Asian Journal of Social Science Studies; Vol. 7, No. 3; 2022
ISSN 2424-8517 E-ISSN 2424-9041
Published by July Press

Anti-Poverty Performance Assessment and Forecasting

Zhengyao Wang[1]

[1] College of Mathematics and Physics, Chengdu University of Technology, Chengdu, China

Correspondence: Zhengyao Wang, College of Mathematics and Physics, Chengdu University of Technology, Chengdu, Sichuan, China. E-mail: 1113436776@qq.com

Received: February 17, 2022 Accepted: March 10, 2022 Online Published: March 28, 2022

doi:10.20849/ajsss.v7i3.1051 URL: https://doi.org/10.20849/ajsss.v7i3.1051

Abstract

In order to further help each unit that mitigates the poverty of impoverished regions to improve the efficiency of poverty alleviation, this paper establishes a poverty alleviation performance evaluation index system. Firstly, we analyze the correlation among poverty alleviation indicators through a matrix density diagram. Second, the questions are divided into target layer (poverty alleviation performance), criterion layer (poverty alleviation efficiency, poverty alleviation effect, and poverty alleviation rate), and indicator layer, and the fuzzy hierarchical integrated evaluation method is used to calculate the performance score of each poverty alleviation unit. In addition, based on the historical data, support vector machines were used to calculate the grading rules and predict whether the village could be awarded the title of "advanced village in poverty alleviation". Finally, based on the study, recommendations were made to the National Poverty Alleviation Office for the differences in the individuality of the villages and the distribution of the work content of the poverty alleviation units.

Keywords: anti-poverty performance, support vector machines, fuzzy hierarchical integrated evaluation

1. Introduction

The performance evaluation mechanism of poverty alleviation and support is an important method to evaluate the effectiveness of poverty alleviation units, which is conducive to better motivating each help unit to improve the efficiency of poverty alleviation. In the evaluation process, it is necessary to consider all factors such as the foundation of the poverty alleviation target and the poverty alleviation unit. In addition to the total score of each indicator, the relative progress of the indicator, the foundation of the village, and the focus of the poverty alleviation unit on poverty alleviation have an impact on the later indicators, so a more detailed, scientific and accurate performance evaluation mechanism is particularly important for the true reflection of the efforts made by the help units on poverty eradication and the results of poverty alleviation and the achievement of the 100-year goal.

In this research context, our problematic hypotheses are.

a) The initial cooperation with poverty alleviation efforts is consistent in each village.

b) The survey has consistent data authenticity and objective score evaluation.

c) Each poor village does not have any major disaster incidents that have a significant impact on the local economy, environment, etc.

2. Method

In this paper, through the poverty survey in 2015 and 2020, five evaluation indicators, including residents' income (recorded as SR), industrial development (recorded as CY), living environment (recorded as HJ), culture and education (recorded as WJ), and infrastructure (recorded as SS), were used to give scores to 32,165 poor villages and standardize the data (the higher the value, the higher the score). Based on the data of 2015, the villages were divided into 160 sets, and specific support units were designated from the six categories of 160 support units to provide one-to-one precise support. In order to fairly and objectively judge the effect of helping, the progress of each indicator needs to be considered comprehensively in addition to the final total performance score. According to the above conditions, we analyze and study the correspondence of each evaluation index before and after poverty alleviation, and effectively rank the performance of different types of help units in terms of their work attitude, objectives, input, and cadre quality, and predict whether the villages can be rated as "advanced villages out of poverty".

2.1 Relationship Between pre- and Post- Poverty Relief Indicators

First, the mean clustering method was used to divide each index into five grades to judge the quality of the index quantitatively. According to the grades, the data of 2015 and 2020 were corresponding to obtain matrix density map to intuitively and qualitatively reflect the relationship between corresponding indicators before and after poverty alleviation. Then, in order to further explore the quantitative relationship before and after the index, Pearson correlation analysis was conducted on the index data of 2015 and 2020 to determine the strength of correlation, and T test was conducted to determine the significance of the data difference, so as to determine whether it is a significant increase.

