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The study of cultivation and development of youth sports' social organization based on the grey evaluation model

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ABSTRACT

Teenagers are the hope of our nation and people. It is every Chinese' duty to develop teenager's sports and make them own healthy bodies. This article analyses problems of cultivation and development of youth sports' social organization by the means of analytic hierarchy process, and does the systematic quantification to the three selected indexes with the multilevel grey evaluation. Finally the text gets the conclusion that donate of public sectors plays a very important role in the development of youth sports' social organization, and the conclusion are reasonable. At the same time, it proves the reasonability of the model.

KEYWORDS

Youth sports; Social organization; Analytic hierarchy process; Grey evaluation; Physical health.

INTRODUCTION

Early in the last century, some countries have formed the distinct cultivation system of youth sports' social organization which mainly includes that the governments, socials, enterprises, individuals and other sports organizations enter into the youth's activities. With the relative documents being promulgated by State Physical Culture Administration in 2000, activities about cultivation and development of youth sports' social organization were stared around our country. The cultivation and development of youth sports' social organization is forging ahead at a high speed.

Many people have done efforts on the correlation study of youth sports organization and they did get great achievements. For example, Luo Lei and other people put forward that China didn't form a model management system of youth clubs, and if people want to achieve the rapid development of youth sport clubs, it was the fundamental guarantee to protect youth clubs to become a part of the market. Zhao Huifen used China and Japan as the objects of study and did systematic analysis aiming at the mode of operation of youth clubs. Zhao proposed the disadvantages and appealed to decrease cost of youth clubs through the power of social to increase financing channels, and encouraged teenagers to join in the clubs.

On the bases of former research results, this article studied algorithm of analytic hierarchy process and multilevel grey evaluation model, and it provided theoretical basis for them. Besides, we used lots of experiences to correctly grasp the cultivation and development level of youth sports' social organization. From many aspects we accessed positive factors of youth social sports' development so that we could lay a good foundation for the development of youth sports' social organization.

THE ESTABLISHMENT AND APPLICATION OF HIERARCHICAL ANALYSIS MODEL

Hierarchical analysis model also is called AHP model. It owns strong logicality and hierarchical structure. Its algorithm mainly calculates the weights among indexes. It can be applied to comprehensive evaluation. It is a powerful mathematical method to turn a problem into quantitative study. The analysis cultivation and development of youth sports' social organization involves many reference indexes. This decision problem is applied for analytic hierarchy process.

First this text choose the three level evaluation index system aiming at the study objects. Combined with former research results, we can make sure each index layer, like TABLE 1:

TABLE 1 : Each index system

Target layer	Criterion layer	Index layer
Cultivation system of youth sports social organization W	Social assistance of youth sports K_1	Donate of companies T_{11}
		Donate of individuals T_{12}
		Donate of foundations T_{13}
		Donate of trust fond T_{14}
		Donate of public sectors T_{15}
	Youth sports association K_2	Single sports association T_{21}
		Amateur athletic association T_{22}
		Youth competitive sports association T_{23}
		Youth armed sports T_{24}
		Youth tournament T_{25}
	Youth sports publicity channels K_3	Calculation webpage T_{31}
		Newspapers and periodicals T_{32}

Radio and television	T_{33}

Construction of judge matrix

Comparing the former three index layers particularly, we use the relative materiality of the two to construct the judge matrix. Therein, we took K_i, K_j to do the comparative structure of importance, and used K_{ij} to express. After all factors being compared, we can get judge matrix W, as following:

$$W = \begin{pmatrix} K_{11} & K_{12} & \cdots & K_{1j} \\ K_{21} & K_{22} & \cdots & K_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ K_{i1} & K_{i2} & \cdots & K_{ij} \end{pmatrix}$$

K_{ij} is the degree of importance value of index i and j compared to target (k). Relatively judge matrix is $T = (T_{ij})_{n \times n}$:

$$T_{ij} = \frac{1}{T_{ji}}; (i \neq j; i, j = 1, 2, 3, \cdots, n)$$

To describe with number 1-9. The meaning of number is as following TABLE 2.

