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The evaluation research of the comprehensive strength of the five football clubs in Europe according to the analytic hierarchy proces

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ABSTRACT

This passage discusses the comprehensive strength of the five football clubs, Barcelona, Real Madrid, Inter Milan, Bayern, Chelsea. According to the problems to be solved, with the method of mathematical modeling and evaluation research, this passage calculates with Matlab after it gets the weight. Due to many factors which influence the football team, this passage just analyzes with the times that the team won the competitions, the history of the team, the social status of the football player. There may be some random errors based on the data, so that the result is not in a long residual action. Then this passage adds a relvar about the factors that influence the comprehensive strength of the football team to the time, which makes it in a long residual action. In the end, we come to the conclusion that the Barcelona football team has the strongest comprehensive strength, and then is Real Madrid; after that is Bayern Munich, then the Inter Milan, at last the Chelsea.

KEYWORDS

Evaluation research; Comprehensive strength; Matlab software; Football club; Mathematic modeling.

INTRODUCTION

The European Cup is the most high-level football competition that the European football association members participate in. Up to now, there are 14 periods. From the beginning, there are 4 football teams at the finals and now there are 16. The European Cup is the competition that just inferior to the World Cup. It consists of the top-level football teams in Europe and the splendidness of the competition represents the development of football in the highest level. Nowadays the strength of the five European football clubs (Real Madrid, Barcelona, Bayern Munich, Chelsea and Inter Milan) is well-known. Fans have his own favorite teams and they wish their team to be the winner, so there must be subjectivity. According to the scientific method to evaluate the comprehensive strength of the football teams may guide the fans objectively. Hou Huisheng picks up 13 indexes that reflect the main technique and tactics of the football teams to do the comprehensive evaluation of the technique and tactics of every football team in the 18 World Cup [1]. Cao lei compares the index of the tactics of the teams participated in the Italian first division Serie A soccer team match in 2007-2008 with the correlation of the competition's results and then he gets the rank of the comprehensive strength of the teams. This passage uses the idea of mathematic modeling and analyzes it with the analytic hierarchy process.

THE ANALYSIS OF THE PROBLEMS

In order to get the comprehensive strength of the five football clubs in Europe (Real Madrid, Barcelona, Bayern Munich, Chelsea and Inter Milan), by analyzing the total value of the players, the ability of the coaches, the number of the fans and the goals scored in three years (the national league matches), this passage gets the results.

To a team, the players are the important part, so the ability of the players directly influences the score of the whole team. If a team wants to be the winner, then it must score goals. After analyzing the number of the goals in their national league matches, we can know their attack ability. Besides the attack ability, to win the competition, you must have the defensive ability. If the team have strong attack ability but fails to stop the rivals scoring goals (which is the number of the lost goals), then they would be failed in the end. So, by analyzing the specific value of the goals and sheet numbers we can know the attack and defensive ability of the team. The bigger the specific value is, the strong the team is, and vice versa. The ability of the coach can directly influence the whole team too, while without the reasonable tactics of the coach, it's hard for the team to be the winner. The number of the fans that the team gets can subjectively reflect the ability of the team. Because if the team is terrific then it must attracts fans and the number of the fans also influences the morale of the players. So the number of the fans is also the factor reflects the comprehensive ability of the team.

THE MODEL OF THE ANALYTIC HIERARCHY PROCESS

In order to get the comprehensive strength of the five football clubs in Europe (Real Madrid, Barcelona, Bayern Munich, Chelsea and Inter Milan), this passage use the method of analytic hierarchy process to divide the problems into three layers, that is the target level, the criterion layer, the scheme layer. The main idea is to quantize the compare of the important influences of the criterion to the target layer. And after the mathematical derivation, we can get the weight coefficient of all the layers (with the help of Matlab software).

After searching for the information, we get the ranking of the players ' total value of the five clubs.

TABLE 1: The ranking of the players ' total value of the five clubs

Ranking	Clubs	Total value (euro)
1	C1	6.32billion
2	C2	5.89billion
3	C4	4.35billion
4	C5	3.89billion
5	C3	3.60billion

The times that the team wins the competition is one of the important reasons that evaluate the comprehensive strength of the team. There are too many competitions, we just enumerate some more important and people concerned more times of the victory to the competition.

TABLE 2：The times that the teams win in the competition

Times	UEFA Champions League	UEFA Super Cup	Other competitions	The total times of victory
C1	4	4	57	65
C2	9	1	59	69
C3	3	5	33	41
C4	0	0	50	50
C5	1	1	19	21

The history of the team influences the strength and the long history the team gets, the more authority and impact the team owns.

