



Research Article

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Application of basketball technical index comprehensive evaluation in performance prediction based on grey system theory

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ABSTRACT

College students' basketball friendly match not only can promote team spirits, but also can increase their collective sense of honor. It is very important to make correct evaluation and bring scientific training orientation guiding to each college representative basketball team. This paper takes one college 12 representative teams' basketball technical index as research objects, use grey system theory establish comprehensive evaluation model so as to read basketball historical data influence on sport performance through mathematic model method, and provide scientific basis for basketball pre-competition preparation. First do standardization handling with each index data from each basketball representative team, and solute differences list of each index, then work out relevancy between technical index and performance, and get each representative team each technical index level advantages ranks, finally utilize composite index method get basketball competition prediction performance with average composite index and sum of score ratio.

Key words: Relevancy, grey system theory, composite index, basketball technical index

INTRODUCTION

For basketball match pre-competition preparation, correct cognition of its own team and opposite team should be done, while historical matches' each team technical index statistics data is the key parameter that reflects participant team's competitive levels, on the basis of mastering such participating teams data, if scientific analysis method be used, it can give clearly direction to pre-competition preparation. This paper establishes a kind of comprehensive evaluation model and composite index model based on grey system theory for above problems so as to explore relevancy between team technical index level and competition performance through mathematic model and its solution, play directive guiding role in pre-competition preparation and provide reliable performance prediction [1-5].

For college students basketball technical index and grey system theory model research, lots of scholars has made efforts, some thoughts and research methods that many scholars put forward are of great help to basketball pre-competition preparation and performance prediction, from which, Take CBA finals champion Guangdong Team in 2013 as research objects, make comparison of Guangdong Team each round opponents' techniques and tactics features, analyze major basketball technical index; Introduce Deng relevancy and others seven grey relevancy model, and analysis its mathematic significance, bring into grey relevancy model features evaluation and its definition, finally contrast analyze the seven grey relevancy performance [6-9]; Apply grey theory's relative analysis method, make analysis and research on students basketball technical test score in physical education department, sports institution, Shaanxi normal university [10, 11].

This paper based on previous studies, make analysis of one college 12 basketball representative teams' historical technique and tactics statistic data, apply standardized method handle basketball technical index, establish grey

system theory comprehensive evaluation model and composite index model, provide direct guidance for each basketball representative team's pre-competition preparation and reliable prediction results to competitive performance.

BASKETBALL TECHNICAL INDEX MODEL ESTABLISHMENT BASED ON GREY SYSTEM THEORY

Main influence factors in basketball competition performance is techniques that player exhibits in competition process. And each technical index statistics data in basketball competition is the important parameter to measure player technical level and also the key influence factor on sport representative team competition performance. In order to make scientific and rational prediction of each representative team performance in basketball game process, quantization of representative teams participating technical index and comprehensive evaluation are key to solve problem, therefore this chapter applies grey system theory to establish comprehensive evaluation model with basketball technical index reflected representative level. This chapter first makes fundamental assumption to model establishment, then researches on each representative team reflected technical index quantitative relevancy model, finally establishes sequence model to evaluate representative teams' comprehensive strength [12, 13].

Fundamental assumption:

- 1) Ignore every outside, subjective factors influence, such as referee misjudgments, abandon the game, court influence and so on.
- 2) All teams in all games are playing normally, without supernormal performance and bad conditions etc.
- 3) Ignore individual influence on total results, team number entering time not regarded as technical index evaluation range
- 4) Presume that grey relevancy model's resolution ratio $\xi = 0.5$.
- 5) Technical indexes in one game are two-point ball, three-point ball, free throw times, shot times, shot percentage, attack times, defense times, total attack and defense times, foul times, fault times, steal times and rejection times;

Grey system theory model deduction and analysis:

Make quantization of technical index in assumption (5), such as attack, defense and other index by times, two-point ball, three-point ball shot percentage by ratio, then unified data with standardization handling, finally apply grey relative analysis method in grey system theory to make relevancy calculation between technical index and performance [14].