TABLE 2 : Meaning of scale 1-9

scale	meaning
1	Two factors are same important to the target
3	Former factor is a bit more important than latter
5	Former factor is more important than latter
7	Former factor is comparatively more important than latter
9	Former factor is much more important than latter
Even number	The importance is between two odd numbers
Reciprocal	The order of factors' positive and negative comparison

Weight vector and maximum eigenvalue

Normalization processing was made according to the judge matrix vector of first level index. We can get the weight vector after the row summation and normalization processing. The eigenvalue can be solves according to the relationship between eigenvalue and eigenvector. The method of realization is as following:

First of all, normalization processing every row of judge matrix, the result is:

$$K_{ij} = K_{ij} / \sum_{k=1}^{n} K_{kj} (i, j = 1, 2, \cdots, n)$$

Next, summing the judge matrix which has been normalization processed by column by row, we can get the following:

$$\overline{\omega_i} = \sum_{j=1}^{n} K_{ij} \, (i = 1, 2, \cdots, n)$$

Then normalization processing above-mentioned vector $\overline{\omega} = \left[\overline{\omega_1}, \overline{\omega_2}, \cdots, \overline{\omega_n}\right]^T$:

$$\overline{\omega_i} = \frac{\overline{\omega_i}}{\sum_{j=1}^{n} \overline{\omega_j}} (i = 1, 2, \cdots, n)$$

So, $\omega = [\omega_1 , \omega_2 , \ldots , \omega_n]^T$ is the eigenvector.

In addition, calculating the max characterized root to establish formula: $\lambda_{\max} = \sum_{i=1}^{n} \frac{(U\omega)_i}{n\omega_i}$

The $(U\omega)_i$ is vector $(U\omega)$'s i-th component.

According above formulation, we can get the first level index and the weight vector and maximum eigenvalue of second level index to first level index.

Consistency test

As far as matrix $U = (b_{ij})_{n*n}$ is concerned, if the elements meet the demand $b_{ij} b_{jk} = b_{ik}$, the matrix is straight matrix. Therein, $b_{ij} > 0$, $b_{ij} = 1/b_{ji}$. In order to use it to calculate vector's weight, we require that the inconsistency of matrix just is under the acceptance conditions. When the problem is complex and we cannot consider all factors, it makes judge matrix can't reach the ideal consistency while doing pairwise comparison to construct judge matrix.

Calculation method of the consistency indicator CI and consistency ratio CR of judge matrix is as following: $CI = \frac{\lambda_{\max} - n}{n - 1}$

n is the order of matrix which is equal to the number of comparison factors: $CR = \frac{CI}{RI}$

RI represents the RUndom Consistency Index, as TABLE 3:

TABLE 3 : RI chart

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

When $CR \geq 0.1$, we think that there is inconsistency in the matrix. It needs to readjust the judge matrix. When $CR < 0.1$, the inconsistency of matrix is under acceptance conditions.

If single level judge matrix satisfies the consistency throughout the consistency test, we think the calculation weight is reasonable. Next step is to do combined consistency test. Assumed that in some level, m factors' result of weight calculation is α_m, and the corresponding consistency indicators are CI_m respectively. The consistency ratio of the combine consistency test is: $CR = \frac{\sum_{j=1}^{m} \alpha_j CI_j}{\sum_{j=1}^{m} \alpha_j RI_j}$

After calculation, the combined consistency ratio is: $CR < 0.1$

So consistency test of total hierarchy permutation meets the consistent demand. Then we can think that results of weight calculation of every index of the cultivation system analysis of youth sports' social organization are reasonable.

Through the above process, we can respectively get the corresponding weight of every level's index and the comprehensive weight, as TABLE 4:

TABLE 4 : The weight chart of each index

Target layer	Criterion layer	Weight	Index layer	Weight
			T_{11}	0.41
			T_{12}	0.05
	K_1	0.57	T_{13}	0.10
			T_{14}	0.15
			T_{15}	0.29
			T_{21}	0.25
W			T_{22}	0.19
	K_2	0.12	T_{23}	0.25
			T_{24}	0.13
			T_{25}	0.18
			T_{31}	0.18
	K_3	0.31	T_{32}	0.16
			T_{33}	0.66

THE MULTILEVEL GREY EVALUATION METHOD BASED ON MATLAB

The establishment of the model

First we need to assure the evaluation matrix. Assumed that U is the set matrix of all evaluation, in order to clarify clearly, we set two levels as example to illustrate. Then the corresponding specific definition of set is:

$$U = \{U_1, U_2, \cdots, U_m\}$$

The corresponding set weight is:

$$A = \{A_1, A_2, \cdots, A_m\}$$

Thus the corresponding set of second level index is:

$$U_i = \{U_{i1}, U_{i2}, \cdots, U_{in}\}$$

And the weight can further represent as:

$$A_i = \{a_{i1}, a_{i2}, \cdots, a_{in}\}$$

According to the specific problems, we can confirm the grey level of grey whitening function evaluation and make e as the evaluation of class which is described by whitening weight function.

