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


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 $D_1, \ldots, D_K, \ldots D_n$. 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), $x_1^{(o)}, \ldots, x_k^{(o)}, \ldots, x_k^{(o)}$.

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

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

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

The systematic dynamic model (1) is:

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

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:

$$Y_T = \left\{x_1^{(2)}, \ldots, x_n^{(2)}\right\}^T$$

and

$$[a, u]^T = (B^T B)^{-1} B^T Y_T$$

Trends of athletes’ technical level are

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

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

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

<table>
<thead>
<tr>
<th>Match</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Player A</td>
<td>Raw data</td>
<td>41</td>
<td>98</td>
<td>162</td>
<td>297</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>Calculating results</td>
<td>41</td>
<td>84.67</td>
<td>156.85</td>
<td>277.37</td>
<td>478.05</td>
</tr>
<tr>
<td></td>
<td>Relative error</td>
<td>0</td>
<td>0.136</td>
<td>0.032</td>
<td>0.066</td>
<td>0.004</td>
</tr>
</tbody>
</table>
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.

5. References


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