

Research on Mathematical Model of Well-off Society Construction and Sustainable Development

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Abstract. The COVID-19 in 2020 alerts us that how to properly respond to emergencies, how to better maintain economic vitality, and how to achieve sustainable social and economic development are an important guarantee for a country's enduring prosperity. This paper first reviews the development of the past 20 years, evaluates the overall construction of index stratification and correlation analysis. Through fuzzy clustering and main component analysis, we classify and evaluate the construction of provinces by MATLAB. Then, based on the long-term sustainable development of countries and provinces, this paper establishes a multi-objective planning model to seek the optimal economic development strategy, at the same time, we creatively consider the impact of emergencies such as COVID-19 to revise the model. This paper introduces mathematical models into social-economic research, which are rigorous and scientific, and have strong reference value for the social development and construction of China.

Keywords: Sustainable development and construction; Mathematical models; MATLAB.

1. Introduction

Promoting the sustainable development of society is a major topic of social construction, and the emergence of COVID-19 puts forward new challenges for the development flexibility of social construction. How to improve the emergency response ability and sustainable development ability of the country and society in an environment full of uncertainty has become the object of many scholars. According to the Statistical Monitoring Index System for Building a moderately prosperous society in all respects publicly published by the National Bureau of Statistics in 2017 (hereinafter referred to as the "Index System"), the specific 39 index systems are classified according to the "five-in-one", sort the weights provided by the index system, and take the top 12 indicators for research;

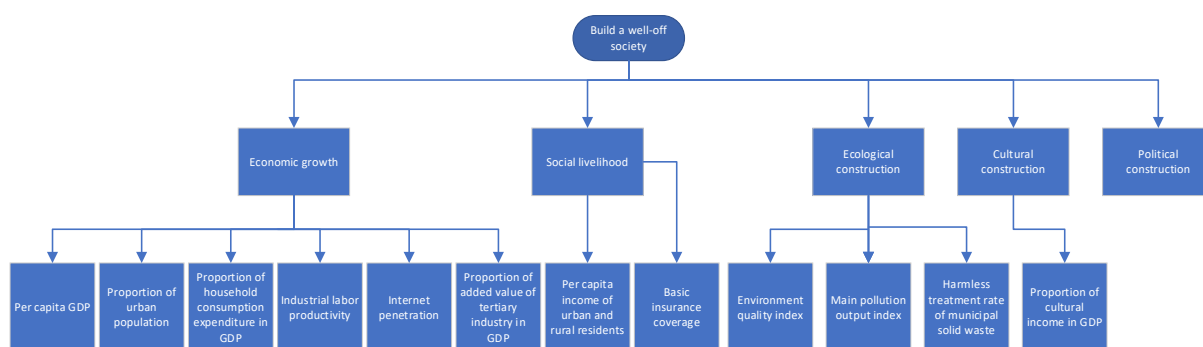


Fig. 1 Index structure chart for completing the building of a moderately prosperous society in all respects

If the 34 provinces are directly evaluated and sorted, the data will be very complicated. Therefore, we try to simplify the problem, and the idea is shown below:

