Location of competitive basketball athletes based on RSR comprehensive evaluation method

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Abstract

Rank sum ratio (RSR) positions each research index to superior or inferior index, conducts rank allocation of these indices in all evaluation objects according to rank principles, sorts them, and carries out grading according to the RSR value. In this way, the superior and inferior indices can be clearly determined. For complex open sports, good sport decisions can make each member give play to their strong points to achieve good results. However, most existing research methods belong to non-quantitative research methods. Research on the location of competitive basketball athletes is rare. This study adopts RSR comprehensive analysis method to assess examination indices for 15 members in a basketball team of a college to select the members that are most suitable for five locations in basketball competitions and corresponding benches and candidates. A general method is provided to decide the location of commercial basketball athletes.

Keywords: sport decision-making RSR comprehensive evaluation method, commercial basketball athlete

1 Introduction

Rank sum ratio (RSR) was proposed by Tian Feng (a famous scholar in China and former professor in Chinese Academy of Preventive Medicine) in 1998 [1]. RSR is a statistical analysis method that integrates the advantages of classical parametric statistics and modern nonparametric statistics [2]. This method was mainly applied in medical field in the early stage. RSR comprehensive analysis method is applicable to statistics and analysis of form and measurement data [3]. The main thought is as follows: in a form including n samples and m characteristics, dimensionless statistical magnitude RSR is gained through rank conversion calculation, and evaluation objects with RSR values are sorted; grading (many comparable groups) is then conducted according to the comparable groups, or a credibility interval of RSR square root arc sine transformation values (few comparable groups) is obtained [4].

Sport decision making means the process that athletes feel information, understand information, and take actions under sport situations [5]. The major differences of sport decision making from general decision-making process are the heavy mental stress in limited time, inconsiderable available decision-making information, and uncertain results [6]. Sport decision making mainly includes cognitive decision making dominated by logical thinking and intuitive decision making dominated by intuitive thinking [7]. For complex open sport events, sport decision making has vital influences on athlete performance and final results [8]. Thus, the study of sport decision making is an important issue in sport field. Basketball sport is a confrontational sport mainly based on shooting, lay-up, and slam dunk [9]. Both teams own five players. The team able to shoot the basketball into the basketball hoop can gain the score. Thus, in basketball competitions, selection and decision of strategies and tactics are vital. In recent years, research on competitive basketball tactic system mainly includes the following two trends:

1) the differences in the technologies are compared to discuss the differences in offensive and defensive techniques of the teams;

2) the scores gained and lost are predicted to conclude the factors that influence the team gaining and losing the score to analyze the offensive and defensive strategies of the teams [10]. The former stresses "to know others," whereas the latter stresses "to know you." As a saying goes, if you know others and know yourself, you will not be imperiled in every battle [11].

Based on the perspective of "knowing yourself," the best location for basketball athletes can be gained through analyzing each index of team members according to RSR comprehensive analysis method [12]. This study introduces classical RSR comprehensive analysis method in competitive basketball decision making, conducts statistical analysis according to the given sample data of the team members to be tested, obtains corresponding conclusions, and provides methods to make decisions about the location in competitive basketball sport [13]. This study has important practical significance and certain innovative significance.

2 RSR comprehensive analysis methods

2.1 BASIC THOUGHT OF RSR

Samples with a large RSR value are generally considered as good. Therefore, the superior and inferior indices during

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ranking must be confirmed. The examination level of students is considered for example. High scores mean good performance. Score is thus the superior index. A long duration to answer questions leads to poor performance. The duration to answer questions is thus the inferior index.

Apart from simply differentiating superior and inferior indices, slightly superior indices and slightly inferior indices should be set in some complex problems. Ranking should generally be considered according to the problem itself.

2.2 GENERAL CALCULATION STEPS OF RSR

The basic steps of RSR are as follows: each research index is first positioned to superior or inferior index through survey, statistics, and professional knowledge; ranking allocation of these indices in all evaluation objects is then conducted according to ranking principle and sorted; they are finally filed according to RSR value. Figure 1 shows the specific flow chart for calculations.

