An Evaluation Model and Its Application of Justice of NBA Match Schedule

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Abstract: For some large-scale and multi-competition games such as NBA, the density of match schedule and the distance of journey affect the physical strength of athletes, and thus affect the achievements and the justice of the matches. An advantages and disadvantages function is given in this paper based on the factors mentioned above. And the justice of the match schedule of 2008-2009 is considered high according to the evaluation model.

Keywords: Density of match schedule; Distance of journey; Away match; Physical strength; Advantages and disadvantages function; Influence factors; NBA

1. Introduction

Nowadays, various sports games are held frequently, while the competition results depend not only on the athletes' skills and abilities but also on some other factors such as the match schedule, which can not be neglected and may even change the final results. Of them, NBA is one of those mostly affected by the match schedule.

NBA is one of the most favorite sports games of fans, and even more preferred by Chinese fans after Yao Ming joined it. There are 30 teams in NBA. In competition season of 2008-2009, the regular season lasted from Oct. 29th,2008(Beijing Time) to April 16th, 2009, and of 1230 matches, 82 for each team. The match arrangements has influence on each team's performance to some extent. Complaints are frequently heard from players, coaches, and media about too dense arrangement, long-distance journey, too many successive off games, and so on. So a pretty relatively fair match schedule seems rather important for NBA teams[1].

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Factors affecting the justice of a match[2][3] are :

1).Density[4]. If 82 matches for each team within 5 months are scheduled too densely, the players can't have enough rest and get restored.

2).Journey. Among the 30 teams, 15 belong to East and West League for each. The West is divided into 3 Districts: southwest, northwest and Pacific, while the east into southeast, central and the Atlantic, 5 teams for each. Games must be arranged in every team's home ground. If the sites between two successive events are too far away(from Boston to Los Angeles, for example), the tiring journey will be across the whole nation and thus affects the physical strenths of the atheletes.

3).Times against top teams. Too many times fighting against top teams auch as Suns, Spurs, Lakers, may affect the confidence to win.

4). Times of successive aways[4]. Familiarity of the court and support from fans on home ground supply players with confidence and psychology to perform well. Although equal times of home and away, successive away games may psychologically affect a team's normal performance.

The preparation of match schedule is rather complicated, and it is impossible to be completely in justice. Analysis of 30 teams from three aspects of density, journey, and successive away games in season 2008-2009 is shown in Table 1[5].

Table 1 Analysis of match schedule of 2008-2009

TEAMS	Average interval of two adjacent matches	Number of successive away matches	Index of journey	TEAMS	Average interval of two adjacent matches	Number of successive away matches	Index of journey
ATL	49.79	33	84	NO	49.75	29	93
BOS	50.07	31	90	NY	49.78	30	90
CHA	49.49	27	93	ORL	49.79	29	98
CHI	50.07	27	82	PHI	49.79	26	96
CLE	50.07	25	100	PHO	49.81	30	72
DAL	49.48	31	86	POR	50.07	33	72
DEN	49.80	30	82	SAC	49.78	33	68
DET	49.78	25	100	SA	49.78	28	92
GS	49.78	30	67	SEA	49.81	32	98
IND	49.78	23	109	TOR	49.79	29	81
LAC	49.78	29	72	UTAH	49.50	29	78
MEM	49.77	29	103	WAS	49.79	27	94
MIA	49.78	29	84	HOU	49.77	30	87
MIN	49.78	31	98	LAL	49.78	33	70
NJ	49.79	23	103	MIL	50.07	31	94

And the index of journey distance is determined after two adjacent matches' fields transfer and the numerical distance.

3. Construction of analysis and evaluation model of NBA match schedule

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Factors mentioned above have effect on athletes, such as physical strength and confidence, and even on the match result. What is affected mainly by the factors is physical strength of athletes, that is to say, the density of match schedule and the journey distance are the two key factors among all the factors. The shorter of interval between two adjacent matches and the longer of journey distance, the more disadvantageous for the team, hence the advantages is directly proportional to the interval, and inversely proportional to the distance between two adjacent matches. Accordingly an advantages and disadvantages function is given to describe the effect of physical strength on athletes:

$$Y = \sum_{i=1}^{81} \frac{t_{i+1} - t_i}{S_i}$$

Of which, t_i :means the start time of the i -th match;

S_i: coefficiency of journey, means the degree of effect of journey between the $i+1$ and the i match on athletes.