2.1.1 Establish Indicator Classification

Because you need to determine the indicators of quality, so the specific index for grading, an average clustering method is used here, the data is divided into 5 groups, were randomly selected from five objects as the initial clustering centers, and then calculated for each object and the distance between every seed clustering center to allocate each object to its nearest cluster center distance. Cluster centers and the objects assigned to them represent a cluster. Each time a sample is assigned, the cluster center of the cluster is recalculated according to the existing objects in the cluster. This process is repeated until some termination condition is met. Until the minimum number of objects are reassigned to different clusters, the center of the minimum number of clusters changes again, and the error square and local minimum (Xue, W., 2008) are obtained, which can be divided into the following index levels:

Table 1. Classification of indicator levels

Number	Project	Type I	Type II	Type III	Type IV	Type V
1	People's income (SR)	[0.78,+∞)	[-0.08, 0.78)	[-0.95,-0.08)	[-2.00,-0.95)	(-∞,-2.00)
2	industrial development (CY)	[0.51,+∞)	[-0.22, 0.51)	[-1.04,-0.22)	[-2.23,-1.04)	(-∞,-2.23)
3	Living environment (HJ)	[0.36,+∞)	[-0.46, 0.36)	[-1.45,-0.46)	[-2.85,-1.45)	(-∞,-2.85)
4	Cultural education (WJ)	[0.51,+∞)	[-0.25, 0.51)	[-1.14,-0.25)	[-2.17,-1.14)	(-∞,-2.17)
5	infrastructure (SS)	[0.45,+∞)	[-0.31,0.45)	[-1.16,-0.31)	[-2.31,-1.16)	(-∞,-2.31)

According to the index classification, all indicators are divided into {1,2,3,4,5} corresponding {V, IV, III, II, I}, and 2015 corresponding to 2020, so as to obtain the matrix density diagram of each indicator in Figure 1 to Figure 5. The darker the color, the higher the density.

