Best all time college coach

Summary

In order to select the “best all time college coach” in the last century fairly, We take selecting the best male basketball coach as an example, and establish the TOPSIS sort - Comprehensive Evaluation improved model based on entropy and Analytical Hierarchy Process.

The model mainly analyzed such indicators as winning rate, coaching time, the time of winning the championship, the number of races and the ability to perceive .Firstly ，Analytical Hierarchy Process and Entropy are integratively utilized to determine the index weights of the selecting indicators Secondly，Standardized matrix and parameter matrix are combined to construct the weighted standardized decision matrix. Finally, we can get the college men's basketball composite score, namely the order of male basketball coaches, which is shown in **Table 7.** Adolph Rupp and Mark Few are the last century and this century's "best all time college coach" respectively. It is realistic. The rank of college coaches can be clearly determined through this method.

Next, ANOVA shows that the scores of last century’s coaches and this century’s coaches have significant difference, which demonstrates that time line horizon exerts influence upon the evaluation and gender factor has no significant influence on coaches’ score. The assessment model, therefore, can be applied to both male and female coaches. Nevertheless, based on this, we have drawn coaches’ coaching ability distributing diagram under ideal situation and non-ideal situation according to the data we have found, through which we get that if time line horizon is chosen reasonably, it will not affect the selecting results. In this problem, the time line horizon of the year 2000 will not influence the selecting results.

Furthermore, we put the data of the three types of sports, which have been found by us, into the above Model, and get the top 5 coaches of the three sports, which are illustrated in **Table10**, **Table 11**, **Table12** and **Table13** respectively. These results are compared with the results on the Internet[7], so as to examine the reasonableness of our results. We choose the sports randomly which undoubtedly shows that our model can be applied in general across both genders and all possible sports. At the same time, it also shows the practicality and effectiveness of our model.

Finally, we have prepared a 1-2 page article for Sports Illustrated that explains our results and includes a non-technical explanation of our mathematical model that sports fans will understand.

Key words: TOPSIS Improved Model; Entropy; Analytical Hierarchy Process; Comprehensive Evaluation Model; ANOVA

Contents

I. Introduction

The paper is to help "Sports Illustrated" to find the “best all time college coach” male or female.

We tackle five main problems:

- Build a mathematical model to choose the best college coach or coaches (past or present) from among either male or female coaches in such sports as college hockey or field hockey, football, baseball or softball, basketball, or soccer, and clearly articulate our metrics for assessment.
- Does it make a difference which time line horizon that you use in your analysis, i.e., does coaching in 1913 differ from coaching in 2013?
- Present our model’s top 5 coaches in each of 3 different sports.
- Discuss how our model can be applied in general across both genders and all possible sports.
- In addition to the MCM format and requirements, prepare a 1-2 page article for Sports Illustrated that explains our results and includes a non-technical explanation of our mathematical model that sports fans will understand.

To tackle the first problem, we searched the indicators of Top 600 men’s basketball coaches of the American colleges. Take selecting the best male basketball coach as an example: for the explicit factors that affect assessment standards, we calculate each indicator’s weight by using Entropy method; for those implicit factors, we calculate the weight through experts’ evaluation. The determination of each indicator’s score should be given by experts evaluation of each indicator. These indicators are then numericalized, and the importance of each indicator is determined through weight coefficients. Then through the multiplication of the scores of coaches’ different ability indicator with corresponding weight coefficients, we get the corresponding scores, and the highest score indicates the best choice.

For the second question, we first use ANOVA to determine whether significant difference exists between the scores of coaches in the last century and this century and the gender factor Significance difference shows that the time line horizon, the gender factor has influence on the assessment, whereas insignificant difference shows no influence. And based on this, we have drawn coaches’ coaching ability distributing diagram under ideal situation and non-ideal situation according to the data we have found, which help us further research the influence of time line horizon on the assessment.

For question 3 and 4, we put the data of the three types of sports, which have been found by us, into the Model , and get the top 5 coaches of the three sports, which are illustrated in **Table10**, **Table 11**, **Table 12** and **Table 13** respectively. These results are compared with the results on the Internet, so as to examine the reasonableness of our results. We choose the sports randomly, which undoubtedly shows that our model can be applied in general across both genders and all possible sports. At the same time, it also shows the practicality and effectiveness of our model.

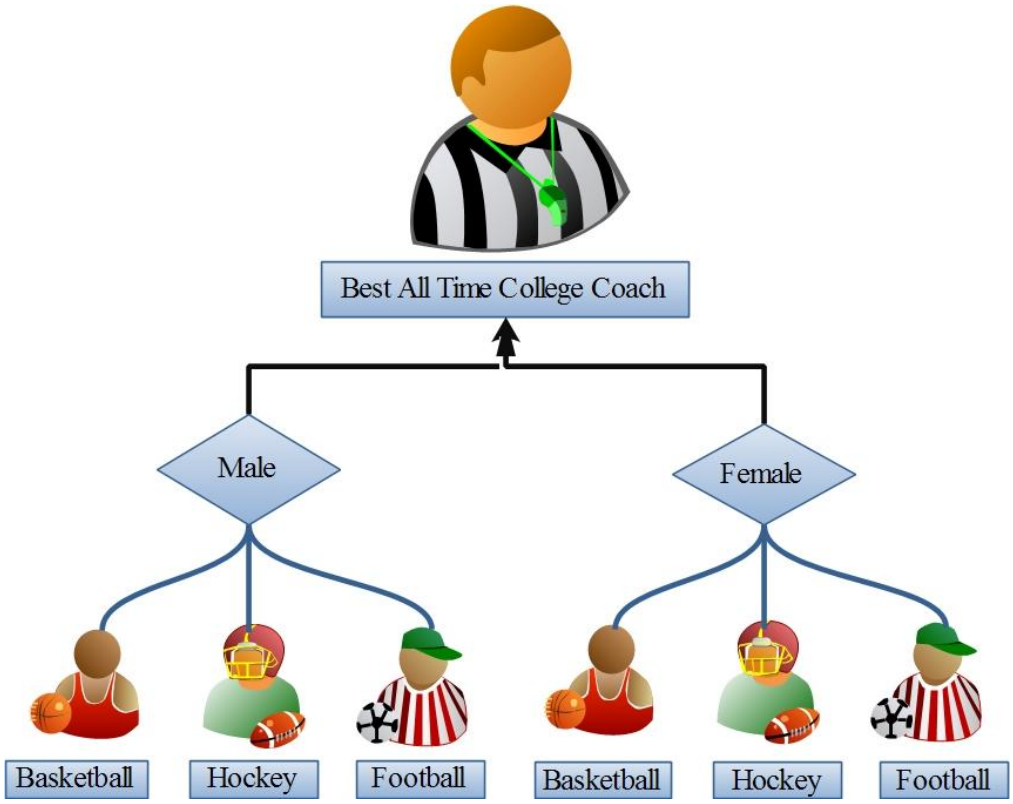

Figure1. The source of the best college coaches

Π. The Basic Assumption

- Experts recessive factors evaluation criteria evaluation is fair and equitable.
- Coaches' coaching level will increase with increasing age, but it will decline due to mental declination and the lack of the physical strength.
- Assessment experts are fully known on college coaches.
- The evaluation criteria only consider the factors enumerated in this paper, without considering other factors.
- The evaluation criteria apply equally to men and women coaches.
- We used the general data from a reliable website, Website (see Appendix).

