www.hanlin.io 仅内部使用,严禁商用

For office use only	Team Control Number	For office use only
T1 _____	**26636**	F1 _____
T2 _____		F2 _____
T3 _____	Problem Chosen	F3 _____
T4 _____	**B**	F4 _____

An evaluation model of college coaches

Summary

In working out a evaluation system that would fairly judge the best all-time college coaches, our team decided to apply the grey correlation analysis model. To figure out parameters in this model, we firstly refer to some expertise and then select four indicators that would be applied in general across both genders and all possible sports –NCAA Champions, Pct, wins, and Coach Awards. We use fuzzy consistent matrix to grant each kind of indicator a proper weight in our evaluation system. Then we use specific statistics in basketball, football and ice hockey and give out the ranks of the coaches. To further examine our model, we compare the top 5 coaches in our lists with those in the reports from ESPN or other research institutes.

We also find out that the competition system of different events of NCAA will inevitably change over time, and that the time line horizon we choose will result in differences in our four factors. The real data prove our supposition – in both of the basketball and the football fields, the "ancient" coaches enjoy a significantly higher average of winning percentage than the present coaches, while the other three factors show no discrimination. To enhance the accuracy of the model, we modify our original model with a correction factor that derives from the moving weighted average method to adjust the winning percentage over time, which is the shining point of our theory. In addition, we find out the significant difference among coaches before 1950s and those in later periods, which is also taken into consideration in the adjustment of our model. In terms of gender, we reach the conclusion that it has no influence on our selection of factors and the metric of our assessment.

We test our model by examining its stability and sensitivity. In stability test, we change the priority of the four factors to judge if the model is still applicable. Furthermore, since fuzzy consistent matrix has inborn disadvantage in subjectivity, Shannon's entropy method is applied to substantiate the stability. In addition, we implement sensitivity test by changing the ρ in the grey correlation analysis model.

In the last part of this report, we state the strengths and weaknesses of our model. Convenience and universality are the greatest advantage of our model, while the subjectivity in selecting indicators may still exist.

www.hanlin.io
仅内部使用，严禁商用

Contents

www.hanlin.io 仅内部使用,严禁商用

1 Introduction

1.1 Background

College sports teams occupy a pivotal position in the sporting world. The major college sports events, such as National Collegiate Athletic Association (NCAA) championships, have long been the focus of attention of the public. Each year, not only the top sports teams but also the head coaches grab the eye of a considerable number of people. To promote the development of college sports, people are increasingly apt to seek for the help of modern science and technology to evaluate the performance of college coaches.

Designing an objective and effective system to evaluate the performance of college coaches has many advantages. Such system will enable either college sports teams or mess media to analyze the strengths and weaknesses of a specific coach, as well as to reveal the keys of victory of those legendary coaches. Current approaches of evaluation, however, are neither quantitative nor broadly applicable.

Most of studies use subjective and qualitative methods for assessment. The methods they use for collecting data include: Designing questionnaires for athletes to judge their coaches (Rushall, B. S.,et, al.,1985), interviewing coaches (Cassidy.,et,al.,2006), observation (Nelson, Lee J.,et,al., 2006), etc. Using the above methods, the evaluation of coaches simply relies on human judgment, which is not optimal since numerous data are accessible on the Internet.

1.2 Our work

As modelers, we are required to build a mathematical model for *Sports Illustrator* to select the best college coach or coaches (male or female, past or present) in various kinds of sports. In addition, we are required to discuss the influence of time line horizon and gender on our model.

Instead of using subjective evaluation method, we adopt a quantitative method to measure and rank the performance of college coaches.

- Firstly, we determine the elements of our evaluation system. In order to make our model applicable in various kinds of sports and both genders, we select wins (the number of times that one specific coach has successfully led a team to win), winning percentage, the number of times that they had led their teams to win national championships, and the number of times that they have won the title of Coach of the Year as evaluation factors.
- Secondly, we create a **fuzzy consistent matrix** to determine the weight of each factor. This approach includes processes of determining fuzzy preferential rela-

www.hanlin.io 仅内部使用,严禁商用

tion matrix and fuzzy consistent matrix, as well as the introduction of root method. We will further explain the above processes in the next section.

- Thirdly, we develop a **grey correlation analysis** model to evaluate and rank the performance of college coaches. This model includes the calculation of grey relational coefficient and grey rational degree, which will be displayed in the next section.

2 Model

2.1 Introduction

The evaluation model we adopt is based on the principle of **grey correlation analysis**. Using this approach, we can calculate the grey relational degree between the coaches on our lists and the ideal coaches (the fictitious coaches with ideal data). Then we sort the grey relational degrees by descending order to get the rank of the coaches. Note that the prerequisite of our model is the determination of the weights of all factors. This prerequisite can be met by establishing a fuzzy consistent matrix.

Therefore, our evaluation system can be divided into two parts:

The first part is the determination of the weight of each factor, which is critical in our model and will exert vital influence on our conclusion. Theoretically speaking, both subjective methods and objective methods can be applied to the determination of weights. Subjective methods are mainly based on human judgment. Such methods depend on the experience of experts. Currently prevailing subjective methods include: The Delphi method (Hwang, C.L.; et, al., 1987), analytic hierarchy process (Saaty, T.L., 1980), the weighted least square method (Chu, A.T.W.; et, al., 1979). Objective methods involve the use of quantitative models. Based on the data collected from databases or websites, researchers can use mathematical models to determine the weights of factors that mostly reflect the performance of the objects they study. Currently prevailing objective methods include: Entropy method (Shannon, C.E., 1948), principle component analytical method (Fan, Z.P., 1996), etc. Therefore, considering the features of NCAA competitions and the interrelationship among factors, we determine the weights of factors by creating fuzzy consistent matrix.

The second part of our evaluation system is the grey relational analysis model. We use this model to evaluate and rank coaches. Because of the scarcity of data sources and the complexity of interrelationship among factors, it is difficult for modelers to acquire enough information. Therefore, it is comparatively advantageous to use grey relational analysis to analyze such a small-sample data system. This system can eliminate the subjectivity to some degree and will thusly lead to an objective conclusion.

仅内部使用,严禁商用 www.hanlin.io

2.2 Notations and definitions

2.2.1 Notations

Notations	Explanations
F	Fuzzy consistent matrix
A	Fuzzy preferential relation matrix
w	Weights of factors
k	The kth factor
$x_0(k)$	Standard data array (The best value of factor k among all coaches)
$x_i(k)$	Correlation data array (The raw data array of factor k among all coaches)
$\zeta_i(k)$	Grey relational coefficient
ρ	Distinguishing coefficient
E	Evaluation matrix
r_i	Grey correlational degree
R	Grey comprehensive evaluation matrix

2.2.2 Definitions

Fuzzy consistent matrix

1) For fuzzy matrix $F=(f_{ij})_{m\times m}$, if $f_{ij}+f_{ji}=1$, then this matrix is defined as fuzzy reciprocal matrix. For any k (k =1,2,…m), if $f_{ij}=f_{ik}-f_{jk}+0.5$, then matrix F is defined as fuzzy consistent matrix.

2) For fuzzy consistent matrix $F=(f_{ij})_{m\times m}$, if $f_{ij}=0.5$, then element i and element j are equally important. If $0\le f_{ij}\le 0.5$, then element j is more important than element i. The smaller f_{ij} is, the more important element j is than element i. If $0.5\le f_{ij}\le 1$, then element i is more important than element j. The greater f_{ij} is, the more important element i is than element j.

Fuzzy preferential relation matrix

We use three numbers (0, 0.5, and 1) to measure the comparative importance among the factors. For fuzzy matrix $A=(a_{ij})_{m\times m}$, if $a_{ij}=0.5$, then element i and element j are

仅内部使用,严禁商用 www.hanlin.io

equally important to the upper level. If $a_{ij} = 0$, then element j is more important to the upper level than element i. If $a_{ij} = 1$, then element i is more important to the upper level than element j.

For example, suppose that we have four factors: a, b, c, and d. If the degree of importance to the upper level degrades from a to d, then we create the fuzzy preferential relation matrix A as follows:

$$A = \begin{pmatrix} 0.5 & 1 & 1 & 1 \\ 0 & 0.5 & 1 & 1 \\ 0 & 0 & 0.5 & 1 \\ 0 & 0 & 0 & 0.5 \end{pmatrix}$$

2.3 Model Designing

Process I: How to determine the weight of each factor

1) We create the fuzzy preferential relation matrix A.

2) We convert the fuzzy preferential relation matrix into a fuzzy consistent matrix:

Sum column vectors of each row in the fuzzy preferential matrix:

$$f_i = \sum_{k=1}^{m} a_{ik}, i = 1,2,...,\mathrm{m}$$

Apply the following conversion:

$$f_{ij} = \frac{f_i - f_j}{2m} + 0.5$$

Thus the fuzzy consistent matrix $F = (f_{ij})_{m \times m}$ is created.