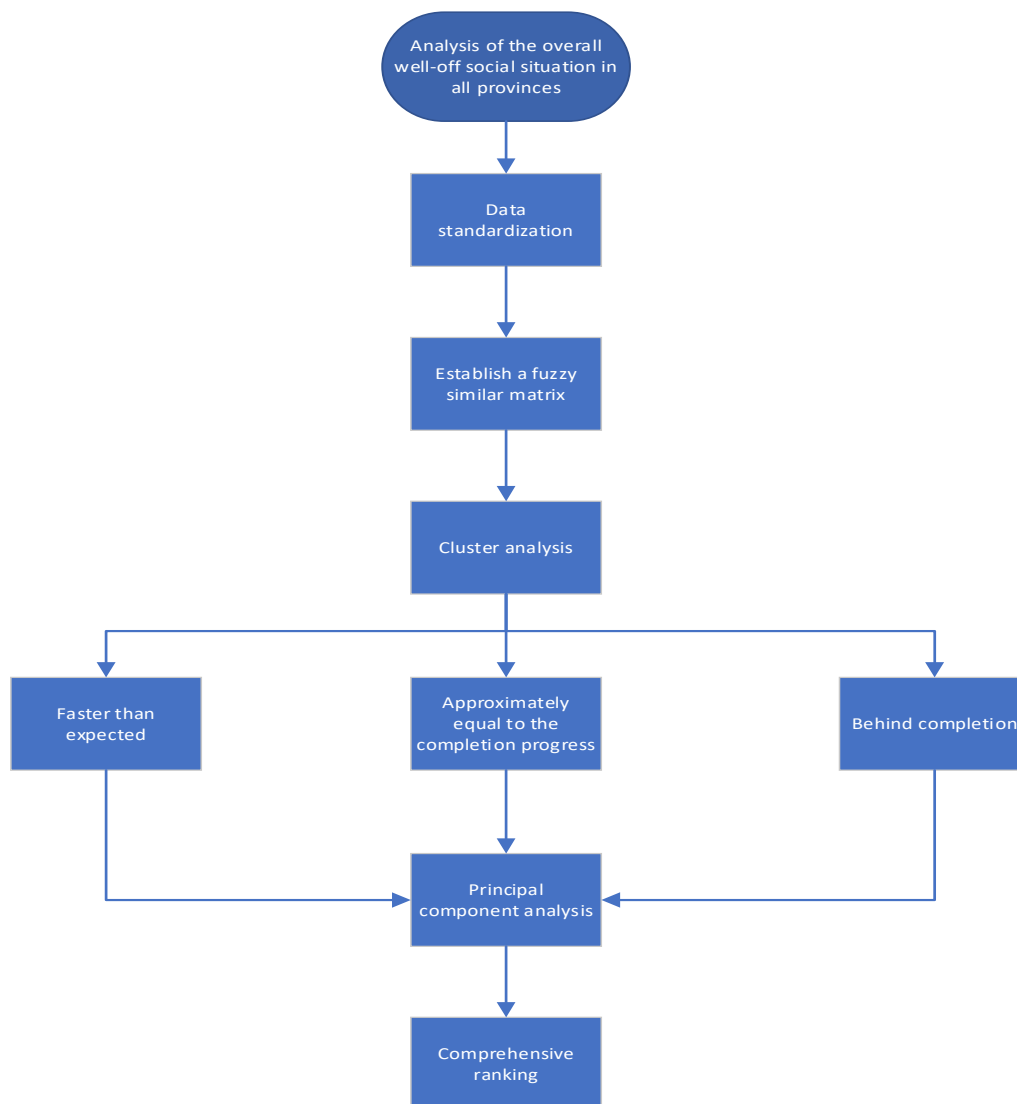


Fig. 2 Evaluation idea flow chart of various provinces

After completing the summary evaluation, combine the evaluation results, summarize the development experience, and further guide the next sustainable development strategy. In the process of planning the overall sustainable development strategy, this paper first clarifies what the specific goals of sustainable development are, and lists the target function, according to the requirements of sustainable development, list specific constraints, from the past data to establish a multi-target planning model, calculate with MATLAB, and find a more reasonable sustainable development scheme with mathematics method. In the planning research of various provinces, this paper just selects typical provinces and selects provinces in medium level. In the short-term development planning, the same ideas and methods are adopted in the short-term development planning, but in the long-term planning, considering the influence and treatment of major emergency, this paper optimizes the model and hopes to explore a sustainable development strategy with strong resistance and large elasticity.

2. Construction process evaluation

2.1 Overall construction evaluation

First conduct the data preprocessing: Through the official website of the National Bureau of Statistics, we consulted 8 of the 12 key indicators on completing the building of a moderately prosperous society in all respects within the period of 20 years and made tables; Then, for each index in each province, take the data most recent in time to 2020, and again form a matrix of 34×8 ; Then

conduct data standardization. The representative secondary indexes are selected according to economy, livelihood, and ecology: per capita disposable income, household garbage clearance and accumulated balance of urban and rural residents to analyze the internal relationship.

