# Establishing of Basketball Coach Evaluation System Based on the Grey Relevance Evaluation Model and Analytic Hierarchy Model

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**Abstract**

This article evaluated the National Collegiate Athletic Association (NCAA) coach problems through the establishing of grey relevance evaluation model and hierarchical analysis model and tested the models using the relative error method, in order to compare and evaluate model with more accurate results.

*Keywords:* grey relevance evaluation model, analytic hierarchy process, coach evaluation model, NCAA

## 1 Introduction

NCAA is the national collegiate athletic association, of which the college student's basketball league is one of the most popular leagues. Sports have a great influence in American higher education. Some university teams in the NCAA basketball league are very popular; the selection standards of team coach are complex and strict. Therefore, coach evaluation model is effectively set up helps to improve the efficiency of the coach's selection. Scientific and correct coach evaluation can simplify the process of screening the coach, and motivate coach reasonably. At present, in some sports magazines, coach rank with strong subjecttivity and big randomness. On the evaluation methods, therefore, we should adopt the combination of qualitative and quantitative methods, establish evaluation model, reasonably confirm evaluation index system and index weight, and effectively conduct coach evaluation.

## 2 Grey Relevance Evaluation Model

In the analysis of grey relevance evaluation model [2], year's influence factor is ignored for the coach model first. Due to the less number of college basketball female coach in the NCAA, inadequate sample size, the weak representtativeness, hence the selected coach data in building model should take American college students male basketball coach evaluation model as the sample. We assume that the collected information about American college coaches in the journal sports sites and magazines are real and reliable. According to related data on coaches performance offered by the NCAA [1], in combination with game characterristics and rules of ball games, and refer to psychology, sociology knowledge, we extract the coach's four main evaluation indexes: outcome ratio (W/L), game PLD number, in charge time and award. The result of SPSS signifycance test [3] can conclude that four evaluation factors we selected can significantly explain rankings. R2 values show that the selected four evaluation factors can explain 73. 6% ranking, and from the Sig values, we can see four evaluation factors can well explain the overall ranking. Therefore, the selected four coach's evaluation indexes are reasonable. In collected university coach data [1], we eliminate coaching time less than or equal to 5 years, or the total ratio is less than 50% competition team coach data. Coach can be directly knocked out if his coaching career is less than or equal to five years and he is lack of guidance experience, and the data instability of short time will bring great deviation for building the model. In addition, coach with outcome ratio less than 505 and too low competitiveness is not taken into account. The eliminated part of data reduces the amount of coach which is convenient for operation and improves the accuracy of model evaluation. Set n college coaches data evaluation standard sequence to form the following matrix:

$$\left(X_1', X_2', \ldots, X_n'\right) = \begin{bmatrix} X_1'(1) & X_2'(1) & \cdots & X_n'(1) \\ X_1'(2) & X_2'(2) & \cdots & X_n'(2) \\ \vdots & \vdots & & \vdots \\ X_1'(m) & X_2'(1) & \cdots & X_n'(m) \end{bmatrix}$$

Among them, Xn' is the obtained evaluation value that the n coach under m evaluation indexes. M is the number of metrics. Here m = 4, X1', X2'. . . Xn' express the coach's data respectively. Firstly process the indicators dimension because of its disunity, transform the absolute value of each index into the relative value. Use different algorithms to standardization process for the positive (negative) index.

Positive index:

Xi(j)=[(Xi'(j)-X'(j) min)/(X'(j) max-X'(j) min)]*100%

Negative index:

Xi(j)=[(X(j) max-Xi'(j)min)/(X'(j)max-X'(j)min)]*100%

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Among them, the subscript i expresses coach's ordinal number, j expresses the ordinal number of metrics, X '(j) min expresses the j item minimum value of metrics, X' (j)max expresses the j item maximum value of metrics, Xi (j) expresses the value of the i coach j metric item after the standardized processing.

The value of NCAA men's basketball coach award is different, therefore different awards should be given a certain weight and according to the NCAA official figures [1] weighting the awards for the corresponding coach. The weight of awards as shown in Table 1:

TABLE 1 Honor and corresponding weight value table

| honor | weight |
|---|---|
| NCAA Tournament appearance | 1 |
| Conference regular season champion | 2 |
| Conference tournament champion | 2 |
| Final Four appearance | 3 |
| NCAA Tournament champion | 4 |

## 3 Analytic Hierarchy Model

Use analytic hierarchy model [5] to supplement the coach evaluation system. Hierarchical analysis is a kind of simple, flexible and applicable multi-criteria decision-making method. Below is to construct a hierarchical structure model by using AHP method for index system [6]. Elements form several levels according to their attribution relations. The elements of last layer plays dominant role for the next level related element.

