Logistic growth curve method-based China football league one development research

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ABSTRACT

With the development of football globalization, all countries football culture, football operational management mode are intermingled with each other, which provides opportunity and challenge for China league one development. The paper carries on specific research on China league one’s athletes, analyzes current Chinese main force athletes’ average age, average height, average weight, and then compares to international stars evaluation criterion, points out that Chinese players have not yet possessed potentials of international stars, which reflects in Chinese players techniques and reaction capacity to be further improved; makes investigation on Chinese coaches’ age, experiences, instructing time and other factors, it gets that among football coaches, Chinese coaches amount are more, foreign senior coaches are fewer, it suggests to introduce more foreign senior coaches so that will helpful for Chinese football development, finally by data table after logistic curve changes, it analyzes that Chinese football players team is growing stronger, especially in professional players amount that is constantly increasing and techniques are constantly promoting, which will impel Chinese football rapidly development, and meanwhile also conforms to strategy of reinvigorating China through human resource development.

KEYWORDS

Coach; Football; Logistic growth curve method; League one; Management mode.
INTRODUCTION

Though Chinese football is slightly inferior to other countries, China’s reform in football has obtained remarkable achievements, so the paper mainly researches on Chinese professional football league development status.

Zhao Jing-Lun in “2006 Chinese super league goal characteristics study”, combined with Chinese present social structure, looked up lots of documents, analyzed Chinese super league goal characteristics, made concrete investigation and research on some Chinese professional players, and proceeded with statistical analysis of their applied techniques in goal instant, got that the common points among them during goal instant was they could calm down, see to every player’s moves, and were ready to make final preparation for passing, goal, approaching, and running.

Fang Li in the article “Chinese football professionalization reform and development measures study”, by analyzing Chinese football professionalization reform measures, he got that the reason why Chinese football was weaker, it mainly because the shortage of technical talents. The paper pointed out that China should employ world excellent football coaches, let them to train Chinese youth from childhood, strengthen their fondness on football, deeply excavate their internal potentials to make preparation for building Chinese world star and then promote Chinese football development.

Cheng Zheng-Tao in the article “2008 to 2010 Chinese super league techniques application research”, analyzed contemporary China league one, went deeper into study Chinese professional football players, and based on present social development, combined with sociological theory, put forward that in Chinese super league, some athletes techniques were normal, which caused Chinese super league quality could not be ensured, so it should make further specific evaluation on Chinese professional players’ techniques, and collectively solve the problems of them.

The paper utilizes logistic growth curve method to establish model regarding Chinese football professionals amount prediction, specific evaluates and predicts on Chinese football, and then provides precious comments on Chinese football.

CHINESE PROFESSIONAL FOOTBALL PLAYERS AND COACHES BASIC CHARACTERISTICS

In order to make the paper to be persuasive, it carries out specific researches on Chinese professional football leagues’ athletes and their techniques status through mathematical models.

Chinese professional football players’ age structure
By interviewing, investigating Chinese large and medium-sized cities teams that participated in Chinese super league first division, it carries out analysis and researches on participants dominating athletes, relative data is as TABLE 1, TABLE 2 and TABLE 3, relative analysis is as Figure 1, Figure 2 and Figure 3.

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age</td>
<td>25.6</td>
<td>26.3</td>
<td>26.6</td>
<td>26.5</td>
</tr>
</tbody>
</table>

Figure 1: professional players average age from 2011 to 2014

<table>
<thead>
<tr>
<th>Average age</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>3</td>
<td>13</td>
<td>5</td>
<td>18</td>
<td>9</td>
<td>23</td>
<td>4</td>
<td>17</td>
<td>16</td>
<td>27</td>
<td>13</td>
</tr>
</tbody>
</table>
According to above analysis of Chinese football dominating athletes’ ages, it gets that Chinese dominating athletes’ ages are generally 22 years old, the age group is just the period of vigorousness, and in the stage, athletes’ learning ability, techniques application capacity arrive at their best.

