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Comprehensive Strength Evaluation of Counties in Guangxi Province Based on Principal Component Analysis

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Abstract: *Guangxi province is located at the junction of eastern, central and western China, as the only coastal autonomous region in China. It is an extremely superior region for foreign exchange, but its GDP is always at the middle and lower level, and there is a large gap between the rich and poor. Based on the data of 48 county-level urban areas in Guangxi Statistical Yearbook in 2021, this article selects the data of economic situation, education foundation and medical security that reflect the comprehensive strength of urban areas, and uses SPSS software to carry out principal component analysis on the relevant data of 48 county-level urban areas, and constructs the comprehensive strength evaluation system of county-level urban areas in Guangxi province. According to the established comprehensive strength evaluation system, this paper explores the main reasons for the development differences between counties and urban areas, and puts forward feasible measures combined with local characteristics to promote the comprehensive strength development of Guangxi province.*

Keywords: *Guangxi Province; county-level city; Principal component analysis; Comprehensive strength evaluation*

1. Introduction

The CPC Central Committee thoroughly implemented the policy of common prosperity. Nevertheless, at present, the comprehensive strength of China's 31 provinces, cities and autonomous regions is uneven, the economic income, health care and education gap are still evident in the life. Xi general secretary in 2017 pointed out that the development potential of Guangxi province in the open degree is very obvious, at the same time also have staying power, in the "area" will play a greater role in construction. Guangxi is located in the central part of South China, southwest China and ASEAN economic development circle. It has the most convenient access to the sea in southwest China, outstanding regional resource advantages, and the superposition of many national development policies, such as the great development of western China, regional autonomy of ethnic minorities, border trade and opening-up of coastal areas, etc. The development of Guangxi by the national people's attention. But in 2020, Guangxi's GDP is the 20th in the country, relatively behind, promoting the development of Guangxi can be no delayed.

Due to the statistical analysis of the human way of skilled, humans began to apply the eye on the statistical analysis method to study the comprehensive ability and discuss the development of China's provinces and cities advice and development trends, such as: Yuhan Zhao etc. (2018) in the literature [1] by using factor analysis and principal component analysis, chose the 31 provinces in China in 2016, a combination of many From the economic society, ecology, Internet penetration rate, etc, to build a comprehensive strength system model; Chengxin Wu (2021) in the literature [2] increased the application of clustering analysis, study of 31 provinces residents income level. Yanhong Wang (2022) establishes an evaluation system of the comprehensive economic strength of cities in Anhui Province in literature [3]. Changke Fan etc. (2010) put forward relevant suggestions on regional development imbalance based on 14 cities in Guangxi in literature [4]. Yi Zhang analyzed the causes of regional class differences in Hubei Province in literature [5]. Wei Yang put forward scientific suggestions suitable for the development of Guangxi province according to various economic indicators in literature [6].

Hence, this article through the principal component analysis method to 48 county of Guangxi urban comprehensive strength are analyzed, to explore the development trend of each county downtown, on the basis of local characteristics and regional characteristics, make its development policy, promote the development of Guangxi province, the overall comprehensive strength, so as to promote the overall

ISSN 2616-7433 Vol. 4, Issue 6: 52-58, DOI: 10.25236/FSST.2022.040609

comprehensive strength development of Guangxi Province.

2. Theoretical review

Principal component analysis, or principal component analysis, can extract more important principal component indicators in multiple indexes.

Main component is generated by the comprehensive index, has an important role in the treatment of dimension reduction, the main contradiction, simplify the analysis difficulty, suitable for deep multivariate statistical analysis. It is more intuitive and fundamental to reflect which factors have a decisive impact on urban comprehensive development.

$$\text{P-dimensional random vector } X = (x_1, x_2 \ldots\ldots x_n)'$$

$$\text{The variance } E(x) = u, \text{ covariance matrix } Var(x) = \sum$$

The principal component analysis model is:

$$\begin{cases} Y_1 = u_{11}X_1 + u_{21}X_2 + \ldots\ldots + u_{P1}X_P \\ Y_2 = u_{12}X_1 + u_{22}X_2 + \ldots\ldots + u_{P2}X_P \\ \ldots\ldots \\ Y_p = u_{1p}X_1 + u_{2p}X_2 + \ldots\ldots + u_{Pp}X_P \end{cases}$$

3. Empirical research

3.1. Index system construction

Based on the relevant index data of 48 urban areas in Guangxi province in 2020, 12 second-level indexes reflecting the comprehensive development level of urban economy, education foundation and medical facilities are selected to construct the comprehensive strength evaluation index system of 48 county-level urban areas in Guangxi Province.