Destination layer: analyze problems to achieve ideal results

Criterion layer: this level includes the involved a number of factors to achieve the goal, here we refer to the four influencing factors: coach charging time, winning percentage of game, participated times, awards.

Measures layer: this level includes a variety of optional measures and solutions in order to achieve the goal, as shown in Figure 1.

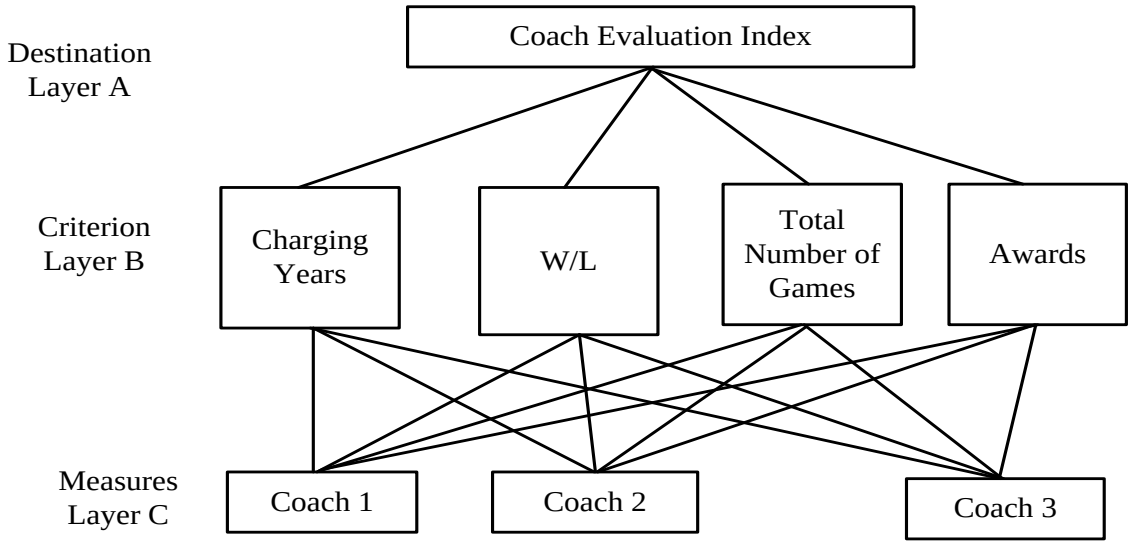


FIGURE 1 Hierarchical relation diagram

In order to construct judgment matrix, we suppose a layer has n factors, X={x1, x2 … xn}. To compare their influence degree of a rule (or goal) on the last layer, make sure the proportion of a certain criteria in the layer. Use aijto express the comparison results of the i factor relative to the j factor. It is:

$$a_{ij} = \frac{1}{a_{ji}}$$

$$A = \left(a_{ij}\right)_{n\times n} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

Among them n=4, and the coach evaluation model can give the influence matrix results for measures layer factors to target layer:

$$A = \begin{bmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{5} \\ 2 & 1 & \frac{1}{2} & \frac{1}{4} \\ 3 & 2 & 1 & \frac{1}{3} \\ 5 & 4 & 3 & 1 \end{bmatrix}$$

Maximum eigenvalue A λ max=4. 0511, the corresponding eigenvector is:

W0= (0. 1362, 0. 2239, 0. 3777, 0. 8881) T . (1)

In common, through the link of criterion layer and measures layer, we can list the judgment matrix of the candidate coach, namely compare the two coaches in various candidate coaches under a specific indicators. We can conclude from the number of index that there are four in measures layer used to judge matrix.

At this point, the ratio of the concrete data of each

candidate coach under the index is used in the two comparison, namely bij = Bni/Bnj, in which Bni and Bnj are the charging data of candidate coach i, j in the index of Bn. It is worth noting that this process needs standardization processing for the data of coach, map the data of coach to within the range of 1:9. Next to test the consistency of judgment matrix.

Coincidence indicator:

$$CI = \frac{\lambda_{\max} - n}{n-1}. \quad (2)$$

We constructed 500 samples matrix with random method: randomly extract numbers from 1:9 and its reciprocal to constructthe straight reciprocal matrix, obtain the average value of the maximum eigenvalue $\lambda$'max, and define the formula:

$$RI = \frac{\lambda'_{\max} - n}{n-1}, \quad (3)$$

n=1…. 9.

RI value can be obtained as shown in Table 2.

TABLE 2 n is the value of RI for different values

| n | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| RI | 0 | 0 | 0. 58 | 0. 90 | 1. 12 | 1. 24 | 1. 32 | 1. 41 | 1. 45 |

Calculate consistency ratio according to the above narration:

$$CR = \frac{CI}{RI}. \quad (4)$$

We can conclude CR=0. 0189<0. 10 by taking formula (2), (3) into formula (4), thus we believe that the consistency of judgment matrix is acceptable.