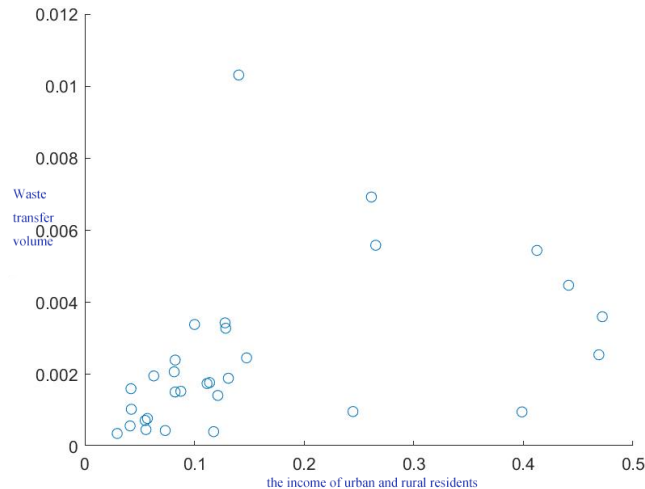


Fig. 3 Relationship chart between garbage traffic volume and urban residents income

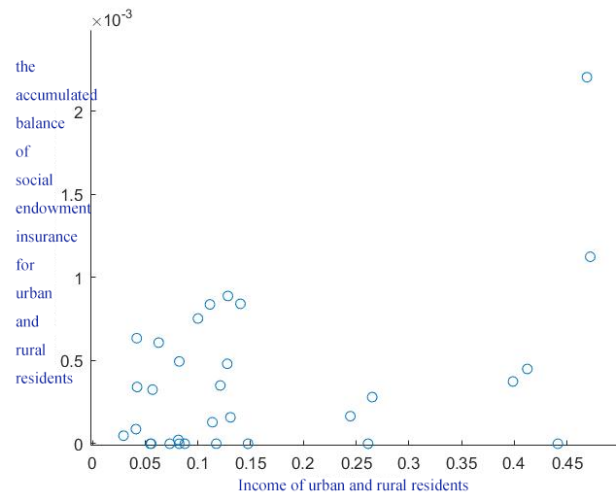


Fig. 4 Relationship chart between residents' per capita disposable income and the accumulated balance of social endowment insurance for urban and rural residents

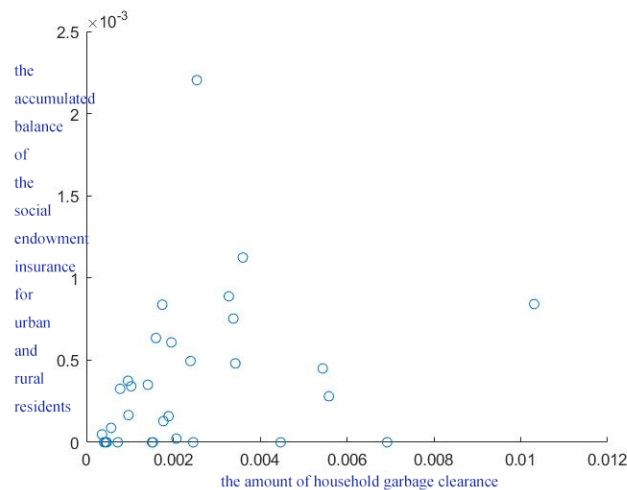


Fig. 5 Relationship chart between the amount of household garbage clearance and the accumulated balance of the social endowment insurance for urban and rural residents

It can be seen from the scatter map that, excluding the individual deviation data, there is a certain positive correlation between the per capita disposable income of the overall residents, the amount of domestic garbage clearance, and the cumulative settlement of the social endowment insurance for urban and rural residents.

We can get :

First, economic construction, people's livelihood construction and ecological construction complement each other and promote each other;

Second, China vigorously promotes the "Five-in-One" and "Four-pronged" strategic layout, especially after the 18th CPC National Congress, focusing on the position of people's livelihood and ecological construction, in line with the concept of completing the building of a moderately prosperous society in all respects;

2.2 Situation assessment of each provinces

Building a well-off society in all respects is mainly reflected in the above 12 indicators, the greater the value of the index, means that the better the development of the region, the difficulty of the comprehensive realization of a well-off society will be reduced accordingly, under the premise of both positive related, can consider directly with 12 indicators to measure the difficulty coefficient of building a well-off society in an all-round way; As for the completion, we calculate the current completion of each set in the above indicators according to the definition of the 16th society, the 17th National Congress and the 18th National Congress of the CPC ; As for sustainable development capacity, it mainly calculates the ecological indicators of each collection, mainly including three indicators: main energy reserves, urban garbage treatment and water resources. The higher the index value, the stronger the sustainable development ability. According to the above indicators, the statistics data of the National Bureau of Statistics are found. We use fuzzy similarity analysis and main component analysis, and the analysis process is as follows:

First, perform data normalization and establish a fuzzy similarity matrix;

Then, with the direct clustering method to classify each province, to take the similarity:
 $\lambda_1 = 0.990 \quad \lambda_2 = 0.960 \quad \lambda_3 = 0.920$.