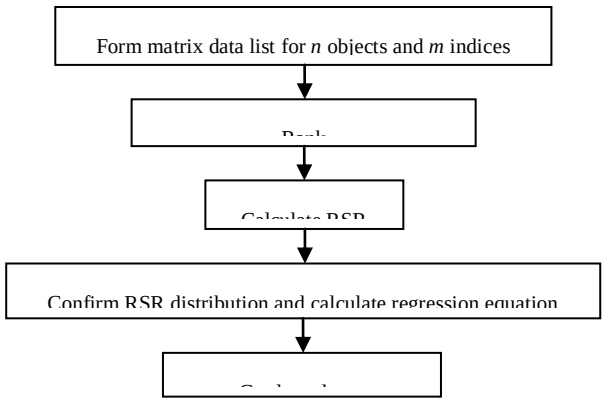

FIGURE 1 Flow chart of RSR calculation

The specific steps are as follows.

2.2.1 Formulation of data table

Formulation of data table is the calculation foundation of the whole RSR method. Follow-up calculation and grading can be effectively conducted only through selecting proper indices or characteristics and measuring them with data. n characteristics of m examples will generally be chosen. They are then ranked to $m \times n$ data table.

2.2.2 Ranking

Each index must be confirmed to superior or inferior index according to experience. The ranking principle is that superior indices are sorted in a descending order, whereas inferior indices are sorted in an ascending order. If the order is the same, the mean value is obtained. Equation (1) is the ranking calculation formula of superior indices. Equation (2) is the ranking calculation formula of slightly superior indices. Equation (3) is the ranking calculation formula of inferior indices. Equation (4) is the ranking calculation formula of slightly inferior indices. This study selects superior and inferior indices to rank for calculation convenience.

$$\text{Ranking of superiorindexes} = \frac{(\text{superiorranking} + \text{n}/2 + 0.5)}{2}, \tag{1}$$

$$\text{Ranking } \textit{ofslightly} \sup \textit{eriorindexes} = \frac{\{(\sup \textit{eriorranking} + \text{n}/2 + 0.5)/2 + \text{n}/2 + 0.5\}}{2}, \tag{2}$$

$$\textit{Rankingof} \inf \textit{eriorindexes} = \frac{(\inf \textit{eriorranking} + \text{n}/2 + 0.5)}{2}, \tag{3}$$

$$\textit{Rankingofslighly} \inf \textit{eriorindexes} = \frac{\{(\inf \textit{eriorranking} + \text{n}/2 + 0.5)/2 + \text{n}/2 + 0.5\}}{2}. \tag{4}$$

2.2.3 Calculation of RSR

RSR is a statistical magnitude with rich connotation and shows the comprehensive level of multiple indices with different measuring units. Calculation of RSR is often conducted according to row or line. The three main calculation methods are shown below.

In Formulas 5 and 6, m is the number of indices, and n is the number of samples. Equation (7) is the RSR calculation formula with weight, where w is the weight. Thus, this study adopts Equation (5) as the calculation foundation.

$$RSR = \sum_{1}^{m} \frac{R}{m \times n}. \tag{5}$$

$$RSR = \sum_{1}^{n} \frac{R}{m \times n}. \tag{6}$$

$$RSR = \sum \frac{RW}{n}. \tag{7}$$

2.2.4 Confirmation of RSR distribution and calculation of regression equation

One row is a group. Ranking R of each group of RSR is confirmed. The probability unit is $profit = \frac{R}{n} \times 100\%$. The regression equation of RSR is calculated. Equation (8) is the regression equation. Equations (9)-(11) are the linear fittings conducted according to least square method. Equation (9) is the augmented matrix of profit, and Equation (10) is the fitting equation of least square method.

$$\hat{RSR} = w_0 + w_1 \times profit. \tag{8}$$

$$A^T = \begin{pmatrix} 1 & 1 & \ldots 1 \\ profit_1 & profit_2 & \ldots profit_n \end{pmatrix}. \quad (9)$$

$$b^T = \left(R\hat{S}R_1 \; R\hat{S}R_2 \quad \ldots R\hat{S}R_n \right). \quad (10)$$

$$A^T A \begin{pmatrix} w_0 \\ w_1 \end{pmatrix} = A^T b. \quad (11)$$

2.2.5 Grading and sorting

Each sample is evaluated and sorted according to optimal principle and calculated in accordance with 95% CI. The computational formulas are Equations (12) and (13).