3) We use the root method to determine the weights of each factor. The procedures of the root method are displayed as follows.

Normalize each column of matrix F:

$$\tilde{w}_{ij} = \frac{f_{ij}}{\sum_{i=1}^{n} f_{ij}}$$

Multiply column vectors of $\tilde{w}_{ij}$ by row and extract the nth root:

仅内部使用,严禁商用 www.hanlin.io

$$\tilde{w}_i = (\prod_{i=1}^{n} \tilde{w}_{ij})^{1/n}$$

Normalize $\tilde{w}_i$:

$$w_i = \frac{\tilde{w}_i}{\sum_{i=1}^{n} \tilde{w}_i}$$

Therefore, the approximate feature vector is:

$$w = (w_1, w_2, ..., w_n)^T$$

Process II: Using grey correlation analysis to rank coaches

1) We determine the factors used for evaluation and collect the data of college coaches. Assume that the number of coaches on the list is m , and the number of factors used is n . The standard data array $x_0(k)$ is the best values of factor k among all coaches. The correlation data array $x_i(k)$ is a raw data array of factor k among coaches on the list.

Therefore, for each factor k , the standard data array is:

$$x_0 = \{ x_0(k) \mid k = 1,2,...,n \}$$

And the correlation data array is:

$$x_i = \{ x_i(k) \mid k = 1,2,...,m \}$$

Then we normalize the standard data array and the correlation data array by scaling between 0 and 1.

Next, we calculate the grey relational coefficient as follows:

$$\zeta_i(k) = \frac{\min\limits_i \min\limits_k \left| x_0(k) - x_i(k) \right| + \rho \max\limits_i \max\limits_k \left| x_0(k) - x_i(k) \right|}{\left| x_0(k) - x_i(k) \right| + \rho \max\limits_i \max\limits_k \left| x_0(k) - x_i(k) \right|}$$

Where $\zeta_i(k)$ is the grey relational coefficient that measures the relationship between the standard data array $x_0(k)$ and the correlation data array $x_i(k)$, when the k th factor is the object of study. And ρ is named as distinguishing coefficient, the values of which range from 0 to 1. The greater ρ is, the greater the distinguishing rate will be, and vice versa. In our model, we choose 0.5 as the value of ρ . Using $\zeta_i(k)$, we can

仅内部使用,严禁商用 www.hanlin.io

get the evaluation matrix $\boldsymbol{E} = (\zeta_i(\boldsymbol{k}))_{n \times m}$.

2) Then we calculate the grey relational degree as follows:

$$\boldsymbol{r_i} = \sum_{k=1}^{n} \boldsymbol{w_i} \zeta_i(\boldsymbol{k})$$

Where $\boldsymbol{r_i}$ is the grey relational degree of the standard data array to the correlation data array.

3) Using $\boldsymbol{r_i}$ and $\boldsymbol{w}$, we get the grey comprehensive evaluation model:

$$\boldsymbol{R} = \boldsymbol{w} \cdot \boldsymbol{E}^{\mathrm{T}} = (\boldsymbol{r}_1, \boldsymbol{r}_2, ... \boldsymbol{r}_n)$$

By sorting the listed coaches by grey relational degree $\boldsymbol{r_i}$ in descending order, we get the rank of all coaches, which enable us to select the top coaches.

3 Application

3.1 Introduction

In this section, we apply our evaluation system to the selection of top 5 all-time college men's basketball coaches.

3.2 The selection of factors

We elect two types of factors to represent the accomplishments the coaches have achieved: The awards they have received as excellent coaches and the performance of the teams they coach. This thusly leads to the choice of four factors: Wins, Pct., NCAAB[1] Champions, and Coach Awards. ***Table 1*** shows the definition of each factor.

Table 1 *Factors and Explanations*

Factors	**Explanations**
Wins	The number of times that one specific coach has successfully led a team to win
Pct.	The winning percentage
NCAAB Champions	The number of times of winning NCAAB championships
Coach Awards	The number of times of winning the following awards: NABC Coach of the Year, Basketball Times National Coach of the year, National Coach of the Year, AP national coach, and Henry iba awards.

[1] NCAAB: National College Athletic Association Basketball

www.hanlin.io 仅内部使用,严禁商用

3.3 Data Collection

We obtain the data of college men's basketball coaches, who meet two criteria as follows:

- The coaches selected should be the head coaches of NCAA Division I teams because Division I teams represent the highest level of intercollegiate teams.
- The wins of coaches, which denote the times that the coaches have led their teams to win, should reach a certain number.

The process of data collection consists of the following steps:

- We obtain a list of college men's basketball coaches with more than 600 wins on Wikipedia.[2]
- Having obtained the name list of coaches, we refer to the *NCAA Basketball Coaching Records*[3] to select the coaches of Division I teams.
- Next, we searched for the data of the Division I coaches with more than 600 wins in the NCAA database[4] to get the data of the four factors we need (wins, winning percentage, times of winning NCAAB championships, and times of winning the title of *Coach of the Year*).

3.4 Calculation

Process I: The determination of weights

Firstly, we sort the importance of the four factors and create a fuzzy consistent matrix to determine the weight of each factor. This step can be divided into two parts as follows:

1) Determine the fuzzy preferential relation matrix

Among the four factors, we assume that the times of winning NCAAB championships has greater influence on the evaluation of college coaches' performances than other factors, while the times of winning the title of *Coach of the Year* has the least influence. The winning percentage and wins rank second and third respectively. ***Table 2*** summarizes the interrelationship among the four factors.

---

[2] Data source: *List of college men's basketball coaches with 600 wins,* http://en.wikipedia.org/wiki/List_of_college_men%27s_basketball_coaches_with_600_wins

[3] Data source: *"NCAA Basketball Coaching Records"*. NCAA. Retrieved June 14, 2012. http://web1.ncaa.org/web_files/stats/m_basketball_RB/2011/Coaching.pdf

[4] Data source: *"NCAA Career Statistics Database"*. NCAA. Retrieved June 14, 2012. (The NCAA Career Statistics database allows the viewer to obtain coaching records for all NCAA coaches by inputting the individual's name in the linked window.) http://web1.ncaa.org/stats/StatsSrv/careersearch

仅内部使用,严禁商用 www.hanlin.io

Table 2.*Interrelationship among the four factors*[5]

	Wins	Pct.	NCAAB champions	Coach Awards
Wins	0.5	0	0	1
Pct.	1	0.5	0	1
NCAAB champions	1	1	0.5	1
Coach Awards	0	0	0	0.5

Therefore, the fuzzy preferential relation matrix is:

$$\boldsymbol{A}=\begin{pmatrix}0.5 & 0 & 0 & 1\\ 1 & 0.5 & 0 & 1\\ 1 & 1 & 0.5 & 1\\ 0 & 0 & 0 & 0.5\end{pmatrix}$$

2) Convert the fuzzy preferential relation matrix to a fuzzy consistent matrix.
Using the calculation we have previously explained. The fuzzy consistent matrix is:

$$\boldsymbol{F}=\begin{pmatrix}0.5000 & 0.3750 & 0.2500 & 0.6250\\ 0.6250 & 0.5000 & 0.3750 & 0.7500\\ 0.7500 & 0.6250 & 0.5000 & 0.8750\\ 0.3750 & 0.2500 & 0.1250 & 0.5000\end{pmatrix}$$

Therefore, the weights of the four factors are:

$$\boldsymbol{w}=\begin{pmatrix}0.2169 & 0.2854 & 0.3527 & 0.1450\end{pmatrix}^{\mathrm{T}}$$

Where 0.2169 is the weight of the times of winning NCAAB championships; 0.2854 is the weight of winning percentage; 0.3527 is the weight of wins; and 0.1450 is the weight of times of winning the title of *Coach of the Year.*

Process II: Using grey correlation analysis to rank coaches

1) After preprocessing the data (see Appendix), we get the correlation data array and standard data array by normalizing them by the scaling between 0 and 1. ***Table 3*** displays the correlation data array and the standard data array.

Table 3*.Correlation data array and standard data array*

Name	Wins	Pct	NCAAB Champions	Coach award	Best Coach
Mike Krzyzewski	1	0.725118	0.4	0.714285714	1
Jim Boeheim	0.89939	0.658768	0.1	0.285714286	1
Bob Knight	0.77743	0.464455	0.3	0.142857143	1

[5] The metric of measuring the interrelationship among the factor has already be explained when we define the fuzzy preferential relation matrix.