Provinces with higher similarity, grouped together;

After fuzzy clustering analysis, provinces with high similarity of comprehensive well-off process can be combined together, and the classification results are as follows:

{Beijing, Zhejiang, Shanghai, Fujian, Jiangxi, Hubei, Hunan}

{Hebei Shanxi, Inner Mongolia, Shandong Hainan}

Tianjin, Jilin, Guangxi}

{Guangdong, Jiangsu, Sichuan, Liaoning}

{Heilongjiang, Anhui, Chongqing, Shaanxi}

{Guizhou, Gansu, Ningxia, Xinjiang, Qinghai-Tibet, Qinghai}

Each province of each of the above six sets has similar degrees of development to each other, so only the six sets are generally ranked and evaluated;

Due to the large number of indicators, the main component analysis is used to simplify the indicators, take the average value, select Fujian, Shanxi, Guangxi, Sichuan, Henan and Gansu respectively as the collection representatives, for evaluation and analysis, and model calculation with MATLAB.

Table 1. Points representing the province can be obtained first

Position in a name list	Province	Score
1	Henan	4.7429
2	Sichuan	0.6474
3	Fujian	0.2216
4	Shanxi	0.1725
5	Guangxi	-0.1816
6	Gansu	-0.5821

The scores of the six provinces in the main energy reserves, urban garbage treatment, water resources, the higher the index value, the stronger the sustainable development capacity are as follows:

Fujian: 0.4538 -0.5193 0.4228 0.6790 0.0353 0.0732

Shanxi: 0.6557 -1.0465 0.9667 0.7668 0.4439 0.1062

Guangxi: -1.0024 2.0301 1.2822 2.8549 2.4313 -0.1093

Sichuan: -0.1683 -1.3270 1.2506 0.2374 1.0515 -0.0578

Henan: -0.9498 -1.7815 1.5508 0.3190 1.9271 -0.2601

Gansu: -6.5162 17.1556 6.8126 13.8629 14.9720 -0.2327

Points shows the collections represented by the above 6 provinces:

1). Beijing and other places are in the forefront in economic development and livelihood construction, and can also timely achieve the economic indicators of a comprehensive well-off society. However, there is still a certain gap in the ecological construction of waste treatment and other areas, which needs to be focused on improvement in the later stage;

2). Tianjin and other places are slightly less than Beijing in terms of economic construction, especially GDP per capita, However, the two collections are similar in terms of people's livelihood, but in ecological construction is indeed due to Beijing and other places, Therefore, these provinces should have a higher comprehensive ranking;

3). Guizhou Province, Qinghai, Tibet and Qinghai Province will lag behind, but these provinces have made remarkable achievements in ecological construction, and have great potential in energy, and have great potential for sustainable development.

3. Outlook for sustainable development planning

3.1 Future short-term construction ideas

It mainly considers three aspects: economic development, energy utilization and population control, constructs three objective functions, and combines specific data to find the optimal or optimal solution.

The goal of sustainable development established in this paper is to achieve the total GDP with the minimum of pollutant emissions (half in 20 years) and the minimum population growth (double in 20 years).

Establish the objective function and the constraints are as follows:

$$\begin{aligned}
 -e &= -e_0 - \alpha_e \cdot t & \alpha_e &= 2\alpha_r - \alpha_p \\
 r &= r_0 - \alpha_r \cdot t & -\alpha_r &\leq -0.025 \cdot r_0 \\
 p &= p_0 + \alpha_p \cdot t & \alpha_p &\leq 0.025 \cdot p_0
 \end{aligned}$$

Table 2. The meanings of each parameters are as follows:

symbol definition	symbol description
$e(t)$	Total GDP s for Year t
e_0	Total GDP s for the start year
α_e	GDP annual growth rate
$r(t)$	Carbon emissions in Year t
r_0	Carbon emissions in the start year
α_r	Rate of decreasing carbon emissions
$p(t)$	Total population in Year t
p_0	Total population for the start year
α_p	Annual population growth rate
Δe	Emergency result in economic losses after t years
Δe_0	Economic damage of the year caused by the emergency
α	Economic loss impact rate

The weight of economy, population and energy can be set to 1:2:2;

Call the fgoalattain function in MATLAB to solve the above model, and the following conclusions are drawn: Population growth is controlled at around 17,603 million people a year, pollutant emissions are reduced by about 1086.200 tons per year, maintaining this speed can make the environment fully protected, and the economy continues under great population pressure, doubling the total volume again in 20 years.

