to constraining factors and countermeasures for county economic development, who shows that unreasonable economic evaluation mechanism, slower scientific transformational system of and issues concerning agriculture, countryside and farmers are the most important restriction on county economic development.

Xu Guihong (2008) investigates into relationship between county financial development and county cconomic growth by unit root tests, cointegration test and causality tests, which shows that county financial seriously keep down the development of county economy. It is important to reform county financial system so as to eliminate county financial suppress on country economy.

Liulin & Qin Wanshun (2009) compares efficiency of country economic development in different regions by DEA, which demonstrates that there exist significant difference between country economic development efficiency in different provinces.

Liu Jie & Gao Huijun (2010) constructs an evaluation indicator system of sustainable county development, according to characteristics and developping direction of county economy in China, on thae principle of coordinated development of the economy, society, natural resources and enviroment.

2. CLUSTERING ANALYSIS ON COUNTY ECONOMIC DEVELOPMENT IN BAODING

2.1 Construction of Evaluation Indicator System

Following previous research and taking into concret situation of Baoding into consideration , we establish an indicator system includeing GDP, per capita GDP, fiscal revenue, per capita revenue, savings deposits of residents, per capita savings deposits of residents, rural per capita net income, total fixed assets investment, per capita fixed assets investment, ratio of revenue to GDP, ratio of increment of savings deposits to GDP, ratio of profit and tax to value-added in above-scale industrial and ratio of value-added in above-scale industrial to GDP, which we denote as

$$Y = (y_1, y_2, y_3, y_4, y_5, y_6, y_7, y_8, y_9, y_{10}, y_{11}, y_{12}, y_{13})$$

Subject investigated is the 18 counties and 4 county-level cities in Baoding, Mancheng County, Qingyuan County, Laishui County, Fuping County, Xushui County, Dingxing county, Tangxian County, Gaoyang County, Rongcheng County, Laiyuan county, Wangdu county, Anxin County, Yixian county, Quyang County, Lixian county, Shunping County, Boye county, Xiongxian County, Zhuozhou City, Dingzhou City, Anguo city, Gaobeidian City, which constitute our sample.

2.2 Standardization of Data

Original data of 13 indicators of 22 counties and country-level cities come form Hebei Economic Yearbook 2010. Due to distinguishalbe difference among the value of the selected indicators, it is difficult to compare them directly. They are non-dimensional-normalized with range transformation method.

2.3 Establishment of Fuzzy Equivalence Relation Matrix

The first step is to calculate the similarity coefficient of each two arbitrary counties by the max-min method, then the following fuzzy similarity matrix, shown in Table 1, Table 2, Table 3.

Table 1

Fuzzy Relation Matrix (1)

Samples	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}
x_1	1	0.745	0.399	0.363	0.793	0.599	0.328	0.788	0.760	0.327	0.415	0.630
x_2		1	0.417	0.311	0.701	0.737	0.385	0.660	0.623	0.292	0.403	0.702
x_3			1	0.601	0.391	0.479	0.501	0.352	0.478	0.255	0.581	0.451
x_4				1	0.340	0.305	0.473	0.337	0.421	0.300	0.482	0.371
x_5					1	0.547	0.314	0.698	0.722	0.321	0.484	0.608
x_6						1	0.384	0.553	0.566	0.211	0.393	0.590
x_7							1	0.275	0.338	0.179	0.412	0.399
x_8								1	0.741	0.333	0.371	0.614
x_9									1	0.318	0.508	0.655
x_{10}										1	0.241	0.330
x_{11}											1	0.557
x_{12}												1

Table 2
Fuzzy Relation Matrix (2)