Considering the effect of the journey distance on match record properly and accurately,stressing the main contradiction of the matter,the index of journey distance is simplified as: when the two adjacent matches are held in the same city,deemed the match place doesn't change,so the impact can be ignored; When the two adjacent matches are held in different districts,the impact on match record is obvious. Combined the elements mentioned above,through expert survey[6] and reapeated test method, with the online complaints about the factors,the index of effect on journey distance S_i is defined as:

$$S_i = \begin{cases} 1, adjacent\ matchs\ held\ in\ same\ the\ city \\ 1.1, adjacent\ matchs\ held\ in\ different\ cities \\ 1.2, adjacent\ matchs\ held\ in\ different\ districts \\ 1.3, adjacent\ matchs\ held\ in\ different\ parts \end{cases}$$

Judged by the advantages and disadvantages function values: the higher of Y ,the more advantageous for teams;the lower of Y ,the less advantageous for teams.We can judge the justice of the match schedule in accordance with the range rate of the advantages and disadvantages function values and the difference rate of that between two adjacent teams[7].The range rate is:

$\frac{\max\{y_j\} - \min\{y_j\}}{\max\{y_j\}}$, y_j means that the advantages and disadvantages function value of the j -th teams sorted by advantageous.

Sequenced by the advantanges, the mean and its range rate of advantages and disadvantages function values between two adjacent teams is:

$$mean(y_{j+1} - y_j) = \frac{1}{29}\sum_{j=1}^{29}(y_{j+1} - y_j), (j = 1, 2, \ldots, 29)$$

$$\frac{mean(y_{j+1} - y_j)}{mean(y_i)} = \frac{\frac{1}{29}\sum_{j=1}^{29}(y_{j+1} - y_j)}{\frac{1}{30}\sum_{i=1}^{30}(y_i)}, (j = 1, 2, \ldots, 29; i = 1, 2, \ldots, 30)$$

The standard deviation of advantages and disadvantages function values between two adjacent teams is:

$$std(y_j) = \{\frac{1}{29}\sum_{j=1}^{29}[(y_{j+1} - y_j) - mean(y_{j+1} - y_j)]^2\}^{1/2} \qquad (j = 1, 2, \ldots, 29)$$

Taking statistical meaning of mean and standard deviation[8],the scale of NBA matches, and its characteristics for reference, the justice of evaluation is divided into four levels based on the range rate of advantages and disadvantages function values and range rate of advantages and disadvantages function values, the levels are as follows[9]:

Definition 1 : If the range rate of advantages and disadvantages function values below 5 percent and range rate of advantages and disadvantages function values between two adjacent teams below 1 percent,then the level of justice is high;

Definition 2 : If the range rate of advantages and disadvantages function values below 8 percent and range rate of advantages and disadvantages function values between two adjacent teams below 2 percent,then the level of justice is media;

Definition 3 : If the range rate of advantages and disadvantages function values below 12 percent and range rate of advantages and disadvantages function values between two adjacent teams below 3 percent,then the level of justice is lower;

Definition 4 : If the range rate of advantages and disadvantages function values above 12 percent and range rate of advantages and disadvantages function values between two adjacent teams above 3 percent,then the level of justice is low;

4. Application and analysis

4.1 Application of the model

Taking team of Houston Rockets as example, analysis based on the advantages and disadvantages function in 2008-2009 match season is as:

The time sequence of interval of two adjacent matchs is:

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$t_i(XS3) = \{T_{i+1}(\text{Houston Rockets}) - T_i(\text{Houston Rockets})\}_{1\times 81}$
= {23.5 48.5 73 50 24 47 73 46 24 47.5 48 47 24 48.5 49 72 23.5 72.5
48 71.5 24.5 74 24 70 72 23.5 47.5 23.5 73 24.5 48 46.5 48 24 72 24.5
48.5 24.5 72 96 41.5 54.5 46.5 47.5 25 49 72 72 23.5 72.5 47.5 48.5
144 72 44.5 51.5 47.5 48.5 22.5 49.5 24.5 47.5 45.5 26 47.5 46.5 25.5
47.5 49.5 47 40.5 57.5 94 97.5 48.5 44.5 49.5 49.5 24.5 70 47.5}

