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# Study on the Application of TOPSIS Method to the Introduction of Foreign Players in CBA Games

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**Abstract**

The TOPSIS method is a multiple attribute decision-making method. This paper introduces the current situation of the introduction of foreign players in CBA games, presents the principles and calculation steps of TOPSIS method in detail, and applies it to the quantitative evaluation of the comprehensively competitive ability during the introduction of foreign players. Through the analysis of practical application, we found that the TOPSIS method has relatively high rationality and applicability when it is used to evaluate the comprehensively competitive ability during the introduction of foreign players.



Keywords: TOPSIS method; multiple attribute decision-making; introduction of foreign players; application study

## 1. Introduction

It's an urgent question for the CBA teams to select an appropriate foreign player with high level. Since the clubs started to introduce foreign players, the selection and introduction are all completed by the clubs. The approaches they take are "going out" and " please coming in". "Going out" means that the coaches of the clubs go abroad personally to select foreign players before each season. But because they have no exact and useful materials and information, selections of foreign players is blind. They may not only endure hardship, but also have no satisfing result. "Please coming in" means trial, that is, the clubs invite foreign players to the clubs to train and compete for a period of time, and it's the club who decides whether the players should leave finally. During the period of trial, the club take responsibility for the accommodation and round-trip ticket of the foreign players. But there are many unskilled persons among the foreign players who take part in the trial, which makes the result that there are too many players, but only a few can be selected. Frequent trials make the clubs spend a lot of money and effort. But they still cannot select an ideal foreign player at last. In these two years, the related officials of the Basketball Administration and the representatives of the clubs fly to the United States to select foreign players together, which will not only save a lot of unnecessary money and effort, but also avoid the blindness of selection. But there also exists some problems in such way of selection. For example, numerous players are busy in entering NBA, which inevitably causes the diversion of excellent players and it will influence

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the quality of selecting CBA players. Referring to a large number of data, we find that people always make decision according to previous competitive scores and the games during the trial of the foreign players when they select. When they need to select among several foreign players, they often judge according to technical statistics. So we can only view the superficial information of technical statistics and hardly make objective evaluation of these players' comprehensively competitive ability of attack and defence. This attempts to explore this field by using TOPSIS method of decision-making science to provide a more scientific and quantitative decision-making method for the CBA teams to select foreign players.

## 2. Introduction and Basic Steps of Application of TOPSIS Method

### *2.1 Introduction to TOPSIS Method*

TOPSIS (Technique for order preference by similarity to ideal solution) method is called as ideal solution. It is an effectively multiple attribute decision-making method. This method is to construct the ideal solutions and minus idea solutions to the problems of multiple attributes and uses the two benchmarks of being close to the ideal solutions and being far away from the minus ideal solutions as the criteria of evaluating the feasible projects. "Ideal solution" and "minus ideal solution" are the two basic concepts of TOPSIS method. The so-called ideal solution (noted as x+) is the hypnotically optimal solution (project), all its attribute value reaches to the best value of every alternative projects; but minus ideal solution (noted as x-) is the worst solution (project) in hypothesis. The rule of ranking projects is to compare each alternative project with x+ and x-. If one of the projects is close to x+ and far away from x- at the same time, then the project is the best project of the alternative projects. It should consider the comprehensive assessment of the foreign players' ability of attack and defence, which includes throw percentage of two-point shot, tree-point shot and free throw, assist, rebound, foul and so on. Each index is an attribute. So it's a typical multiple attribute decision-making question to sort foreign players. And then TOPSIS method can be applied to sort foreign players.

### *2.2 The basic steps of TOPSIS method*

**Step one:** construct standardized decision matrix A. For the comprehensive assessment questions with n evaluation units and m evaluation indexes, its decision matrix A is:

$$A = \begin{array}{c} \\ x_1 \\ x_2 \\ \cdots \\ x_n \end{array} \begin{array}{c} \begin{array}{cccc} f_1 & f_2 & \cdots & f_m \end{array} \\ \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{bmatrix} \end{array}$$

In the formula, $aij = fj(xi)$, which shows the jth assessment index of the ith assessment unit (alternative project). $i = 1,...,n; j = 1,2,...,m$. Standardize the matrix A as matrix R:

