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The fuzzy comprehensive evaluation of tennis players performances

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ABSTRACT

There are many uncertainties of the tennis players' performances. In order to better evaluation to the players, in this passage we use the comprehensive assessment of fuzzy mathematics to analyze the tennis player's performances, which mainly includes the game technical, competition consciousness, physical quality and psychological quality in the field. We come to the evaluation matrix by means of the model and then we get the range of the changing scores of the tennis play. Although the results are not so certain, we can still get the exact variation range and though all the factors we can get the sections of the changing scores. Thus we can choose the tennis player and begin our analysis.

KEYWORDS

Tennis player; Performance; Fuzzy evaluation; Mathematical model.

INTRODUCTION

Tennis is a turn-based competition. In 1885, tennis was first introduced into China. Until 2003, Chinese tennis was on track and thrived, especially women's tennis received a lot of wonderful scores. For China, there is a lot of room for improvement. Every country's scholar has studied tennis. Forsyth and Schlenkey choose 122 tennis players in a random way and investigate. Later they say that the loser spare less effort than the winner and other factors of different aspects, especially women always think their failures are due to themselves, not due to the luck. Qiu Yijun analyzes the psychological factors of the tennis and comes to the conclusion that the psychological factors in the tennis competition are the major point of getting success. Because of the less of reification and explicitation and less of the research based on the complicated psychological factors, Wang Fang put forward the feature of the specific technique of tennis and the evaluation system. He gets his weight based on the experts and some experiences. It's very objective. Wang Ni makes the evaluation model of the tennis specific performance based on the neural networks, and she uses the method of multiple linear regression to forecast the tennis score. Besides she shows the exact program to promote the quality levels of the tennis players. Yin Hang shows the research and analysis of physical fitness, body physique towards different ranks of the tennis players. Mark and others choose 59 as the target and the results show that the players with different scores don't have apparent difference, but other successful people think it is because of the stability and controllability. In this passage we use the comprehensive assessment of fuzzy mathematics to analyze the tennis players' performances and we mainly consider the game technical of the player in the field which includes the game technical, competition consciousness, physical quality and psychological quality. We hope that this can be the reference for the tennis player, coach and researchers of tennis.

THE ESTABLISHMENT OF THE MODEL

Based on the fuzzy comprehensive evaluation, the steps are as follows:

(1) establish factor gather U

(2) establish evaluation set V(evaluation set) $R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$

Establish weight set, $A = (a_1, a_2, \cdots, a_n)$,meet the requirements:

$$\sum_{i=1}^{n} a_i = 1 \quad a_i \geq 0$$

$$\sum_{i=1}^{n} r_{ij} \quad j = 1, 2, 3, \cdots, m$$

$$B = A \cdot R$$

$$= \left(a_1, a_2, a_3, \cdots, a_n\right) \cdot \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

$$= \left(b_1, b_2, b_3, \cdots, b_n\right)$$

The fuzzy combination of V is evaluation set B. To sum up, the changing model is actually:

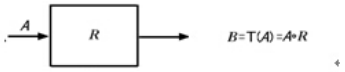

Figure 1 : The changing model

As the Figure 1 shows, after getting the changing model of the fuzzy comprehensive assessment, we can set up the transitional function of all kinds of corresponding factor assessments in different levels. The subordinate function of factor u1, u2,u3, u4, and u5 can shown as follow:

$$u_{v1}(u_1)=\begin{cases}0.5(1+\dfrac{u_i-k_1}{u_i-k_2}), & u_i \ge k_1\\ 0.5(1-\dfrac{k_1-u_i}{k_1-k_2}), & k_2 \le u_i < k_1\\ 0 \quad , & u_i < k_2\end{cases}$$

$$u_{v2}(u_1)=\begin{cases}0.5(1-\dfrac{u_i-k_1}{u_i-k_2}), & u_i \ge k_1\\ 0.5(1+\dfrac{k_1-u_i}{k_1-k_2}), & k_2 \le u_i < k_1\\ 0.5(1-\dfrac{u_i-k_3}{k_2-k_3}), & k_3 \le u_i < k_2\\ 0.5(1-\dfrac{k_3-u_i}{k_2-u_i}), & u_i < k_3\end{cases}$$

$$u_{v1}(u_1)=\begin{cases}0, & u_i \ge k_2\\ 0.5(1-\dfrac{k_1-u_i}{k_2-k_3}), & k_3 \le u_i < k_2\\ 0.5(1+\dfrac{k_3-u_i}{k_2-u_i}), & u_i < k_3\end{cases}$$

According to the distribution of the court, the text takes competition spirit into consideration and draw a conclusion that competition spirit is needed to control the game to a player.

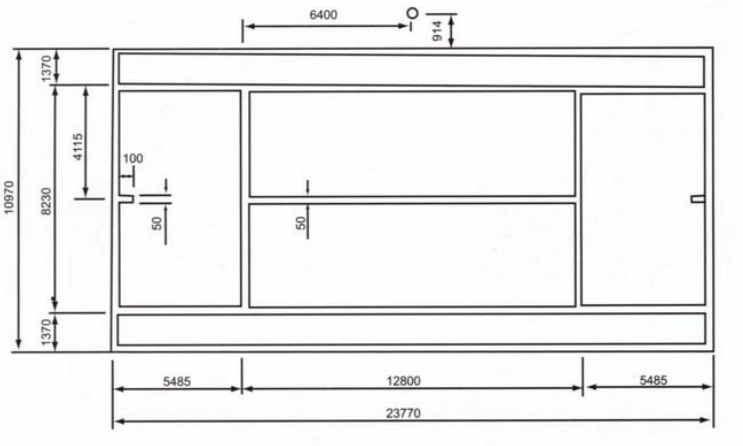

Figure 2 : Distribution of the court

To set up the factor set U and U=(U1 U2 U3 U4). U1 is the technique. U2 is the competition spirit. U3 is the physical quality and U4 is the mental quality. Then we can make TABLE 1.

