

Assessment System of College Coaching Legends

Rui Chen

North China Electric Power University, Baoding, China

Keywords: Assessment System; College Coaching.

Abstract. In order to rank the top college coaches, we choose seven metrics to help us set up the evaluation model, which are historical records, performance, honors, media popularity, game gold content, contributions to sports, coaching experience. And we get all the data we need in our model from the Internet, Google, Wikipedia, etc. In this article, we use the Analytic Hierarchy Process (AHP) to obtain the weight of each metric and calculate the evaluation grades of the college football coaches. As there is a number of college coaches in the ranking list of Ranker.com online, we first choose 20 of them according to their coaching time and ranks in order to meet the requirement of the problem. Then we calculate the indicators of each coach and put them into the alternative level of the three-hierarchy structure. After that, we get a top 5 rank according to the final evaluation grade each coach gets.

1. Symbols, Definitions and Assumptions

1.1 Symbols and Definitions

Table1 Symbols for Analytic Hierarchy Process

	Symbol	Definition
	A	the judgment matrix
	a_{ij}	the element of judgment matrix
	w	the eigenvector
	λ_{\max}	the maximum eigenvalue
	CI	the consistency index
	CR	the consistency ratio
	S_i	the evaluation grade of Model I

1.2 General Assumptions

The data we collected from the Internet are accurate and reliable.

Indicators we use in our models are the main indicators, other indicators can be negligible to our ranking results, which means the rest of indicators we neglect make no contribution to the final result.

Our coaches are selected to achieve a sufficiently long-life coaching period and coaching extreme circumstances do not exist

The ranks we found online is reliable and accurate to some extent and they are based on the data we found from Google.

2. Articulate our metrics

2.1 Specify evaluation norms

In order to evaluate the performance of the college coaches, seven assessment norms should be considered, which are discussed as follows.

Historical record: As the historical records plays an important role in ranking the “best college coach of all time”, we define the win-and-loss percentage expressed in the following expression:

$$a_k = \frac{\sum_{i=1}^n g_i}{\sum_{i=1}^n t_i} \quad (k = 1, \dots, m) \quad (1)$$

Where a_k denotes the winning percentage of the coach, g_i represents the wins of the year, t_i denotes the total number of matches played in the year, m denotes the total number of the coaches, n denotes the sum of the games led by the coach.

Performance: According to the history of American football games, the Bowl Championship Series (BCS) are regarded as the most symbolic games. Thus, the average performance of a coach can be calculated as follows:

$$p_k = \frac{\sum_{j=1}^c t_j s_j}{te_k} \quad (k = 1, \dots, m) \quad (1)$$

-Where t_j denotes the times of the team entered into the BCS that year, s_j represents the score it earns, te_k denotes the tenure of the coach k , c denotes the sum of the times the team led by the coach entered the BCS.

Game gold content: Simple Rating System (SRS) is a rating system used to rank teams based on their point differential and strength of schedule, which can indirectly reflect the leading capacity of the coach. Thus, we get the average SRS to stand for each coach's game gold content.

$$SRS_k = \frac{\sum_{i=1}^n SRS_i}{n} \quad (k = 1, \dots, m) \quad (2)$$

-Where SRS_i denotes the Simple Rating System of the team of the year.

Honors: Gradually, the sum of the personal awards a coach received can on behalf of the ability of the coach to a huge extent. So we calculate the sum of the awards of each coach to represent the honors of him, which can be denoted as follows:

$$H_k = \sum_{i=1}^a r_i \quad (k = 1, \dots, m) \quad (3)$$

-Where r_i denotes the award number of the coach, a represents the total number of the awards.

Media popularity: The Associated Press Poll can directly reflect the team's competitiveness each year. And the AP top 25 is determined by a simple points system based on how each voter ranks college football's best teams. Then the process can be calculated as the following expression:

$$M_k = \frac{\sum_{i=1}^n s_i}{te_k} \quad (k = 1, \dots, m) \quad (4)$$

-Where s_i stands for the post poll score of the team in the corresponding year.

Contributions to sports: The contributions a coach made to sports during his coaching period can largely decide the excellence of him. So in the following chapter we choose three indexes to evaluate a coach's contributions to sports: the number of sports stars he cultured, new tactics, others.

Coaching experience: The tenure of a coach on behalf of the total experience he gained during his sports career. It is normally recognized that the longer a coach's tenure is, the more experience he will gain because of the longer time he spend in sports. Generally, an outstanding coach should have more experience than others. Thus we use the tenure of each coach as an indicator of his coaching experience, which is denoted as $te_k (k = 1, \dots, m)$.