仅内部使用，严禁商用 www.hanlin.io

	9				
Dean Smith	0.707317	0.781991	0.2	0.571428571	1
Adolph Rupp	0.698171	1	0.4	0.714285714	1
Jim Calhoun	0.689024	0.436019	0.3	0	1
Jim Phelan	0.557927	0.009479	0.1	0.142857143	1
Eddie Sutton	0.478659	0.469194	0	0.285714286	1
Lefty Driesell	0.42378	0.260664	0.1	0	1
Lute Olson	0.405488	0.592417	0.1	0.142857143	1
Lou Henson	0.402439	0.203791	0	0	1
Henry Iba	0.356707	0.388626	0.2	0	1
Edgar Diddle	0.341463	0.492891	0	0	1
Phog Allen	0.301829	0.606635	0.1	0	1
Jerry Tarkanian	0.25	0.819905	0.1	0	1
Norm Stewart	0.246951	0.236967	0	0	1
Ray Meyer	0.234756	0.2891	0.1	0.428571429	1
Don Haskins	0.219512	0.28436	0.1	0	1
Bob Huggins	0.192073	0.549763	0	0	1
Roy Williams	0.195122	0.85782	0.2	0.428571429	1
Denny Crum	0.085366	0.402844	0.2	0.428571429	1
Gary Williams	0.064024	0.123223	0.1	0	1
John Wooden	0.051829	0.914692	1	1	1
Rick Pitino	0.051829	0.587678	0.2	0.285714286	1
Ralph Miller	0.030488	0.099526	0	0.285714286	1

仅内部使用，严禁商用 www.hanlin.io

Mike Montgomery	0.027439	0.345972	0	0.285714286	1
Cliff Ellis	0	0	0	0	1

2) Calculate the grey relational coefficient and the grey relational degree.

Table 4. *Grey relational coefficient and Grey relational degree matrix*

Name	Wins	Pct.	NCAAB Champions	Coach Awards	Grey relational degree
Mike Krzyzewski	1	0.64526	0.454545455	0.636363636	0.653648096
Jim Boeheim	0.832487	0.594366	0.357142857	0.411764706	0.535868778
Bob Knight	0.691983	0.482838	0.416666667	0.368421053	0.488272356
Dean Smith	0.630769	0.69637	0.384615385	0.538461538	0.54928851
Adolph Rupp	0.623574	1	0.454545455	0.636363636	0.673244141
Jim Calhoun	0.616541	0.469933	0.416666667	0.333333333	0.463138417
Jim Phelan	0.530744	0.335453	0.357142857	0.368421053	0.3902421
Eddie Sutton	0.489552	0.485057	0.333333333	0.411764706	0.421891832
Lefty Driesell	0.464589	0.403442	0.357142857	0.333333333	0.39020928
Lute Olson	0.456825	0.550914	0.357142857	0.368421053	0.435701385
Lou Henson	0.455556	0.38574	0.333333333	0.333333333	0.374800311
Henry Iba	0.437333	0.449893	0.384615385	0.333333333	0.407244353
Edgar Diddle	0.431579	0.496471	0.333333333	0.333333333	0.40120218
Phog Allen	0.417303	0.559682	0.357142857	0.333333333	0.424543753
Jerry Tarkanian	0.4	0.735192	0.357142857	0.333333333	0.470881312
Norm Stewart	0.399027	0.395872	0.333333333	0.333333333	0.365430894
Ray Meyer	0.395181	0.412916	0.357142857	0.466666667	0.397191835
Don Haskins	0.3904	0.4113	0.357142857	0.33333333	0.376378649

仅内部使用，严禁商用 www.hanlin.io

	76	06		3	
Bob Huggins	0.382284	0.526185	0.333333333	0.333333333	0.39899055
Roy Williams	0.383178	0.778598	0.384615385	0.466666667	0.508643536
Denny Crum	0.353448	0.455724	0.384615385	0.466666667	0.410046943
Gary Williams	0.348195	0.363167	0.357142857	0.333333333	0.353469034
John Wooden	0.345263	0.854251	1	1	0.816390818
Rick Pitino	0.345263	0.548052	0.384615385	0.411764706	0.426661333
Ralph Miller	0.340249	0.357022	0.333333333	0.411764706	0.352966627
Mike Montgomery	0.339545	0.433265	0.333333333	0.411764706	0.374573553
Cliff Ellis	0.333333	0.333333	0.333333333	0.333333333	0.333333333

3) Sort the listed coaches by grey relational degree in descending order to select the top coaches.

Table 5. *Rank of college men's basketball coaches*

Name	Wins	Pct	NCAAB Champions	Coach Awards	Grey relational degree
John Wooden	664	0.804	10	7	0.816421266
Adolph Rupp	876	0.822	4	5	0.673237909
Mike Krzyzewski	975	0.764	4	5	0.653625969
Dean Smith	879	0.776	2	4	0.549279075
Jim Boeheim	942	0.75	1	2	0.535847239
Roy Williams	711	0.792	2	3	0.508643731
Bob Knight	902	0.709	3	1	0.488258607
Jerry Tarkanian	729	0.784	1	0	0.470877508
Jim Calhoun	873	0.703	3	0	0.463127488
Lute Olson	780	0.73	1	1	0.435696335

仅内部使用,严禁商用 www.hanlin.io

		6			
Rick Pitino	664	0.735	2	2	0.426663053
Phog Allen	746	0.739	1	0	0.424539802
Eddie Sutton	804	0.71	0	2	0.421885645
Denny Crum	675	0.696	2	3	0.410049682
Henry Iba	764	0.693	2	0	0.407240719
Edgar Diddle	759	0.715	0	0	0.401197092
Bob Huggins	710	0.727	0	0	0.398987605
Ray Meyer	724	0.672	1	3	0.397191997
Jim Phelan	830	0.613	1	1	0.390234465
Lefty Driesell	786	0.666	1	0	0.390203744
Don Haskins	719	0.671	1	0	0.37637647
Lou Henson	779	0.654	0	0	0.374794534
Mike Montgom-ery	656	0.684	0	2	0.374574409
Norm Stewart	728	0.661	0	0	0.365427663
Gary Williams	668	0.637	1	0	0.353468964
Ralph Miller	657	0.632	0	2	0.352967731
Cliff Ellis	647	0.611	0	0	0.333333333

Coaches marked in grey are the top 5 basketball coaches of all time.

3.5 Application of our model to other sports

In our model, the four factors we choose can be broadly applied to various kinds of college sports. When we apply our model to other fields, what we should to is just to choose the projects which can represent NCAA champions and Coach Awards in the specific field. So it is convenient for us to apply our model to other fields. The factors and explanations are shown in ***Table 6.1*** and ***Table 6.2***. The top 5 of both sports are shown in ***Table 7.1*** and ***Table 7.2*** respectively.

仅内部使用,严禁商用 www.hanlin.io

Table 6.1. *Factors and Explanations in football*

Factors	**Explanations**
Wins	The number of times that one specific coach has successfully led a team to win
Pct.	The winning percentage
NCAA National Championship	The amount of Bowl
Coach Awards	Bobby Dodd Coach of the Year Award Walter Camp Coach of the Year Award Amos Alonzo Stagg Award AFCA Coach of the Year Paul 'Bear' Bryant Award George Munger Award Home Depot Coach of the Year Award Sporting News College Football Coach of the Year Associated Press Coach of the Year Joseph V. Paterno Award National Coach of the Year

Table 6.2. *Factors and Explanations in ice-hockey*

Factors	**Explanations**
Wins	The number of times that one specific coach has successfully led a team to win
Pct.	The winning percentage
NCCA Champions	NCAA National Championship
Coach Awards	Spencer Penrose national Coach of the Year(only for division one) Lester Patrick Trophy (start from 1966) Jack Adams Award NCAA Coach of the Year

Table 7.1.*Top 5college men's football coaches*

Name	Wins	Pct.	National champions	Coach Awards	Grey relational degree
Bear Bryant	323	0.78	6	3	0.744053013
Jim Tressel	229	0.74	5	12	0.605457523
Tom Osborne	255	0.84	3	2	0.605088237
Bobby Bowden	377	0.74	2	3	0.592330117
Woody Hayes	238	0.76	5	4	0.588162393

Table 7.2.*Top 5 college men's ice hockey coaches*

Name	Wins	Pct.	NCAA champions	Coach	Grey relation-

www.hanlin.io 仅内部使用,严禁商用

				Awards	al degree
Jerry York	935	0.614	5	2	0.694032022
Vic Heyliger	352	0.685	6	1	0.684648603
Jack Parker	897	0.643	3	3	0.609648054
Ron Mason	924	0.696	0	1	0.598317509
Ned Harkness	380	0.74	3	1	0.590984292

4 Comparison of the ranks from different sources

We compare the top 5 coaches in our lists with those in the reports from ESPN or other research institutes. We find that the results are mostly identical.