**Chinese professional football player’s height and weight status**

Athlete weight and height are linked to his technology performing in the sports fields, especially for their own energies reasonable utilization that is particular important, relative data is as TABLE 4, TABLE 5 and TABLE 6, relative analysis is as Figure 4, Figure 5 and Figure 6.

**TABLE 4 : 2011-2014 professional players’ heights characteristics**

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height(cm)</td>
<td>182.2</td>
<td>183.3</td>
<td>182.9</td>
<td>183.5</td>
</tr>
</tbody>
</table>

**TABLE 5 : 2011-2014 professional players’ weights characteristics**

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight(kg)</td>
<td>74.6</td>
<td>75.4</td>
<td>74.2</td>
<td>74.8</td>
</tr>
</tbody>
</table>
TABLE 6: 2011-2014 four seasons dominating athletes’ characteristics

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>183.2</td>
<td>183.1</td>
<td>183.9</td>
<td>183.4</td>
</tr>
<tr>
<td>Average age</td>
<td>26.3</td>
<td>25.9</td>
<td>24.7</td>
<td>24.8</td>
</tr>
<tr>
<td>Average weight</td>
<td>75.8</td>
<td>75.3</td>
<td>74.3</td>
<td>75.5</td>
</tr>
</tbody>
</table>

Chinese professional football coaches status

By researching on athletes’ weights, heights, it gets that Chinese main players heights are 183m, weights are 75, which also gets closer to experts one research on most suitable kicking stage, it shows Chinese football is on track.

TABLE 7: Proportions of Chinese and foreign coaches

<table>
<thead>
<tr>
<th>Coach</th>
<th>China</th>
<th>Foreign countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion(%)</td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Figure 7: The proportion of Chinese and foreign coaches

TABLE 8: 2011-2014 Coaches’ ages

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum age</td>
<td>64</td>
<td>63</td>
<td>65</td>
<td>62</td>
</tr>
<tr>
<td>Average age</td>
<td>43</td>
<td>40</td>
<td>39</td>
<td>41</td>
</tr>
<tr>
<td>Minimum age</td>
<td>29</td>
<td>30</td>
<td>28</td>
<td>29</td>
</tr>
</tbody>
</table>
TABLE 9: 2014 Chinese coaches instructing time

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longest</td>
<td>28</td>
<td>25</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>Average</td>
<td>15</td>
<td>15</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>Shortest</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

TABLE 10: 2014 Foreign coaches average ages and instructing time

<table>
<thead>
<tr>
<th>Coach</th>
<th>Average age</th>
<th>Average time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>53</td>
<td>9</td>
</tr>
</tbody>
</table>

LOGISTIC GROWTH CURVE-BASED PREDICTIONS ON NUMBER OF SPORTS SYSTEM INSTITUTION STAFF

On the basis of correlation analysis, it selects sports system institution that suffers maximum influences from athletes' technological levels to make predictions on number of people, which are professional sports schools, amateur sports schools and sports schools.

Logistic curve guiding thought

Chinese football education system institution staff amount change trend is uncertain with time passing, here, introduce Logistic curve (growth curve).

Logistic curve general mathematical model is:
\[
\frac{dy}{dt} = ry(1 - \frac{y}{L}) \tag{1}
\]

\[
y = \frac{L}{1 + ce^{-rt}} \tag{2}
\]

In the following, record Logistic curve general form as:

\[
y_i = \frac{1}{K + ab^i}, K > 0, a > 0, 0 < b 
eq 1 \tag{3}
\]

Among them, in Logistic curve, parameter estimation makes following changes: 

\[
y'_i = K + ab^i \tag{4}
\]

Averagely divide time sequence \( n \) pieces of observation value into three parts, for every part; it has \( m \) periods, which is \( n = 3m \).