2.2 Collect data

Firstly, we get the ranking result of the best college football coaches from the Internet. Then, we choose 20 coaches from them according to the time period he taught and the ranking.

In order to express our data clearly, take Bear Bryant as an example. We get his evaluation norms from spots-reference, a combination of sites providing top notch statistics and resources for sports fans everywhere.

Finally, we calculate the norms we need and list them in the following table:

Table 2 the evaluation norm of Bear Bryant

Name	te_1	a_1	p_1	SRS_1	H_1	M_1
Bear Bryant	37	0.78	0.945946	16.77	13	10.67568

2.3 Preprocess data

In order to quantify the norm of contributions to sports, we give each coach a contribution score by comparing with others and analyzing the extent of his achievement.

2.4 Model I: Analytic Hierarchy Process (AHP)

While the problem we need to solve does not have quantitative metrics, and the Analytic Hierarchy Process (AHP) is known as a simple method to make decision for some of the complex, fuzzy problems, and it is especially suitable for problems that are difficult to quantitatively analyze. So in our first model, we use AHP to get the weight of each metric and grade each coach to get a rank of them.

Set Up the three-hierarchy structure

The three-hierarchy structure of the model is displayed as follows. It contains three parts: the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.

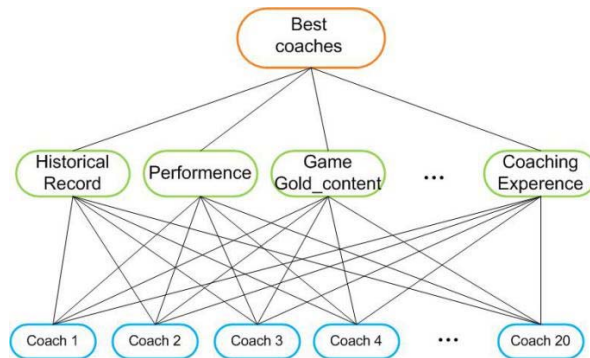


Fig 1 the three-hierarchy structure

Obtain the index weight. Construct the judgment matrix

Then, we begin to set up the judgment matrix.

Calculate the eigenvector and maximum eigenvalue

After normalize each column vector of the judgment matrix A and calculate the sum of the row element, we get the eigenvector $w = (w_1, w_2, \dots, w_7)^T$ and the maximum eigenvalue λ_{\max} . The eigenvector's calculating expression can be described as follows:

$$\tilde{W}_i = \frac{a_{ij}}{\sum_{i=1}^7 a_{ij}} \quad (i = 1, \dots, 7) \tag{5}$$

$$w_i = \frac{\tilde{W}_i}{\sum_{i=1}^7 \tilde{W}_i} \quad (i = 1, \dots, 7)$$

Do the consistency test. The consistency index (CI) value can be calculated as the following expression:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (6)$$

-Where n is the number of the metrics.

Next the consistency ratio (CR) is obtained by dividing the CI value by the Random index (RI) as given in the table below, here n=7. If the CR value is smaller than 0.10, then the test of Consistency Check is right, which is denoted as

$$CR = \frac{CI}{RI_n} < 0.1 \quad (7)$$

Table 4 RI values for different values of n

n	1	2	3	4	5	6	7	8	9
RCI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Finally, the evaluation grade can be calculated as follows:

$$S_i = \sum_{i=1}^7 w_i \cdot F_{ij} \quad (8)$$

-Where w_i denotes the i^{th} weight of the criterion level, F_{ij} denotes the j^{th} coach's i^{th} metric.

Results & analysis .According to the data we collected from the Internet in 3.2 and 3.3, we get the following result.

The Evaluation Grade and the ranking result

Table 6 Ranking Result

Rank	Name	Evaluation Grade	Rank on the Internet
1	Bear Bryant	0.8134	Bear Bryant
2	Barry Switzer	0.7708	Joe Paterno
3	Joe Paterno	0.7377	Nick Saban
4	Tom Osborne	0.6693	Knute Rockne
5	John McKay	0.6380	Bobby Bowden

From the table 6, we can see that the result of Model I is similar with the result of the Internet except for Barry Switzer and John McKay. But from our research on the Internet and data, we find that every metric of the two coaches rank at the frontier part of the list, so it is no doubt that their ranking result come into the top 5 best college coach of all time.

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