The Best Coach Evaluation Based on CW-TOPSIS

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Abstract. We analyze the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS). We build an old model based on the combination of them, which is named AHP-TOPSIS. The old model is built as: First, use the AHP to determine the weight of each factor on the coach's evaluation. Then, use TOPSIS to rank the coaches. After analyzing the result of the old model, we draw a conclusion that the weight vector calculated by AHP is subjective. Therefore, we decide to find a more objective method.Next, we build a totally new evaluation method based on the Entropy and AHP, which is named Composite Weight-TOPSIS (CWTOPSIS). The AHP is a representative of calculating subjective weight, which ignores the objective factors. The Entropy is a representative of calculating objective weight. It depends on objective numerical indicators, but ignores the relevant experts experience and subjective judgment. So we introduced the preference factor β to combine them together. We compare the results of the two models, and we can see the improved one has more advantages. Then, we take other factors into consideration: time the coach coaches and gender of the coach. We analyze them separately, and draw the conclusion that the time factor does affect the evaluation result and the gender factor has little influence on the final result.

1. Introduction

We are discussing the problem basing on the problem B in 2014MCM.Sports Illustrated is an American sports media franchise owned by Time Inc. Its self-titled magazine has over 3 million subscribers and is read by 23 million people each week, including over 18 million men. Now, the magazine Sports Illustrated is looking for the "best all time college coach", male or female, over the previous century, in any kind of sports.

We face four mainly problems as listed:
- Find the coaching record, which is representative.
- The model we build should be appropriate for any time and any kind of sports.
- Set up the evaluation system for the performance of the model.
- Analyze the influence of the parameters, and then discuss whether our model could be applied more widely.

2. The Composite Weight-TOPSIS (CW-TOPSIS) model

CW-TOPSIS model is a model base on AHP, Entropy and TOPSIS, we introduced the preference factor β to combine them together.
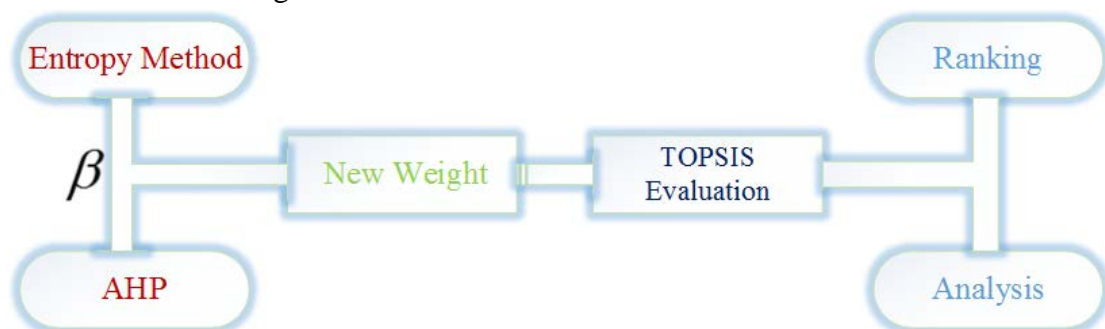

Fig.1. The process of our model.

Determine objective weight by entropy

We have already got the evaluation matrix X, then standardize the evaluation matrix X, the value of positive indexes and negative indexes are calculated as:

$$y_{ij} = \frac{x_{ij}}{\max(x_{ij})}, 1 \le i \le n, 1 \le j \le m \quad y_{ij} = \frac{x_{ij}}{\min(x_{ij})}, 1 \le i \le n, 1 \le j \le m$$

Calculate the entropy of each index, the value of entropy is calculated as:

$$H_i = -k \sum_{j=1}^{n} \ln f_{ij}$$

The value of the entropy coefficient is calculated as:

$$T_j = \frac{(1 - H_j)}{(m - \sum_{j=1}^{m} H_j)}$$

Determine the preference factor β by Delphi method:

$$\beta(0 \le \beta \le 1)$$

Determine the composite weight:

$$D_j = \beta w_j + (1 - \beta)T_j$$

Use the TOPSIS evaluation as listed in the old model, process after this is all the same as the old model, so we will not give the specific process.

