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Research of the college coaches evaluation index system based on the fuzzy comprehensive evaluation model

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ABSTRACT

In order to know how to choose the best college coach or coaches, a mathematic model will be built in this paper. Firstly, according to Delphi method and CES scale, the indicator system of coaches' competence is given and improved. Thus nine indicators for evaluation of best coaches are determined. We know the most influenced factors are won pct, years, popularity through weighted analysis. By applying Matlab, gain the weight vector $A = (0.5464, 0.1804, 0.2732)^T$. At the same time,

the fuzzy comprehensive evaluation of both male and female college coaches in basketball, ice hockey and soccer are gained as follows respectively: 146.576, 152.6493, 127.0001, 147.8392. An outstanding test is conducted on comprehensive evaluation, and there is no big difference in each evaluation indicator. The evaluation model of best college coaches can be applied to all projects and genders based on fuzzy mathematics. Secondly, after the study of teaching methods of PE coaches, the indicators of best representative coaches are chosen across the whole America. Data are integrated, and then a line chart is drawn, in which each indicator changes with time. Pct changes obviously in this chart and the other three indicators change within a certain range. All this shows that teaching methods of college coaches change evidently. Finally, choose data of top 50 college coaches in baseball, football and softball in America. Based on Principal factor weight vector in this model,

$A = (0.5464, 0.1804, 0.2732)^T$, fuzzy comprehensive evaluation is

gained. Calculate the top 5 best college coaches in sports mentioned above across America with the help of matlab. To ensure the rationality of the model, BP nerve net will be used to test it. According to

$w_j(t+1) = w_j(t) + \eta(t)\sigma_p o_{pj} + \alpha[w_j(t) - j(t-1)]$, the data of

top 4 in softball will be input, we know $t = 4.9276$, which is similar to the output of 5th one. © 2014 Trade Science Inc. - INDIA

KEYWORDS

College coaches;
Grade analysis;
Fuzzy comprehensive
evaluation;
BP nerve net.

INTRODUCTION

The best college coach for the previous century is seeking by the Sports Illustrated magazine. A mathematical model is built for choosing the best college coach the sports of hockey or field hockey, football, baseball or softball, basketball, or soccer. The model will consider coaching with time line horizon, such as the differences of coaching in 1913 and in 2013. 5 best coaches in 3 different sports will apply to this model^[1]. An article will be presented to Sports Illustration, which the results will be explained clearly and understandably.

ESTABLISHMENT OF INDEX SYSTEM

Firstly, the index will be deleted which has the same or similar meaning or high correlation. Secondly, the index will be deleted with little change through the primary collection of the index data^[2]. The contribution of the evaluation's results is very little if some index change very little or changeless in different periods, which should be deleted among the indexes.

Secondly, according to the operational principle of the index system, the indexes will be deleted which can not be collected or data inaccuracies or need long time or high-cost for collecting.

Finally, combine the indexes which reflect the similar meaning.

Above all, get an evaluation index system for the best coach in college, as the following figure.

The selection of the major effects

Using the analytic hierarchy^[3] process to ensure the analytic hierarchy process of weight for decision based on the analyzing of the essence and influential facts and inner relationships of complex problems. Build a hierarchy structure model the use the less quantitative information to make the processing the decision thought mathematization, which provides a simple method for the complex decisive problems with multi-objective, multi-principle or without structure. In order to quantify comparative judgment, combing with the practical conditions, we assume the percentage scale of 1-9 to assignment according to the importance of each fact and write down in judgment matrix. In the following figure, the locations for comparing are *i* and *j*, each for the row index and line index.

Through collecting data and combing the proportion of influence for the practical facts, and make a subjective evaluation by individuals. Evaluate the coach by using the simulate method of AHP and build a positive and negative matrix of rule hierarchy. As the following TABLE 2:

Using the same method and through system evaluation and getting a judgment matrix of index level's rank. As the following TABLE 3.