Table 8*.Comparison of the rank of top 5 college men's basketball coaches*

RANK	The Model	Bleacher Report	ESPN(include woman)	Yahoo Sports
1	John Wooden	John wooden	John Wooden	John Wooden
2	Adolph Rupp	Bob knight	Dean Smith	Mike Krzyzewsk
3	Mike Krzyzewski	Mike Krzyzewski	Mike Krzyzewski	Dean Smith
4	Dean Smith	Adolph Rupp	Pat Summitt	Bob Knight
5	Jim Boeheim	Dean Smith	John Mclendon	Jerry Tar-Tarkanian

Table 9.*Comparison of the rank of top 5 college men's football coaches*

RANK	The Model	Yahoo Sports	Statesman	Orlando Sentinel
1	Bobby Bowden	Bear Bryant	Bear Bryant	Bear Bryant
2	Bear Bryant	Knute Rockne	Knute Rockne	Nick Saban
3	Glenn Scobey Warner	Joe Paterno	Glenn Pop Warner	Bobby Bowden
4	Amos Alonzo Stagg	Tom Osborne	Fielding Yost	Eddie Robinson
5	Joe Paterno	Woody Hayes	Joe Paterno	Woody Hayes

Table 10. *Comparison of the rank of top 5 college men's ice-hockey coaches*

RANK	The Model	Inside College Hockey
1	Jerry York	Bob Johnson
2	Vic Heyliger	Herb Brooks
3	Jack Parker	Murray Armstrong
4	Ron Mason	Jack Parker

5	Ned Harkness	Ned Harkness

5 The analysis of time line horizon

5.1 Introduction

The NCAA Championships have a history of approximately seventy years. During such a long span of time, the competition system has experienced a series of reforms. In early years, the number of sports events was much less than it is today, thus the competition among sports teams might be less intense. Therefore, there might be a difference among the average winning percentages in different time line horizon. If so, we can no longer justify our previous model, which ignores the influence of time line horizon and equally treats coaches from different periods in terms of winning percentage.

Therefore, we intend to explore whether there is a connection, to some degree, between the factors we choose and the time line horizon. Note that it is difficult to acquire the data of the times of winning *coach of the year* within limited amount of time. So we decide to use the rest of factors (Wins, Pct., and times of winning national championships) to examine if those factors change during different time line horizons. If the time line horizon does have significant influence on the rest of our factors, we need to modify our model. Now we process the data of college men's basketball coaches to see if there is a need for us to modify our model.

5.2 Procedures

Step 1. Firstly, we obtain the data of college men's basketball coaches who have coached their teams in more than 400 games. We select the coaches from all three divisions because the reforms of competition system cover all the divisions. The raw data are attached in appendix.

Step 2. Secondly, we sort the coaches by the year they start their coaching career and divide them into five groups as follows:

- Coaches who started their career before 1930s (group 1).
- Coaches who started their career during 1930s and 1940s (group 2).
- Coaches who started their career during 1950s and 1960s (group 3).
- Coaches who started their career during 1970s and 1980s (group 4).
- Coaches who started their career during 1990s and 2000s (group 5).

Then we calculate the mean and variance of each factor in each group. Figure 1 shows the means of winning percentages in all groups. Figure 2 shows the means of wins in all groups. Figure 3 shows the mean values of the times of winning NCAAB championships in all groups.

www.hanlin.io 仅内部使用,严禁商用

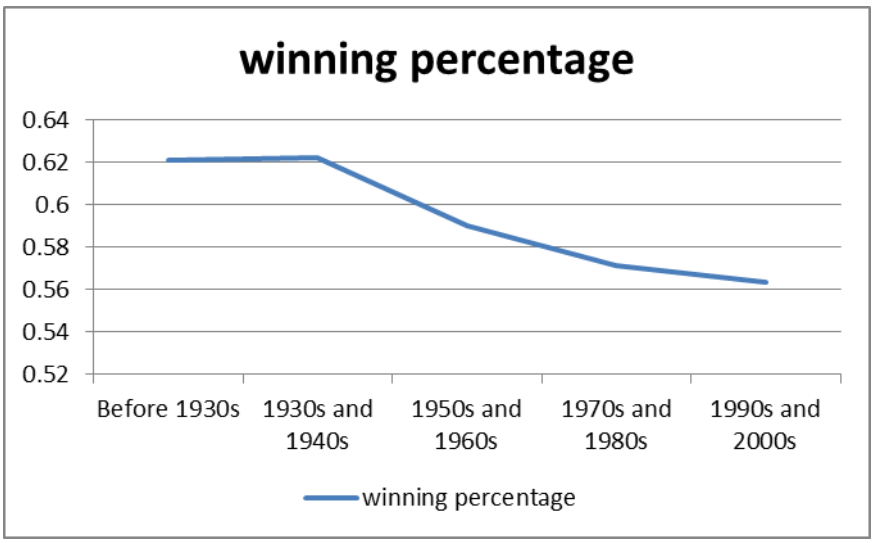


Figure 1.*The mean values of winning percentages*

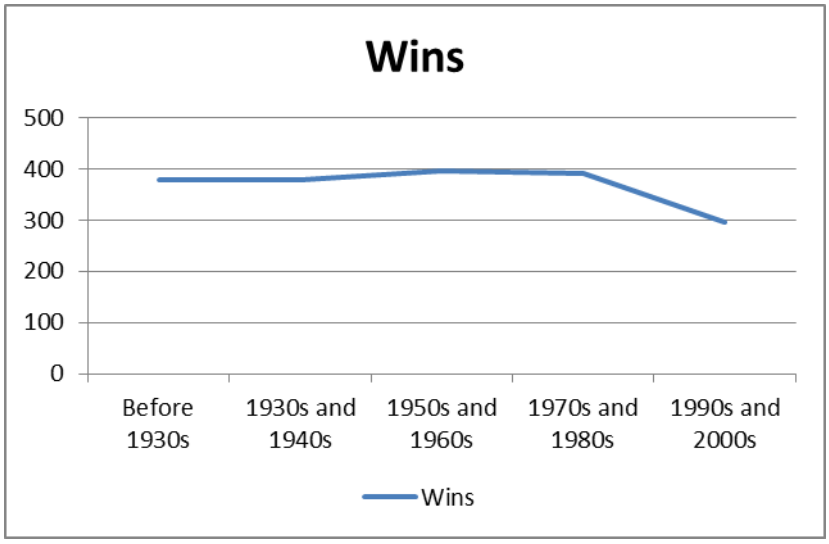
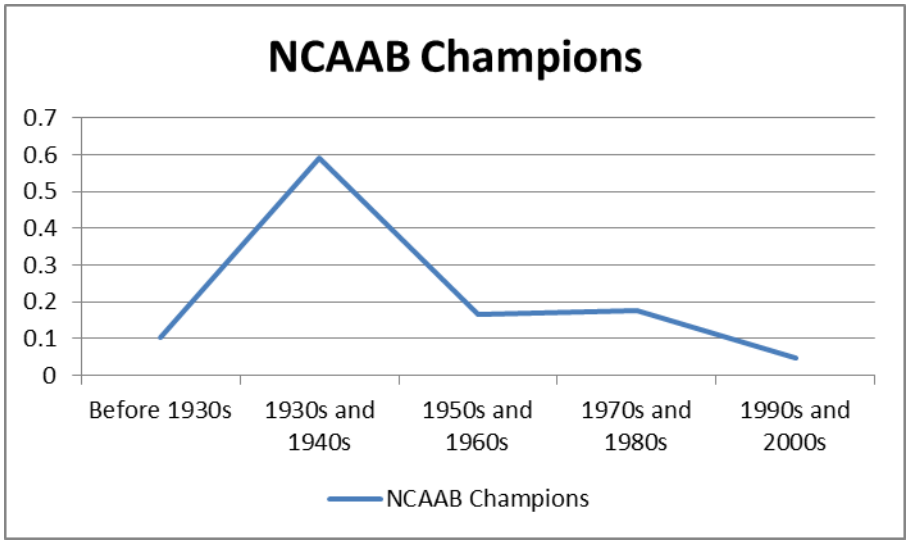


Figure 2.*The mean values of wins*



仅内部使用，严禁商用 www.hanlin.io

Figure 3.*The mean values of NCAAB Champions*[6]

Step 3. We find that the line in ***Figure 1*** smoothly goes down, which means that it is easier for good college basketball coaches in early years to get a high winning percentage. This is reasonable because the competition in not so intense in previous years as it is today. Therefore, with the same weights, using winning percentage to evaluate performance is not fair for younger coaches. Thus we should devise a correction factor to modify it.

Although this trend is clearly shown in ***Figure 1.*** It is still necessary for us to use one-way analysis of variance to test whether there is a significant difference among the variances of different groups. If the difference among variances is acceptable, we need to make adjustment to our model according to the tendency.

Table 11.

Source of Difference	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Among the five groups	0.026814016	2	0.013407	1.9886535	0.138645	3.025253
Within each group	2.062976049	306	0.006742			
Sum	**2.08979006**	**308**				

Table 12.