Ⅲ. Nomenclature

Variable	*Meaning*
X	Index data normalization matrix
w_j	j Index weights
θ_{ij}	Transformed normalized matrix
θ^+	"Positive ideal solution"
θ^-	"Negative ideal solution"
ϕ_i	*i* comprehensive evaluation index values of being evaluated
e_j	j Index entropy
ψ_j	j Index Information utility
F	*F* statistic

Ⅳ. Model

4.1 Data Processing

In order to better assess the extent of outstanding coaches, we selected a number of indicators to determine the coach for the "best all time college sports coach". We found information on the various indicators of data on the site and get some reliable indicators data of these college coaches. Due to the dimensions of each index inconsistencies exist, so we transformed the data to eliminate the effects of dimensionless. And through poor conversion get a normalized matrix $X = \left[x_{ij} \right]_{m \times n}$,

$$X = \begin{vmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{vmatrix}, \ i = 1, 2, \cdots m; \ j = 1, 2, \cdots n \qquad (4-1)$$

$$x_{ij} = \frac{r_{ij}}{\sqrt{\sum_{j}^{n} r_{ij}}}, \quad i = 1,2,\cdots m; j = 1,2,\cdots n \qquad (4-2)$$

x_{ij} is a dimensionless quantity and $x_{ij} \in [0,1]$, $i = 1,2,\cdots m; j = 1,2,\cdots n$.

4.2 Model analysis

In order to address the problems mentioned above and provide a valid, feasible assessment strategy for Sports Illustrated, we decide to select softball, basketball and football by reviewing the relevant literature. Coaching time, Competition winning rate, Cultural qualities, Athletic ability, Social skills, Ability to withstand, Innovation capacity, Ability to perceive, and so on, which are evaluation indexes. These evaluation indexes are divided into dominant factors and recessive factors. Specific factors of affecting the evaluation criteria are shown in Figure X. These indicators will be quantified and determine the degree of importance of each index by weight coefficient. When selecting coaches, the scores of the indicators multiply corresponding weight coefficient, getting corresponding scores, and the person with the highest score is the best candidate.

Multi-level analysis method to determine the weight is more subjective. It is suitable to determine the weights for hidden factors, which are not used widely in both sexes and all possible requirements for sport. We need to build a more reasonable model to determine the weight for the dominant factor and recessive factors. Finally, we determine the “best all time college coach”.

4.3 Model building

We look for the “best all time college coach” by establishing a mathematical model in Technique for Order Preference by Similarity to Ideal Solution. Take choosing the best college coach or coaches from among male coaches in such sports as basketball as an example. For the dominant factor, we calculate the weight of each indicator in Entropy Method; For the hidden factors, we calculate the weight of each indicator in expert assessment method. According to the situation of the coaches , the scores of all levels should be determined by experts, and these indicators should be quantified. Weighting coefficients represent the importance of each indicator. The scores of the indicators multiply corresponding weight coefficient to obtain the total score, and the person of highest score is the best candidate. This method is more objective, comprehensive, accurate and wide-applicable than the previous evaluation model.

Flow chart of looking for the “best all time college coach” is shown in Figure 2.

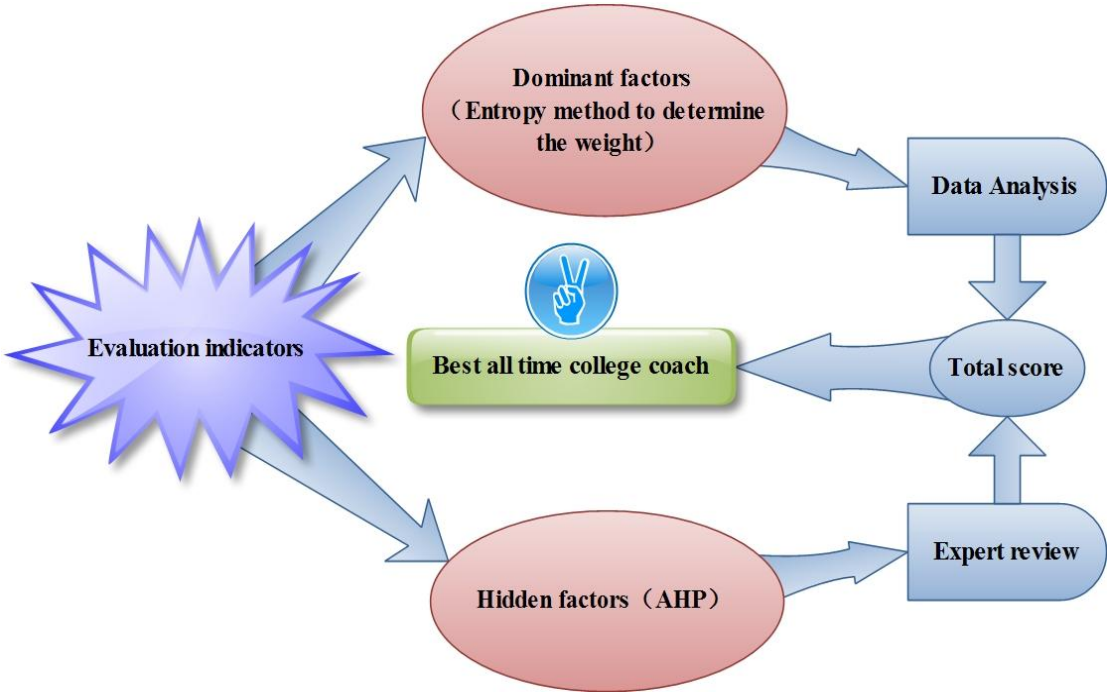

Figure 2. Flow chart of Model

TOPSIS Model (Technique for Order Preference by Similarity to an Ideal Solution) was firstly introduced by C.L.Hwang and K.Yoon in 1981.TOPSIS Model is based on the proximity of a limited number of evaluation objects and idealistic goals and evaluate the relative merits of existing objects. Meanwhile, TOPSIS Model is an approximation of the ideal solution in order model, the model requires only a monotonically increasing (or decreasing) of each Utility function. Furthermore, TOPSIS multi-objective decision analysis model is a commonly used and effective model, also known as the merits of the solution from the law. The basic principle is evaluated by detecting the distance the optimal solution and the solution of the worst sort, if the evaluation of the optimal solution while the object closest to farthest from the worst solution, the result is optimal; otherwise, is not optimal， where the value of each index has reached the optimal solution for the optimal value of each index. Each index value solution has reached the worst the worst value of each index.

