Research on Technical Level of Chinese Men's Volleyball Team Player by Using Grey System Theory

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Abstract. Launch a research into technical level of Chinese men's volleyball team player by using literature research, spot technology statistics and grey statistics. The result shows that after accumulating the matches' statistics based on Grey System Theory, the regular pattern of athletes' tactics level is easily found and it is practical to build the prediction model.

Key Words: sports statistics; Grey System Theory; technical level; volleyball

1. Preface

Sport technology of athletes affected by numerous factors is of hierarchy and complexity. Building the prediction model of athletes' technical level and applying it to practice can provide coaches information while predicting and making decisions. Thus it has great practical significance. Grey prediction model is a theoretical method to predict unknown information according to small amount of information. Its main feature is to find out the regular pattern from the irregular data by changing the structure of the given data (for example by cumulative or regressive generation) to make the prediction results accurate. The thesis will predict the technical level of Chinese volleyball team players with this method.

2. Research Methods

2.1. Research on literature

Know and master the current status and trends of world volleyball teams by reading the data of world men's volleyball in recent years.

2.2. Spot technology statistics

Get statistics of seven matches including Italian, Russian and French teams in 2006 World Men's Volleyball League and Chinese, Polish, Bulgaria and Argentine teams in 2007 World Men's Volleyball League. Count up and sort out the corresponding technical indexes of Chinese men's volleyball team players collected on spot.

2.3. Grey statistics

Main steps of grey prediction model are as follows:

A) Accumulate the spot statistical data to get the cumulative sequence.

B) Build the systematic dynamic model.

C) Derive the estimated spot data from the solutions of the above-mentioned model.

3. Results and Analysis

3.1. Build the systematic dynamic model of Chinese men's volleyball team player.

In order to compare the technical level of Chinese men's volleyball team player, seven attackers of

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Chinese men's volleyball team players (players ABCDEFG)are chosen as the subjects.

Statistic data are converted into the data used in the grey model according to the statistics of athletes' scoring and losing and that's the scoring rate.

Assume the score of the match K is D_k. Score data of these matches are D_1, …, D_K, …D_n. The score rate of the the match K is

$$x_K^o = \frac{D_k}{\sum_{j=1}^{k} D_j}$$

Obtain the data used in the grey model (the score rate of several matches), $x_1^{(o)}, ..., x_k^{(o)}, ..., x_k^{(o)}$

Accumulate the original sequence, $x_1^{(1)}, ..., x_k^{(1)}, ..., x_k^{(1)}$. And the $x_k^{(1)} = \sum_{j=1}^{k} x_j^{(0)}$.

The second accumulation, $x_1^{(2)}, ..., x_k^{(2)}, ..., x_k^{(2)}$. And the $x_k^{(2)} = \sum_{j=1}^{k} x_j^{(1)}$.

The third accumulation, $x_1^{(3)}, ..., x_k^{(3)}, ..., x_k^{(3)}$. And the $x_k^{(3)} = \sum_{j=1}^{k} x_j^{(2)}$.

The systematic dynamic model (1) is:

$$x_k^{(3)} = \left(x_1^{(2)} - u/a\right)\exp(-a.(k-1) + \frac{u}{a})$$

In the formula, a and u are identification parameters. Building a model is actually to find out the two parameters determined by the following formula:

$$B = \begin{bmatrix} -\dfrac{x_2^{(3)} + x_1^{(3)}}{2} & 1 \\ \vdots & ...\vdots \\ -\dfrac{x_n^{(3)} + x_{n-1}^{(3)}}{2} & 1 \end{bmatrix} \quad \text{and} \quad \begin{array}{c} Y_M = \left\{x_2^{(2)}, \cdots x_n^{(2)}\right\}^T \\ [a,u]^T = (B^T B)^{-1} B^T Y_M \end{array}$$

Trends of athletes' technical level are

$$dx_K^{(3)} = (x_1^{(3)} - \frac{u}{a})\exp(-ak).(-a)$$

3.2. Prediction of technical level of Chinese men's volleyball team player

Use the above-mentioned model to calculate the data of the first, second and third accumulation (table 1).

Table 1 Cumulative data of seven athletes in Chinese men's volleyball team

	Match	1	2	3	4	5
Play A	Raw data	41	16	7	71	48
	the 1st accumulation	41	57	64	135	183
	the 2nd accumulation	4l	98	162	297	480
	the 3rd accumulation	4l	139	301	958	1078
Play B	Raw data	46	72	70	31	
	the 1st accumulation	46	118	188	219	did not play
	the 2nd accumulation	46	164	352	517	
Play C	Raw data	41	16	7	71	48
	the 1st accumulation	44	39	62	50	60
	the 2nd accumulation	44	127	272	467	722

Play D	Raw data	71	60	67	64	82
	the 1st accumulation	71	131	198	262	344
	the 2nd accumulation	71	202	400	662	1006
Play E	Raw data	53	67	54	75	42
	the 1st accumulation	53	120	174	249	291
	the 2nd accumulation	53	173	347	596	887
Play F	Raw data	58	57	61	68	
	the 1st accumulation	58	115	176	244	did not play
	the 2nd accumulation	59	173	349	593	
Play G	Raw data	58	65	66	50	61
	the 1st accumulation	58	123	189	239	300
	the 2nd accumulation	58	181	370	609	909