Table 1: Urban comprehensive strength evaluation index system

Level indicators	The secondary indicators
The economic situation	**Permanent Resident Population at year-end (10,000) X_1**
	Gross Regional Product (100 million yuan) X_2
	Value-added of tertiary industry X_3
Education foundation	Regular Secondary Schools (Schools) X_4
	Number of Full-time Teachers in Regular Secondary Schools(persons) X_5
	Number of Full-time primary School teachers(persons) X_6
	Number of students in regular Secondary Schools(persons) X_7
	Number of primary school students(persons) X_8
Medical facility	Number of beds in medical and health institutions X_9
	Medical and health institution technician(person)X_{10}
	Practicing(assistant)physician X_{11}
	The number of rural residents participating in basic endowment insurance X_{12}

Main sources of data: Guangxi Statistical Yearbook in 2021 and related statistical data.

3.2. Principal component analysis

3.2.1. Applicability test

First of all, to KMO test and Bartlett sphere test data, results (shown in the table below)

ISSN 2616-7433 Vol. 4, Issue 6: 52-58, DOI: 10.25236/FSST.2022.040609

Table 2: KMO and Bartlett tests

KMO sampling suitability quantity.		.843
Bartlett sphericity test	The approximate chi-square	1226.044
	degree of freedom	66
	significance	.000

As can be seen from Table 2, KMO test value of 0.843> critical value of 0.6, KMO as an indicator, greater than critical value indicates that the selected 12 variables have strong partial correlation coefficient. Bartlett sphericity test concluded that the significance was 0.000<0.05, which rejected the null hypothesis, indicating that principal component analysis was suitable for processing the data.

3.2.2. Solve for principal components

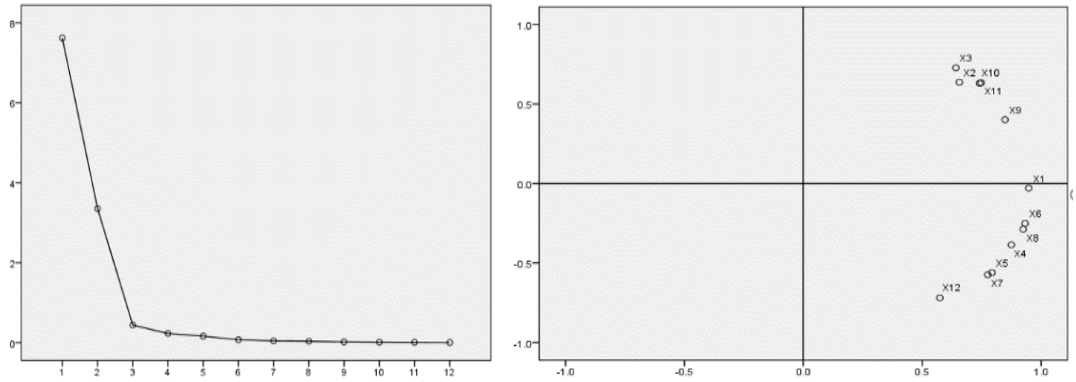
Figure 1: Total variance interpretation

	Initial eigenvalue			Extract the sum of squares of l oads		
ingre dient	aggreg ate	Percentage of variance	accumul ate%	aggreg ate	Percentage of variance	accumul ate %
1	7.620	63.501	63.501	7.620	63.501	63.501
2	3.353	27.942	91.443	3.353	27.942	91.443
3	.441	3.674	95.117			
4	.230	1.916	97.033			
5	.161	1.345	98.378			
6	.073	.611	98.989			
7	.044	.368	99.357			
8	.034	.284	99.641			
9	.019	.159	99.800			
10	.012	.102	99.902			
11	.009	.078	99.981			
12	.002	.019	100.000			

Extraction method: principal component analysis.

Figure 2 shows that the first two principal components can explain 91.501% of the total variance. According to the selecting principle of principal component is greater than 87%, the first two principal components factor can better response 48 county in Guangxi province urban comprehensive strength. Therefore, the first two principal component phonemes are selected for principal component score calculation and comprehensive ranking.

Figure 2: Gravel diagram and component diagram



Gravel figure more intuitive to show that the first two principal component index can represent all the factors. Starting from the third factor, the image area is flat and finally close to a straight line without fluctuation. Therefore, it is reasonable to select two principal component factors.