Samples	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}
x_1	0.586	0.307	0.691	0.470	0.385	0.761	0.472	0.587	0.783	0.747
x_2	0.712	0.370	0.654	0.535	0.448	0.726	0.385	0.575	0.641	0.583
x_3	0.547	0.458	0.466	0.643	0.346	0.463	0.245	0.317	0.376	0.409
x_4	0.384	0.382	0.383	0.494	0.228	0.384	0.248	0.259	0.357	0.404
x_5	0.544	0.293	0.721	0.449	0.326	0.688	0.492	0.629	0.798	0.671
x_6	0.681	0.420	0.612	0.522	0.503	0.651	0.304	0.439	0.507	0.471
x_7	0.494	0.519	0.432	0.491	0.214	0.321	0.177	0.248	0.297	0.421
x_8	0.505	0.263	0.604	0.419	0.355	0.738	0.505	0.514	0.735	0.572
x_9	0.534	0.327	0.682	0.566	0.416	0.750	0.426	0.481	0.713	0.611
x_{10}	0.289	0.166	0.240	0.283	0.157	0.365	0.412	0.394	0.364	0.255
x_{11}	0.472	0.385	0.496	0.527	0.304	0.457	0.231	0.305	0.390	0.435
x_{12}	0.614	0.436	0.624	0.532	0.383	0.746	0.330	0.472	0.595	0.552

Table 3
Fuzzy Relation Matrix (3)

Samples	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}
x_{13}	1	0.521	0.555	0.687	0.452	0.592	0.267	0.436	0.506	0.463
x_{14}		1	0.382	0.459	0.178	0.315	0.158	0.226	0.277	0.308
x_{15}			1	0.484	0.362	0.771	0.394	0.486	0.653	0.695
x_{16}				1	0.472	0.540	0.246	0.358	0.426	0.416
x_{17}					1	0.440	0.192	0.280	0.320	0.296
x_{18}						1	0.392	0.572	0.690	0.549
x_{19}							1	0.618	0.482	0.480
x_{20}								1	0.564	0.554
x_{21}									1	0.578
x_{22}										1

It turns out readily that R characterizes by reflexivity and symmetry, but not transitivity, which results in lack of fuzzy equivalence relation, so one can not be handled by fuzzy clustering analysis. We employ successive square method to solve transitive closure of similar matrix. According to $R \to R^2 \to R^4 \to R^8$, we may get equivalent matrix, which are shown in Table 4, Table 5 and Table 6.

Table 4
Fuzzy Equivalent Matrix (1)

Samples	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}
x_1	1	0.745	0.643	0.601	0.793	0.737	0.519	0.788	0.76	0.412	0.581	0.746
x_2		1	0.643	0.601	0.745	0.737	0.519	0.745	0.745	0.412	0.581	0.745
x_3			1	0.601	0.643	0.643	0.519	0.643	0.643	0.412	0.581	0.643
x_4				1	0.601	0.601	0.519	0.601	0.601	0.412	0.581	0.601
x_5					1	0.737	0.519	0.788	0.76	0.412	0.581	0.746
x_6						1	0.519	0.737	0.737	0.412	0.581	0.737
x_7							1	0.519	0.519	0.412	0.519	0.519
x_8								1	0.76	0.412	0.581	0.746
x_9									1	0.412	0.581	0.746
x_{10}										1	0.412	0.412
x_{11}											1	0.581
x_{12}												1

Table 5
Fuzzy Equivalent Matrix (2)

Samples	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}
x_{13}	1	0.521	0.712	0.687	0.503	0.712	0.618	0.629	0.712	0.712
x_{14}		1	0.521	0.521	0.503	0.521	0.521	0.521	0.521	0.521
x_{15}			1	0.687	0.503	0.771	0.618	0.629	0.761	0.747
x_{16}				1	0.503	0.687	0.618	0.629	0.687	0.687
x_{17}					1	0.503	0.503	0.503	0.503	0.503
x_{18}						1	0.618	0.629	0.761	0.747
x_{19}							1	0.618	0.618	0.618
x_{20}								1	0.629	0.629
x_{21}									1	0.747
x_{22}										1

Table 6
Fuzzy Equivalent Matrix (3)