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{bmatrix}$$

$$r_{ij} = a_{ij} / \sqrt{\sum_{i=1}^{n} a_{ij}^2}, i = 1,2,...,m. \tag{1}$$

**Step two:** construct weighted and standardized decision matrix V, weight vector W=(w1,w2,……,wn)

$$V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{1m} \\ v_{21} & v_{22} & \cdots & v_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ v_{n1} & v_{n2} & \cdots & v_{nm} \end{bmatrix}$$

$$v_{ij} = w_j r_{ij}, i = 1,2,...,n, j = 1,2,...m. \tag{2}$$

**Step three:** determine the ideal solution $x^+$ and minus ideal solution $x^-$

$$x^+ = \left\{ \max_i v_{ij} \mid j \in J), (\min_i v_{ij} \mid j \in J') \mid i = 1,2,...,n \right\} = \left\{ x_1^+, x_2^+, ...x_m^+ \right\}$$

$$x^- = \left\{ \min_i v_{ij} \mid j \in J), (\max_i v_{ij} \mid j \in J') \mid i = 1,2,...,n \right\} = \left\{ x_1^-, x_2^-, ...x_m^- \right\}$$

**Step four:** calculate distance. The distance of each project to the ideal solution $x^+$ is:

$$s_i^+ = \sqrt{\sum_{j=1}^{m} (v_{ij} - x_j^+)^2} \tag{3}$$

The distance of each project to the minus ideal solution $x^-$ is:

$$s_i^* = \sqrt{\sum_{j=1}^{m} (v_{ij} - x_j^*)^2} \tag{4}$$

**Step five:** calculate the relative proximity index of each project to the ideal solution $c_i$ :

$$c_i = s_i^* \Big/ (s_i^* + s_i^+) \tag{5}$$

Obviously, $0 \le c_i \le 1$ , In the project, if $x_i = x^+$ , then $c_i = 1$ ; if $x_i = x^-$ , then $c_i = 0.5$ ; if $x_i = x^*$ , then $c_i = 0$ .

**Step six:** rank the priority of the projects in descending order of $c_i$ .

### 3. The Application of TOPSIS Method to the Introduction of Foreign Players in CBA Games

During the selection of foreign players, we can view the foreign players to be selected as the decision projects of TOPSIS method. Through TOPSIS method, we can obtain $c_i$ of each project. Then we can get the comprehensive quality of each project and the comparison among different projects of their comprehensively competitive ability by ranking $c_i$ . This paper take four foreign players A, B, C, D as an example. The specific data are shown in Table 1:

Table 1 Data Statistics of Foreign Players

| Players | score | second -point | three -point | free throw | rebound | fast break | slam -dunk | block | steal | assist | foul | miss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 20 | 45.5% | 40.0% | 66.7% | 9.2 | 1.8 | 0 | 1.3 | 2.3 | 1.6 | 4.8 | 3.1 |
| B | 19 | 50.0% | 33.3% | 83.3% | 8.5 | 1.5 | 1.3 | 0 | 2.4 | 2.4 | 3.3 | 1.6 |
| C | 22 | 40.0% | 42.9% | 62.5% | 6.8 | 1.3 | 0.8 | 0 | 1.2 | 1.8 | 4.2 | 2.2 |
| D | 19 | 41.7% | 25.0% | 77.8% | 10.6 | 2.3 | 1.8 | 1.9 | 3.0 | 3 .2 | 3.8 | 1.3 |

*4.1 Determine decision matrix A:*

$$A=\begin{vmatrix} 45.5\% & 40.0\% & 66.7\% & 9.2 & 1.8 & 0 & 1.3 & 2.3 & 1.6 & 4.8 & 3.1 \\ 50.0\% & 33.3\% & 83.3\% & 8.5 & 1.5 & 1.3 & 0 & 2.4 & 2.4 & 3.3 & 1.6 \\ 40.0\% & 42.9\% & 62.5\% & 6.8 & 1.3 & 0.8 & 0 & 1.2 & 1.8 & 4.2 & 2.2 \\ 41.7\% & 25.0\% & 77.8\% & 10.6 & 2.3 & 1.8 & 1.9 & 3.0 & 3 .2 & 3.8 & 1.3 \end{vmatrix}$$

