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Research Article

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An improved ELECTRE method to the evaluation of extracurricular sports lifestyle

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ABSTRACT

The sports participative behavior is the most important manifestation of sports lifestyle, which is also the key point to measure the sports lifestyles of different populations at various times. For this reason, an improved ELECTRE method is proposed to the evaluation of extracurricular sports lifestyle. The experimental results suggest that the improved ELECTRE-II method is effective and feasible.

Key words: Evaluation Approach; Extracurricular Sports Lifestyle; ELECTRE-II

INTRODUCTION

At the international meeting of Health Promotion and Physical Activity held by WHO and FIMS, the WHO presented the concept of sports lifestyle. The Japanese scholars once again proposed that the sports in the twenty-first century are a kind of cultural lifestyle, namely the sports lifestyle [1]. Since the Nationwide Fitness Program Outline was put into enforcement, the mass sports activities in China have entered a new stage of development, and many scholars discussed the sports lifestyle, as well as the relation between lifestyle and sports from different angles [2-3]. The sports lifestyle is subject to the lifestyle system, being the part-whole relationship. It is the sum of sports activities and behavior characteristics for people to meet the requirements of self-maintenance and development by available sport resources according to their subjective desire under certain natural conditions and social background [4-5]. The sports lifestyle focuses on maintaining the exercise habit.

EVALUATION INDEX SYSTEM

After the evaluation objective is set, based on theoretical analysis, present the evaluation indexes determined initially. Design the questionnaire, whose contents are the purpose, site facility, project and effect of sports activities and up to basic standards of sport population. It has a total of more than 30 questions. The reliability and validity test: the reliability coefficient R of this questionnaire is 0.87, and by expert judgment, its validity test shows that 80% experts agree with it. It can thus be seen that, this questionnaire has a good reliability and validity, meeting the requirements of statistics and research.

Consult the experts by Delphi method and request them to assign all the listed indexes by the five-grade scoring method. After the experts complete scoring, calculate the mean number to obtain the average score for each index, and finally screen out the indexes with the average score ≥4. Count and optimize them (the second screening). Through experts' evaluation and based on research need, the indexes were analyzed respectively during the second screening. Then they were consolidated and concluded. The first-grade indexes are: the objectives of sports activities (fitness, entertainment, social intercourse); the sports activities process (site facility, sports event, sports time, frequency and intensity); the effects of sports activities (the results of fitness, education and social adjustment).

The retest method was employed to test their reliability. Firstly, test them two times, and calculate the interclass correlation coefficients of their test results to obtain the test-retest reliability coefficients. The reliability coefficients between 0.65-0.75 are acceptable, fairly good between 0.75-0.85, and very good above 0.85, representing the degree of reliability for the tested indexes. The test results show that, the reliability coefficients of all indexes are within the acceptable range. The test project indexes are highly correlated to the sports lifestyle on college students. It indicates that the test indexes are highly associated with the extra-curricular sports lifestyle of college students.

In an index system, the importance degrees of various indexes are different. In order to reflect their degrees of importance when making an evaluation conclusion, their corresponding weights should be determined. The weights of evaluation indexes in all grades can be determined by AHP method. 1) The experts sorted the evaluation indexes by their importance degrees in descending order through pair-wise comparison with their experiences, and assigned relatively important rank values; 2) Construct matrixes to judge various index weight coefficients; 3) Calculate the weights q of all indexes to obtain the weight coefficients of the first and second grade indexes, as shown in Table 1. By testing the index weights, the reliability coefficient is 93%, which is satisfactory.