Source of Difference	**SS**	**Df**	**MS**	**F**	**P-value**	**F crit**
Among the five groups	0.114121057	4	0.02853026	3.3817495	0.00977028	2.395002616
Within each group	3.264940845	387	0.00843654			
sum	**3.3790619**	**391**				

Table 11 demonstrates that the P-value is greater than 0.05, which means there is not a significant difference of variances among group 3, group 4 and group 5. ***Table 12*** shows that there is a significant difference of variances among all five groups. So there exists some extreme values (the data of some outstanding coaches) that raises the variances of group 1 and group 2.

Therefore, only the increasing tendency of group 3, group 4, and group 5's winning percentages can be used to set a correction factor. Under two circumstances as follows, we should adopt different approaches to set correction factors.

[6] The sharp change of the line in 1930s-1940s is because that John wooden had won about 10 champions, if we exclude him from the sample, the line will become flat, so the time line horizon makes no difference on the NCAAB champion.

仅内部使用，严禁商用 www.hanlin.io

- The selection of the best all-time coaches who start coaching after 1950s
- The selection of the best all-time coaches who start coaching after 1900s

Step 4. Now we set a correction factor to reduce the winning percentages of coaches in previous years and increase the winning percentages of present coaches. We adopt the weighted moving average method to calculate the correction factor.

1) To select the best all-time coaches who started their coaching careers after 1950s, we need to modify our model. The correction factor α_i is:

$$\alpha_i = \frac{1}{S_i}$$

Where $S_i = \frac{\sum_{i=1}^{n} Y_i Z_i}{\sum_{i=1}^{n} Z_i}$, Z_i is the number of samples within group i, Y_i is the mean value of the winning percentage of group i.

Table 13 shows the winning percentages and grey relational degree of top 10 coaches before adjustment, while ***Table 14*** shows the winning percentages and grey relational degree of top 10 coaches after adjustment.

Table 13.*The rank of Top 10 college men's basketball coaches before adjustment*

Name	Pct.	Grey relational degree
John Wooden	0.804	0.816421
Adolph Rupp	0.822	0.673238
Mike Krzyzewski	0.764	0.653626
Dean Smith	0.776	0.549279
Jim Boeheim	0.75	0.535847
Roy Williams	0.792	0.508644
Bob Knight	0.709	0.488259
Jerry Tarkanian	0.784	0.470878
Jim Calhoun	0.703	0.463127
Lute Olson	0.736	0.435696

Table 14[7]***.****The rank of Top 10 college men's basketball coaches after adjustment*

Name	Correction factor	Pct.	Grey relational degree
Mike Krzyzewski	1.733399695	1.324317367	0.9204074
Roy Williams	1.733399695	1.372852558	0.586667007
Dean Smith	1.695298373	1.315551537	0.574608911
Jim Boeheim	1.733399695	1.300049771	0.53458653

[7] Because we select the best all time coaches who start coaching after 1950s, John Wooden and Adolph Rupp who start their coaching careers in 1930s should not have been on the list.

仅内部使用,严禁商用 www.hanlin.io

Bob Knight	1.695298373	1.201966546	0.525580488
Jim Calhoun	1.733399695	1.218579985	0.508524212
Jerry Tarkanian	1.733399695	1.35898536	0.496549075
Rick Pitino	1.733399695	1.274048775	0.438797739
Lute Olson	1.733399695	1.275782175	0.419173266
Denny Crum	1.733399695	1.206446187	0.417960291

2) For coaches who started their coaching careers between 1900s and 1950s, we find out that group 1 and group 2 contains extreme values. The two outstanding coaches, those data are probably the extreme values, are John Wooden and Adolph Rupp. After eliminating their data, we repeat our one-way data analysis of variance and find that the P-value among five groups increases to 0.08, which is greater than 0.05. Thus we can know for sure that the data of John Wooden and Adolph Rupp are extreme values.

Although John Wooden and Adolph Rupp are among the greatest coaches in NCAAB in early years, we cannot assume that they would be as successful today. Therefore, when we select the best all-time coaches who started their coaching careers after 1900s, we should set a correction factor to reduce their grey relational degrees. However, because of the scarcity of data, we cannot use a precise formulation for calculation.

Although we only explain the principle for modifying our model based on the data of college men's basketball coaches in this section, this approach is applicable to other sports (such as football and ice-hockey) because of the generality of the factors we select. We also find that the winning percentage we use to select the best all-time coaches in NCAA football has the same tendency as it is when we analyze the relationship between winning percentage and the time line horizon. Using the one-way analysis of variance, we find that its P-value is 0.07 (greater than 0.05), which means that we can still use the moving weighted average method to get our correction factor in the evaluation of best all-time college men's football coaches.

6 The analysis of gender

By analyzing the data of college women's basketball coaches, we find that the four factors we select have no relation to gender and that the weight of each indicator doesn't change. ***Table 15*** displays the top 5 of college women's basketball coaches.

Table 15 *The top 5 of college women's basketball coaches*

Name	Wins	Pct.	NCAA Champions	Coach Awards	Grey relational degree
Pat Summitt	1098	0.841	8	8	0.989807143
C. Vivian Stringer	916	0.732	0	0	0.60757619

仅内部使用,严禁商用 www.hanlin.io

Tara VanDerveer	910	0.817	2	4	0.54686006
Sylvia Hatchell	908	0.739	1	6	0.481908161
Barbara Stevens	900	0.785	0	0	0.476794451

7 Stability test

7.1 Testing the influence of changing the method on the determination of weights

7.1.1 Introduction

In this section, we use Shannon's entropy method to determine the weight of each factor. Then we use grey correlation analysis, which has identical processes as above, to obtain the rank of coaches to see if there is any difference between the two methods (the fuzzy consistent matrix method and the entropy method) for determining weights.

7.1.2 Notation

Notation	**Explanation**
C	Raw data matrix
C'	Modified raw data matrix
Q	Decision matrix
h_i	Entropy
W	Weights of factors under the entropy method

7.1.3 Using Shannon's entropy method to determine the weight of each factor

Shannon's entropy method is a well-known method for determining the weights for multiple attribute decision making (MADM) process (Lotfi., et, al.,2010). Entropy is a metric for measuring the degree of disorder in a system. For a specific factor in the system, when there is a large difference among its values, the entropy value is comparatively large, while a factor with less discrepancy among its values has smaller entropy value.

Using this approach, we can determine the weight of each factor in our coach evaluation system. The factor with larger entropy is less importance in our system, and thus

仅内部使用，严禁商用 www.hanlin.io

has smaller weight. The factor with smaller entropy is more important in our system, and thus has larger weight.

Therefore, the procedures for determining weights can be expressed as follows:

1) If the i th factor has some extreme values, we should modify the raw data matrix $C=(c_{ij})_{n\times m}$ to create a new matrix $C'=(c_{ij})_{n\times m}$ and thusly eliminate the negative influence of extreme values on our model.

The formula for creating C' is:

$$c_{ij}' = u + \frac{c_{ij} - min(c_{ij})}{max(c_{ij}) - min(c_{ij})} \times v$$

Where $u = \sum_{i=1}^{m} c_{ij} / \sqrt{\sum_{i=1}^{m} (c_{ij} - \bar{c}_{ij})^2}$, $v = 1/\sqrt{\sum_{i=1}^{m} (c_{ij} - \bar{c}_{ij})^2}$.

2) Normalize the raw data matrix $C'=(c_{ij})_{n\times m}$ to create matrix $Q=(q_{ij})_{n\times m}$.

The factors of this model are positive factors, which mean that the factors with greater values are better. Therefore, the formula for creating Q is:

$$q_{ij} = \frac{c_{ij} - \min\limits_{j}\{c_{ij}\}}{\max\limits_{j}\{c_{ij}\} - \min\limits_{j}\{c_{ij}\}} + 1$$

By normalizing the modified raw data matrix, we can eliminate the anomalies resulted from different dimensions and metrics for measuring the data.

3) Based on the decision matrix Q , we calculate the entropy of each factor:

$$h_i = -\mathrm{k}\sum_{j=1}^{m} d_{ij} \ln d_{ij}$$

Where h_i is the i th factor's entropy. $d_{ij} = q_{ij} / \sum_{i=1}^{m} q_{ij}$. k=1/ $\ln$ m . $\ln d_{ij}$ is defined as 0 if $d_{ij} = 0$.

4) Now we can calculate the weight of each factor. Suppose that the number of objects is m and the number of factors is n .

By using the following formula, we can calculate the weight of each factor in a sys-

仅内部使用,严禁商用 www.hanlin.io

tem.

$$W_i = \frac{1 - h_i}{n - \sum_{i=1}^{n} h_i}$$

Where $0 \le W_i \le 1, \sum_{i=1}^{n} W_i = 1$.