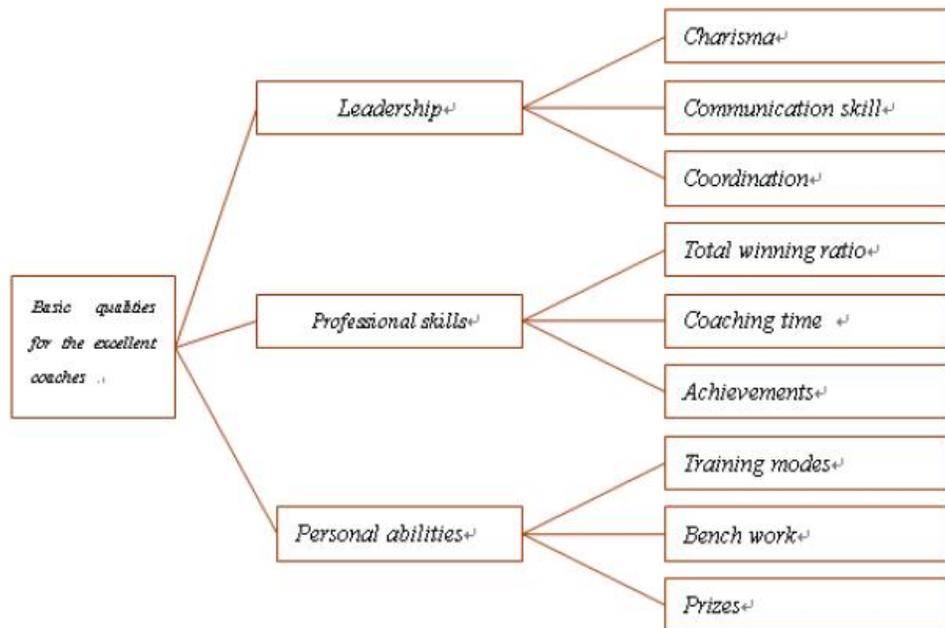


Figure 1 : The index evaluation system for the excellent coach

TABLE 1 : Scale

Index	Comparison between the two groups of indexes	Explanation
1	Equal important	The index i is equal important to j
3	Weakly important	The index i is a little important than the index j
5	Obviously important	The index i is important than the index j
7	Very important	The index i is obviously important than the index j
9	Especially important	The index i is especially important than the index j
2,4,6,8	Between the two important adjacent degrees	
The reciprocal value of the above numbers		Reversed comparison between the two targets

TABLE 2 : Judgment matrix of rule hierarchy

$A - B$	B_1 Leadership	B_2 Professional technology	B_3 Personal skills
B_1 Leadership	1	1/3	2
B_2 Professional technology	3	1	4
B_3 Personal skills	1/2	1/4	1

TABLE 3 : Judgment matrix of index level

$B - P$	Total winning rate	Coaching time	Popularity
Total winning rate	1	3	2
Coach time	1/3	1	1/3
Popularity	1/2	3	1

the component matrix. Through computing variable get the main composition variable are the Pct, Years, Popularity.

THE ESTABLISHMENT OF FUZZY COMPREHENSIVE EVALUATION

Fuzzy comprehensive evaluation is a comprehensive evaluation method based on the fuzzy mathematics, applying theory of the fuzzy relations synthesis and qualifying some facts which are unclear edge and uneasy to quantitative^[4].

The paper uses the fuzzy mathematics to establish a model of the comprehensive evaluation system for the excellent coaches.

Establish a comprehensive evaluation matrix based

Considering the results of rule hierarchy and index hierarchy, and get a weighted table of each fact occupies the whole facts, as the following TABLE 4.

Through checking the each index of professional skills and personal skills of influential college coaches throughout the United States (See appendix). Use the software of SPSS to deal with each quantitative index to analyze each data with factor analysis. Finally, get the eigenvector matrix through the object variable on

TABLE 4 : The table of weight distribution

Criterion layer	B_1			B_2			B_3		
Single sorting	0.238			0.625			0.136		
Project level	p_1	p_2	p_3	p_4	p_5	p_6	p_7	p_8	p_9
Single sorting	0.351	0.237	0.314	0.546	0.180	0.273	0.326	0.272	0.402
Total sorting	0.084	0.056	0.075	0.341	0.112	0.171	0.044	0.040	0.057

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pct.	5	.708	.764	.72920	.025946
Years	5	34	47	41.80	5.718
Popularity	5	.165	.247	.20000	.031718
Training modes	5	7	8	7.60	.548
Bench work	5	7	8	7.60	.548
Prizes	5	36	40	37.80	1.483
Valid N (listwise)	5				

on the three indexes pct,years,popularity of the male basketball coaches through out the United States.