"Positive ideal solution" and "negative ideal solution" are two basic concepts TOPSIS Model. "Positive ideal solution" is an envisaged optimal solution (program), it's the individual attribute values to achieve the best value of each option; rather negative ideal solution is a solution envisaged for the worst (program), each of which have reached the attribute value of each option in the worst value. Program to sort the various alternative rules are the ideal solution and the negative ideal solution for comparison, if one has a solution closest to the ideal solution, while away from the negative ideal solution, the solution is the best alternative solution.

4.3.1 Dominant index weights calculation

For the dominant factor, we calculate the entropy method using the weight of each indicator.

According to the data we found, we list the dominant influence coaches criteria indicators (see **Figure 3**). These dominant indicators are intuitive and easy to quantify,

due to the weight of these data to calculate the specific rights-based approach, with strong objectivity. Degree of dispersion of data can be seen as the degree of disorder (entropy), the greater the entropy index data, the smaller the proportion of the index.

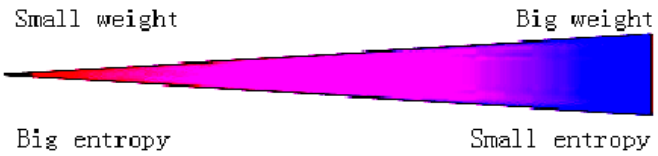

Figure 3. The diagram of the entropy and weights

Information entropy method is a method completely dependent on the data, but it is not affected by subjective factors.

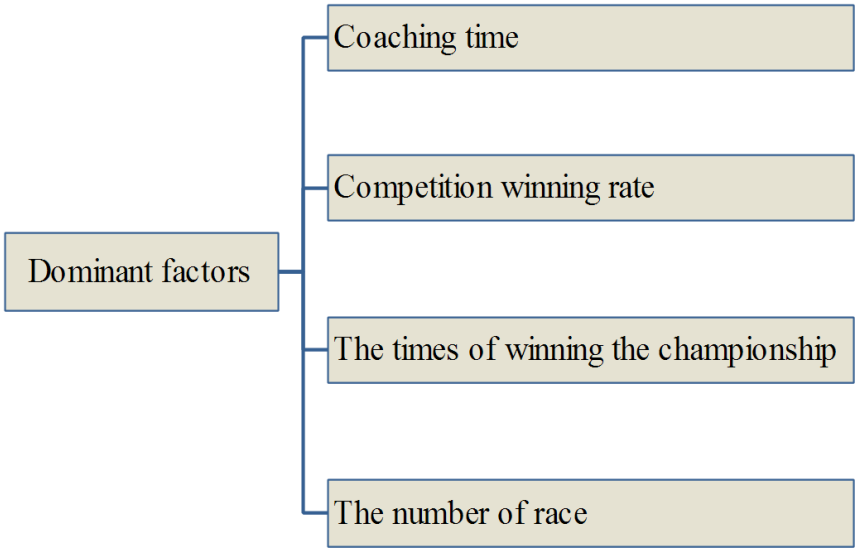

Figure 4. The structure of influence the selection criteria for the dominant factors

Formula to calculate the information entropy index for item j :

$$e_j = -\frac{1}{\ln m}\sum_{i=1}^{m} x_{ij} \ln x_{ij}, \quad x_{ij} \in [0,1] \tag{4-3}$$

Information utility depends on the difference between the value of an index of the index information entropy between A and 1. It directly affects the size of the weight: the greater the utility value of the information, the greater the importance of the evaluation, and the greater the weight.

$$\psi_j = 1 - e_j \tag{4-4}$$

Estimating the weight of each index using entropy method, its essence is to use the value of the coefficient to calculate the index information, the higher the value of

the coefficient, the greater the importance of the evaluation (or the greater the weight, the bigger contribution to the evaluation results).

Right item j index weight is:

$$w_j = \frac{\psi_j}{\sum_{i=1}^{m} \psi_j} \qquad (4-5)$$

4.3.2 Hidden index weights calculation

For recessive factors, we take expert assessment method to calculate weights. The determination of index score at all levels should be carried out by an expert score for each indicator according to the situation of the coaches.

According to the data we found, we cited the impact coach implicit criteria indicators (see **Figure 4**). These indicators are visually hidden but not easy to quantify. Because of these hidden right index weight calculation method based on highly subjective, we used AHP to accurately calculate the weights of these hidden indicators.

AHP is a decision problem in terms of total goals layers of sub-goals, evaluation criteria and specific equipment investment program in order to break down the different hierarchies, then use judgment matrix eigenvector method to obtain the elements of each level of priority on a certain level of heavy elements, and finally re-weighted and hierarchical approach to merge the various alternative solutions to the overall goal of the final weights. "Priorities" is a relative measure, which indicates the alternative criteria for the evaluation of a program or sub-features of the target, which means excellent measure of the relative degree of each sub-target and the target level for the purposes of the relative importance of measure. Specific usage is to judge the matrix, find the maximum eigenvalue, then the corresponding feature vector normalization, finally we can get a level indicator on one level for a related indicators relative importance weights.

Features of AHP are based on the nature of complex decision problems, influencing factors and internal factors affecting the relationship between in-depth analysis, and use less quantitative information to make decisions mathematical thinking process, so as to multi-target, multi-standard or non-structural properties of the complex issues simple decision making methods. Especially suitable the occasion for decision-making results difficult to directly and accurately measure.