On the basis of the Grey System Theory, calculation of multi-accumulation is utilized to transform the disorder data into regular curve, then to evaluate it and predict the technical level.
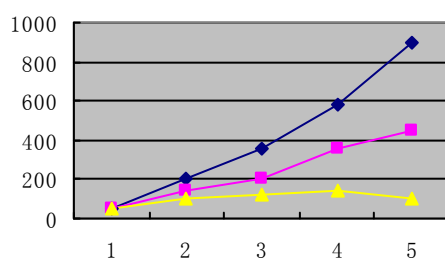
Curves of four representative athletes are as follows:
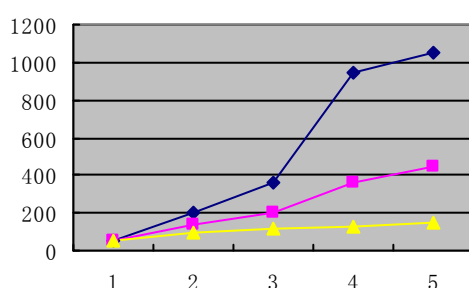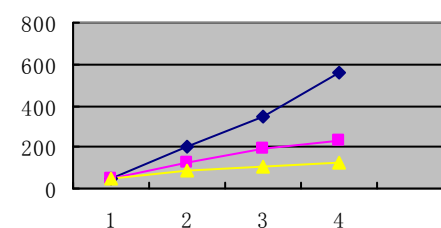

Picture 1 player A
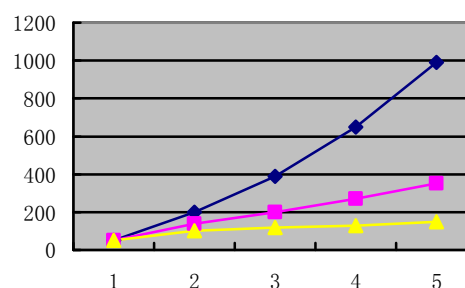
picture 2   player D

Picture 3   player E

Picture 4   player F

The analysis of the above table shows that most diagrams made on the basis of raw data is an irregular curve except for the famous athlete Shenqiong's (in table 2) and other athletes' are irregular. The diagrams of some veterans and several elite young athletes are regular curves after the 1st accumulation (in table3 and 4), while the diagrams of most young athletes will display regularity after the 2nd accumulation. And the diagrams of several young athletes will show regularity after the 4th accumulation (in table 1).Table 2 is made based on formula 2.

Table 2 Prediction data of seven athletes in Chinese volleyball team

	Match	**1**	**2**	**3**	**4**	**5**	**results**
Player A	Raw data	41	98	162	297	480	
	Calculating results	41	84.67	156.85	277.37	478.05	256.17
	Relative error	0	0.136	0.032	0.066	0.004	

Player B	Raw data Calculating results Relative error	46 46 0	164 174.7 0.065	352 344.5 0.021	571 568.2 0.012	did not play 0.036	337.53
Player C	Raw data Calculating results Relative error	44 44 0	127 133.94 0.054	272 266.33 0.019	467 461.2 0.015	722 748.04 0.028	345.85
Player D	Raw data Calculating results Relative error	71 71 0	202 206.2 0.021	400 394.1 0.015	662 655 0.011	1006 1017.5 0.011	425.26
Player E	Raw data Calculating results Relative error	53 53 0	173 171.97 0.006	374 342.41 0.013	596 586.58 0.016	887 936.38 0.048	416.44
Player F	Raw data Calculating results Relative error	58 58 0	173 175.4 0.014	349 343.6 0.015	593 584.7 0.014	did not play	409.09
Player G	Raw data Calculating results Relative error	58 58 0	181 187.5 0.036	370 363.9 0.016	609 604 0.008	909 931 0.021	380.03

Assume athlete Shen Qiong's prediction result as the standard value to calculate the play rate of athletes' technical level: A：60．2％,B 79．4％,C 81．3％,D 100％,E 97．9％,F 96．2％ and G 89．4％. Meanwhile they show that relative error between results and actual data is small and they are of high precision.

4. Conclusion

4.1 With reference to the data above, Chinese men's volleyball team made appropriate adjustments after 2007 and accomplished the match excellently in 2008 ranking fifth in 2008 Beijing Olympic Games.

4.2 According to the grey system theory, we come to the conclusion that the randomness in the data sequence will be gradually diminished after the process of multi-accumulation. Seeing from the double accumulation curve, the degree of irregularity will reduce step by step. By comparing the curves of athletes, we are likely to quantify the extent to which the athletes have given play to their technical level and the gap between the old and new athletes.

4.3 The derivative formula in the third-layer of the grey prediction formula can forecast how much progress the athletes can make in the next round and future matches. The formula is blessed with high precision in practical operation, and as a result it can minimize the artificial factors, make use of the young athletes to better advantage, with a view to boosting the team's scores.

4.4 In practice, we should take courage to give full play to those young athletes with excellent performances；for those with not so good performances we try to find out the causes to the high rate of errors and improve their techniques in the drills；decide early which athlete should be eliminated or resettled, to give them a better chance for development in some other fields.

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