Table 1. The evaluation indexes and weights

First-grade index	Weight	Second-grade index	Weight	First-grade index	Weight	Second-grade index	Weight
The objective of sports activities	0.16	Fitness	0.46	The sports Activities process	0.57	Site facility	0.23
		Entertainment	0.32			Sports event	0.19
		Social intercourse	0.22			Sports time	0.20
The effect of sports activities	0.27	Fitness result	0.41			Sports frequency	0.21
		Educational effect	0.34			Sports intensity	0.17
		Result of social adjustment	0.25				

THE IMPROVED ELECTRE METHOD

The respective evaluation: When using this individual method, the attribute weights of criteria and alternatives applied by each member in the group can be different. Suppose that the union of criterion sets used by the decision maker i=1, …, n is C={c_1, c_2, …, c_t}, its weight vector is $W^i=\left(w_1^i,w_2^i,\ldots,w_p^i\right)$, $\sum_{q=1}^{p}w_q^i=1$, and $w_q^i\geq 0$, if the member i adopts the criterion p, $w_p^i=0$. Following the steps of ELECTRE-II, it can get the individual ranking of alternatives by each decision maker in the group. After all the members sort the alternative sets, the ELECTRE-II method can be used to gather these individual rankings to form the group sequencing.

Firstly, suppose that the weight of the decision made by the decision maker i=1,…,n in the group decision is $w_i\in\{w_1, w_2, \ldots, w_n\}$, and the decision committee can obtain the weights of decision makers by the AHP method (Yasar et al., 2009). If the individual ranking of the member i shows that the alternative x_k is better than the alternative x_l ($x_k \phi_i x_l$), and the set of all decision makers i satisfying the condition $x_k \phi_i x_l$ is written as $I^+(x_k, x_l)$, the set of members i satisfying the condition $x_k \sim_i x_l$ is $I^=(x_k, x_l)$ and the set of members i satisfying the condition $x_k \prec x_l$ is $I^-(x_k, x_l)$. Calculate the harmony indexes

$$I_{kl}=\left(\sum_{i\in I^+(x_k,x_l)}w_i+\sum_{i\in I^=(x_k,x_l)}w_i\right)\Big/\sum_{i=1}^{n}w_i \tag{1}$$

$$\hat{I}_{kl}=\sum_{i\in I^+(x_k,x_l)}w_i\Big/\sum_{i\in I^-(x_k,x_l)}w_i \tag{2}$$

Determine the high, medium and low thresholds α^*, α^0 and α^-, 0.5<α^-<α^0<α^*<1. Given $d_i^0<d_i^*$ and define D_i^h, D_i^m and D_i^l. Define the strong outranking relation and the weak outranking relation:

$$x_kO_sx_l \Leftrightarrow \left\{\hat{I}_{kl}\geq 1, and \begin{array}{l} 1\ I_{kl}\geq\alpha^*,(y_{ki},y_{li})\in D_i^m \\ or,2\ I_{kl}\geq\alpha^0(y_{ki},y_{li})\in D_i^l \end{array}\right. \tag{3}$$

$$x_kO_wx_l \Leftrightarrow \left\{\hat{I}_{kl}\geq 1, and \begin{array}{l} 1\ I_{kl}\geq\alpha^0,y_{ki}-y_{li}<d_i^0 \\ or,2\ I_{kl}\geq\alpha^-,y_{ki}-y_{li}<d_i^- \end{array}\right. \tag{4}$$

The forward strong and weak relation graphs G_s and G_w of alternative sets were constructed by the outranking relations of all the alternatives obtained by the above formulas.

Firstly, make sort ascending by the directive diagram, calculate the sort $v'(x_i)$ of each alternative and draw the ranking table. Then mirror the forward strong and weak relation graphs to get the sort descending diagram, calculate the order $v^0(x_i)$ of alternatives' sort descending by using the same method and draw the sort descending table. Combined with the results of sort ascending and sort descending, by the formulas

$$v^* = \max_{x_j \in X} v^0(x_j) \tag{5}$$

$$v(x_j) = 1 + v^* - v^0(x_j) \tag{6}$$

$$\bar{v}(x_j) = [v'(x_j) + v(x_j)]/2 \tag{7}$$

Calculate the mean sort $\bar{v}$ of alternatives and draw the mean ranking table of alternative sets, and the group can get the final sort of alternative sets by the rule that the smaller the $\bar{v}$ is, the higher the rank of the alternative.