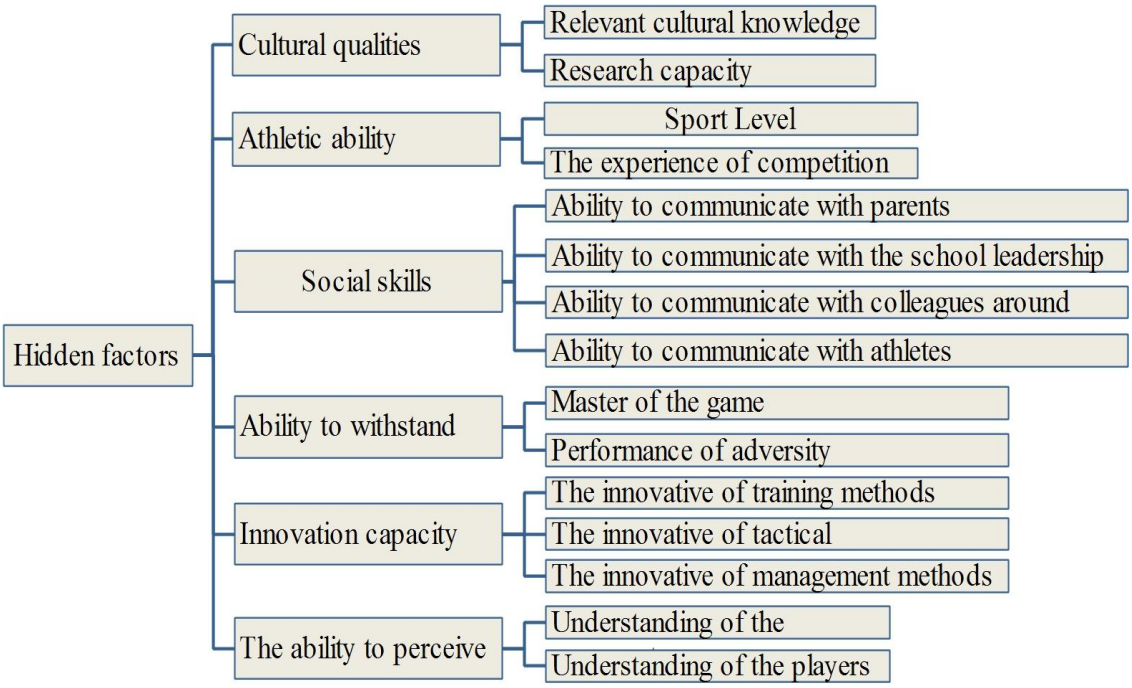

Figure 5. The structure of influence the selection criteria for the hidden factors

We can know from the **Figure 5** , the hierarchy is divided into one-level indicator, two-level indicators, so it belongs to the multi-level hierarchical structure model.

★Comparison matrix construction

According to the analysis of psychologists, the importance of being divided into nine grades, and secondary indicators for the level indicators can be pairwise comparison of their importance to quantify the value using the following scale.

Table 1. Evaluation scale

Scale	*Definition*
1	i is for j equally important
3	i is for j slightly important
5	i is more important for j
7	i is very important for j
9	i is absolutely vital for j
2,4,6,8	Two intermediate value corresponding to the scale
Reciprocal	i compared with j , $c_{ij} = \frac{1}{c_{ij}}$ or $c_{ij} = 1$ are obtained for the judge value

According to the above scale, relative matrix is as follows:

By comparison, the comparison matrix of level indicators and secondary indicators are as follows:

$$C_i = \begin{vmatrix} c_{11} & \cdots & c_{1n} \\ \vdots & \ddots & \vdots \\ c_{n1} & \cdots & c_{nn} \end{vmatrix} \qquad (4-6)$$

Due to the above judgment matrix symmetry, so when filling out, usually the first to fill $c_{ii} = 1$ section, and then judge and triangular or lower triangular $n\ (n-1)/2$ elements on the form. In exceptional circumstances, the judgment matrix is transitive, that satisfies the equation： $c_{ik} * c_{kj} = c_{ij}$ .When the formula to determine all the elements of the matrix are established, the consistency of judgment matrix is a matrix.

★Level single-sorting (Weight vector calculation) and Test

For the judgment of experts to fill in the matrix， we took advantage of some mathematical methods for sorting. Level single-sorting refers to the various factors of each judgment matrix for weight relative weights of the criteria, so essentially calculating the weight vector. There are many ways to calculate the weight vector, such as the eigen value method, and the method, the root method, power method. Here is a brief overview and method.

Principle "and the law", for consistency of judgment matrix, each column after normalization, we can get the corresponding weights. For non-consistency of judgment matrix, each column after normalization, which can be approximated by the corresponding weights, n column vectors and these strike the arithmetic average as the final weight of the weight. Specific formula is:

$$W_i = \frac{1}{n} \sum_{j=1}^{n} \frac{c_{ij}}{\sum_{k=1}^{n} c_{kl}} \qquad (4-7)$$

It should be noted that, in the layers of the sort, you need to test the consistency of judgment matrix. In exceptional circumstances, determining the matrix has passed and consistency. Under normal circumstances, the judge is not required to meet the strict nature of the matrix. But looking at the human understanding of the law, a right to judge the importance of the matrix there is some sort of logical law. For example, if A is more important than B, and B surpasses C importantly, from a logical perspective, A should be significantly more important than C, if the two a comparison of two important results than C, then the consistency of judgment matrix in violation of norms, logically unreasonable. If pairwise comparisons, C is more important than the result of A, the consistency of judgement matrix in violation of the guidelines, it was logically irrational.

Therefore, in practice it is required to meet the general consistency of judgment matrix, which requires consistency checking. Only by testing can it illustrate that the logical judgment matrix is reasonable and to continue to analyze the results.

Steps of consistency test are as follows.

First, calculate the consistency index $C.I.$(consistency index).

$$C.I.=\frac{\lambda_{\max}-n}{n-1} \qquad (4-8)$$

Second, look-up table to determine the corresponding average random consistency index $R.I.$（random index）

According to the different order of judgment matrix, we check the table below, and get the average random consistency index $R.I.$ For example, for a 5-order judgment matrix, we can get $R.I.$= 1.12 easily.

Table 2. Average random consistency index $R.I.$ Table(1000 reciprocal matrix calculations)

Matrix order	1	2	3	4	5	6	7	8
$R.I.$	0	0	0.52	0.89	1.12	1.26	1.36	1.41
Matrix order	9	10	11	12	13	14	15	
$R.I.$	1.4	1.49	1.52	1.54	1.56	1.58	1.59	

Third, calculate the proportion of consistency $C.R.$ (consistency ratio) and determine.

$$C.R.=\frac{C.I.}{R.I.} \qquad (4-9)$$

When $C.R.<0.1$, the consistency of judgment matrix is considered acceptable and when $C.R.>0.1$, it is considered the consistency of judgment matrix does not meet the requirements, we need to re-amend the judgment matrix.