Arbitrarily choose one representative team T from participating teams, when it plays with i representative team, index J quantitative index of player x represents as $a_i^j(x)$, when representative team T plays with i representative team, the item J index amounts total represents as X_j^i , then formula between X_j^i and $a_i^j(x)$ as formula(1) shows:

$$X_j^i = \sum_x a_i^j(x) \quad (1)$$

Due to index total that got is not unified; standardization handling should be done to data. Given \bar{X}_j^i to be total of item J index when standardized representative team T plays with i team, use X_j^0 to represent reference of total of item J index when standardized representative team T plays with i team, then standardized each index total can be calculated with formula(2).

$$\bar{X}_j^i = \frac{X_j^i}{X_j^0} \quad (2)$$

If use $\bar{\bar{X}}_j^i$ to indicate the absolute value of difference between standardized representative team T technical index \bar{X}_j^i and total performance \bar{X}_1^i which is nonnegative number, then can get each technical index maximum deviation and minimum deviation, as formula(3) shows.

$$\begin{cases} \Delta \max(j) = \max\{\bar{\bar{X}}_1^1, \bar{\bar{X}}_1^2, \dots, \bar{\bar{X}}_j^1, \dots, \bar{\bar{X}}_j^i\} \\ \Delta \min(j) = \min\{\bar{\bar{X}}_1^1, \bar{\bar{X}}_1^2, \dots, \bar{\bar{X}}_j^1, \dots, \bar{\bar{X}}_j^i\} \end{cases} \quad (3)$$

If use K_j^i to indicate relevancy between item j index and total performance when representative team T plays with i team, then basic relevancy model of each index and total performance in each game as formula(4) shows.

$$K_j^i = \frac{\Delta \min(j) + \xi \cdot \Delta \max(j)}{\bar{\bar{X}}_j^i + \xi \cdot \Delta \max(j)} \quad (4)$$

ξ in formula(4) represents resolution ratio and this paper uses 0.5, if given $R(j)$ to be the final relevancy between each index and performance, then it can be solved according to formula(5).

$$R(j) = \frac{1}{k} \sum_j K_j^i \quad (5)$$

Competition rank prediction model based on basketball technical index:

In basketball round-robin process, final after group games will choose two teams to reach that are two teams with highest total points in each group would reach the final, draw would not happen to final, therefore champion would only be got by one representative team. Teams without reaching the final would rank with their points, in case same points sequence would be made according to their sum of score ratios.

Given ΔS_j to be individual index of each indicator, then it can be solved according to formula(6), when the index has positive correlations to game performance, then take formula(6) positive number, when it has negative correlations to game performance, then take formula(6) reciprocal.

$$\Delta S_j = \begin{cases} \frac{X_j^i}{X_j^0}, j \neq 14,15 \\ \frac{X_j^0}{X_j^i}, j = 14,15 \end{cases} \quad (6)$$

In formula (6), $j = 14,15$ represents the 14th index foul times and 15th index fault times.

Each representative team comprehensive index represents as S_j and its calculation as formula (7) shows.

$$S_j = \sum_j \Delta S_j \quad (7)$$

The whole participating teams are divided into two parts, one of which are 4 teams that reach the final, the other of which are 4 teams that don't reach the final. Due to composite index of four teams that reach the final can be got from composite index evaluation method, apply the model in prediction final 6 games results, and acquire the top four ranking. However, due to the others which not reach the final haven't had played in final, this paper takes points as ranking basis. Since same points teams are existing, this paper can solve score ratio sum of same points teams, that is one's own scores ratio covers the opponent scores then summation, define ranks according to score ratios, this paper defines same scores team total points ratio as μ .

If use ΔT to represent champion team by prediction, then champion team can be got by formula (8).

$$\Delta T = \max\{S_1, S_2, S_3, S_4\} \quad (8)$$

RESULTS AND DISCUSSION

EMPIRICAL RESEARCH AND RESULTS ANALYSIS

The research takes 12 representative teams that composed by different majors in one college as research objects, due to excessive larger data, takes representative team A to carry on data demonstration in each representative relevancy solution results analysis; carry out analysis of 12 representative teams in technical index ranking, and utilize composite index model to predict champion team.