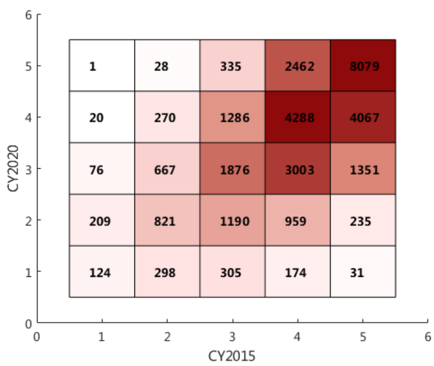

Figure 1. Industrial development

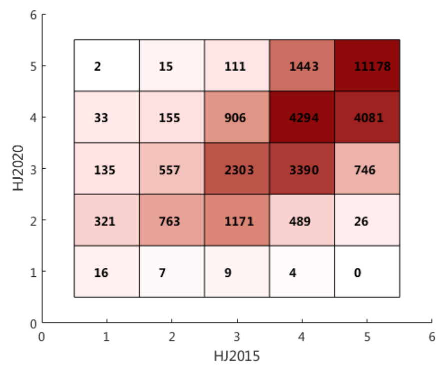

Figure 2. Living environment

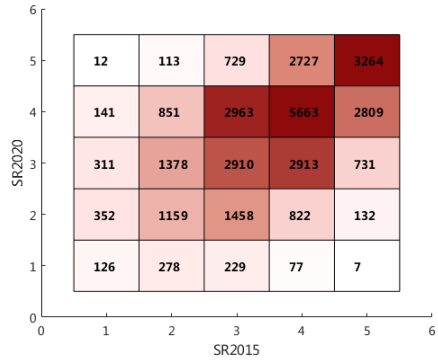

Figure 3. Household income

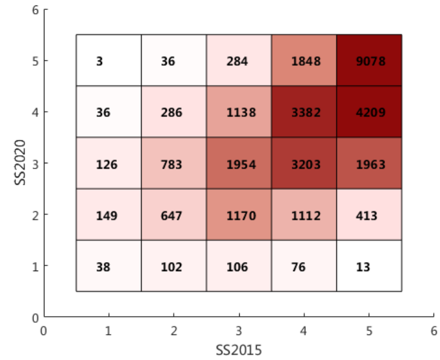

Figure 4. Infrastructure

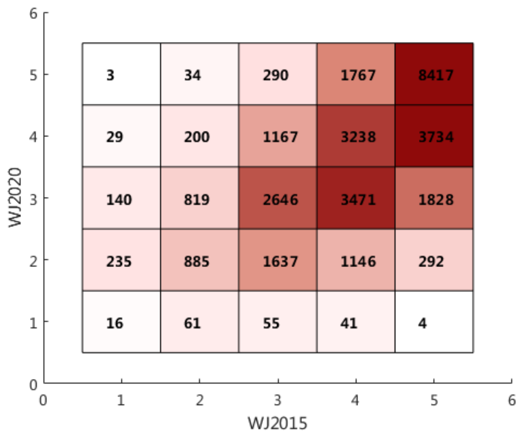

Figure 5. Culture and education

According to the matrix density of industrial development in Fig.1 it can be seen from the figure that in 2015, there are 306 villages above Grade 1 in 2020, accounting for 71.1%. In 2015, there were 1786 villages at grade 2 or above in 2020, accounting for 85.7%; In 2015 and 2020, 3,499 villages, accounting for 70.1%, were at level 3 or above. In 2015, 6,750 villages were at grade 4 or above, accounting for 62%; In 2015, 8,079 villages, accounting for 58.7%, were at level 5 or above in 2020. Similar conclusions can also be drawn in Figures 2 to 5. In other words, the density of each index at or above the diagonal is high, that is, the poor villages below the level in 2015 are likely to be at or above level five years later, that is, at the qualitative level, it can represent that when the index performance value in 2015 is in a good position, 2020 will still be in a good position.

2.1.2 Corresponding Relationship Exploration

First, Pearson correlation analysis was conducted for 15-year indicators and 20-year indicators, and the correlation strength of variables was judged by the following value range: correlation coefficients 0.8-1.0 strongly correlated, 0.6-0.8 strongly correlated, 0.4-0.6 moderately correlated, 0.2-0.4 weakly correlated, 0.0-0.2 extremely weak correlated.

Table 2. Correlation coefficients of each index

2015 / 2020	SR	CY	HJ	WJ	SS
SR	.524				
CY		.640**			
HJ			.737**		
WJ				.636**	
SS					.594**
**The Sig (double tail) of each indicator is 0.000					

According to the results in Table 2, it can be found that the correlation coefficients of the corresponding indicators are all greater than 0.5. Therefore, the scores of the five indicators in 2015 and 2020 are moderately correlated and positively correlated.

Make a difference between the indicators of 2020 and 2015, and conduct a T-test to judge whether they are significantly greater than 0, that is, a significant growth trend.

Since SPSS is equipped with a bilateral test method, the bilateral test is performed at the significance level of 0.05 to obtain the corresponding value. If $P/2 < \alpha$, it is proved that unilateral test is performed at the significance level of 0.05, and the change difference between 2015 and 2020 is significantly greater than 0 (Liu, Z., & Wang, S.-P., 2020).

Table 3. T-test results

	T	Degrees of freedom	Sig.	Mean difference
ΔSR	10.704	16382	.000	.06758
ΔCY	9.307	16382	.000	.03880
ΔHJ	27.137	16382	.000	.10320
ΔWJ	-1.752	16382	.080	-.00868
ΔSS	5.225	16382	.000	.02603

It can be concluded from Table 3 that under the T-test at the significance level of 0.05, the change difference value is greater than 0, that is, all indicators show a significant growth trend.

It can be concluded that, at the quantitative level, resident income and infrastructure scores in 2020 are moderately positively correlated with resident income and infrastructure scores in 2015, and industrial development, residential environment, culture, and education in 2020 are strongly correlated.