In our model, we calculate the weights of the four factors as follows:

$$W = (0.2493 \quad 0.2492 \quad 0.2508 \quad 0.2507)^T$$

Where 0.2493 is the weight of the times of winning NCAAB championships; 0.2492 is the weight of winning percentage; 0.2508 is the weight of wins; and 0.2507 is the weight of times of winning the title of *Coach of the Year.*

Table 16 shows the rank of college coaches based on Shannon's entropy method and grey correlation analysis.

Table 16.*Results based on Entropy Method*

NAME	WINS	Pct.	NCAAB Champions	Coach Awards	Grey relational degree
John Wooden	664	0.804	10	7	0.80048
Mike Krzyzewski	975	0.764	4	5	0.68361
Adolph Rupp	876	0.822	4	5	0.678202
Dean Smith	879	0.776	2	4	0.562236
Jim Boeheim	942	0.75	1	2	0.548441
Roy Williams	711	0.792	2	3	0.503022
Bob Knight	902	0.709	3	1	0.489688
Jim Calhoun	873	0.703	3	0	0.458873
Jerry Tarkanian	729	0.784	1	0	0.456083
Lute Olson	780	0.736	1	1	0.433112
Eddie Sutton	804	0.71	0	2	0.429747
Rick Pitino	664	0.735	2	2	0.422348
Phog Allen	746	0.739	1	0	0.416651
Denny Crum	675	0.696	2	3	0.415138
Ray Meyer	724	0.672	1	3	0.407979
Henry Iba	764	0.693	2	0	0.401171
Edgar Diddle	759	0.715	0	0	0.398482
Jim Phelan	830	0.613	1	1	0.397834
Bob Huggins	710	0.727	0	0	0.393601
Lefty Driesell	786	0.666	1	0	0.389495
Mike Montgomery	656	0.684	0	2	0.379449

仅内部使用,严禁商用 www.hanlin.io

Lou Henson	779	0.654	0	0	0.376859
Don Haskins	719	0.671	1	0	0.372983
Norm Stewart	728	0.661	0	0	0.365295
Ralph Miller	657	0.632	0	2	0.360621
Gary Williams	668	0.637	1	0	0.350446
Cliff Ellis	647	0.611	0	0	0.333333

Coaches marked in grey are the top 5 basketball coaches of all time.

7.1.4 Comparison of the outcomes

In order to test the stability of our model, we now compare the outcome from using the fuzzy consistent matrix to determine weights with the outcome from using the entropy method.

Table 17.*Comparison between Fuzzy Consistent Matrix Method and Entropy Method*

RANK	Fuzzy Consistent Matrix	Entropy Method
1	John Wooden	John Wooden
2	Adolph Rupp	Mike Krzyzewski
3	Mike Krzyzewski	Adolph Rupp
4	Dean Smith	Dean Smith
5	Jim Boeheim	Jim Boeheim
6	Roy Williams	Roy Williams
7	Bob Knight	Bob Knight
8	Jerry Tarkanian	Jim Calhoun
9	Jim Calhoun	Jerry Tarkanian
10	Lute Olson	Lute Olson

Table 17 shows that the name lists of top 10 coaches generated from the above two methods are identical, while there is a slight difference among the ranks. Therefore, we can reach the conclusion that our model is stable.

7.2 Testing the influence of changing the comparative importance among the four factors

Now we change the comparative importance among the four factors in the evaluation of college men's basketball coaches to see if there is a significant difference between the outcomes.

Table 18.*The comparative importance among factors after adjustment*

	Wins	Pct.	NCCAB Champions	Coach Awards
Wins	0.5	0	0	0
Pct.	1	0.5	0	0

仅内部使用,严禁商用 www.hanlin.io

NCCAB Champions	1	1	0.5	1
Coach Awards	1	1	0	0.5

Table 19 displays the rank of college men's basketball coaches after adjustment. ***Table 20*** compares the outcome in this section with the outcome in the previous section.

Table 19.*Rank of college men's basketball coaches after adjustment*

NAME	WINS	Pct.	NCAAB Champions	Coach Awards	Grey relational degree
John Wooden	664	0.804	10	7	0.873444278
Adolph Rupp	876	0.822	4	5	0.649232275
Mike Krzyzewski	975	0.764	4	5	0.626894346
Dean Smith	879	0.776	2	4	0.531824804
Roy Williams	711	0.792	2	3	0.493260791
Jim Boeheim	942	0.75	1	2	0.493108718
Bob Knight	902	0.709	3	1	0.45717316
Jerry Tarkanian	729	0.784	1	0	0.438544324
Jim Calhoun	873	0.703	3	0	0.433420385
Rick Pitino	664	0.735	2	2	0.422098796
Denny Crum	675	0.696	2	3	0.4189328
Lute Olson	780	0.736	1	1	0.416837441
Eddie Sutton	804	0.71	0	2	0.411274136
Ray Meyer	724	0.672	1	3	0.406011386
Phog Allen	746	0.739	1	0	0.402993475
Henry Iba	764	0.693	2	0	0.391780608
Edgar Diddle	759	0.715	0	0	0.382957853
Bob Huggins	710	0.727	0	0	0.382252792
Jim Phelan	830	0.613	1	1	0.380833646
Mike Montgomery	656	0.684	0	2	0.378288688
Lefty Driesell	786	0.666	1	0	0.375969596
Don Haskins	719	0.671	1	0	0.366927201
Lou Henson	779	0.654	0	0	0.362422603
Ralph Miller	657	0.632	0	2	0.361857247
Norm Stewart	728	0.661	0	0	0.356422014
Gary Williams	668	0.637	1	0	0.350356494
Cliff Ellis	647	0.611	0	0	0.333333333

Table 20.*Comparison of outcomes based on two different Fuzzy Consistent Matrixes*

RANK	Fuzzy Consistent Matrix1	Fuzzy Consistent Matrix2
1	John Wooden	John Wooden
2	Adolph Rupp	Adolph Rupp
3	Mike Krzyzewski	Mike Krzyzewski
4	Dean Smith	Dean Smith

仅内部使用,严禁商用 www.hanlin.io

5	Jim Boeheim	Roy Williams
6	Roy Williams	Jim Boeheim
7	Bob Knight	Bob Knight
8	Jerry Tarkanian	Jerry Tarkanian
9	Jim Calhoun	Jim Calhoun
10	Lute Olson	Rick Pitino

We can see from ***Table 20*** that the outcome is slightly different when compared with the outcome in the previous section. Based on section **6.1** and **6.2**, we can reach the conclusion that our model is stable.

8 Sensitivity test

In previous section, we assume that the distinguishing coefficient $\rho = 0.5$. This assumption of this value is based on experience. Therefore, we need to change the value of ρ to see if the value of ρ will exert significant influence on our model.

Table 21 shows the rank of coaches when $\rho = 0.5$, while ***Table 22*** and ***Table 23***show the rank of coaches when ρ is equal to 0.4 and 0.6 respectively.

Table 21. *Rank of college men's basketball coaches (ρ =0.5)*

RANK	NAME	Grey Relational Degree (ρ =0.5)
1	Mike Krzyzewski	0.816390818
2	Jim Boeheim	0.673244141
3	Bob Knight	0.653648096
4	Dean Smith	0.54928851
5	Adolph Rupp	0.535868778
6	Jim Calhoun	0.508643536
7	Jim Phelan	0.488272356
8	Eddie Sutton	0.470881312
9	Lefty Driesell	0.463138417
10	Lute Olson	0.435701385

Table 22. *Rank of college men's basketball coaches (ρ =0.4)*

RANK	NAME	Grey Relational Degree (ρ =0.4)
1	Mike Krzyzewski	0.816421

www.hanlin.io 仅内部使用,严禁商用

2	Jim Boeheim	0.673238
3	Bob Knight	0.653626
4	Dean Smith	0.549279
5	Adolph Rupp	0.535847
6	Jim Calhoun	0.508644
7	Jim Phelan	0.488259
8	Eddie Sutton	0.470878
9	Lefty Driesell	0.463127
10	Lute Olson	0.435696

Table 23.*Rank of college men's basketball coaches (ρ =0.6)*

RANK	NAME	Grey Relational Degree (ρ =0.6)公式
1	Mike Krzyzewski	0.831661964
2	Jim Boeheim	0.70427652
3	Bob Knight	0.687185051
4	Dean Smith	0.590853876
5	Adolph Rupp	0.574939217
6	Jim Calhoun	0.54878576
7	Jim Phelan	0.531490084
8	Eddie Sutton	0.511362919
9	Lefty Driesell	0.507122379
10	Lute Olson	0.479680225

By comparing the above three tables, we find that the top 10 college men's basketball coaches are identical, which means that our model is insensitive to the change of ρ .