In empirical data analysis, 17 basketball technical indexes are chosen, which are respectively 2-point shot times, 2-point attempts, 2-point shot percentage, 3-point shot times, 3-point attempts, 3-point shot percentage, free throw times, free throw attempts, free throw percentage, attack times, defense times, attack and defense total times, assist times, foul times, fault times, steal times and rejection times.

Table 1: Team A and other representative teams' competition index difference series as well as deviation extreme value

Index opponent	Team B	Team C	Team D	Team E	Team F	minimum deviation value	maximum deviation value
1	0	0.3463	0.1851	0.1472	0.0714	0	0.3463
2	0	0.3190	0.0286	0.0131	0.1214	0	0.3190
3	0	0.1530	0.0727	0.0770	0.0189	0	0.1530
4	0	0.4365	0.1786	0.3730	0.1508	0	0.4365
5	0	0.0810	0.3386	0.7419	0.1114	0	0.7419
6	0	0.1773	0.0405	0.0127	0.2016	0	0.2016
7	0	0.2656	0.2555	0.2766	0.0714	0	0.2766
8	0	0.6143	0.4452	0.0714	0.6619	0	0.6619
9	0	0.3203	0.0287	0.0458	0.4945	0	0.4945
10	0	0.5857	0.3548	0.1286	0.6714	0	0.6714
11	0	0.4790	0.4586	0.3019	0.4314	0	0.4790
12	0	0.5190	0.1536	0.2369	0.5214	0	0.5214
13	0	0.1032	0.8452	0.0714	0.4841	0	0.8452
14	0	0.3095	0.1786	0.5476	0.1190	0	0.5476
15	0	0.1960	0.2555	0.7234	0.1484	0	0.7234
16	0	0.8690	0.6548	0.0714	0.2381	0	0.8690
17	0	0.8810	1.1786	0.2619	0.0714	0	1.1786

Note: 1 to 17 in Index column are respectively 2-point shot times, 2-point attempts, 2-point shot percentage, 3-point shot times, 3-point attempts, 3-point shot percentage, free throw times, free throw attempts, free throw percentage, attack times, defense times, attack and defense total times, assist times, foul times, fault times, steal times and rejection times

Table 2: Team A and other teams' competition index's relative index and relevancy

Index opponent	Team B	Team C	Team D	Team E	Team F	relevancy
1	1	0.6298	0.7610	0.8001	0.8919	0.8166
2	1	0.6488	0.9538	0.9783	0.8291	0.8820
3	1	0.7938	0.8902	0.8844	0.9690	0.9075
4	1	0.5745	0.7674	0.6124	0.7962	0.7501
5	1	0.8792	0.6351	0.4427	0.8410	0.7596
6	1	0.7687	0.9357	0.9788	0.7451	0.8857
7	1	0.6893	0.6976	0.6806	0.8919	0.7919
8	1	0.4896	0.5696	0.8919	0.4710	0.6844
9	1	0.6479	0.9536	0.9279	0.5437	0.8146
10	1	0.5015	0.6242	0.8209	0.4674	0.6828
11	1	0.5516	0.5624	0.6612	0.5773	0.6705
12	1	0.5317	0.7933	0.7133	0.5305	0.7138
13	1	0.8510	0.4108	0.8919	0.5490	0.7405
14	1	0.6556	0.7674	0.5183	0.8319	0.7547
15	1	0.7504	0.6976	0.4489	0.7989	0.7392
16	1	0.4041	0.4737	0.8919	0.7122	0.6964
17	1	0.4008	0.3333	0.6923	0.8919	0.6637

Note: 1 to 17 in Index column are respectively 2-point shot times, 2-point attempts, 2-point shot percentage, 3-point shot times, 3-point attempts, 3-point shot percentage, free throw times, free throw attempts, free throw percentage, attack times, defense times, attack and defense total times, assist times, foul times, fault times, steal times and rejection times

Each representative team relevancy result analysis

According to index summarize model X_j^i , \bar{X}_j^i and $\bar{\bar{X}}_j^i$ solution method, it can get series of competition index

difference between team A and other representative teams as Table 1 shows as well as conditions of maximum deviation and minimum maximum.