TABLE 3：The history of the team

Team	Number of years
C1	114
C2	111
C3	105
C4	113
C5	108

After the construction of the analytic hierarchy process, we will put the five factors that influenced the comprehensive strength in order. So we need to compare every other two factors according to the criterion of last layer in the same level and then establish the matrix. We use the relative dimension of the gage (TABLE 4), and we show with numbers then make the judgment matrix.

TABLE 4：Proportional scale value

X_i / X_j	Equal	Less strong	strong	stronger	The strongest
a_{ij}	1	3	5	7	9

Between those two, then take 2, 4, 6, 8.

Confirm the weight W_0 of the criterion layer (*B*) to the target layer（*A*）

So, first of all, we should verdict the importance that *B1*、*B2*、*B3*、*B4*、*B*5 to *A*. To a team, the players are the important part, so the ability of the players directly influences the score of the whole team and the total value of the players is an important part to reflect the strength of the team. The ability of the coach can directly influence the whole team too, while without the reasonable tactics of the coach, it's hard for the team to be the winner. Then, to evaluate the strength, we should evaluate their attack and defensive ability. By analyzing the specific value of the goals and sheet numbers we can know the attack and defensive ability of the team. The bigger the specific value is, the strong the team is, and vice versa. At last, the number of the fans is also the factor reflects the comprehensive ability of the team.

Based on the description, we can confirm the weight of every factor. From the biggest to the smallest are the value of the player, the ability of the coach, the ability of the attack and defensive, the number of the fans. According to the data in TABLE 4, we can confirm that the matrix of A-B is TABLE 5.

TABLE 5 : *A*-*B* matrix

A	*B1*	*B2*	*B3*	*B4*
B1	1	2	3	8
B2	1/2	1	2	6
B3	1/3	1/2	1	4
B4	1/8	1/6	1/4	1

This is a straight reciprocal matrix of five-level. After the calculation, the eigenvalue of maximum of *A is* $\lambda_{\max} = 4.03098$, and the normalization of the feature vector is W_0 = （0.491，0.291，0.168，0.05）^{T}. The coincidence indicator （TABLE 6）RI $_0$=0.9 is $CI_0 = \frac{\lambda_{\max} - 4}{4-1} \approx 0.0103$ and the consistency ratio is $CR_0 = \frac{CI_0}{RI_0} \approx 0.01148 < 0.1$, W_0 is the weight of B layer to A layer.
so

TABLE 6：Random coincidence indicator

N	1	2	3	4	5	6
RI	0	0	0.58	0.90	1.12	1.24

Confirm the weight W_1 of scheme layer (*C*) to criterion layer（*B1*）

According to the data on the sports website, the value of the player in each team is (billion euros), Real Madrid 5.245, Barcelona 5.4, Bayern Munich 3.031, Inter Milan 3.6725, Chelsea 3.62. So the B1-C matrix is as TABLE 7.

TABLE 7：B1-C matrix

B1	C1	C2	C3	C4	C5
C1	1	1/2	7	3	5
C2	2	1	9	5	6
C3	1/7	1/9	1	1/4	1/3
C4	1/3	1/5	4	1	2
C5	1/5	1/6	3	1/2	1

This is a straight reciprocal matrix of five-level. After the calculation, the eigenvalue of maximum of *A is* $\lambda_{\max} = 5.11864$, and the normalization of the feature vector is W_1 = （0.264，0.518，0.035，0.112，0.069）^{T}. The coincidence indicator （TABLE 6）RI $_1$=1.12 is $CI_1 = \frac{\lambda_{\max} - 5}{5-1} \approx 0.02966$ and the consistency ratio is $CR_1 = \frac{CI_1}{RI_1} \approx 0.02648 < 0.1$, so W_1 is the weight of C layer to B1 layer.

Confirm the weight W_2 of scheme layer (*C*) to criterion layer（*B2*）

According to the data on the sports website, the ranking of the coaches of the teams are: Jose Mourinho of Real Madrid No.3, Frank Rijkaard in Barcelona No.2, Joseph Heynckes of Bayern Munich No.1, Walter mazzarri of Inter Milan No.43 (this ranking is far behind other coaches, so we can count it 0), Rafael benitez in Chelsea No.9, so the B2-C matrix is TABLE 8.