9 Strengths and Weaknesses

9.1 Strengths

- **It is convenient and broadly applicable to use our model to select the top college coaches.** Utilizing the grey correlation analysis method, our model has high precision and is convenient for researches to assess the performances of coaches. The four factors we select can be universally adopted when analyzing different sports in NCAA or coaches of different genders.
- **Our model has good stability.** Our outcomes are nearly identical when different method of analyzing stability and sensitivity is adopted.

www.hanlin.io 仅内部使用,严禁商用

9.2 Weaknesses

- **The standard for selecting factors is rigorous to some degree.** In terms of selection of best all-time college men's football coaches, we choose Division I coaches with more than 200 wins. However, some famous coaches, although fail to achieve 200 wins, should have been granted the qualification to be selected as best all-time coaches.
- **The collection of the numbers of Coach Awards is subjective.** Some awards should not have been included.
- **The analysis of time line horizon is imperfect.** For example, it is difficult for us to set a correction factor for coaches who started their careers before 1950s.

Reference

[1] Rushall, B. S., and K. Wiznuk. "Athletes' assessment of the coach--the coach evaluation questionnaire." *Canadian journal of applied sport sciences. Journal canadien des sciences appliqu ées au sport*.10.3 (1985): 157.

[2] Cassidy, Tania, Paul Potrac, and Alex McKenzie. "Evaluating and Reflecting Upon a Coach Education Initiative: The CoDe^ 1 of Rugby." *Sport Psychologist*20.2 (2006): 145.

[3] Nelson, Lee J., and Christopher J. Cushion. "Reflection in coach education: the case of the national governing body coaching certificate." *Sport Psychologist*20.2 (2006): 174.

[4] Lotfi F H, Fallahnejad R. Imprecise Shannon's entropy and multi attribute decision making[J]. Entropy, 2010, 12(1): 53-62.

[5] Saaty, T.L. *The Analytic Hierarchy Process*; McGraw-Hill: NewYork, NY, USA, 1980.

[6] Hwang, C.L.; Lin, M.J. *Group Decision Making under Multiple Criteria: Methods and Applications*; Springer: Berlin, Germany, 1987.

[7] Fan, Z.P. Complicated multiple attribute decision making: Theory and applications. Ph.D Dissertation; Northeastern University, Shenyang, China, 1996.

[8] Chu, A.T.W.; Kalaba, R.E.; Spingarn, K. A comparison of two methods for determining the weights of belonging to fuzzy sets. *J. Optimiz. Theor. App.* 1979, *27*, 531–538.

[9] Shannon, C.E. A mathematical theory of communication. *Bell Syst. Tech. J.* 1948, *27*, 379–423.

www.hanlin.io 仅内部使用,严禁商用

[10]Sun, L. J.; Xing, X. J.; Zhou, D. Q. Improvement of Entropy Method. *Statistics and Decision. J.* 2010,21.

[11]Lu, T. C.; Kang, K. The Application of Entropy method and AHP in determining the weights . *Computer Programming Skills & Maintenance. J.* 2009, 22.

[12]Chen, X. The Application of fuzzy analytic hierarchy process in the preferred aspects of the program. *Computer Engineering and Design. J.* 2004, 10.

Appendix

Men's basketball college coaches

a	NCCAB Champions
b	Coach Awards
c	NABC Coach of the Year
d	Basketball Times National Coach of the Year
e	National coach of the year
f	AP national coach
g	Henry iba awards
h	Coach Year

Name	Year	Wins	Pct.	a	b	c	d	e	f	g	h
Mike Krzyzewski	38	975	0.764	4	5	1	2	0	2	0	1976
Jim Boeheim	37	942	0.75	1	2	1	0	0	1	0	1977
Bob Knight	42	902	0.709	3	1	0	0	0	1	0	1966
Dean Smith	36	879	0.776	2	4	0	0	4	0	0	1962
Adolph Rupp	41	876	0.822	4	5	0	0	5	0	0	1931
Jim Calhoun	39	873	0.703	3	0	0	0	0	0	0	1973
Jim Phelan	49	830	0.613	1	1	0	0	1	0	0	1989
Eddie Sutton	37	804	0.71	0	2	0	0	0	2	0	1970
Lefty Driesell	41	786	0.666	1	0	0	0	0	0	0	1961
Lute Olson	34	780	0.736	1	1	0	0	1	0	0	1974
Lou Henson	41	779	0.654	0	0	0	0	0	0	0	1963
Henry Iba	41	764	0.693	2	0	0	0	0	0	0	1930
Edgar Diddle	42	759	0.715	0	0	0	0	0	0	0	1959
Phog Allen	48	746	0.739	1	0	0	0	0	0	0	1906
Jerry Tarkanian	31	729	0.784	1	0	0	0	0	0	0	1970
Norm Stewart	38	728	0.661	0	0	0	0	0	0	0	1968
Ray Meyer	42	724	0.672	1	3	1	0	0	2	0	1943

仅内部使用,严禁商用 www.hanlin.io

Don Haskins	38	719	0.671	1	0	0	0	0	0	0	1962
Bob Huggins	30	710	0.727	0	0	0	0	0	0	0	1985
Roy Williams	24	711	0.792	2	3	1	0	0	1	1	1989
Denny Crum	30	675	0.696	2	3	0	0	3	0	0	1972
Gary Williams	33	668	0.637	1	0	0	1	0	0	0	1979
John Wooden	29	664	0.804	10	7	0	0	7	0	0	1947
Rick Pitino	27	664	0.735	2	2	1	0	1	0	0	1979
Ralph Miller	38	657	0.632	0	2	0	0	2	0	0	1952
Mike Mont-gomery	31	656	0.684	0	2	1	0	1	0	0	1979
Cliff Ellis	37	647	0.611	0	0	0	0	0	0	0	1976

Men’s football college coach

a	NCCA Champions
b	Coach Awards
c	Bobby Dodd Coach of the Year Award
d	Walter Camp Coach of the Year Award
e	Amos Alonzo Stagg Award
f	AFCA Coach of the Year
g	Paul 'Bear' Bryant Award
h	George Munger Award
i	Home Depot Coach of the Year Award
j	Sporting News College Football Coach of the Year
k	Associated Press Coach of the Year
l	Joseph V. Paterno Award
m	National Coach of the Year

Name	Years	Wins	Pct.	a	b	c	d	e	f	g	h	i	j	k	l	m
Bowden, Bobby	44	377	0.743	22	3	1	1	1	0	0	0	0	0	0	0	0
Bryant, Bear	38	323	0.78	15	3	0	0	0	3	0	0	0	0	0	0	0
Warner, Glenn Scobey	49	319	0.733	4	1	0	0	1	0	0	0	0	0	0	0	0
Stagg, Amos Alonzo	57	314	0.605	2	1	0	0	0	1	0	0	0	0	0	0	0
Paterno, Joe	46	298	0.685	24	17	2	3	1	5	1	3	1	1	0	0	0
Beamer, Frank	33	266	0.666	9	7	1	1	0	1	1	1	0	0	1	1	0
Edwards, LaVell	29	257	0.716	7	3	1	0	1	1	0	0	0	0	0	0	0
Osborne, Tom	25	255	0.836	12	2	1	0	0	0	0	0	0	0	0	0	1

仅内部使用,严禁商用 www.hanlin.io

Holtz, Lou	33	249	0.651	12	5	0	1	0	0	2	0	0	2	0	0	0
Brown, Mack	30	244	0.666	13	2	1	1	0	0	0	0	0	0	0	0	0
Moore, Jerry	31	243	0.642	3	0	0	0	0	0	0	0	0	0	0	0	0
Hayes, Woody	33	238	0.759	5	4	0	1	1	1	0	0	0	1	0	0	0
Schembechler, Bo	27	234	0.804	5	4	1	1	1	1	0	0	0	0	0	0	0
Ault, Chris	28	233	0.681	2	0	0	0	0	0	0	0	0	0	0	0	0
Fry, Hayden	37	232	0.564	7	2	0	0	1	0	0	0	0	1	0	0	0
Tressel, Jim	25	229	0.742	6	12	12	0	0	0	0	0	0	0	0	0	0
Laycock, Jimmye	34	222	0.573	1	0	0	0	0	0	0	0	0	0	0	0	0
Spurrier, Ste-ve	24	219	0.733	9	0	0	0	0	0	0	0	0	0	0	0	0
Nehlen, Don	30	202	0.609	4	3	1	1	0	1	0	0	0	0	0	0	0
Dooley, Vince	25	201	0.715	8	5	1	1	1	1	0	0	0	1	0	0	0

Men’s ice-hockey college coach

a	NCAA Champions
b	Coach Awards
c	Lester Patrick Trophy(1966 起评)
d	Spencer Penrose national Coach of the Year(only for division one)
e	Jack Adams Award
f	NCAA Coach of the Year