After getting differences series and deviation extreme values as Table 1 shows, it can get correlation between each technical index in every game and total performance through basic relation model formal(4), then get final relevancy through final grey relative index model formula(5), achieve representative team A and other teams index's competition index relative index and relevancy data results as Table 2 shows through calculation with resolution index $\xi = 0.5$.

Other teams' data can also deduce according to model, result data is similar to Table 1 and Table 2, get relevancy between each representative team technical index and total performance as Table 3 shows.

Table 3: Each institution representative team technical index and total performance relevancy

relevancy	1	2	3	4	5	6	7	8	9
A	0.8166	0.8820	0.9075	0.7501	0.7596	0.8857	0.7919	0.6844	0.8146
B	0.7418	0.7891	0.8338	0.6130	0.7097	0.6851	0.7766	0.8136	0.8661
C	0.9523	0.9276	0.8265	0.8573	0.8421	0.8344	0.7893	0.7107	0.9384
D	0.7638	0.8169	0.8670	0.7923	0.8552	0.8219	0.7083	0.7025	0.9171
E	0.9297	0.8576	0.9554	0.8316	0.7119	0.8352	0.8255	0.7774	0.7516
F	0.9459	0.9064	0.9613	0.9203	0.9023	0.9045	0.7633	0.7363	0.9031
G	0.7802	0.7834	0.8257	0.6453	0.7342	0.6810	0.7991	0.7674	0.8688
H	0.8865	0.7521	0.8120	0.7940	0.7491	0.8075	0.5523	0.6128	0.8332
I	0.8904	0.7249	0.8960	0.8680	0.8436	0.8850	0.5913	0.5404	0.8735
J	0.8513	0.9364	0.8528	0.7083	0.7475	0.6553	0.8719	0.7968	0.8805
K	0.9247	0.8959	0.9091	0.6767	0.6950	0.8799	0.6751	0.6747	0.8181
L	0.8163	0.7935	0.7753	0.7090	0.5928	0.8031	0.6194	0.6497	0.8398
relevancy	10	11	12	13	14	15	16	17	
A	0.6828	0.6705	0.7138	0.7405	0.7547	0.7392	0.6964	0.6637	
B	0.6747	0.6439	0.6820	0.8414	0.7901	0.8241	0.7879	0.6148	
C	0.7674	0.8862	0.8768	0.8282	0.7620	0.8065	0.8046	0.7702	
D	0.7653	0.6575	0.7348	0.7926	0.7978	0.6976	0.7326	0.7688	
E	0.6859	0.8088	0.7804	0.8772	0.8865	0.6977	0.5462	0.7804	
F	0.6987	0.9340	0.9162	0.8324	0.8592	0.7194	0.8957	0.7952	
G	0.6983	0.9368	0.8725	0.7946	0.7437	0.5420	0.7054	0.6574	
H	0.6243	0.8821	0.7821	0.6434	0.8325	0.6855	0.6200	0.5320	
I	0.7712	0.8625	0.8792	0.8244	0.8091	0.8431	0.8740	0.7945	
J	0.7310	0.7989	0.8079	0.7626	0.7294	0.7763	0.8018	0.7109	
K	0.7892	0.7690	0.7861	0.6550	0.7762	0.7617	0.6681	0.5831	
L	0.6651	0.7900	0.7423	0.7808	0.6047	0.7247	0.7671	0.5530	

Note: A to L are respectively Team A, Team B, Team G, Team H, Team C, Team D, Team E, Team F, Team I, Team J, Team K and Team L; 1 to 17 are respectively 2-point shot times, 2-point attempts, 2-point shot percentage, 3-point shot times, 3-point attempts, 3-point shot percentage, free throw times, free throw attempts, free throw percentage, attack times, defense times, attack and defense total times, assist times, foul times, foul times, foul times, steal times and rejection times

Each group basketball team technical index ranking:

Apply Table 3's each index and performance relevancy, can get each institution representative technical index ranking conditions as Table 4 show.