4.3.3 Positive and negative ideal solution building

We define $\theta_{ij}=w_{ij}\bullet x_{ij}, i=1,2,\cdots m; j=1,2,\cdots n;$ Determine the positive ideal solution θ^{+} and negative ideal solution θ^{-}； Assuming positive ideal solution θ^{+}

Negative ideal solution： $\theta_j^{-}=\min_i\left\{\theta_{ij}\right\}, i=1,2,\cdots m; j=1,2,\cdots n;$

Positive ideal solution： $\theta_j^{+}=\min_i\left\{\theta_{ij}\right\}, i=1,2,\cdots m; j=1,2,\cdots n;$

4.3.4 Distance calculation

The Euclidean distance between being evaluated and Positive ideal solution

$$d_i^{+}=\sqrt{\sum_{j=1}^{n}(\theta_{ij}-\theta_j^{+})^2}, i=1,2,\cdots m \qquad (4-10)$$

The Euclidean distance between being evaluated and Negative ideal solution

$$d_i^- = \sqrt{\sum_{j=1}^{n}(\theta_{ij} - \theta_j^-)^2},\ i = 1,2,\cdots m \qquad (4-11)$$

4.3.5 Comprehensive evaluation value

The value of comprehensive evaluation index evaluated is

$$\phi_i = \frac{d_i^-}{d_i^+ + d_i^-},\ i = 1,2,\cdots m \qquad (4-12)$$

4.4 Model solution

4.4.1 Dominant index weights calculation

We find four dominant indicators for the last century of the impact evaluation criteria through the network, namely, "The time of winning the championship", "The number of races", "Coaching time", "Completion wining rate". Specific data are in **Table 3.**

Table 3. Four indicators for men's basketball coaches

Name	*The time of winning the championship*	*The number of race*	*Coaching time*	*Completion wining rate*
Dean Smith	70	1133	36	0.776
Hank Iba	29	1085	40	0.693
Ray Meyer	20	1078	42	0.672
Don Haskins	29	1072	38	0.671
Adolph Rupp	71	1066	41	0.822
E.A. Diddle	17	1061	42	0.715
Ralph Miller	17	1044	38	0.646
Slats Gill	13	992	36	0.604
Norm Stewart	30	967	32	0.656
Tony Hinkle	4	952	41	0.586
Norm Sloan	14	917	33	0.609
Jack Friel	3	872	30	0.568
Guy Lewis	26	871	30	0.68
Ned Wulk	17	837	31	0.59
John Thompson	37	835	27	0.714
John Wooden	54	826	29	0.804
Bill E. Foster	7	820	30	0.515
Johnny Orr	13	812	29	0.574
...	...	...	...	...

We will enter the above data by calculated entropy method to get the dominant index weights as follows:

Table 4. Men's basketball coach dominant index weights table

Dominant index	*The time of winning the championship*	*The number of race*	*Coaching time*	*Completion winning rate*
weight	0.7481	0.1195	0.1145	0.0178

From the **Table 4** we can observe "The time of winning the championship" share of the weight is larger than the "Completion wining rate". But the proportion of "The number of race" and "Coaching time", is less. This shows that the dominant indicators, "The time of winning the championship" for the selection of the coach plays a very important role.

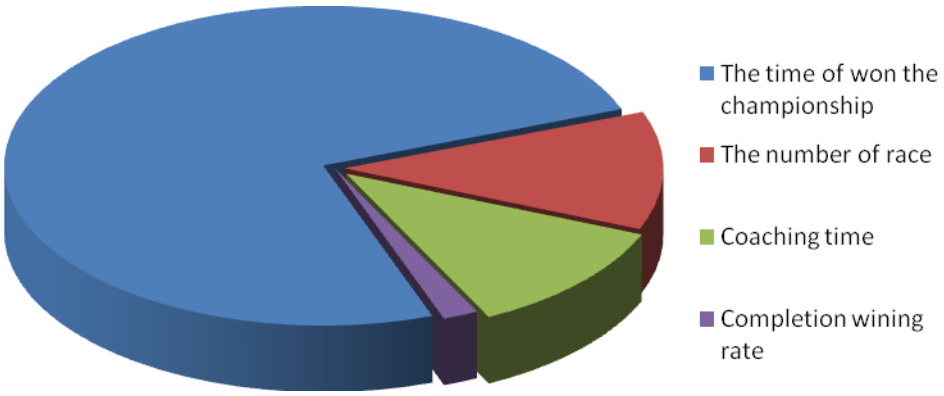

Figure 6. Men's basketball coach dominant index weights pie

From **Figure 6**, we can observe that "The time of winning the championship" significant weightings are larger in the share of other indicators. On the surface this is actually somewhat contradictory, but in fact, as "The time of winning the championship" indicators of the degree of dispersion is larger, therefore, its impact is huge coach rankings, while the smaller degree of dispersion of other indicators, so they rank impact on the coach is smaller.

4.4.2 Hidden factors weights calculation

Using the comparison scale of the model we can go to the comparison matrix level indicators and secondary indicators. Since the pairwise comparison is subjective, the Hidden factors weight is subjective. Using the way of expert reviewing, finding information or questionnaires to get the comparison matrix. Then calculate the weights. Then we examined whether it could through consistency test. We did a series of comparison matrix and then through examination we selected the following comparison matrix.

Table 5. The best comparison matrix of the University men's basketball coach indicators

Hidden factors	*Cultural qualities*	*Athletic ability*	*Social skills*	*Ability to withstand*	*Innovation capacity*	*The ability to perceive*
Cultural qualities	1	1/3	1/3	1/3	1/6	1/7
Athletic ability	3	1	1/3	1/3	1/5	1/5
Social skills	3	3	1	1/3	1/5	1/4
Ability to withstand	5	3	3	1	1/3	1/5
Innovation capacity	6	5	5	3	1	1/4
The ability to perceive	7	5	4	5	4	1

Known by its consistency index, $C.R.=0.9870<0.10$, $C.I.=0.1360$, so it can go through consistency test. The maximum value weight , $\lambda=6.6799$,which we calculated are shown in **Table 5.**

The consistency is index $C.R.=0.9870<0.10$, $C.I.=0.1360$. Through consistency test, the maximum characteristic value is $\lambda=6.6799$. Weights form table below.

Table 6. Best college men's basketball coach recessive factor index weights table

Hidden factors	*Cultural qualities*	*Athletic ability*	*Social skills*	*Ability to withstand*	*Innovation capacity*	*The ability to perceive*
Weights	0.0345	0.0554	0.0836	0.1340	0.2491	0.4435

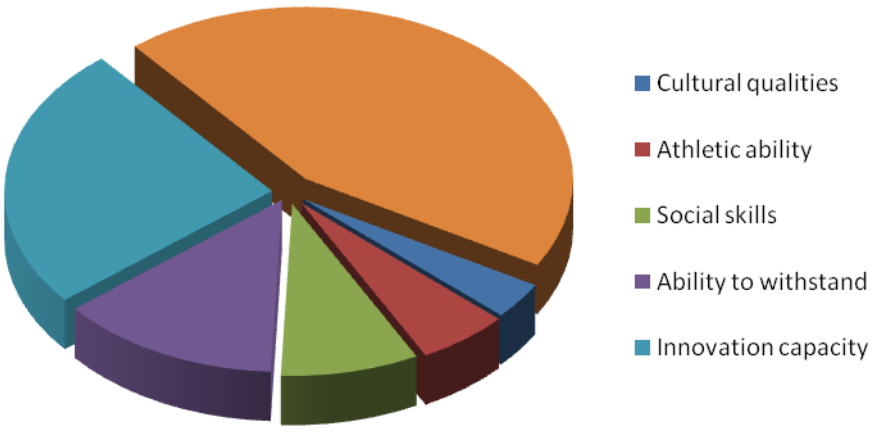

Figure 7. Best college men's basketball coach recessive factor index weights pie

We obtain the weight values though consistency test and Analytic Hierarchy Process, Athletic ability of coaches is great importance of hidden index. Second, the cultural qualities, the innovation capacity is not important. The results are subjective more or less. We can not be generalized, with the development of society, the proportion of innovative indicators may increase.