$$y = \sin^{-1} \sqrt{RSR}. \quad (12)$$

$$Filingvalue = y \pm \sqrt{\frac{820.7}{m \times n}}. \quad (13)$$

2.2 STEPS FOR APPLICATION OF RSR IN COMPETITIVE BASKETBALL SPORT

The detailed steps for application of RSR in competitive basketball sport are as follows:

1) a data structure statistic table similar to Table 1 is established;

2) the indices are positioned to superior or inferior indices according to experience and basketball knowledge;

3) they are ranked according to line, and numerical values of the samples of each index are gained;

4) RSR value is calculated, i.e., $RSR = \sum \frac{R}{m \times n}$;

5) RSR distribution is confirmed, and site selection, analysis, and decision making are conducted according to optimal principle.

TABLE 1 General RSR statistic table

	L1	L2	…	RSR
Player 1				
Player 2				
…				
Player 15				

3 Five locations in competitive basketball sport and analysis of relevant examination indices

Basketball sport location was only divided according to the locations of rear guard, forward, and center during offensive and defensive in the past. In fact, global basketball development trend gradually divides the five locations according to the distinction of "technical functions" of basketball athletes on the court. Each location is introduced one by one as follows. Superior and inferior indices are also selected.

3.1 CENTER

The center should own a tall figure, explosive power, balance, and the ability to resist collision. The center plays important work in scoring in the forbidden zone, passing, grasping the rebound, and defense.

First, the center should own strong ability to seize the rebound.

Second, the forbidden zone is a place of strategic importance. One team should not let the opponents to enter the forbidden zone easily. Thus, the ability of offensive resistance and block shot is essential.

Finally, during offensive, the center often has the opportunity to catch the ball in the forbidden zone near free-throw line. The center should therefore have favorable ball-leading ability and deliver the ball at the proper corner.

To sum up, eight important indices should be considered when selecting the center, such as inside shot, close shot, low-post shot, free-throw, block shot, backboard, height, and strength.

3.2 POINT GUARD

The point guard primarily protects ball handling over the half court and drives the pace of the entire team to attack and defend. He should be capable of rapid traverse, ball handing, assisting offense, having a high range of three point line and commanding the pace for offense and defense.

Therefore, the eight most important considerations for selecting the point guard are: three-point shot, ball-controlling ability, passing ability, ball handling, shooting, stealing, physical agility, and speed.

3.3 SHOTTING GUARD

The shooting guard is the second ball controller and the one who initiates offense. The shooting guard is responsible mainly for scoring. He should have good three-point shot rate and stability.

Moreover, the shooting guard must be fast enough to seek the gap for a three-point shot. He sometimes has to seek gaps or opportunities for conducting singles because his shooting distance is usually quite remote. Thus, his shooting rate will not be high.

Therefore, when selecting the shooting guard, the factors mainly considered are: three-point shot, speed, perimeter shot, lay-up, close shot, passing, and physical agility.

3.4 SMALL FORWARD

First, the small forward should have a good bodily form and speed. Second, he should be capable of controlling and passing the ball well. Third, the small forward should handle the ball to enter, or enter empty-handed and catch the ball to score a lay-up. Fourth, he should be capable of long shooting. Fifth, if necessary, he must know how to conduct singles in the forbidden zone and have certain destruction ability.

In fact, the fundamental requirement for the small forward is scoring through long shot. His shot rate is not necessarily high.

In selecting the small forward, the following should be considered: perimeter shot, lay-up, slam dunk, free throw, block shot, backboard, height, and strength.

3.5 POWER FORWARD

The power forward should be tall and capable of grabbing the rebound. Meanwhile, he should be flexible, well-coordinated, and assist offense, defense, and covering. He also should be capable of perimeter shots and low-post singles.

Generally speaking, the indices to be considered in selecting the power forward are inside shot, close shot, perimeter shot, defensive, block shot, backboard, height, and strength.

4 Data statistics and analysis

In summary, the present paper selects 35 members of a college basketball team as the samples and the center of a competitive basketball game as basis for data, with each index scored by the coach (0-100 scores). The scores represent the mean performance of each member in basketball games. Table 2 is the table of center selection decision-making.

