Game analysis based on double moving score probability in table tennis

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Abstract: double moving score probability (DMSP) is a way to describe the changing situations of competition. 88 single matches were randomly selected in this study and double moving score probability was calculated by the unit based on scoring and losing points. The results showed that there were a significant difference in the occurrence rate and mean value of DMSP between the winning group and losing group, and the effectiveness value of DMSP is highly correlated with match winning probability.

Keywords: game analysis, double moving score probability, competition winning probability.

1. INTRODUCTION

Double moving score probability (DMSP) is a way to describe the changing situations of competition. This study aims to find out some basic characteristics of table tennis matches through a comparison of the differences between the winner and the loser.

2. METHOD

2.1 Study object

Eighty eight single matches were randomly selected from the 2008-2012 world top 20 male players (based on world ranking in January 2013). Among them, 44 matches were for the winning group, and the other 44 matches were for the losing group.

2.2 Setting up an analysis model for table tennis competition state based on the double moving score probability

Moving average method is a time series forecasting method. If there is no apparent tendency moving in time series, the moving average method can accurately reflect actual situation.

Double moving score probability (DMSP) is the same as second moving average method. It is a way to average the first moving average value, and then establish a prediction model, according to the lag relationship among the actual value, first moving average value, and second moving average value.

In conclusion, the second moving average method is an important time series forecasting method. As an advanced form of moving average method, it can overcome some defects of first moving average.

The calculation formula of moving average is as follows [1-2]:

Firstly, take N (i.e. step) as the number of terms for time series moving average. Let time series be

$$y_0, y_1, \cdots, y_t, \cdots, y_8;$$

The calculation formula of first moving average is as follows:

$$M_t^{(1)} = \frac{y_t + y_{t-1} + \cdots + y_{t-N+1}}{N} \qquad (t \geq N)$$

($M_t^{(1)}$ - first moving average value of t phase)

The second moving average method is to take another moving average based on the first moving average. The calculation formula is:

$$M_t^{(2)} = \frac{M_t^{(1)} + M_{t-1}^{(1)} + \cdots + M_{t-N+1}^{(1)}}{N}$$

($M_t^{(2)}$ - second moving average value of t phase)

Double moving score probability (DMSP) was calculated by the unit (1 or 0) based on scoring (1) and losing (0) points, and the average of every 4 scores is calculated in turn.

If we assume that the ideal state of the players in the competition to get 1 point and lose 1 point is alternately generated, then the observation units of the order is 1,0,1,0,1,0 ... And if the players scores 3 points and above (1,0,1,0,1,1,1,1 ...), derived by calculating the probability of a double moving score DMSP ≥ 0.625, in this case, the player is in a good state of the match, defined as the advantage state; when player in the game loses 3 points and above (1,0,1,0,0,0,0 ...), the DMSP is ≤ 0.375, and the player is in a poor game momentum, defined as the disadvantage state; when the player and his opponent are in a state of confrontation, i.e. 0.625 > DMSP > 0.375, it is defined as the strained state.

3. RESULTS

Based on the DMSP model, the player's state of the competition is calculated and the occurrence rate of the advantage state, strained state, and disadvantage state is illustrated in Table 1.

Table 1 Comparison of occurrence rate of different states between winner and loser

State	Groups	occurrence rate (mean)	t	p
Advantage state	Winning	41.86%	9.31	< 0.01
	Losing	25.01%		
Strained state	Winning	31.38%	-0.095	> 0.05
	Losing	31.52%		
Disadvantage state	Winning	26.76%	-9.62	< 0.01
	Losing	43.48%		

In the match, the occurrence rates for the winning and losing groups were very close in strained state. In disadvantage state it turned out to be in a lower percentage in the winning group than that in the losing group.

Table 2 shows the mean value of DMSP between winners and losers in the different states.

Table 2 Comparison of mean value of DMSP between winner and loser

State	Groups	Mean	t	p
Advantage state	Winning	0.74	4.65	< 0.01
	Losing	0.71		
Strained state	Winning	0.50	2.80	< 0.01
	Losing	0.49		
Disadvantage state	Winning	0.28	3.22	< 0.01
	Losing	0.26		

The effectiveness value of each group has been calculated as shown in Table 3, and the formula used [3] is: Effectiveness Value (EV) of DMSP = Frequency Rate (FR) × Mean Value of DMSP.

Table 3 Comparison of effectiveness value of DMSP between winner and loser

State	Groups	EV of DMSP	t	p
Advantage state	Winning	0.31	9.42	< 0.01
	Losing	0.18		
Strained state	Winning	0.16	0.22	> 0.05
	Losing	0.16		
Disadvantage state	Winning	0.08	-8.25	< 0.01
	Losing	0.11		

To further study the relevance between match winning probability and DMSP, the partial correlations between the match winning probability and DMSP in three states were calculated.

Through a calculation, the relevance between the match winning probability and occurrence rate in three states is shown in Table 4.

Table 4 Correlation coefficient between match winning probability and occurrence rate

State	r	p
Advantage state	-0.056	> 0.05
Strained state	-0.057	> 0.05
Disadvantage state	-0.057	> 0.05

As it can be seen from table 4, the correlation coefficients between the occurrence rate of advantage state, disadvantage state, strained state and match winning probability is $r = -0.056$, $r = -0.057$, and $r = -0.057$, revealing that it is almost irrelevant in between the occurrence of the three states and the match winning probability, and there is no significant difference ($P > 0.05$).

As it can be seen from the data in the table 5, it is relevant between match winning probability and mean value of DMSP.

Table 5 Correlation coefficient between match winning probability and mean value of DMSP

State	r	p
Advantage state	0.64	< 0.01
Strained state	0.42	< 0.01
Disadvantage state	0.46	< 0.01

The coefficient between the match winning probability and the mean value of advantage state is $r = 0.64$ ($P < 0.01$), the coefficient between the match winning probability and the mean value of strained state is $r = 0.42$ ($P < 0.01$), and the coefficient between the match winning probability and the disadvantage state is $r = 0.46$ ($P < 0.01$). They show the match winning probability has a moderate correlation with the three states.

The relevance of match winning probability and double moving average score probability is revealed in Table 6.

Table 6 Correlation coefficient between the match winning probability and the EV of DMSP

State	r	p
Advantage state	0.98	< 0.01
Strained state	0.94	< 0.01
Disadvantage state	0.81	< 0.01

The three coefficients being all above 0.7, they indicate that the match winning probability has a significantly high correlation with the effectiveness

value of DMSP.

4. CONCLUSIONS

4.1 There was a significant difference in the occurrence rate of the advantage state and disadvantage state in the winning group and losing group, but there is no significant difference in the strained state.

4.2 Both in the winning group and the losing group, there is a very significant difference in the mean value of DMSP in the advantage state, disadvantage state, and the strained state.

4.3 Both in the winning group and the losing group, there is a very significant difference in the effectiveness value in the advantage state and the disadvantage state, but no significant difference in the strained state.

4.4 Further analysis revealed that there was little correlation between match winning probability and occurrence rate of player's advantage state, strained state, and disadvantage state. But there was a moderate correlation with the mean value of DMSP, and a high correlation with the effectiveness value of DMSP of the three states.

4.5 The game analysis based on double moving score probability could demonstrate the situational characteristics of the winner and loser, and reveal that the player's effectiveness value of DMSP in advantage state is playing an essential role in table tennis match.

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