4.4.3 Consolidated score

weights above put in TOPSIS model can get a score for each coach. Because hidden indicators expert review in our paper is difficult to achieve. Thus weakened expert evaluation index, highlighting calculations dominant indicators.

Thus, we get the following scoring table.

Table 7. Last century University men's basketball coach total score

Name	*The time of won the championship*	*The number of race*	*Coaching time*	*Completion wining rate*	ϕ_i
Adolph Rupp	71	1066	41	0.822	0.0183
Dean Smith	70	1133	36	0.776	0.0181
John Wooden	54	826	29	0.804	0.0139
John Thompson	37	835	27	0.714	0.0097
Norm Stewart	30	967	32	0.656	0.0081
Hank Iba	29	1085	40	0.693	0.0080
Don Haskins	29	1072	38	0.671	0.0080
Guy Lewis	26	871	30	0.68	0.0071
Everett Case	27	511	19	0.738	0.0071
Lou Carnesecca	26	726	24	0.725	0.0070
Gene Bartow	25	744	24	0.66	0.0067
Neil McCarthy	23	681	23	0.665	0.0062
Pete Carril	22	798	30	0.658	0.0061
Frank McGuire	22	785	30	0.699	0.0061
Joe B. Hall	23	463	16	0.721	0.0060
Jack Gardner	22	721	28	0.674	0.0060
Ray Meyer	20	1078	42	0.672	0.0058
Terry Holland	21	634	21	0.659	0.0057
…	…	…	…	…	…

As can be seen from **Table 7** Adolph Rupp's highest overall score, it is reasonable to judge him in the last century's "best all time college coach". Due to the weakening of the influence of implicit indicators, so here was "best all time college coach" on the hidden indicators may have less. Using the same method to evaluate the coach of the century can be the century of the "best all time college coach" is Mark Few.

4.5 Judgment of significant differences between the last century's and this century's coaching score.

4.5.1 Preliminary investigation of the last century and the coach of the century standards.

Taking into account the tremendous changes in the last century and this century,

we see time as a factor. We performed univariate analysis of variance (F-test) about coach scores of the two centuries, to determine whether their scores were significant differences. If there is no significant difference between the two scores century coach, the selected time line horizon will not affect the outcome of the vote.

First, we propose a null hypothesis: H_0: the last century and this century coaching score no significant change ($\mu_1 = \mu_2$); H_1: the last century and this century coaching change scores were significant ($\mu_1 \neq \mu_2$).

Secondly, we constructed the F statistic $F = \dfrac{n\sum\left(\bar{x}_i - \bar{x}\right)^2 \Big/ (m-1)}{\sum\left(x_{ij} - \bar{x}\right)^2 \Big/ (mn-n)}$, the statistic obey molecular degrees of freedom $m-1$, $mn-m$'s denominator degrees of freedom for the F distribution.

Given the significance level a, if the value is calculated based on a sample of the F statistic is less than equal to the critical value; then the null hypothesis is not true, that is not exactly equal to the population mean. Differences are not only caused by random factors.

According to the model, we obtained two-century coaching score data, analysis of variance and then we can get the following analysis of variance table.

Table 8. ANOVA

	Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
Between Groups	.001	1	.001	222.187	.000
Within Groups	.008	1335	.000		
Total	.010	1336			

From the **Table 8** We can observe the Sig. = 0.000 <0.05, reject the null hypothesis A, while accepting the assumption B, which indicates that the time line horizon significantly affect the coach's scores. For the convenience of analysis, we have drawn a bar chart, showing the average scores of coaches in the two centuries. From Figure?, we can see that coaches' score in this century is much higher than that in last century. This phenomenon may be caused due to advances in technology, as well as tactical innovation of the last century, their learning by themselves to improve their own level. This Figure also tells us that the difference between 2013's and 1913's coaching is that 2013's coaching requires more ability on the coaches themselves than coaching in 1913.

ANOVA results illustrate the overall level of the century coaches significantly improved, but that does not determine whether the selected time line horizon affects it. As the ANOVA results only show that the overall coaching ability increases, but it

does not mean any changes of the relative rankings; therefore, further discussion is required.

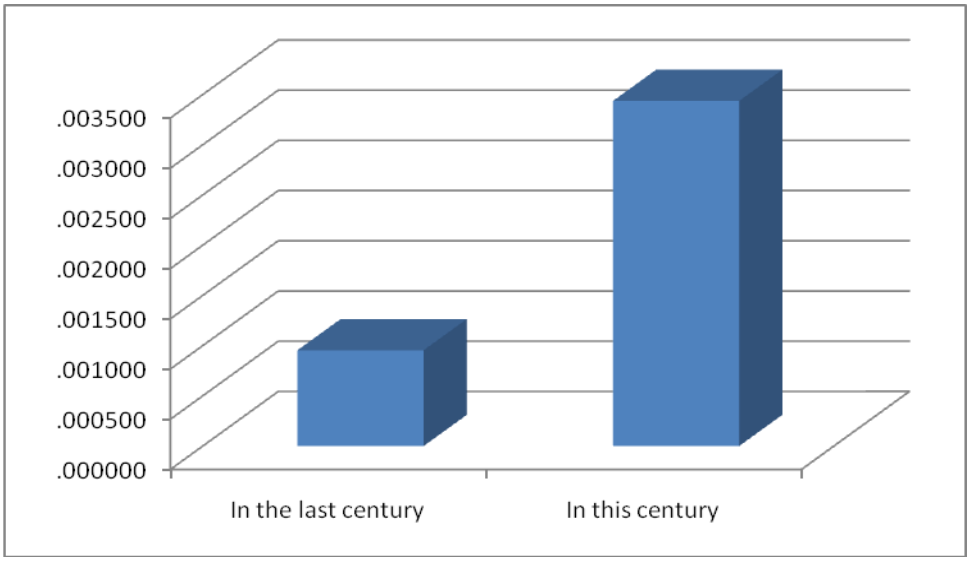

Figure 8. The average score of the two centuries

4.5.2 Further exploration on the influence of different time line horizons on the assessment results

In order to observe changes in the level of coaching ability, we made a distribution map X.