TABLE 8：B2-C matrix

B1	C1	C2	C3	C5
C1	1	1/2	1/3	4
C2	2	1	1/2	5
C3	3	2	1	6
C5	1/4	1/5	1/6	1

This is a straight reciprocal matrix of four-level. After the calculation, the eigenvalue of maximum of *A is* $\lambda_{\max} = 4.06578$, and the normalization of the feature vector is W_2 = （0.176，0.289，0.476，0.059，0）^{T}. The

coincidence indicator （TABLE 6）RI $_2$ =0.90 is $CI_2 = \frac{\lambda_{\max} - 4}{4-1} \approx 0.021925$ and the consistency ratio is $CR_2 = \frac{CI_2}{RI_2} \approx 0.02436 < 0.1$, so W_2 is the weight of C layer to B2 layer.

Confirm the weight W_3 of scheme layer (*C*) to criterion layer（*B*3）

According to the data from the document, the goals and lost number of the teams in their national league matches and the specific value in the last three years (2010-2013).

TABLE 9 ：The specific value of the goals and the lost

Team	Real Madrid	Barcelona	Bayern Munich	Chelsea	Inter Milan
The number of the goals	326	324	256	182	209
The number of the lost	107	90	80	154	118
Specific value	3.047	3.6	3.2	1.182	1.771

TABLE 10：B3-C matrix

B1	C1	C2	C3	C4	C5
C1	1	1/3	1/2	7	3
C2	3	1	2	9	6
C3	2	1/2	1	8	4
C4	1/7	1/9	1/8	1	1/3
C5	1/3	1/6	1/4	3	1

This is a straight reciprocal matrix of five-level. After the calculation, the eigenvalue of maximum of *A is* $\lambda_{\max} = 5.1037$, and the normalization of the feature vector is W_3 = （0.178, 0.442, 0.275, 0.033, 0.073） ^{T}. The coincidence indicator （TABLE 6）RI $_2$ =1.12 is $CI_3 = \frac{\lambda_{\max} - 5}{5-1} \approx 0.02592$ and the consistency ratio is $CR_3 = \frac{CI_3}{RI_3} \approx 0.02315 < 0.1$, so W_3 is the weight of C layer to B3 layer.

Confirm the weight W_4 of scheme layer (*C*) to criterion layer（*B*4）

According to the agency “Sport+Markt”. in the ranking of the number of fans that they declare (only in Europe), the fans that each team has (ten thousands) are: Real Madrid 4100, Barcelona 4420, Bayern Munich 1980, Inter Milan 1030, Chelsea 2560. So the B4-C matrix is as TABLE 11.

TABLE 11 ： B4-C matrix

B1	C1	C2	C3	C4	C5
C1	1	1/2	4	7	3
C2	2	1	5	8	4
C3	1/4	1/5	1	3	1/2
C4	1/7	1/8	1/6	1	1/3
C5	1/3	1/4	2	3	1

This is a straight reciprocal matrix of five-level. After the calculation, the eigenvalue of maximum of *A is* $\lambda_{\max} = 5.0286$, and the normalization of the feature vector is W_4 = （0.300, 0.453, 0.085, 0.0384, 0.124） ^{T}. The

coincidence indicator （TABLE 6）RI $_4$=1.12 is $CI_4 = \frac{\lambda_{\max} - 5}{5-1} \approx 0.007412$ and the consistency ratio is $CR_4 = \frac{CI_4}{RI_4} \approx 0.006612 < 0.1$, so W_3 is the weight of C layer to B4 layer.

Confirm the weight W of scheme layer (*C*) to target layer（A）

According to the weight W_0 of B to A, and the weight W_1、W_2、W_3、W_4 of C to B, so after simplifying the weight W of C to A, we can get:

Weight of Real Madrid $= 0.264*0.491+0.176*0.291+0.178*0.168+0.3*0.05 = 0.2257$

Weight of Barcelona $= 0.518*0.491+0.289*0.291+0.442*0.168+0.453*0.05 = 0.4353$

Weight of Bayern Munich $= 0.035*0.491+0.476*0.291+0.275*0.168+0.085*0.05 = 0.2062$

Weight of Inter Milan $= 0.112*0.491+0.059*0.291+0.033*0.168+0.0384*0.05 = 0.0796$

Weight of Chelsea $= 0.069*0.491+0*0.291+0.073*0.168+0.124*0.05 = 0.0523$

CONCLUSION

This passage uses the method of analytic hierarchy process to analyze the data, and then come to the conclusion: based of the data that the literature provides and the analysis of ourselves, the comprehensive strength we get must be more objective. This passage compare, evaluate and think from many aspects, which makes the analytic hierarchy process has the reliability. The number of the fans subjectively reflects the strength of the team. A strong team must attract more fans, and we can know according to the data that the team which has the most fans is exactly the strongest team of its comprehensive strength, so this is reasonable and has the subjective factors.

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