Rank the preference of coaches. Then we get the best coach in the method of CW-TOPSIS.

We obtain the following results:

Fig.2 shows the weight calculated by entropy. Fig.3 shows the composite weight. We determined the preference factor

Fig.2 The weight calculated by entropy. Fig.3 The composite weight

Table 1. Compare of two models

Rank	AHP-TOPSIS	CW-TOPSIS
1	Mike Krzyzewski	Mike Krzyzewski
2	Roy Williams	Roy Williams
3	Billy Donovan	Billy Donovan
4	Jim Boeheim	Rick Pitino
5	Rick Pitino	Jim Boeheim
6	John Calipari	John Calipari
7	Bill Self	Bill Self
8	Tom Izzo	Tom Izzo
9	Bob Huggins	Dave Rose
10	Mike Montgomery	Bo Ryan

Conclusion

The improved model show more accurate model, and that means Championship will not be a crucial factor. The improved model CW-TOPSIS is more objective than the old model AHP-TOPSIS.

But, we still need add more factors in our model for a more objective result. So we add two factors into our model to analyze how they affect our model.

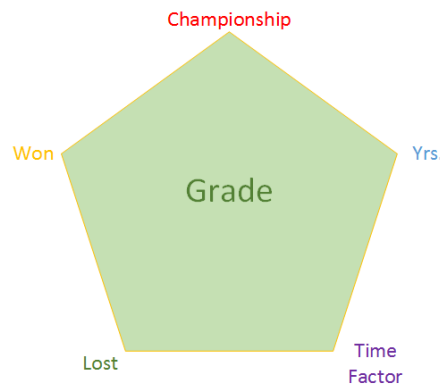## 3. Further discussion of our model

Fig.4 Take the time factor into consideration

The NCAA basketball starts in 1939. With time going by, the number of teams participating has increasing, the competition has become more intense than before. So it will influence the evaluation of the coaches.

To quantify the time factor, we attach a weight (1-5) to different time period, mainly based on the number of participated teams. Fig.4 shows that we take time factor into consideration.

Result after adding the time factor

Table 2 shows the new top 10 college basketball coaches'grade. Compared with the former result, it dose change a lot. So we can draw a conclusion that time factor will change the evaluation.

Table 2.The new top 10 college basketball coaches' grade

Coach name	College	Yrs.	Won	Lost	Championship	Grade
Mike Krzyzewski	5	38	957	297	5	0.9843
Roy Williams	5	25	700	180	2	0.4802
Billy Donovan	5	19	450	186	2	0.4501
Rick Pitino	4	37	920	314	1	0.3038
Jim Boeheim	3	28	664	239	1	0.3018
John Calipari	2	21	526	164	1	0.2507
Bill Self	3	20	507	164	1	0.2058
Tom Izzo	5	18	439	178	1	0.2054
Bob Huggins	4	31	723	286	0	0.0353
Mike Montgomery	3	31	656	303	0	0.0253

4. Conclusion

We deeply analyzed the AHP, which is a structured technique for organizing and analyzing complex decision, based on mathematics and psychology. It was developed by Thomas L. Satty in the 1970s and has been extensively studied and refined since then. Thomas L. Sattyprovided a large amount of background information and their work served as an important introduction. But we found that the AHP method exist some weakness. The AHP is a representative of calculating subjective weight, which ignores the objective factors. The Entropy is a representative of calculating ob-

jective weight. It depends on objective numerical indicators, but ignores the relevant experts experience and subjective judgment. So we introduced the preference factor β to combine them together. Therefore, we build a totally new evaluation method based on the AHP, which is named Composite Weight-TOPSIS (CWTOPSIS). Here are some Strengths of our model:

- We have set up two models. One is old, and based on AHP. The other is improved, and based on Entropy and AHP.
- We have compared our improved model with the old one, and get a lot of useful information.
- Our improve model is more objective than the old one.
- Our model for evaluation includes all the important factors of a coach, won, lost, years of coaching, championships.
- We evaluate our model and finally add two factors, time and gender.

Reference

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