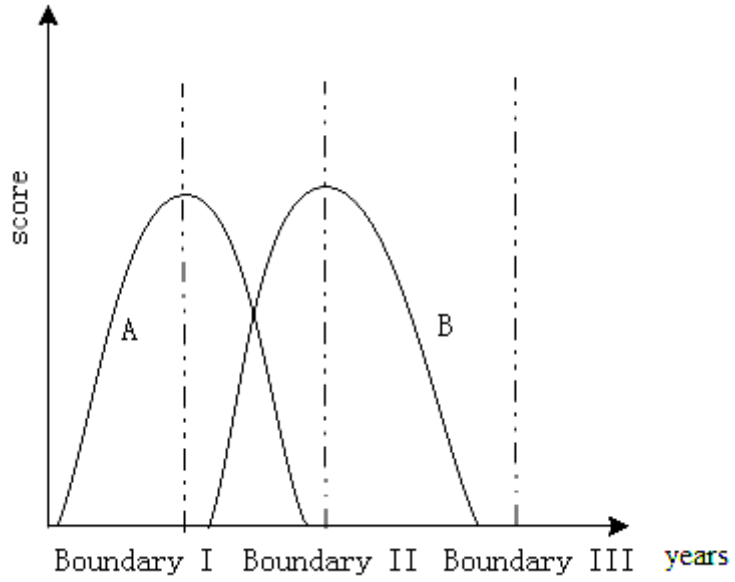

Figure 9. Score-year distribution of two college male basketball coaches under ideal situations

Figure 9 shows that a coach's score will increase with seniority increase, but the increase would lead to a decline in mentality and physical strength, etc., which will

result in reduced score. There are three boundaries in the above the Figure, obviously, when select the best coaches, each of the three time lines reflects that the best coaches are different.

If you choose the boundary I, you can get the best coach is A;

If you choose to boundary II, you can get the best coach is B;

If you choose the boundary III, you can get the best coach is B.

Boundary III is the most reasonable. Therefore, a reasonable time line horizon will not affect the selection results, otherwise it will affect the selection results.

The above discussion is the impact of time limits on the selection results of any two coaches in the ideal case. In the non-ideal circumstances, we plotted the year - score distribution Figure of the top-6 coaches to analyze.

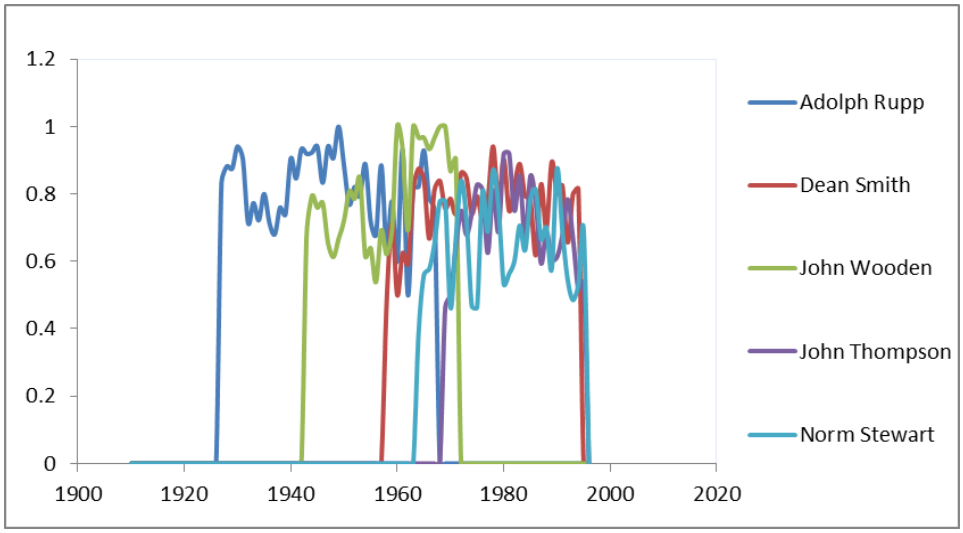

Figure 10. Score-year distribution of Top-6 coaches in real situation

We can observe from Figure 10, and the time period Adolph Rupp John Wooden located are in front, and the time period is relatively close to the other four coaches. In short, the 2000 is the reasonable time boundary. That is to say the time boundary of the year 2000 and the lower boundary III in the ideal case are equivalent. So, selecting 2000 as the time line horizon for the model I is reasonable.

In short, we can conclude that the time limits significantly affect the coach's score, but the reasonable time limits will not affect the selection results, otherwise it will affect the selection results.

4.6 Test of model's applicability to both gender

Basketball is taken as an example to analyze whether the difference in genders apply to Model. We can get the different types of indicators data of both male and female basketball coaches. The comprehensive scores can be obtained by putting the data into Model. Here, we regard gender as influence factors, and our task it to test

whether the factor of gender can have a significant influence on the comprehensive scores. Similar to the test of time line horizon, ANOVA is used to test the gender factor.

Make the assumption H_0 gender factor has no significant influence on coaches'score($\mu_1 = \mu_2$), and H_1 : gender factor has significant influence on coaches'score($\mu_1 \neq \mu_2$).

The repetitive account is omitted here, and we move to the discussion of the results. The ANOVA table is as follows:

Table 9. ANOVA table of gender

	Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
Between Groups	0.002	1	0.001	50.0866	0.084
Within Groups	0.0078	200	0.004		
Total	0.023	201			

We can see from Table 9 that Sig.=0.084>0.05, so the original hypothesis H_0 is accepted; therefore, the gender factor has no significant influence on the score. We, thus, can infer that gender factor exerts no significant influence on coaches' comprehensive score statistically.

The assessment model, therefore, can be applied to both male and female coaches.

4.7 The selection for the top five college coaches of three sports

We arbitrarily chosen football, basketball, hockey college coaches' data to rank. Corresponding coaching data online was found, and the Model is carried out for the selection.

For football, we have to sort through the top five models calculated, see the **Table 10.**

Table 10. The top five men's football college coaches table

Name	*The time of winning the championship*	*The number of race*	*Coaching time*	*Completion winning rate*	ϕ_i
Bear Bryant	29	425	38	0.780	0.008990
TomOsbore	25	307	25	0.836	0.007571
VinceDooley	20	288	25	0.715	0.006183
Hayden Fry	17	420	37	0.56	0.005705
John Vaught	18	263	25	0.745	0.005606

From the **Table 10** We can observe these college football coaches in the top five, Bear Bryant come in first, but his success rate is not the highest. This shows that A is

affected by a number of indicators.

We compared them with the actual situation of the online search, and you can see our results are reasonable and realistic.