TABLE 1: The evaluation system of tennis players

Technique U_1 0.35	**Competition spirit U_2 0.3**	**Physical quality U_3 0.2**	**Mental quality U_4 0.15**
Hitting the ball u_{11}	Tactics u_{21}	Stamina u_{31}	Concentration u_{41}
Receiving u_{12}	Discretion u_{22}	Speed u_{32}	Confidence u_{42}
Serve u_{13}	Response u_{23}	Physical strength u_{33}	Personal quality u_{43}
Volley u_{14}	Competition experience u_{24}	Sensitivity u_{34}	
Footwork u_{15}			

We can gain the evaluation set.

$$U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}\}$$

$$U_2 = \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}\}$$

$$U_3 = \{u_{31}, u_{32}, u_{33}\}$$

$$U_4 = \{u_{41}, u_{42}, u_{43}, u_{44}\}$$

By collecting statistics and analyzing, we can sort the four factors by the degree of importance, as shown in TABLE 2.

TABLE 2 : The order of the four factors by the degree of importance

Classification	**Order1**	**Order2**	**Order3**	**Order4**
Competition spirit U_1	23	7	4	0
Technique U_2	7	18	8	0
Mental quality U_3	0	9	13	12
Physical quality U_4	3	0	9	21

But,

$$U_2 = \{23, 7, 4, 0\}$$

$$U_2 = \{7, 18, 8\ 0\}$$

$$U_3 = \{0, 9, 13, 12\}$$

$$U_4 = \{3, 0, 9, 21\}$$

The weight vector gained from order1 to order2:

$$\beta = \{\beta_1, \beta_2, \beta_3, \beta_4\} = \{0.4, 0.3, 0.2, 0.1\}$$

$$U_i^* = U_i \cdot \beta^T$$

$$U_1^* = 12, U_2^* = 9.7, U_3^* = 6, U_4^* = 5$$

We further put the statistics in order

$$U_1^* = 0.35, U_2^* = 0.3, U_3^* = 0.2, U_4^* = 0.15$$

Then we get the result:

$$\bar{A} = (0.35 \quad 0.3 \quad 0.2 \quad 0.15)$$

TABLE 3: Evaluation and membership

Evaluation methodology	Point interval setting			
	0-60	60-80	80-90	90-100
Very good	0	0	0.05	0.95
Good	0	0.05	0.9	0.05
Ordinary	0.05	0.9	0.05	0
Bad	0.95	0.05	0	0

Through the evaluation of every indexes of a tennis player, we can get TABLE 4.

TABLE 4: the Evaluation value of every indexes of a tennis player

Indexes	Evaluation value	Indexes	Evaluation value
Strike u_{11}	Very good	Stamina u_{31}	Very good
Receive u_{12}	Very good	Speed u_{32}	Good
Serve u_{13}	Ordinary	Strength u_{33}	Good
Volley u_{14}	Ordinary	Sensitivity u_{34}	Ordinary
Basic footwork u_{15}	Ordinary	Fixation u_{41}	Good
Tactics u_{21}	Very good	Confidence degree u_{42}	Very good
Judgment u_{22}	Very good	Self-diathesis u_{43}	ordinary
Ability of react u_{23}	Very good		
Competition experience u_{24}	Good		

Through the model above, we can get the weighting factor Fuzzy set of the monolayer index as follow:

$$U_1^* = \{U_{11}, U_{12}, U_{13}, U_{14}, U_{15}\} = \{0.25\ 0.25\ 0.2\ 0.15\ 0.15\}$$

$$U_2^* = \{U_{21}, U_{22}, U_{23}, U_{24}\} = \{0.54\ 0.1\ 0.24\ 0.14\}$$

$$U_1^* = \{U_{31}, U_{32}, U_{33}, U_{34}\} = \{0.4\ 0.3\ 0.1\ 0.2\}$$

$U_1^* = \{U_{41}, U_{42}, U_{43}\} = \{0.3\ 0.4\ 0.3\}$

Through TABLE 4 and TABLE 3 Evaluation and membership, we can get the evaluation set of technique, field consciousness, physical fitness and mental fitness.

Technique: $U_1 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \end{pmatrix}$

Field consciousness: $U_2 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$

Physical fitness: $U_3 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$

Mental fitness: $U_4 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$

$B_i = A_i \cdot R_i$

Normalization B_i, we can get the second stage of fuzzy evaluation matrix.

$$\bar{B} = \begin{pmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{pmatrix} = \begin{pmatrix} 0.07 & 0.27 & 0.13 & 0.53 \\ 0 & 0.1 & 0.4 & 0.5 \\ 0.08 & 0.46 & 0.38 & 0.08 \\ 0.14 & 0.2 & 0.3 & 0.36 \end{pmatrix}$$

$Z = U^* \cdot B = (0.15 \quad 0.26 \quad 0.29 \quad 0.36)$

On account of $0.36 > 0.29 > 0.26 > 0.15$, the tennis player get the excellent goal, and by comprehensive fuzzy evaluation, the point interval setting is in 90-100.

CONCLUSION

Because of sports including tennis contain great inconclusive result, this essay built the mathematic model of comprehensive fuzzy evaluation, and analyzed the performance of the tennis players. We mainly considered the technique, field consciousness, physical fitness and mental fitness of the players during the tennis playing. And we get the evaluation matrix by the model to figure out the grade set of the tennis players.

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