It can be seen from Table 2 that, in terms of the inside shot, No.35 performs most outstandingly; members No.17, No.22, No.13, No.25, and No. 32 perform relatively well. In the aspect of close shot, No.35 still performs best; members No. 10, No.17, No.9, and No.22 perform relatively well. In the perimeter shot, No.35 member still performs best, followed by members No. 15, No.13 and, No. 25. No.35 performs best in free throws, followed by members No.13, No.16, No.22 and No.33. For block shots, No.33 performs most outstandingly this time, and No.13, No.24 and No.35 perform favorably. In terms of grabbing the rebound, No.35 member performs best again; No.13, No.17, and No.22 are relatively excellent. No.17 is the tallest player, followed by No.13, No.25, No.32 and No.35 members, whereas the strongest member is No.35 followed by members No.33, No.22, No.24, and No.25 members.

TABLE 2 Table of center selection decision-making

Member No.	Inside shot	R1	Close shot	R2	Perimeter shot	R3	Free throw	R4	Block shot	R5	Backboard	R6	Height	R7	Strength	R8	RSR
1	59	19.0	52	15.0	68	12.5	65	13.5	48	25.5	44	21.5	66	15.5	62	16.5	0.50
2	54	21.0	45	20.0	70	11.0	73	7.5	66	13.0	44	21.5	49	24.5	55	18.5	0.49
3	32	28.0	34	25.0	38	30.5	50	26.0	44	28.5	25	28.0	35	31.0	15	34.0	1.14
4	61	15.5	54	12.5	71	10.0	76	6.0	56	22.0	59	8.0	58	19.0	62	16.5	0.39
5	11	34.0	13	35.0	9	35.0	16	35.0	16	35.0	0	35.0	30	33.0	13	35.0	0.99
6	28	30.0	32	26.0	48	26.0	46	27.0	43	30.0	29	26.0	44	28.0	45	24.5	0.78
7	52	23.0	35	24.0	54	20.5	36	29.5	58	19.5	33	25.0	46	26.0	53	20.0	0.67
8	23	33.0	22	28.0	38	30.5	36	29.5	20	34.0	19	30.0	40	29.0	16	33.0	0.88
9	67	12.0	73	4.0	62	17.0	66	12.0	61	16.0	45	19.5	67	13.5	65	13.5	0.38
10	65	13.0	79	2.0	75	5.5	64	16.0	71	8.5	56	12.5	71	6.5	64	15.0	0.28
11	32	28.0	26	27.0	52	23.0	37	28.0	45	27.0	18	31.0	13	35.0	30	31.0	0.82
12	48	24	40	22.0	39	29.0	52	24.5	48	25.5	49	16.5	45	27.0	41	27.0	0.70
13	82	5.0	50	16.0	78	3.0	77	4.0	77	2.5	72	4.0	79	2.0	76	11.5	0.17
14	79	8.5	43	21.0	66	14.5	64	16.0	68	10.5	45	19.5	68	11.5	66	11.5	0.40
15	42	26.0	21	29.5	49	25.0	30	32.0	44	28.5	9	33.0	32	32.0	43	26.0	0.83
16	53	22.0	65	6.0	75	5.5	78	2.0	64	14.0	49	16.5	68	11.5	52	21.0	0.35
17	86	2.0	72	5.0	75	5.5	72	9.0	59	18.0	70	5.0	83	1.0	71	7.5	0.19
18	59	19.0	39	23.0	45	28.0	53	23.0	49	24.0	41	23.0	53	23.0	45	24.5	0.67
19	32	28.0	16	31.0	32	32.0	33	31.0	25	33.0	27	27.0	36	30.0	32	30.0	0.86
20	26	31.0	46	19.0	56	19.0	73	7.5	71	8.5	37	24.0	67	13.5	65	13.5	0.49
21	72	11.0	63	8.0	52	23.0	65	13.5	63	15.0	57	11.0	63	17.0	55	18.5	0.42
22	83	3.0	77	3.0	72	8.5	77	4.0	73	5.5	79	2.5	66	15.5	86	2.0	0.16
23	25	32.0	12	32.0	22	33.0	20	34.0	38	31.0	21	29.0	49	24.5	36	28.0	0.87
24	76	10.0	63	8.0	63	16.0	70	10.0	74	4.0	79	2.5	69	10.0	79	4.0	0.23
25	82	5.0	62	10.0	80	2.0	62	19.0	73	5.5	62	7.0	72	5.0	78	5.0	0.21
26	61	15.5	54	12.5	72	8.5	64	16.0	72	7.0	68	6.0	54	21.0	46	23.0	0.39
27	64	14.0	48	18.0	60	18.0	62	19.0	53	23.0	58	9.5	71	6.5	51	22.0	0.46
28	79	19.0	53	14.0	68	12.5	62	19.0	60	17.0	52	14.5	54	21.0	71	7.5	0.44
29	80	7.0	21	29.5	46	27.0	61	21.5	58	19.5	56	12.5	70	8.5	79	9.0	0.48
30	60	17.0	55	11.0	66	14.5	61	21.5	67	12.0	48	18.0	70	8.5	67	10.0	0.40
31	5	35.0	10	33.0	20	34.0	23	33.0	37	32.0	2	34.0	17	34.0	17	32.0	0.95
32	82	5.0	63	8.0	54	20.5	67	11.0	68	10.5	58	9.5	75	3.0	77	6.0	0.26
33	79	8.5	49	17.0	75	5.5	77	4.0	78	1.0	52	14.5	54	21.0	80	3.0	0.27
34	45	25.0	5	34.0	52	23.0	52	24.5	57	21.0	11	32.0	62	18.0	35	29.0	0.74
35	87	1.0	80	1.0	93	1.0	85	1.0	77	2.5	82	1.0	73	4.0	96	1.0	0.04