The journey distance of two adjacent matchs of Houston Rockets is as follows:

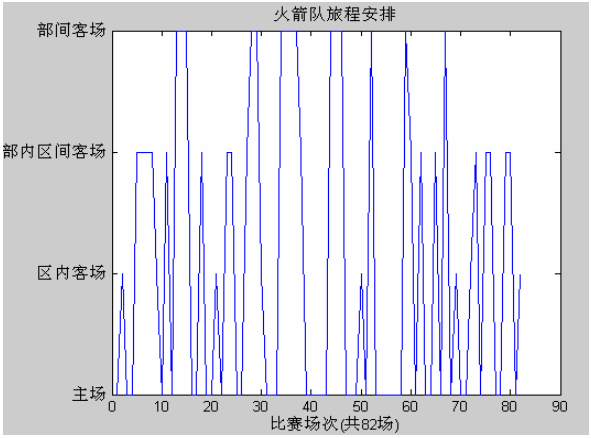

Figure 1 Jurney of Houston Rockets

The advantages and disadvantages function values of Houston Rockets team is:

$$Y(\text{Houston Rockets}) = \sum_{i=1}^{81} \frac{t_i(\text{Houston Rockets})}{S_i(\text{Houston Rockets})} = 3684.69$$

Advantages and disadvantages function values calculated according to the same algorithm,and sorted descendingly as below:

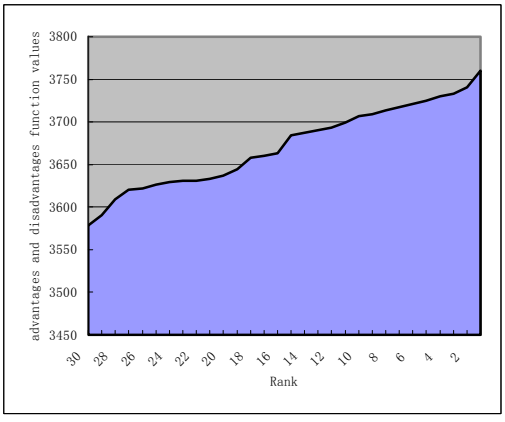

Figure 2 The sort of function values of thirty teams

4.2 Analysis of results

Range rate of advantages and disadvantages function values:

$$\frac{\max\{y_j\} - \min\{y_j\}}{\max\{y_j\}} = \frac{92.21}{3670.47} = 2.51\%$$

The mean and difference rate of advantages and disadvantages function values between the two adjacent teams:

$$mean(y_{j+1} - y_j) = \frac{1}{29}\sum_{j=1}^{29}(y_{j+1} - y_j) = 6.2831$$

$$\frac{mean(y_{j+1} - y_j)}{mean(y_i)} = \frac{\frac{1}{29}\sum_{j=1}^{29}(y_{j+1} - y_j)}{\frac{1}{30}\sum_{i=1}^{30}(y_i)} = \frac{6.2831}{3671.6} = 0.171\%$$

The standard deviation of advantages and disadvantages function values between the two adjacent teams:

$$std(y_{j+1} - y_j) = \{\frac{1}{29}\sum_{j=1}^{29}[(y_{j+1} - y_j) - mean(y_{j+1} - y_j)]^2\}^{1/2} = 5.73$$

Through the analysis above, we can see that the mean and the standard deviation of the range rate of advantages and disadvantages function values and the average range between the two adjacent teams,and we can conclude that the justice of the schedule is high,the range rate is below 5 percent and the mean of range rate is far below 1 percent.The schedule is most beneficial for Portland Trail Blazers team,the advantages and disadvantages function value of the team is 3760.47;and is lest beneficial for Indiana Pacers team,the advantages and disadvantages function value of the team is 3578.26.

5. Evaluation and improvement of the model

By the model constructed in this paper,the justice of NBA schedule is numerically described, which can be reference to draw up a fair schedule for teams.The model constructed in this paper bases on the fitness of the two important factors,and as to how to described the effect of confidence of athletes,it is still a work to be studied further.

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