Name	Years	Wins	Pct.	a	b	c	d	e	f
Jerry York	40	935	0.61	5	2	1	1	0	0
Jack Parker	40	897	0.64	3	3	0	3	0	0
Red Berenson	30	770	0.66	2	2	0	1	1	0
Don Lucia	26	623	0.64	2	1	0	1	0	0
John "Snooks" Kelley	36	501	0.67	1	3	1	2	0	0
Ron Mason	36	924	0.7	0	1	0	1	0	0
Rick Comley	37	783	0.56	0	2	0	2	0	0
R.H. "Bob" Peters	36	744	0.7	2	0	0	0	0	0
Len Ceglarski	35	689	0.66	0	3	0	3	0	0
Jeff Sauer	31	655	0.55	2	0	0	0	0	0
John MacInnes	26	555	0.65	3	6	1	2	0	3
Don Brose	34	540	0.59	0	0	0	0	0	0
Dick Umile	23	519	0.64	0	0	0	0	0	0
John P. Riley, Jr.	36	542	0.61	0	0	0	0	0	0
Bruce Marshall	25	351	0.48	0	0	0	0	0	0

仅内部使用,严禁商用 www.hanlin.io

Murray Armstrong	21	460	0.67	0	2	1	1	0	0
Bill Wilkinson	26	437	0.48	0	0	0	0	0	0
Shawn Walsh	17	423	0.68	0	1	0	1	0	0
John Gasparini	17	407	0.6	0	0	0	0	0	0
Doug Woog	14	390	0.66	0	0	0	0	0	0
Amo Bessone	31	387	0.46	1	1	0	1	0	0
Ned Harkness	23	380	0.74	3	1	0	1	0	0
Jeff Jackson	14	367	0.68	2	1	0	1	0	0
Vic Heyliger	23	352	0.69	6	1	0	1	0	0
Bob Daniels	21	350	0.48	0	2	0	2	0	0
Mike McShane	32	633	0.65	0	0	0	0	0	0
George Gwozdecky	27	592	0.6	2	2	0	2	0	0
Joe Marsh	26	482	0.53	0	1	0	2	0	0
Doug Ross	27	457	0.6	0	0	0	0	0	0
Rick Gotkin	25	453	0.58	0	0	0	0	0	0
Mike Gilligan	25	407	0.54	0	0	0	0	0	0
Craig Dahl	24	407	0.5	0	0	0	0	0	0
Mike Sertich	21	375	0.49	0	1	0	1	0	0
Rand Pecknold	19	367	0.6	0	0	0	0	0	0
Bruce Marshall	25	351	0.48	0	0	0	0	0	0

Woman's basketball college coach

a	NCAA Champions
b	Coach Awards
c	NCAA Coach of the Year
d	Naismith Coach of the 20th Century
e	NAIA

Name	Year	Wins	Pct.	a	b	c	d	e
Pat Summitt	38	1098	0.841	8	8	7	1	0
C.Vivian Stringer	42	916	0.732	0	0	0	0	0
Tara VanDerveer	34	910	0.817	2	4	4	0	0
Sylvia Hatchell	38	908	0.739	1	3	2	0	1
Barbara Stevens	36	900	0.785	0	0	0	0	0
Jody Conradt	38	900	0.744	2	6	6	0	0
Debbie Ryan	34	739	0.695	1	1	0	1	0
Kay Yow	38	737	0.682	0	0	0	0	0
Sue Gunter	34	708	0.697	0	0	0	0	0
Muffet McGraw	31	714	0.735	1	1	0	1	0
Amy Ruley	29	671	0.772	5	0	0	0	0
Theresa Grentz	33	671	0.683	0	0	0	0	0

Nancy Fahey	27	639	0.844	5	0	0	0	0

Program

1)Apply Fuzzy Consistent Matrix to determine weight

```
A=[0.5 0 0 1
1 0.5 0 1
1 1 0.5 1
0 0 0 0.5]

c=sum(A,2);
b=sum(A);
m=c(1,:)+b(:,1);
for i=1:4
for j=1:4
r(i,j)=(c(i,:)-c(j,:))/(2*m)+0.5;
end
end

d=sum(r);
for j=1:4
for i=1:4
s(i,j)=r(i,j)/d(:,j);
end
end

 k=power(prod(s,2),1/4);

for i=1:4
w(i,:)=k(i,:)/sum(k);
end
w=w’
```

2)Apply Entropy Method to determine weight

```
x=xlsread('E:\2014 美赛\B 题\数据\basketball.xls');
x=x';
k=mean(x,1)
t=sum(x)
s3=0;
s4=0;
```

```
for i=1:27
a3=(x(i,3)-k(3))^2;
s3=s3+a3;
end
d3=1/(sqrt(s3))
c3=t(:,3)/(sqrt(s3))

for i=1:27
a4=(x(i,4)-k(4))^2;
s4=s4+a4;
end
d4=1/(sqrt(s4))
c4=t(:,4)/(sqrt(s4))
y=[]
[m,n]=size(x);
for i=1:n
y(:,i)=x(:,i)/sum([x(:,i)]);
end

for i=1:27
y(i,3)=y(i,3)*d3+c3;
y(i,4)=y(i,4)*d4+c4;
end

for i=1:n
y(:,i)=x(:,i)/sum([x(:,i)])+1;
end

for l=1:n
s(1,l)=0;
for j=1:m
p(1,l)=y(j,l)*log(y(j,l))
s(1,l)=s(1,l)+p(1,l)
end
end
k=(log(m))^(-1)
e=-k*s
h=ones(1,n)-e
w=h/(n-sum(h))
w=w/sum(w,2)
```

3)Total model

Weight and calculate grey relational degree

www.hanlin.io 仅内部使用,严禁商用

```
A=[0.5 0 0 1
1 0.5 0 1
1 1 0.5 1
0 0 0 0.5]

c=sum(A,2);
b=sum(A);
m=c(1,:)+b(:,1);
for i=1:4
for j=1:4
r(i,j)=(c(i,:)-c(j,:))/(2*m)+0.5;
end
end

d=sum(r);
for j=1:4
for i=1:4
s(i,j)=r(i,j)/d(:,j);
end
end

  k=power(prod(s,2),1/4);
for i=1:4
w(i,:)=k(i,:)/sum(k);
end
w=w';

a=xlsread('E:\2014 美赛\B 题\数据\basketball.xls');
for i=1:4
a(i,:)=(a(i,:)-min(a(i,:)))/(max(a(i,:))-min(a(i,:)));
end
[m,n]=size(a);
cankao=max(a')'
t=repmat(cankao,[1,n])-a;
mmin=min(min(t));
mmax=max(max(t));
rho=0.5;
xishu=(mmin+rho*mmax)./(t+rho*mmax);
correlation=w*xishu

xlswrite('C:\Users\Administrator\Desktop\correlation.xls',correlation)
```

www.hanlin.io 仅内部使用,严禁商用

An article for Sports Illustrated

The best all-time college coaches

College coaches are critical to the performance of their teams. As the heat of National College Athletic Association Championships spreads throughout the country, the coaches that have led their teams to win a considerable number of trophies become the legends among sports fans. Who is your favorite college coach?

May be he is John Wooden, the legend on basketball court, who won the most amount of NCAA champions?

May be he is "Bear" Bryant, the hero in the field of football ,who held the record for most wins as head coach when he retired as a coach in 1982?

May be she is Pat Summitt, the most successful woman basketball coach, who hold the most all-time wins in NCAA basketball history above 1000 victories?

We know that you are tired of the endless debate on your choice of the best all-time coaches. Thus we build a quantitative evaluation system to rank the college coaches of all time. The results are just in! Check whether your favorite college coach is among the top!

Top 5 College Men's Basketball Coaches

1. John Wooden
2. Adolph Rupp
3. Mike Krzyzewski
4. Dean Smith
5. Jim Boeheim

www.hanlin.io 仅内部使用,严禁商用

Top 5 College Men's Football Coaches

1. Bear Bryant
2. Jim Tressel
3. Tom Osborne
4. Bobby Bowden
5. Woody Hayes

Top 5 College Men's Ice Hockey Coaches

1. Jerry York
2. Vic Heyliger
3. Jack Parker
4. Ron Mason
5. Ned Harkness

In our evaluation system, we select four indicators to assess the performance of coaches: The times that they lead their teams to win NCAA championships, the winning percentage, the times of victory throughout their coaching career, and the times they win the title of Coach of the Year. We use appropriate method to determine the weight of each factor, and then use mathematical model to rank all the coaches.

One of the advantages of this model is that it eliminates the arbitrariness of human judgment. We know that most of media use online-voting system to collect data and rank the coaches, which is not convincible. Instead of that, we obtain the data of all college coaches from NCAA database, and use mathematical model to determine which indicator is more important.

Another advantage is that our model is universally applicable. We can apply this model across both genders and various kinds of sports.

The function of our model might be limited, but your enthusiasm of sports is unlimited!