After the judgment matrix of each layer pass through the consistency check, we can calculate the weight value of index through the matrix of each layer, and then implement the coach order.

After the judgment matrix is determined consistency matrix, we can use the corresponding normalized feature vector of maximum eigenvalue $\lambda$ max to represent the effect of the next level to the last level.

After normalization of formula (1), feature vectorW0 change into:

W0= (0. 0838, 0. 1377, 0. 2323, 0. 5462) T

Calculate weight value of destination layer to the last layer. Finally, we can get the weight matrix w of destination layer from four factors in criterion layer:

w= (w1, w2, w3, w4) T

Any total order of full-time coaches in destination layer can be calculated by the following way:

$$c_i = \sum_{j=1}^{4} w_{ij} w_{0j}$$

Through the matrix manipulation, we can easily get all coach's total order weight value: c=w•w0

Through the above manipulation, we can get top 10 coaches in NCAA basketball.

TABLE 3 Analytic hierarchy process top 10 coaches in NCAA basketball

| name | score |
|---|---|
| Adolph Rupp | 0. 00431 |
| Mike Krzyzewski | 0. 004108 |
| Dean Smith | 0. 004065 |
| John Wooden | 0. 003892 |
| Jim Calhoun | 0. 003493 |
| Denny Crum | 0. 003304 |
| Roy Williams | 0. 003264 |
| Jerry Tarkanian | 0. 003138 |
| Rick Pitino | 0. 003057 |
| Jim Boeheim | 0. 003048 |

## 4 Model Test and Comparison

Select a leading sports site [7], take top 10 coaches as inspection standard, test the two models accuracy and compare the test results, namely, compare the two models screening coach results and the magazine rankings.

We define relative deviation as $\beta$ ($0 \leqslant \beta < 1$)

$$\beta = \frac{1}{10}\sum_{i=1}^{10} \frac{\left|m_i - m_i'\right|}{m_i'},$$

$m_i$ represents the ranking of coach i in our constructed model, mi represents the ranking of coach i in magazine. We define the evaluation result is more accurate if evaluation model of $\beta$ is closer to zero.

Test results as follows:

TABLE 4 The relative of grey correlation model and hierarchical analysis model

| Grey correlation model | hierarchical analysis model |
|---|---|
| 10. 2252 | 6. 6024 |

We can conclude from test results that analytic hierarchy model is more accurate than grey correlation model.

## 5 Conclusion

This paper studied the evaluation problems of college coach through the establishing of grey correlation prediction and analytic hierarchy model. Firstly, select four coach evaluation indexes, they are: the outcome ratio (W/L), PLD, charging time and the awards. Through the significance test from SPSS, we can draw a conclusion that the selected evaluation index can reasonably explain the coach ranking. Secondly, the built grey correlation model and analytic hierarchy model results showed that the college coach evaluation results of two models had some differences. Test results showed that evaluation accuracy of analytic hierarchy model was better than the grey correlation evaluation model. In addition, in 1981, NCAA official database newly increased index number of evaluation team, therefore to further optimize the coach evaluation model. Finally, although this paper only studied the evaluation system of American college basketball coach, as a result of general degree of the selected indicators and methods was higher, the model can also do

further application in other sports coaches. Because the evaluation results of program simulating and the reality had a slight deviation, the subsequent optimization of evaluation model can increase some quantitative indicators, for example: coach management and communication skills, education background of coach, and the basic level of team and so on.

## References


[1] NCAA Team Success [BD/OL] (2010. 07. 11) http://www. sports-reference. com/cbb/coaches.
[2] Yang Xun, Luo Haiyan 2010 Grey Correlation Evaluation Model in the Application of the Performance Evaluation of State-owned Enterprises. *Research of Financial & Accounting*. (18) 57-60.
[3] Bao Gui, Xi Yan 2010 Statistical Significance Testing: Problems and Reflection. *Journal of Nanjing Institute of Technology*: Social Science Edition. 10(4) 27-32.
[4] Mathematical Modeling Research Group of Northwestern Polytechnical University 2012 The MCM/ICM Competition Guide Books:Questions Analysis and Research on the American College Students' Mathematical Modeling Competition. *Beijing: Higher Education Press*, 180-210.
[5] Sun Jiguo 2007 Performance Appraisal of Enterprise CEO Based on Analytical Hierarchy Process and Fuzzy Evaluation. *Journal of Shijiazhuang University of Economics*. (5) 37-39.
[6] Wang Xiuming, Chen Mingrui 2012 Application in College Teachers' of AHP In-depth Analysis Comprehensive Assessment System. *Natural Science Journal of Hainan University*, (03) 46-48.
[7] The NCAA Coach for the Team Record [BD/OL](2010. 04. 11) http://www. ranker. com/list/best-college-basketball-coaches-of-all-time/ranker-ncaa-basketball.


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