2.2 Unit Performance Ranking Model Based on the Fuzzy Hierarchical Comprehensive Evaluation

The factors which are difficult to be quantified in the performance of poverty alleviation work are transformed into quantified treatment by establishing a fuzzy comprehensive evaluation system. The target layer is the performance evaluation system of poverty alleviation. The criterion layer includes poverty alleviation efficiency (B1), poverty reduction rate (B2), and poverty alleviation effect (B3). The indicator layer takes the change value of each indicator, the score of each indicator in 20 years, and the percentage of poverty-reduction villages as indicators. According to the final score calculation formula obtained from the model, the comprehensive scores of 6 types of poverty alleviation units were calculated and ranked. Similarly, the comprehensive scores of 160 assistance units were obtained and the top 10 were taken out.

2.2.1 Establishing a Performance Evaluation Index System

Firstly, a comprehensive evaluation system of fuzzy hierarchy is established. The first layer is the target layer, i.e. the poverty alleviation performance evaluation system (A1), and the second layer is the criterion layer, which includes poverty alleviation efficiency (B1), poverty reduction rate (B2), and poverty alleviation effect (B3) (Wang, K.-X., & Yang, Y.-Z., 2020). The third layer is the indicator layer, which contains 10 indicators, as shown in Figure 6:

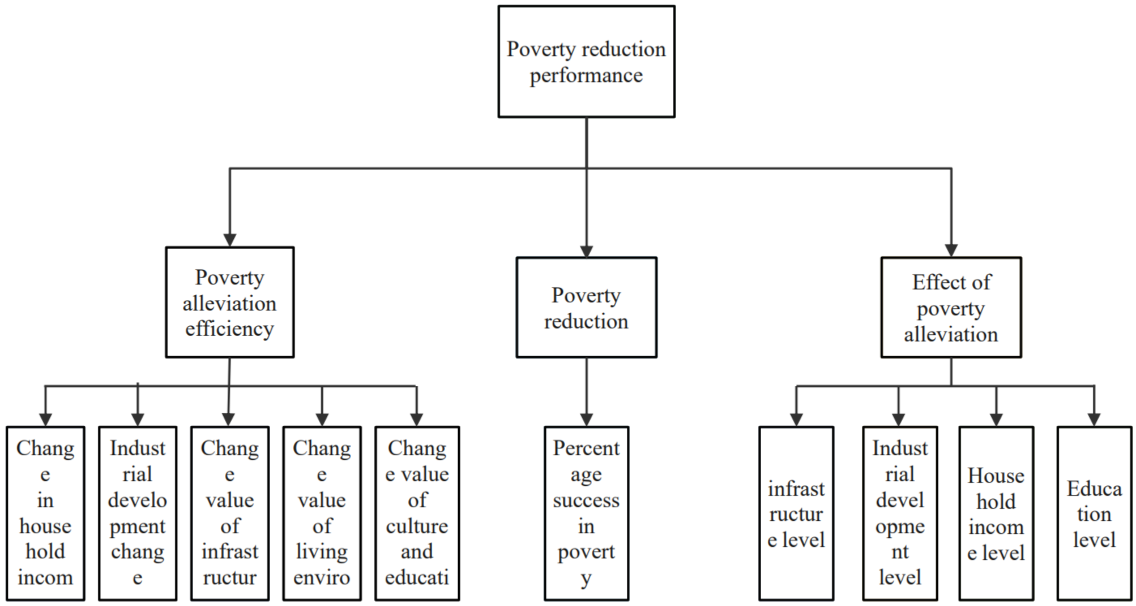

Figure 6. Index evaluation system

2.2.2 Fuzzy Hierarchical Comprehensive Evaluation Calculation

Secondly, the index weight is determined. According to Li, Y., (2016), the relative importance of the criterion layer is established to constitute a judgment matrix, as shown in Table 4:

Table 4. The relative importance of criteria

Indicators	Poverty alleviation efficiency	Poverty reduction rate	Effect of poverty alleviation
Poverty alleviation efficiency	1	3	2
Poverty reduction rate	1/3	1	1/2
Effect of poverty alleviation	1/2	2	1

Normalized processing:

$$\bar{B}_{ij} = \frac{B_{ij}}{\sum B_{ij}}$$

The weight of each index W_i is {0.5390; 0.1637; 0.2972}

Then solve the consistency index of the matrix:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

λ_{max} is the characteristic root with the largest absolute value of the judgment matrix, and n is the order of the judgment matrix.