For men's basketball, we calculated the order of the top five by the model (see Table 11):

Table 11. The top five men's basketball college coaches table

Name	*The time of winning the championship*	*The number of race*	*Coaching time*	*Completion winning rate*	ϕ_i
Adolph Rupp	71	1066	41	0.822	0.0183
Dean Smith	70	1133	36	0.776	0.0181
John Wooden	54	826	29	0.804	0.0139
John Thompson	37	835	27	0.714	0.0097
Norm Stewart	30	967	32	0.656	0.0081

We compared them with the actual situation of the online search, and you can see our results are reasonable and realistic.

For women's basketball, we calculated the order of the top five by the model I (see **Table 12**):

Table 12. The top five women's basketball college coaches table

Name	*The time of winning the championship*	*The number of race*	*Coaching time*	*Completion winning rate*	ϕ_i
Auriemma	45	994	28	0.866	0.2225
Summitt	40	1306	38	0.841	0.1980
VanDerveer	24	1114	34	0.817	0.1190
Conradt	23	1210	38	0.744	0.1141
Hatchell	16	1229	38	0.739	0.0795

We compared them with the actual situation of the online search, and you can see our results are reasonable and realistic.

For men's hockey, we calculated the order of the top five by the model I (see **Table 13**):

Table 13. The top five men's hockey college coaches table

Name	*The time of winning the championship*	*The number of race*	*Coaching time*	*Completion winning rate*	ϕ_i
Toe Blake	8	582	13	0.563408	0.097338
Hap Day	5	308	10	0.492013	0.060609
Dick Irvin	4	792	27	0.483221	0.056055
PunchImlach	4	446	14	0.454638	0.05114
Jack Adams	3	465	20	0.434986	0.040836

We compared them with the actual situation of the online search, and you can see our results are reasonable and realistic.

By model I, we selected the top 5 coaches in the three sports as rugby, basketball, and hockey. Comparison of these results with the online search shows that our results are reasonable.

As we choose the sports randomly, and each sports item includes both male and female coaches; therefore, our model can be applied in general across both genders and all possible sports.

V. Analysis of our Model

5.1 Applications of our models

The TOPSIS sort improved model based on entropy and Analytical Hierarchy Process improves TOPSIS model weights section, it can evaluate comprehensively the impact indicators of subjective and objective factors. This evaluation is more comprehensive and reasonable manner, so this high evaluation method can be extended to a variety of evaluation system with subjective and objective factors. There it not only can be applied to the selection of outstanding college coaches, but also can be applied to the excellent staff selection, outstanding faculty selection, hydraulic engineering evaluation, water quality assessment, water resources assessment, and so on.

5.2 Strengths

TOPSIS Model based on Entropy and Analytical Hierarchy Process is employed in the assessment of best college coaches. Entropy is utilized to determine the weight objectively, whereas Analytical Hierarchy Process is utilized to determine the weight subjectively. The combination of subjective and objective determination provides a new way for the assessment of best college coaches.

The TOPSIS model based on entropy and analytical hierarchy process has such advantages as simple calculation, clear thinking ways, reasonable calculating results, which is quite appropriate to select the best college coaches.

5.3 Weaknesses

One of the weaknesses of the TOPSIS model based on entropy and analytical hierarchy process is that the assessment indicators are not complete. There are some secondary indicators that are not listed in the assessment model, which is unfair for those coaches with lower scores. Therefore, it needs further improvement. Besides, the different choice of time line horizon may influence the assessment results to some extent.

5.4 Future Improvements

The implicit factors that influence the assessment of college coaches are rather subjective. In the future, we can establish a more comprehensive and objective assessment system of implicit factors, and then our results might be more accurate and

objective.

Ⅵ. Conclusions

TOPSIS Model based on Entropy and Analytical Hierarchy Process is employed in the assessment of best college coaches. Entropy is utilized to determine the weight objectively, whereas Analytical Hierarchy Process is utilized to determine the weight subjectively. The combination of subjective and objective determination provides a new way for the assessment of best college coaches.

Best college coaches, male or female, not only possess excellent coaching ability, advanced scientific research ability, and higher rank in sports, but also possess some ability to withstand, strong innovative ability and good character, although the time of winning the championship play a vital role.

The selection of time line horizon does exert influence on the assessment, namely differences do exist between the coaching in 1913 and 2013. However, if the time line horizon is appropriately chosen, it will not influence the assessment results, and the time line horizon—year 2000 will not affect the assessment results. Through TOPSIS model, we successfully get the data of top 5 coaches of three ball sports, and compare it with the real situation on the Internet. The comparison verifies our assessment results. Besides, we choose the three sports items randomly, and each sports item includes both male and female coaches, and the gender factor has no significant influence on the score,which undoubtedly indicates that our model can be applied in general across both genders and all possible sports.

Ⅶ.A letter to the sports enthusiasts

How to choose the best college coach or coaches (past or present) from among either male or female coaches in such sports as college hockey or field hockey, football, baseball or softball, basketball, or soccer It is not a great challenge for people who are good at thinking.

We collected the evaluation index of college basketball, football and hockey coaches online including the wining the competition rate, life coaching, innovation, social skills, and so, and obtained top 5 coaches in each of these 3 different sports by using TOPSIS model based on multi-level analysis and entropy method. The selection of time line horizon does exert influence on the assessment, namely differences do exist between the coaching in 1913 and 2013. But if the selection of time line horizon is reasonable, the impact on the selection results is very small. Besides, we choose the three sports items randomly, and each sports item includes both male and female coaches, the gender factor has no significant influence on the score, which undoubtedly indicates that our model can be applied in general across both genders and all possible sports.

Simply, we need to determine the evaluation indicators including life coaching, competitions success rate, number of games to participate in the competition, and cultural qualities, athletic ability, social skills, innovation ability at first. Some of these indicators can be quantified by the relevant inspection data, and others require expert assessment, so we divided these indicators into indicators of dominant factors

and indicators of hidden factors. We use entropy method to achieve the weight of the dominant factor calculated, whereas expert evaluation method is adopted to determine the hidden factors.

Then we collected the data of the excellent college coaches for the last century and this century, hockey, basketball, football coach, and calculated the weight of each index by using the appropriate mathematical methods. These indicators are then numericalized, and the importance of each indicator is determined through weight coefficients. Then through the multiplication of the scores of coaches' different ability indicator with corresponding weight coefficients, we get the corresponding scores, and the highest score indicates the best candidate.

When looking for the best college coaches, we need to pay attention to the following:

(1)Experts' evaluation is fair and equitable;

(2)Coaches' coaching level will increase with their age, but it will decline due to mental declination and the lack of the physical strength;

(3)Assessment experts are fully known on college coaches;

(4)The evaluation criteria only consider the factors enumerated in this paper, without considering other factors;

(5)The evaluation criteria apply equally to men and women coaches;

(6)We used the general data from a reliable website.

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