ISSN 2616-7433 Vol. 4, Issue 6: 52-58, DOI: 10.25236/FSST.2022.040609

Figure 3: Component matrix

	composition	
	1	2
X1	.948	-.030
X6	.933	-.251
X8	.925	-.288
X4	.875	-.385
X9	.848	.401
X5	.793	-.560
X7	.776	-.574
X11	.748	.634
X10	.741	.631
X2	.656	.638
X3	.642	.728
X12	.574	-.719

Extraction method: principal component analysis. a, two components were extracted.

By the characteristic value of the principal component and component matrix numerical principal component factor model are obtained

The eigenvalues belong to the first principal component is 7.62

$$\sqrt{7.62} = 2.76$$

$F_1=0.343*X_1^*+0.238*X_2^*+0.233*X_3^*+0.317*X_4^*+0.287*X_5^*+0.338*X_6^*+0.281*X_7^*+0.335*X_8^*+0.307*X_9^*+0.268*X_{10}^*+0.271*X_{11}^*+0.208*X_{12}^*$

The eigenvalue of the second principal component is 3.3534

$$\sqrt{3.353} = 1.83$$

$F_2= -0.016*X_1^*+ 0.349*X_2^*+ 0.398*X_3^*-0.210*X_4^*-0.306*X_5^*-0.137*X_6^*-0.314 *X_7^*-0.157*X_8^*+0.219*X_9^*+ 0.345*X_{10}^*+ 0.346*X_{11}^*-0.393*X_{12}^*$

Variance contribution rate is used as factor weight to obtain a new model.

$$Y=0.635*F_1+0.279*F_2$$

3.2.3. Ranking of comprehensive strength evaluation

As can be seen from Table 6, the comprehensive strength of 48 county-level urban areas varies significantly, with a large gap between the rich and the poor. Qingxiu area as the capital of Guangxi Nanning prefecture best comprehensive development, education and health care and economic development balanced, comprehensive score of 7.41, is ahead and scored a total of eight county city above 1, Guiping city, Beiliu city, Xingbin area these three county-level city health care and better economic foundation, However, basic education is obviously backward, hindering urban development. Among them, 11 county-level cities and urban areas scored 0-1 in comprehensive strength, and the rest were all below 0 in comprehensive strength. In 48 county-level urban areas, the educational foundation of most urban areas is close to 0 or negative, indicating that the overall educational foundation of Guangxi province is relatively weak and education awareness and facilities need to be strengthened. In 20 county-level urban areas, F1 and F2 are negative, indicating that economic medical foundation and education investment are closely related and interact with each other.

ISSN 2616-7433 Vol. 4, Issue 6: 52-58, DOI: 10.25236/FSST.2022.040609

Figure 4: Comprehensive strength situation ranking

region	F1	F2	Y	ranking
Qingxiu area	8.14	8.03	7.41	1
Xixiangtang area	6.86	2.65	5.1	2
Yuzhou area	5.73	0.32	3.73	3
Guigang city	7.82	-4.72	3.64	4
Beiliu city	5.87	-3.83	2.66	5
Jiangnan area	2.24	0.37	1.52	6
Xingbing area	2.64	-0.95	1.41	7
Yufeng area	1.26	1.78	1.3	8
Gangbei area	1.44	0.22	0.98	9
Xingning area	0.62	1.6	0.84	10
Youjiang area	1.28	0.07	0.83	11
Cenxi city	2.24	-2.79	0.64	12
Haicheng area	0.23	1.78	0.64	13
Liunan area	0.44	0.91	0.53	14
Chengzhong area	-0.17	2.25	0.52	15
Liangqing area	0.19	0.55	0.27	16
Liubei area	-0.24	1.35	0.22	17
Qinbei area	0.9	-1.25	0.22	18
Yizhou area	0.33	-0.43	0.09	19
Jinchengjiang area	-0.41	0.29	-0.18	20
Babu area	0.47	-1.8	-0.2	21
Xiangshan area	-0.96	1.18	-0.28	22
Liugui area	-0.36	-0.22	-0.29	23
Wangxiu area	-1.49	1.32	-0.58	24
Liujiang area	-1.02	-0.21	-0.71	25
Gangnan area	-0.45	-1.55	-0.72	26
Qinnan area	-0.89	-0.61	-0.74	27
Tantang area	-0.55	-1.67	-0.82	28
Fangcheng area	-1.1	-0.56	-0.85	29
Jingxi city	-0.67	-1.74	-0.91	30
Qixing area	-1.8	0.79	-0.93	31
Jiangzhou area	-1.47	-0.12	-0.97	32
Changzhou area	-1.85	0.48	-1.04	33
Pinggui area	-1.13	-1.31	-1.09	34
Lipu city	-1.66	-0.48	-1.19	35
Yongning area	-1.74	-0.4	-1.21	36
Gangkou area	-2.22	0.7	-1.22	37
Xiufeng area	-2.22	0.66	-1.23	38
Tianyang area	-1.92	-0.58	-1.38	39
Longyu area	-1.97	-0.52	-1.4	40
Yinghai area	-2.17	-0.11	-1.41	41
Fumian area	-2.05	-1.02	-1.59	42
Diecai area	-2.78	0.57	-1.61	43
Dongxing area	-2.44	-0.47	-1.68	44
Tieshangang area	-2.82	-0.05	-1.81	45
Pingxiang area	-3.17	-0.13	-2.05	46
Heshan area	-3.35	-0.16	-2.17	47
Yanshan area	-3.61	-0.16	-2.34	48