3.2 Future long-term construction ideas

However, if it is a long-term sustainable development, we have to consider the impact of some sudden factors. Therefore, new influence factors α are introduced. Assuming that the incident duration is half the total planned duration, the new constraint and the target function are:

$$\begin{aligned}
 \alpha_e &= 2\alpha_r - \alpha_p - \alpha & -e &= -e_0 - \alpha_e \cdot t \\
 -\alpha_r &\leq -0.025 \cdot r_0 & r &= r_0 - \alpha_r \cdot t \\
 \alpha_p &\leq 0.025 \cdot p_0 & p &= p_0 + \alpha_p \cdot t \\
 \alpha &\leq 0.0125 \cdot \alpha_0 & \Delta e &= \Delta e_0 + 0.5 \cdot \alpha \cdot t
 \end{aligned}$$

The specific indicators are reflected in through calculate: Controlling population growth is about 569 million per year, and reducing pollutant emissions decrease by about 355,5400 tons per year. When the economic economy is affected, efforts are made to ensure that economic losses are within 50.061 billion yuan and adjust to reduce the impact time of the event within 50% of the planned time.

4. Summary

4.1 Research conclusions

First, the gross industrial product of Beijing, Zhejiang, Shanghai, and Fujian far exceeds that of Gansu and Ningxia, especially in the scale of large and medium-sized enterprises. By setting up enterprise branches in the western region, or even directly moving the headquarters to the west, and then drive the urbanization rate of the western region, the average income of employment population and residents, and timely achieve a higher leap in the economic level;

Second, the western region has rich resources, and has a remarkable effect in ecological environment construction. On the basis of ecological guarantee, the western region carries out technical cooperation with the central and eastern provinces to realize the effective development and utilization of resources;

Third, in the face of major public emergencies such as new coronavirus, the provinces should be strategic reserve, clear the province advantage industry, in the rapid development of the tertiary industry, properly maintain the development of the secondary and tertiary industries, actively use agriculture policy, on the one hand to benefit people's livelihood, on the one hand, drive the modernization of agriculture, solve the problem of food reserves;

4.2 Research Significance

The research significance of this paper lies in two levels. The first layer is the scientific evaluation of our social construction process, and obtains the national sustainable development strategy through mathematical modeling. In particular, we study how to overcome the difficulties for emergencies under the uncertain environment, minimize the impact, and ensure the robustness and frustration resistance of development. Provide an important reference for China's next development planning. The second level is that the correlation analysis and main component analysis used in this paper can be extended to more fields: First, deepen the research level from the province to the city and county level, and more accurately analyze the regional differences existing in the process of building a moderately prosperous society in an all-round way, so as to facilitate the precise policies in the later stage; Second, refine the index, build a scientific index evaluation system and data processing method, and solve the situation of serious inconsistency between magnitude and magnitude; Third, we will improve the model of social and economic operation under an emergency, give more reasonable and sustainable social development plans, and provide scientific, rigorous and effective reference for China on the way forward of the second centenary goal.

References

- [1] Zhu Weidong, Zhou Fei, Wei Boning Construction and Measurement of China's High-quality Development Index System in the new era [J]. Wuhan Finance, 2019 (12): 18-26.
- [2] Li Chungen. Complete the building of a moderately prosperous society in all respects: theoretical analysis, progress monitoring, and policy optimization [J]. Journal of Social Sciences, Hunan Normal University, 2018,47 (04): 1-9.
- [3] Zhang Qian, Ma Qiuhua. Construction of the index system for completing the building of a moderately prosperous society in all respects [J]. Statistics and Management, 2018 (10): 114-116.
- [4] Jiang Qiyuan, Xie Jinxing, Ye Jun., Mathematical Model [M]. Beijing. Higher Education Press., 2018.348-353.
- [5] Hu Xiaodong, Dong Chenhui. MATLAB went from entry to mastery at [M]. Beijing. China Industry and Information Technology Publishing Group. 2018.452-453.
- [6] National Bureau of Statistics. Regional data. Provincial annual data.
- [7] National Bureau of Statistics. Annual data.