Calculation of consistency evaluation indicators:

$$CR = \frac{CI}{RI}$$

Plug it in, solve it: $CR = 0.009 < 1$, and pass the test.

According to the above steps, 10 specific indicators of the indicator layer are constructed to obtain the specific weight

$A_{ij} = \{0.226\ 0.058\ 0.141\ 0.060\ 0.055\ 0.163\ 0.124\ 0.032\ 0.077\ 0.033\ 0.030\}$.

Then the indexes are standardized

Positive indicators:

$$y_i = \frac{x_i - MINx_i}{MAXx_i - MINx_i}$$

Negative indicators:

$$y_i = \frac{MAXx_i - x_i}{MAXx_i - MINx_i}$$

The standardized data under each index C_{ij} are obtained

The final score is calculated as follows:

$$Z = \sum_{j=1}^{n} W_i A_{ij} C_{ij}$$

Matlab program into the data to run the results.

Table 5. Performance ranking of unit types

Types of poverty alleviation units	Poverty alleviation efficiency (0.5390)	Poverty reduction rate (0.1637)	Effect of poverty alleviation (0.2972)	Score	Ranking
0	0.1312042	0.7556985	0.309	0.3100588	3
1	0.129	1	0.2591637	0.3417077	1
2	0.1316587	0.8170844	0.1680653	0.278454	4
3	0.1290588	0.994612	0.1673214	0.3120262	2
4	0.364	0	0	0.178542	6
5	0.1302791	0.6111876	0.1196974	0.2220062	5

According to the weighted total score of all types of poverty alleviation units in Table 5, the ranking of poverty alleviation performance of all types of units is 3,1,4,2,6,5.

2.3 Classification Prediction Based on Support Vector Machine

SVM can theoretically approach any nonlinear function in a global sense, and it improves the generalization ability of the model according to the principle of structural risk minimization. Even when the statistical sample size is small, good statistical rules can be obtained (Si, S.-K., 2015). The principle of SVM nonlinear regression is briefly described below.

Given a set of real numbers $A = \{(x_i, y_i), i = 1,2, \ldots, n\}$. Suppose it obeys an unknown function $y = g(x)$ Where x_i is the input vector of the ith sample, y_i is the target value of the ith sample, and n is the sample size.

In order to use data set A regression $y = g(x)$, the fitting function form of SVM is:

$$f(x) = \omega\phi(x) + b$$

Where, ω is the weight vector; b is bias; $\phi(x)$is a nonlinear mapping function.

And it can be obtained through the risk minimization function R_{srm}.

$$R_{srm} = C\sum_{i=1}^{n} L_{\varepsilon}(y_i, f(x_i)) + \frac{1}{2}||w||^2$$

In order to obtain w and b, the relaxation variables ξ_i and ξ_i^* are introduced, thus minimizing R_{srm} can be written as

$$\min R_{srm} = \frac{1}{2}||w||^2 + C\sum_{i=1}^{n}(\xi_i + \xi_i^*)$$

$$Subject\ to \begin{cases} y_i - b - [w\phi(x_i)] \leqslant \varepsilon + \xi_i \\ [w\phi(x_i)] + b - y_i \leqslant \varepsilon + \xi_i * \\ \xi_i, \xi_i^* \geqslant 0, i = 1, \cdots, n \end{cases}$$

The above problems can be solved by the Lagrange optimization method, and can be obtained:

$$w = \sum_{i=1}^{n}(a_i - a_i^*)\phi(x_i)$$

Where, α_i、$\alpha_i^*$is the Lagrange multiplier corresponding to the ith sample.