RESULTS

Taking the practical decision problem as an example, it applies the respective evaluation to illustrate the above process and its reasonability. For ease of analytical calculation, suppose that an evaluation committee composed of p_1, p_2, p_3, p_4 and p_5 evaluates x_1, x_2, x_3, x_4 and x_5 in the alternative set X of three persons.

Step 1: the group determines the weight of each member by the AHP method as W={0.3, 0.2, 0.25, 0.15, 0.1}. The individual ranking made by the decision maker i shows that the alternative x_k is better than the alternative x_l ($x_k \succ_i x_l$). The set of all decision makers i satisfying the condition $x_k \succ_i x_l$ is written as $\Gamma^+(x_k, x_l)$, similarly, the set of members i satisfying the condition $x_k \sim_i x_l$ is $\Gamma^=(x_k, x_l)$ and the set of members i satisfying the condition $x_k \prec x_l$ is $\Gamma^-(x_k, x_l)$. Calculate the harmony indexes and the experimental results can be listed as follows.

$$I = \begin{Bmatrix} - & 0.25 & 0.00 & 0.40 & 0.25 \\ - & - & 0.20 & 0.75 & 0.3 \\ - & - & - & 0.80 & 0.60 \\ - & - & - & - & 0.10 \\ - & - & - & - & - \end{Bmatrix}$$

$$\hat{I} = \begin{Bmatrix} - & 0.333 & 0.000 & 0.667 & 0.333 \\ - & - & 0.250 & 3.000 & 0.428 \\ - & - & - & 4.000 & 1.500 \\ - & - & - & - & 0.111 \\ - & - & - & - & - \end{Bmatrix}$$

Step 2: given the high, medium and low thresholds α^*, α^0 and α^-, 0.5<α^-<α^0<α^*<1; given $d_i^0 < d_i^*$ and define D_i^h, D_i^m and D_i^l. Define the strong and weak outranking relations based on which the strong relation graph G_S and the weak relation graph G_W are constructed.

Step 3: make the sort ascending by the forward directive diagram, and calculate the sort $v'(x_i)$ of all alternatives, as shown in Table 2.

Table 2. The Experimental Results of $v'(x_i)$

i	1	2	3	4	5
$v'(x_i)$	5	3	1	4	2

Step 4: mirror the strong and weak relation graphs of sort ascending to get the sort descending diagram. Make the sort by the sort descending diagram, calculate the sort descending value $v^0(x_i)$ of each alternative, and list out the calculated values $v(x_i)$ of sort ascending and descending for each alternative as shown in Table 3.

Table 3. The Experimental Results of $v^0(x_i)$ and $v(x_i)$

i	1	2	3	4	5
$v^0(x_i)$	1	3	5	2	4
$v(x_i)$	5	3	1	4	2

Table 4. The Experimental Results of $\bar{v}(x_i)$

i	1	2	3	4	5
$\bar{v}(x_i)$	5	3	1	4	2

Calculate the mean sort $\bar{v}(x_i)$ for each alternative as shown in Table 4. Thus, the sort of alternatives made by the group is: $x_3 \succ x_5 \succ x_2 \succ x_4 \succ x_1$.

CONCLUSION

The indexes were determined by the Delphi method. After expert surveys, the AHP was employed to analyze the results, obtaining the weights and sub-weights of all indexes. The grade evaluation criteria for indexes of extra-curricular sports lifestyle on college students were built by the percentile method. Upon testing, there is a significant relation between the evaluation result and the result of expert evaluation (P<0.01), indicating the consistency of the results obtained from these two evaluation methods is good.

The analysis of reliability and validity of evaluation results: the self-assessment reliability coefficient is 0.754, the expert evaluation reliability coefficient is 0.769, so the reliability is high and the evaluation results are reliable; the overall validity coefficient is 0.968, so the coefficient error is small and the validity is high. Thus, the evaluation index system of extra-curricular sports lifestyle on college students is of high reliability and validity.

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