Samples	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}	x_{21}	x_{22}
x_1	0.712	0.521	0.761	0.687	0.503	0.761	0.618	0.629	0.793	0.747
x_2	0.712	0.521	0.745	0.687	0.503	0.745	0.618	0.629	0.745	0.745
x_3	0.643	0.521	0.643	0.643	0.503	0.643	0.618	0.629	0.643	0.643
x_4	0.601	0.521	0.601	0.601	0.503	0.601	0.601	0.601	0.601	0.601
x_5	0.712	0.521	0.761	0.687	0.503	0.761	0.618	0.629	0.798	0.747
x_6	0.712	0.521	0.737	0.687	0.503	0.737	0.618	0.629	0.737	0.737
x_7	0.519	0.519	0.519	0.519	0.503	0.519	0.519	0.519	0.519	0.519
x_8	0.712	0.521	0.761	0.687	0.503	0.761	0.618	0.629	0.788	0.747
x_9	0.712	0.521	0.76	0.687	0.503	0.76	0.618	0.629	0.76	0.747
x_{10}	0.412	0.412	0.412	0.412	0.412	0.412	0.412	0.412	0.412	0.412
x_{11}	0.581	0.521	0.581	0.581	0.503	0.581	0.581	0.581	0.581	0.581
x_{12}	0.712	0.521	0.746	0.687	0.503	0.746	0.618	0.629	0.746	0.746

3.4 Fuzzy Clustering

We sort the values of the elements in the Fuzzy Equivalent Matrix, rank and number them by $1=\lambda_1>\lambda_2>\cdots\lambda_k$, so as to get a series of classifications, which can reflects comprehensive development level of countries in Baoing. Rearranging these classifications, we devide 22 countries and country-level cities in Baoding into several categories, each possesses its own characteristics.

One category includes Zhuozhou City and Dingzhou City. These two cities both have good historical development foundations, and the Integration of Beijing-Tianjin-Hebei brings about them enormous development opportunities. To make the best of these opportunities and advantages, they invested much in recent years, second only to Laiyuan county, which boosts them with a very good development prospects.

Another category includes Mancheng county, Qingyuan county and Anguo city, whose most important superiority lies in geographic advantage. Expansion of Baoding offers great development opportunities for these surrounding countries, which other counties can not have. Enjoying geographic advantage and pulled by investment, they are expected to maintain a good development momentum.

.A third category includes Xushui, Lixian, Gaobeidian, Anxin, Quyang, Xiongxian, Rongcheng and Tangxian. They all characterize by higher economic development level, higher fiscal revenue and higher farmers' income, which are based on their well-established industrial foundation. Taking each country or country-level city's respective development characteristics and mainstay industry into account, it is anticipated that they go on developping stablely in the future.

The fourth category includes Dingxing County, Yixian County and Gaoyang County. Their pillar industry's contribution to economic development is less than the third category, which makes the biggest difference between the two categories. But on the other hand, these counties and cities also have their own development features and pillar industries. So long as they can make the most of these advantages and features, there is still a much broad development space in front of them.

A fifth category includes Laishui, Shunping, Fuping, Wangdu and Boye. Their lower economic development level depends mainly on agriculture, which may be result of lower contribution of industry and results in farmers' lower income. It should be noted that residents in these areas deposit the most. Relevant economic theory and practice show that expanding domestic demand is an important engine to economic development. So it should be an effective avenue to wash out farmers'fears of trouble in the rear in social security and pension, which may expand domestic demand, and further more, promote economic growth. They can also make use of their inherent advantages to develop green agriculture, such as tourism agriculture and sightseeing agriculture, in order to catch up with the pace of development of other counties and cities.

Laiyuan county itself constitutes a category. It may be classified into the fifth category according to the level of economic development, with the lowest farmers' income. The reason that we don't attribute it to that category lies mainly on the fact that it tops the investment in 22 counties and cities in recent years. Laiyuan county is possessed of rich tourism resources, most of these year's substantial investment flowed into tourism and tourism-relevant-industry. It is expected that, driven by tourism industry, Laiyuan will boom its economy, increase farmers' income on a grand scale, and catch up with some other countries and cities' comprehensive development level.

CONCLUSION

It is simple and effective to make classification for counties in Baoding by Fuzzy Cluster Analysis, which help us to dissect the relationship and economic ties between conomic development in different counties in Baoding more clearly. We found that some counties in Baoding bear similar characteristics of economic development to each other, while some others differ greatly. Such a classification of county economy aims managers in working out strategies and policies in accordance with actual circumstances of local conditions, which is supposed to promote county economy development.

REFERENCES

Xie Jijian & Liu Chengping (2004). *Fuzzy Mathematical Method and Application*. Huazhong University of Science and Technology Press Co. Ltd.(in Chinese).

He Zhongxiong (1983). *Fuzzy Mathematical and Application*. Tianjin Science and Technology Press Co. Ltd.(in Chinese).