Substitute the formula into the decision function:

$$f(x) = \sum_{i=1}^{n}(a_i - a_i^*)K(x,x_i) + b$$

The kernel function of this paper is RBF kernel (Jiang, Q.-Y., & et al., 2011), and the equation is

$$K(x_i,x_k) = \exp(-\gamma||x_i - x_k||^2),(\gamma > 0)$$

Where, γ is the kernel parameter of the kernel function.

According to different selected kernel functions and different proportions of the selected training set and test set, a support vector machine is used for classification prediction (Si, S.-K., 2015), and the accuracy table in Table 6 is obtained.

Table 6. Prediction accuracy rate

	RBF Accuracy of training set	RBF test set Accuracy	RBF total sample accuracy
50%:50%	0.7755	0.7529	0.7642
60%:40%	0.775	0.7535	0.7664
70%:30%	0.7762	0.7565	0.7703
80%:20%	0.7744	0.7608	0.7717
90%:10%	0.7738	0.7627	0.7727

Combined with the above table data comparison, we selected 70% of the training set and 30% of the test set, and adopted the RBF kernel function for classification prediction.

3. Results

Targeted poverty alleviation is the new requirement of the CPC Central Committee and The State Council for poverty alleviation and development work. It is an important way to solve the problems of poverty alleviation and development work, such as unclear bases, inaccurate targets, and poor results, and an important guarantee for the building of a moderately prosperous society in all respects. In order to better reflect the effectiveness of targeted poverty alleviation, accurate assessment should not only measure the performance of poverty alleviation and development work in a true and scientific way but also serve as an important basis and reference for further adjusting poverty alleviation policies, measures, and projects.

Through the established model and the results of the research, it is found that the village basis has a certain influence on the poverty alleviation achievement and index evaluation score of the follow-up poverty alleviation units, and also affects the goals of the poverty alleviation units in the poverty alleviation work and the investment in different indicators. Therefore, in order to more reasonably evaluate the performance of poverty alleviation units and better stimulate and promote the enthusiasm of poverty alleviation units, the following suggestions are put forward:

1. In the performance evaluation of poverty alleviation units, in addition to the overall score of the index evaluation during the assessment period, the basis of each index of poverty-stricken villages connected by

poverty alleviation units should also be considered, and the progress of index scoring and the reasonable and accurate setting of index weight should be included in the performance evaluation. The poverty alleviation units in villages with poor foundations should be evaluated with certain tendencies or more indicators.

2. The performance evaluation index can also provide a corresponding index evaluation for those poverty alleviation units that have excellent performance in solving the most urgent and weakest poverty points in villages.

3. Incorporate the progress range of each indicator, performance score of unit, and type of unit into performance evaluation.

References

Jiang, Q.-Y., & *et al.*. (2011). *Mathematical Model.* Beijing: Higher Education Press.

Li, Y. (2016). Practical difficulties and countermeasures of performance appraisal mechanism of targeted poverty alleviation. *Qinghai Social Sciences*, (3), 132-137.

Liu, Z., & Wang, S.-P. (2020). Fuzzy comprehensive evaluation of poverty alleviation performance from precise perspective -- A Case study of Xiangxi Tujia and Miao Autonomous Prefecture. *Journal of Yunnan University of Finance and Economics, 36*(5), 104-112.

Si, S.-K. (2015). *Mathematical Modeling Algorithm and Application* (2nd ed.). Beijing: National Defense Industry Press.

Wang, K.-X., & Yang, Y.-Z. (2020). Grey clustering -- Fuzzy Synthesis Model and its application for performance Evaluation of green agricultural supply Chain. *Mathematics in Practice and Cognition, 50*(2), 111-119.

Xue, W. (2008). *Statistical Analysis and APPLICATION of SPSS*. China Renmin University Press.

Copyrights