Consequently, the primary conclusion is that member No.35 gains good scores in each index and may be the best candidate for the center. No.17 and No. 24 members are also excellent and can be considered as the center bench.

To make decisions more accurately, the 35 members are graded using the data in Table 2.

Table 3 shows the RSR value distribution of Table 2.

TABLE 3 Table of RSR value distribution

RSR	$\frac{\bar{R}}{n}\times 100\%$	profit
0.04	2.9	3.1043
0.16	5.7	3.4195
0.17	8.6	3.6342
0.19	11.4	3.7945
0.21	14.3	3.9331
0.23	17.1	4.0498
0.26	20.0	4.1584
0.27	22.9	4.2579
0.28	25.7	4.3474
0.35	28.6	4.4349
0.38	31.4	4.5155
0.39	37.1	4.6708
0.40	40.0	4.7467
0.42	42.9	4.8211
0.44	45.7	4.8920
0.46	48.6	4.9649
0.48	51.4	5.0351
0.49	54.3	5.1080
0.49	57.1	5.1789
0.50	60.0	5.2533
0.67	62.9	5.3292
0.70	68.6	5.4845
0.74	71.4	5.5651
0.78	74.3	5.6526
0.82	77.1	5.7421
0.83	80.0	5.8416
0.83	82.9	5.9502
0.86	85.7	6.0669
0.87	88.6	6.2055
0.88	91.4	6.3658
0.95	94.3	6.5805
0.99	97.1	6.8957

For the data in Table 4 is obtained using least squares fitting, and the linear regression equation of RSR is: $\hat{RSR} = 0.256\,profit - 0.787$.

TABLE 4 The four categories for 35 members

	Most suitable (RSR<0.109)	Bench (0.109<RSR<0.493)	Candidate 0.493<RSR<0.877	Inappropriate RSR>0.877
Member No.	35	2, 4, 9, 10, 13, 14, 16, 17, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 32, 33	1, 6, 7, 11, 12, 15, 18, 19, 23, 34	3, 5, 8, 31

Among 35 members, No. 35 member the most suitable center. The members listed in the second line of Table 4 are suitable for being the center bench. When members are lacking, members can be selected from the third line. Members in the last line are not suitable for being the center.

5 Conclusions

Traditionally, RSR is mainly used in the medical field. However, as a visual quantitative classification statistics method, RSR can be introduced in decision-making in sports. The present paper introduces classical RSR comprehensive statistics method in basketball decision-making. 35 members in a basketball team were chosen as the research samples. They were scored according to different indices and the RSR value of their scores were calculated and used as bases for selecting the optimal center player and benches.

The feasibility of using RSR comprehensive analysis in decision-making in basketball is proven through data. The ability of each member in different aspects is visualized through data, which is beneficial to targeted training and cultivation. In conclusion, this paper determines the athletes' location according to RSR comprehensive analysis, which makes the members harness their strong points in practical competitions and gain the best state and the optimal result. Thus, RSR has certain practical significance.

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