4. Conclusions and suggestions

This article from the economy, education and medical facilities three aspects of the comprehensive strength of the comprehensive inspection area, draw the conclusion: Guangxi province, each county downtown development gap bigger and most of the city below average, so according to the study and analysis, using principal component analysis of SPSS software build 48 urban comprehensive strength evaluation system, and gives Suggestions accordingly:

4.1. Strengthen regional cooperation plus

In this paper, the comprehensive strength of 48 county-level urban areas in Guangxi province is evaluated, which reflects the differences in regional economy and education and medical care. Qingxiu area, Xixiangtang area, Guiping city and other urban areas as Guangxi the main urban area of Nanning,

ISSN 2616-7433 Vol. 4, Issue 6: 52-58, DOI: 10.25236/FSST.2022.040609

the provincial capital, has a high level of overall economic development and education. Surrounding the city shall strengthen the exchanges and cooperation, and developed city, the provincial capital, to improve surrounding underdeveloped city central cities, realize the development drive before development. At the same time, excavate the characteristic area, promote the characteristic area to develop the economy, drive the local economy with the characteristic later. Make full use of coastal geographical advantage, promote foreign exchanges, expand trade, innovation and development concept.

4.2. Give play to geographical advantages

Analysis of regional influence, Xixiangtang area superior geographical location, more developed tourism has brought economic benefits. As the only autonomous region, coastal development, develop characteristic tourism and service industry and other tertiary industry economy, so as to promote the comprehensive development of the province. Adjust measures to local conditions, improve the development strategy of areas with relatively backward comprehensive strength, and develop development industries suitable for their own.

Expanding areas of exchanges and cooperation, relying on the geographical advantage of its proximity to the ASEAN Sea, accelerate building open the new pattern of win-win cooperation, to become an important part of the Marine silk road, driving the development of trade in Guangxi province.

4.3. Balanced industrial development

We should optimize the distribution of industries, expand the distribution of industrial chains, constantly promote industrial transformation, and promote the development of industrialization in the middle and later stages, build regional modern trade and logistics bases, keep pace with the development of The Times, strengthen emerging industries such as the Internet and high and new technology, new technology will drive economic growth, optimizing the economic structure of industry chain. Strengthening brand awareness, build brand Guangxi characteristics.

4.4. Support backward areas

At the same time, effective resources should be transferred to backward areas, facilities construction and development of backward county-level urban areas should be strengthened, development direction should be explored based on local conditions, and the government should increase financial assistance to narrow regional economic differences in the form of "One Belt one", "One belt many" in developed areas.

4.5. Strengthen transportation hubs

According to economic benefit and reasonable planning and traffic routes, convenient transportation for county urban traffic, is conducive to connect, increase trade, Guangxi province should grasp the coastal advantages, enhance the traffic to the outside and the surrounding developed cities, the traffic hub is the bridge of economic trade.

4.6. Attach importance to education

High-quality talents can make the city maintain vitality and creativity, strengthen the talent introduction and settlement policy, with beautiful scenery, convenient transportation, comfortable housing and children's education preferential policies to attract high-quality talents to settle down in Guangxi County urban areas, improve the accumulation of human resources, with knowledge to drive economic development. Increasing the financial input in economic policy at the university of high quality, build first-class university, attaches great importance to the university teachers' scientific research output, encourage scientific research innovation, increase investment in basic education.

4.7. Improve social security

For the purpose of people-oriented, pay attention to people's livelihood, further implement the policy of the people's livelihood. During the epidemic prevention and control period, it is especially important to pay attention to public health, and strengthen investment in medical facilities and service policies of medical staff.

Guangxi attaches great importance to the protection of ecological environment. As an old industrial

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base, Guangxi suffers from serious environmental pollution. While improving environmental pollution, we should strengthen environmental protection measures.

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