*4.2 calculate standardized matrix R*

Because in the above data, second-point, three-point, free throw, rebound, fast break, slam-dunk, block, steal and assist are positive indexes, while foul and miss are negative indexes, so it must give standardized operation of the data. Calculate standardized matrix R according to formula (1):

$$R=\begin{vmatrix} 0.5116 & 0.5560 & 0.4569 & 0.5180 & 0.5097 & 0.0000 & 0.5647 & 0.4824 & 0.3727 & 0.5921 & 0.7168 \\ 0.5622 & 0.4629 & 0.5706 & 0.4785 & 0.4247 & 0.5513 & 0.0000 & 0.5034 & 0.5140 & 0.4070 & 0.3700 \\ 0.4498 & 0.5964 & 0.4281 & 0.3828 & 0.3681 & 0.3393 & 0.0000 & 0.3775 & 0.3855 & 0.5181 & 0.5087 \\ 0.4689 & 0.3475 & 0.5330 & 0.5968 & 0.6513 & 0.7634 & 0.8253 & 0.6712 & 0.6853 & 0.4688 & 0.3006 \end{vmatrix}$$

*4.3 Determine weight vector W:*

In order to achieve the weight coefficient of each index, this paper uses software SPSS12.0 to analyse the related data to get related coefficient at first, and then normalize the related coefficient to obtain the weight coefficient of each index. Referfing to relevant materials, we find that the weight coefficient obtained by this method is consistent with the research results of many experts, which can be used as the weight vector of this study.

W=(0.119，0.106，0.115，0.090，0.113，0.061，0.064，0.113，0.096，0.065，0.058)

*4.4 Calculate weighted and standardized matrix V according to formula (2)*

$$V=\begin{vmatrix} 0.0609 & 0.0589 & 0.0525 & 0.0466 & 0.0576 & 0.0000 & 0.0361 & 0.0545 & 0.0358 & 0.0385 & 0.0417 \\ 0.0669 & 0.0491 & 0.0656 & 0.0430 & 0.0480 & 0.0336 & 0.0000 & 0.0569 & 0.0493 & 0.0265 & 0.0215 \\ 0.0535 & 0.0632 & 0.0493 & 0.0331 & 0.0416 & 0.0207 & 0.0000 & 0.0427 & 0.0370 & 0.0337 & 0.0295 \\ 0.0558 & 0.0368 & 0.0613 & 0.0586 & 0.0736 & 0.0446 & 0.0528 & 0.0758 & 0.0658 & 0.0304 & 0.0117 \end{vmatrix}$$

*4.5 Determine ideal solution x+ and miinus ideal solution x-*

x+ =( 0.0669, 0.0632, 0.0656, 0.0586, 0.0736, 0.0446, 0.0528, 0.0758, 0.0658, 0.0385, 0.0417)
x- =( 0.0535, 0.0368 , 0.0493, 0.0331, 0.0416, 0.0000, 0.0000, 0.0427, 0.0358, 0.0265, 0.0117)

*4.6 Calculate the distance of each project to ideal solution and miinus ideal solution according to formula (3) and (4).*

S1+=0.1045， S2+=0.1543, S3+=0.0870, S4+=0.0425
S1- =0.0589, S2- =0.0477, S3- =0.0387, S4- =0.0928,

*4.7 Calculate the relative proximity index of each project to the ideal solution according to formula (5).*

c1=0.3605 c2=0.2361 c3=0.3078 c4=0.6853

*4.8 Rank the priority of the projects in descending order of* $c_i$ *, the result is:*

C4 > C1 > C3 > C2

So we can confirm that D is the best choice of foreign players when the difference among the four players' ability is not significant. He is very good at attack and defence. His comprehensive ability is strongest. While the other players are only well in certain aspect, their comprehensive ability is relatively weak.

## 5 Conclusion

TOPSIS method is a decision-making method of multiple objectives, and it is suitable for handling decision questions with multi-objectives. This paper puts forward that TOPSIS method is applied to the evaluation of foreign players during the introduction of foreign players in CBA teams, which achieved good result. Compared with other methods, the principle of this method is simple and it can evaluate several targets at the same time. What's more, the calculation is quick, the result is clear and the evaluation is objective. It can combine cleverly with foreign players of CBA to determine the level that each evaluative object belongs to, which contributes to compare the priority of quality among differently evaluative objects. Practice shows that during the introduction of foreign players in CBA, TOPSIS can reflect the situation of foreign players more directly and clearly, and it has much rationality and applicability.

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