(1) Confirm factors concerning domain of the evaluation object, $U = \{u_1, u_2, u_3\}$

(2) Confirm evaluation degree

In the analyzing, assuming $V = \{v_1, v_2, v_3, v_4, v_5\} = (1, 2, 3, 4, 5)$

I.e. makes the top five coaches into 1, 2, 3, 4,5five degrees, the relevant degree score column $C = \{c_1, c_2, c_3, c_4, c_5\}^T$. Confirming of the level vector is between 100 and 0, and assuming the distance between each degree is the same. Then the confirm of grade points in the range according to the arithmetic progression, so $C = (100,80,60,40,20)$.

(3) Establish the fuzzy relation matrix

After establishing the fuzzy degree subsets, quantifying every evaluated matter, i.e. confirm from the single matter to deal with the evaluated matters to each degree fuzzy subset's membership, (R/u_i) . R stands for the fuzzy relation between u and v,i.e. fuzzy relation matrix

$$R = \begin{pmatrix} r_{11} & r_{12} & r_{13} \\ r_{21} & r_{22} & r_{23} \\ r_{31} & r_{32} & r_{33} \end{pmatrix}$$

$A = \{a_1, a_2, a_3\}$ and the fuzzy set

$B = \{b_1, b_2, b_3, b_4, b_5\}$ satisfies $B = A \cdot R$ then R is a fuzzy relation from U to V. Use the min-max operator method for consuming and get the comprehensive evaluation vector $B = A \cdot R$.and consuming the comprehensive fuzzy evaluation $H = B \cdot C$.

The construction of the judgment matrix

The hierarchy reflects the relations among the factors, but the each rule of the rule hierarchy may share differently in the measurement of the goals. The paper adopts the hierarchy analyzing to compare the weight into 3 groups of the rule hierarchy P_4, P_5, P_6 and establish a comparison matrix D :

$$D = \begin{pmatrix} 1 & 3.048 & 1.994 \\ 0.331 & 1 & 0.661 \\ 0.502 & 1.513 & 1 \end{pmatrix}$$

By using MATLAB to consume, and getting the professional skill's eigenvalue vector $A = (0.5464, 0.1804, 0.2732)^T$.

Hierarchy single sorting and consistency check

The judgment matrix A is corresponding to the max eigenvalue λ_{max} iseigenvector W. Through the normalizing, i.e the corresponding facts in the same hierarchy for the relative importance of weight values^[5].some facts in the previous hierarchy, the process can be named hierarchy single sorting.

The coincidence indicator:

$$CI = \frac{\lambda - n}{n - 1} \tag{1}$$

When $CI = 0$,that is consistent matrix, with CI grows the degree of inconsistent will be more serious.

The value of the random consistent index RI is as the following TABLE 5

For $n \geq 3$'s comparative matrix pairs C, the ratio between its consistent index and the random of the same hierarchy (which has the same n)named consistent ratio CR , when

TABLE 5 : The random consistent index RI

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

$$CR = \frac{CI}{RI} < 0.1 \tag{2}$$

Considering the inconsistent degree of C is within the range, and can use its eigenvector as the weight vector.

Making use of the software MATLAB, consuming the max eigenvalue of comparison matrix C is $\lambda_{max} = 3.0033$, using the formula and gets the result,

$$CI = \frac{3.0033 - 3}{3 - 1} = 0.0165. \text{ Also because } n = 3, \text{ according to the table } RI \text{ is } 0.58. \text{ Bring } CI, RI \text{ into the formula can be consumed}$$

According to the table RI is 0.58. Bring CI, RI into the formula can be consumed

$$CR = \frac{0.0165}{0.58} = 0.028 < 0.1, \text{ so comparison matrix C}$$

meets the consistent test. Therefore, A can be used as weight vector.

Confirming the fuzzy comprehensive evaluation value

Get the five evaluation index data of the excellent male basketball coach throughout the United States according to the survey data.

The fuzzy matrix according to the data from the TABLE 3:

$$R = \begin{pmatrix} 0.708 & 0.71 & 0.764 & 0.714 & 0.75 \\ 0.225 & 0.206 & 0.163 & 0.225 & 0.182 \\ 0.215 & 0.186 & 0.247 & 0.187 & 0.165 \end{pmatrix}$$

The fuzzy transformation of matrix is

$$B = A \cdot R$$

$$= (0.5464, 0.1804, 0.2732)$$

$$\begin{pmatrix} 0.708 & 0.71 & 0.764 & 0.714 & 0.75 \\ 0.225 & 0.206 & 0.163 & 0.225 & 0.182 \\ 0.215 & 0.186 & 0.247 & 0.187 & 0.165 \end{pmatrix}$$

$$= (0.4862, 0.4759, 0.5143, 0.4818, 0.4877)$$

Consume the fuzzy comprehensive evaluation value

$$H = B \cdot C$$

$$= (0.4862, 0.4759, 0.5143, 0.4818, 0.4877)$$

$$(100, 80, 60, 40, 20)^T$$

$$= 146.576$$

Thus the fuzzy comprehensive evaluation value of the best college male basketball coaches is 70.5860.