From the evaluation result of valuator, we can get grade. So the corresponding matrix is D:

$$D = \begin{bmatrix} d_{111} & d_{112} & \cdots & d_{11p} \\ d_{121} & d_{122} & \cdots & d_{12p} \\ \cdots & \cdots & \cdots & \cdots \\ d_{in1} & d_{in2} & \cdots & d_{inp} \end{bmatrix} \begin{matrix} U_{11} \\ U_{12} \\ \cdots \\ U_{in} \end{matrix}$$

Then we can use valuator's grey coefficient X_{ije} to express:

$$X_{ije} = \sum_{i=1}^{p} f_e\left(d_{ij1}\right)$$

Synthesizing all results of evaluation, we can get the comprehensive evaluation result X_{ij}, then we can set up the formula:

$$X_{ij} = \sum_{e=1}^{g}\left(X_{ije}\right)$$

As same as the former result, we can ensure gray evaluation weight:

$$r_{ije} = \frac{X_{ije}}{X_{ij}}$$

We can make sure gray evaluation weight vector of every evaluation indicator:

$$r_{ij} = \left(r_{ij1,} \quad r_{ij2,} \quad \cdots, \quad r_{ijg}\right)$$

Aiming at weight matrix of second level indicator's every grey evaluation, we can make it as R:

$$R_i = \begin{bmatrix} r_{i1} \\ r_{i2} \\ \cdots \\ r_{in1} \end{bmatrix} = \begin{bmatrix} r_{i11} & r_{i12} & \cdots & r_{i1g} \\ r_{i21} & r_{i22} & \cdots & r_{i2g} \\ \cdots & \cdots & \cdots & \cdots \\ r_{in1} & r_{in2} & \cdots & r_{ing} \end{bmatrix}$$

So the result of comprehensive evaluation B, we can know:

$$B_i = A_i \cdot R_i = \left(b_{i1}, b_{i2}, \cdots, b_{ig}\right)$$

Through above process, we can get the results of valuator's comprehensive evaluation and we can get assignment of grey level after the normalization processing. The results go through

$$Z = B \cdot D^T$$

So we can gain foundation of the same level detection index's order of quality.

United with this article's objects, evaluation matrix D can be formed through TABLE 4:

$$D = \begin{bmatrix} 4 & 3.5 & 3.5 & 3 & 4 \\ 2 & 3 & 2 & 2.5 & 2 \\ 2.5 & 2 & 2.5 & 3 & 2.5 \\ 3 & 2.5 & 3 & 3 & 3.5 \\ 3.5 & 4 & 3.5 & 3 & 3 \\ 4 & 3 & 3 & 3.5 & 2.5 \\ 3 & 3.5 & 3 & 2.5 & 4 \\ 4 & 3.5 & 3.5 & 3 & 3 \\ 2.5 & 2 & 2.5 & 3 & 2.5 \\ 3 & 2.5 & 3 & 3.5 & 2.5 \\ 2 & 2 & 2.5 & 3 & 2 \\ 2 & 2 & 2 & 2.5 & 2.5 \\ 3 & 2.5 & 3 & 3.5 & 3 \end{bmatrix}$$

With the former evaluation level, we can set four sorts of grey evaluation: $e = 1, 2, 3, 4$. And the grey number and whiting function related to index are shown as TABLE 5:

TABLE 5 : Grey function table

$e=1$	$e=2$	$e=3$	$e=4$
$\otimes_1 \in [4, \infty)$	$\otimes_2 \in [0,3,6]$	$\otimes_3 \in [0,2,4]$	$\otimes_4 \in [0,1,2]$
$f_1\left(d_{ijk}^{(S)}\right) = \begin{cases} \frac{d_{ijk}^{(S)}}{4} & d_{ijk}^{(S)} \in [0,4] \\ 1 & d_{ijk}^{(S)} \in [4,\infty) \\ 0 & d_{ijk}^{(S)} \notin [0,\infty) \end{cases}$	$f_2\left(d_{ijk}^{(S)}\right) = \begin{cases} \frac{d_{ijk}^{(S)}}{3} & d_{ijk}^{(S)} \in [0,3] \\ \frac{d_{ijk}^{(S)}-6}{-3} & d_{ijk}^{(S)} \in [3,6] \\ 0 & d_{ijk}^{(S)} \notin [0,6] \end{cases}$	$f_3\left(d_{ijk}^{(S)}\right) = \begin{cases} \frac{d_{ijk}^{(S)}}{3} & d_{ijk}^{(S)} \in [0,2] \\ \frac{d_{ijk}^{(S)}-4}{-2} & d_{ijk}^{(S)} \in [2,4] \\ 0 & d_{ijk}^{(S)} \notin [0,4] \end{cases}$	$f_4\left(d_{ijk}^{(S)}\right) = \begin{cases} 1 & d_{ijk}^{(S)} \in [0,1] \\ \frac{d_{ijk}^{(S)}-2}{-1} & d_{ijk}^{(S)} \in [1,2] \\ 0 & d_{ijk}^{(S)} \notin [0,2] \end{cases}$