Table 4: Each representative team technical index advantages ranking from strong to weak

	NO.1	NO.2	NO.3	NO.4	NO.5	NO.6	NO.7	NO.8	NO.9	NO.10	NO.11	NO.12	NO.13	NO.14	NO.15	NO.16	NO.17
A	3	6	2	1	9	7	5	14	4	13	15	12	16	8	10	11	17
B	9	13	3	15	8	14	2	16	7	1	5	6	12	10	11	17	4
C	1	9	2	11	12	4	5	6	13	3	15	16	7	17	10	14	8
D	9	3	5	6	2	14	13	4	17	10	1	12	16	7	8	15	11
E	3	1	14	13	2	6	4	7	11	12	17	8	9	5	15	10	16
F	3	1	11	4	12	2	6	9	5	16	14	13	17	7	8	15	10
G	11	12	9	3	7	13	2	1	8	14	5	16	10	6	17	4	15
H	1	11	9	14	3	6	4	12	2	5	15	13	10	16	8	7	17
I	3	1	6	12	16	9	4	11	5	15	13	14	17	10	2	7	8
J	2	9	7	3	1	12	16	11	8	15	13	5	10	14	17	4	6
K	1	3	2	6	9	10	12	14	11	15	5	4	7	8	16	13	17
L	9	1	6	2	11	13	3	16	12	15	4	10	8	7	14	5	17

Note: 1 to 17 are respectively 2-point shot times, 2-point attempts, 2-point shot percentage, 3-point shot times, 3-point attempts, 3-point shot percentage, free throw times, free throw attempts, free throw percentage, attack times, defense times, attack and defense total times, assist times, foul times, foul times, foul times, steal times and rejection times No.1 to No.17 show technical index advantage sequence from strong to weak.

Champion team prediction:

Divide 12 representative teams into M,N two groups, from which group A including Team B, Team C, Team D, Team E, Team A and Team F, while group B including Team I, Team H, Team G, Team J, Team K and Team L. Group M and Group N key matches are as Table 5 shows.

Table 5: Each representative team key matches

Group M Key matches				Group N Key matches			
Representative Team	Key Match	Representative Team	Key Match	Representative Team	Key Match	Representative Team	Key Match
F	F VS G	B	B VS F	D	D VS K	J	J VS D
E	E VS F	G	G VS F	C	C VS I	K	K VS J
H	H VS B	A	A VS H	L	L VS J	I	I VS K

Each representative team final predicted ranking is as Table 6 shows.

Table 6: Final prediction results ranking

NO.	ranking by prediction				ranking according to match performance							
	NO.1	NO.2	NO.3	NO.4	NO.5	NO.6	NO.7	NO.8	NO.9	NO.10	NO.11	NO.12
<i>T</i>	B	D	C	F	J	E	L	G	K	A	H	I
Score	5		3		3		2		1		0	
Average comprehensive index					Sum of each match score ratios							
11.159	10.555	10.217	10.200		2.608	2.566	2.487	2.464	2.451	2.415		

CONCLUSION

This papers analyzed relations between each sport index and final performance in basketball competition, and applied grey system theory to establish basketball technical index comprehensive evaluation model, focused research on relevancy of basketball technical index in each representative team and relevancy between technical index and applying performance, got performance influence degrees sequence from 12 representative team 17 items sport indexes so as to provide guiding to each representative team technical improvement by using such sequence. Utilized index composite evaluate model predict top four teams from 12 representative teams, and got each representative team competitive level sequence with evidence of average comprehensive index and scores ratio sum.

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