Besides, choose the indicators of the excellent female basketball coaches, hockey coaches, and soccer coaches, and gain each of their fuzzy comprehensive evaluation value^[6].

Fuzzy comprehensive evaluation value of coaches in each sport as follows

Test of significance

In order to test its application on genders and sports, use the test of significance to assess fuzzy comprehensive evaluation value. σ^2 is Index Variance, and level of significance is $\alpha = 0.05$

Suppose $H_0 : \sigma^2 = \sigma_0^2$, opposite supposing is $\sigma^2 \neq \sigma_0^2$

Test statistic

$$\chi^2 = \frac{\sum (x_i - \bar{x})^2}{\sigma_0^2}$$

The sample calculation is $\chi^2 = v$,

In which $\chi^2 \sim \chi^2(n-1) \quad p = P\{\chi^2 > v\}$

$p = 0.1374 > \alpha$ is gained through SAS

There is no significant difference between general variance and sample one. It shows that this model can be applied to other sports on either male or female^[7]. So the ranks of best coaches comply with the known ranks.

The analysis of training influence by time

By checking the data and analyzing the four indicators including 3-pt pct, free throw pct, field goal, pct during the period when college coaches do their teach-

TABLE 6 : Fuzzy comprehensive evaluation value of the excellent coaches

Coache	Basketball (m)	Basketball (f)	The coach of ice hockey	The coach of soccer
Fuzzy comprehensively-Evaluated values	146.576	152.6493	127.0001	147.8392

TABLE 7 : The rank of top 5 excellent coaches

Coache Rankin	The coach of basketball (m)	The coach of basketball (f)	The coach of ice hockey	The coach of soccer
1	Harry Statham	Pat Summitt	Jerry York	Jay Martin
2	Danny Miles	C.Vivian Stringer	Ron Mason	Tony Tocco
3	Mike Krzyzewski	Tara VanDerveer	Jack Parker	Joe Bean
4	Herb Magee	Sylvia Hatchell	Rick Comley	C.Clifford McCrath
5	Jim Boeheim	Barbara Stevens	Red Berenson	Ron Butcher

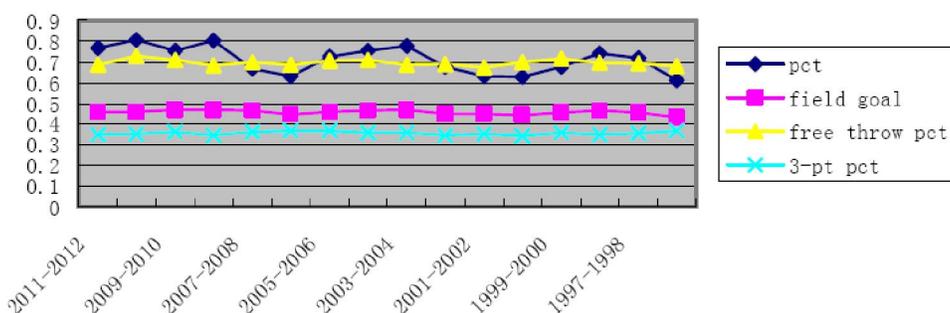


Figure 3 : Line chart of performance indicators

ing^[8]. The average rate of four indicators as Figure 3.

Despite some wave, 3-pt pct, free throw pct, field goal, pct are in a rising generally after analysis. We know the level of coaches is higher as time passes by, which shows the difference of teaching methods^[9].

CONCLUSIONS

The paper builds the model through analyzing and studying the practical problems, and draws a conclusion as follows: Using the analysis hierarchy process to decrease the artificial emotions and other non-objective factors which can disturb the quality's quantitative index of the coaches. The three important factors which influence the coaches through the weighed analysis are winning ratio, coaching time, and popularity^[10]. Build a fuzzy synthetic evaluation model based on the three indexes and get the results of the reasonable rank for the coaches. Using the arithmetic of BP neural network to test the model, and get the result that has the less error and high accuracy. The model has a general explicitly for the evaluation of the college sports.

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