The confirmation of gray coefficient

Via the weights of the former evaluation index, we can get the total number of grey evaluation of all grey evaluation, and the calculation process is following:

e=1 $$x_{111} = \sum_{k=1}^{5} f_1(d_{11k}) = f_1(4) + f_1(3.5) + f_1(3) + f_1(4) = 1 + 0.875 + 0.875 + 0.75 + 1 = 4.5$$

e=2 $x_{112} = f_2(4) + f_2(3.5) + f_2(3) + f_3(3) + f_2(4) = 0.664 + 0.8333 + 0.8333 + 1 + 0.337 = 4$

e=3 $x_{113} = f_3(4) + f_3(3.5) + f_3(3.5) + f_3(3) + f_3(4) = 0 + 0.25 + 0.25 + 0.5 + 0 = 1$

e=4 $x_{114} = f_4(4) + f_4(3.5) + f_4(3.5) + f_4(3) + f_4(4) = 0 + 0 + 0 + 0 + 0 = 0$

Through the total evaluation index e, we can further gain the grey evaluation weight vector:

e=1 $r_{111} = x_{111}/x_{11} = 4.5/9.4 = 0.473$

e=2 $r_{112} = x_{112}/x_{11} = 4.9/9.4 = 0.421$

e=3 $r_{113} = x_{113}/x_{11} = 1/9.4 = 0.106$

e=4 $r_{114} = x_{114}/x_{11} = 0/9.4 = 0$

We can get the grey evaluation matrix from the former calculation, and every matrix is:

$$R_1 = \begin{bmatrix} r_{11} \\ r_{12} \\ r_{13} \\ r_{14} \\ r_{15} \end{bmatrix} = \begin{bmatrix} 0.46 & 0.42 & 0.11 & 0 \\ 0.26 & 0.35 & 0.39 & 0 \\ 0.28 & 0.38 & 0.34 & 0 \\ 0.42 & 0.38 & 0.20 & 0 \\ 0.42 & 0.43 & 0.15 & 0 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} r_{21} \\ r_{22} \\ r_{23} \\ r_{24} \\ r_{25} \end{bmatrix} = \begin{bmatrix} 0.38 & 0.42 & 0.19 & 0 \\ 0.39 & 0.42 & 0.19 & 0 \\ 0.42 & 0.43 & 0.15 & 0 \\ 0.29 & 0.38 & 0.33 & 0 \\ 0.33 & 0.41 & 0.26 & 0 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} r_{31} \\ r_{32} \\ r_{33} \end{bmatrix} = \begin{bmatrix} 0.26 & 0.39 & 0.36 & 0 \\ 0.25 & 0.34 & 0.41 & 0 \\ 0.34 & 0.43 & 0.23 & 0 \end{bmatrix}$$

To do the corresponding evaluation to the second level index, like the first level. Through applying the formula $Z = B \cdot D^T$, we can get evaluation results, as TABLE 6:

TABLE 6 : Comprehensive evaluation table

Target layer	Comprehensive score	Criterion layer	Comprehensive score	Index layer	Comprehensive score
				T_{11}	3.35
				T_{12}	2.80
W	2.97	K_1	3.26	T_{13}	2.95
				T_{14}	3.21
				T_{15}	3.68

		T_{21}	3.11
		T_{22}	3.05
K_2	3.14	T_{23}	2.96
		T_{24}	3.07
		T_{25}	3.27
		T_{31}	2.84
K_3	3.6	T_{32}	2.09
		T_{33}	2.89

In order to show the distinction, this text drew broken line graph Figure 1.

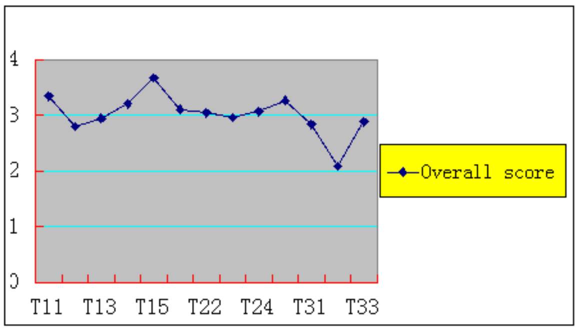

Figure 1 : Index layer evaluation results

CONCLUSION

(1)This article makes sure weight by the means of analytic hierarchy process, and use the multi-level grey approach to give evaluation about the cultivation and development of youth sports' social organization. From the final graph we can see that donate of social organization plays a so important role in the development youth social sports.

(2)Via the calculation data, we can know that even if we have the final result, it is essential to analyses the result, this text's investigation of cultivation and development of youth sports' social organization is by the means of the comprehensive analysis' achievement. And we obtain the conclusion that the weakness should be improved and enhanced.

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