Part one: \( y_1, y_2, y_3, \cdots, y_m \);
Part two: \( y_{m+1}, y_{m+2}, y_{m+3}, \cdots, y_{2m} \);
Part three: \( y_{2m+1}, y_{2m+2}, y_{2m+3}, \cdots, y_{3m} \)

Among them, every part trend sum is equal to corresponding observation values sum, therefore provide parameters estimation, three sums method steps are as following:

Record observation values each part sum is:

\[
S_1 = \sum_{i=1}^{m} y'_i, \quad S_2 = \sum_{i=m+1}^{2m} y'_i, \quad S_3 = \sum_{i=2m+1}^{3m} y'_i, \tag{5}
\]

And it has:

\[
\begin{align*}
S_1 &= \sum_{i=1}^{m} y'_i = \sum_{i=1}^{m} (K + ab^i) = mK + ab(1 + b + b^2 + \cdots + b^{m-1}) \\
S_2 &= \sum_{i=m+1}^{2m} y'_i = \sum_{i=m+1}^{2m} (K + ab^i) = mK + ab^{m+1}(1 + b + b^2 + \cdots + b^{m-1}) \\
S_3 &= \sum_{i=2m+1}^{3m} y'_i = \sum_{i=2m+1}^{3m} (K + ab^i) = mK + ab^{2m+1}(1 + b + b^2 + \cdots + b^{m-1})
\end{align*} \tag{6}
\]

Among them: \((1 + b + b^2 + \cdots + b^{m-1})(b - 1) = b^m - 1\)
And then it can get:

\[
\begin{align*}
S_1 &= mK + ab \frac{b^{m-1}}{b - 1} \\
S_2 &= mK + ab^{m+1} \frac{b^{m-1}}{b - 1} \\
S_3 &= mK + ab^{2m+1} \frac{b^{m-1}}{b - 1}
\end{align*} \tag{7}
\]

Therefore, it can get:
Logistic growth curve method-based China football league one development research  

\[
\begin{align*}
    b &= \left( \frac{S_1 - S_2}{S_2 - S}\right)^2 \\
    a &= (S_2 - S_1) \left( \frac{b - 1}{b \ln b - 1} \right) \\
    K &= \frac{1}{m} \left( \frac{a b^m - 1}{b - 1} \right)
\end{align*}
\]  

(8)

Besides, when predict data, it should test data, test method is:

\[
\frac{Y_{i+1} - Y_i}{Y_i - Y_{i-1}} \approx b
\]  

(9)

### Logistic curve data processing and results

By \( y_i = \frac{1}{y_i} \), it gets 2008–2012 data after changing as following TABLE 11:

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y_i / \times 10^3 )</td>
<td>Professional, sports technical college</td>
<td>0.456</td>
<td>0.347</td>
<td>0.337</td>
<td>0.377</td>
<td>0.234</td>
</tr>
<tr>
<td></td>
<td>Sports school</td>
<td>0.0851</td>
<td>0.0633</td>
<td>0.0430</td>
<td>0.0637</td>
<td>0.0591</td>
</tr>
<tr>
<td></td>
<td>Amateur sports school</td>
<td>0.0373</td>
<td>0.0375</td>
<td>0.0507</td>
<td>0.0410</td>
<td>0.0414</td>
</tr>
</tbody>
</table>

According to formula(5), it gets: \( S_1^1 = 0.682, S_2^1 = 0.614, S_3^1 = 0.478 \)

\( S_1^2 = 0.1274, S_2^2 = 0.1256, S_3^2 = 0.1232 \)

\( S_1^3 = 0.0778, S_2^3 = 0.0817, S_3^3 = 0.0766 \)

Then by formula(8), it gets: \( b_1^1 = 1.867, a_1 = -0.005111, K_1^1 = 0.35468 \)

\( b_2^2 = 1.6999, a_2 = -0.0001453, K_2^2 = 0.1281 \)

\( b_3^3 = 1.5128, a_3 = 0.000786, K_3^3 = 0.0758 \)

So obtained sports system institution staff amount logistic growth curve mathematical model is:

\[
\begin{align*}
    y_i &= \frac{1}{0.35468 - 0.005111 \times 1.867} \\
    y_i &= \frac{1}{0.1281 - 0.0001453 \times 1.6999} \\
    y_i &= \frac{1}{0.0748 + 0.000796 \times 1.5128}
\end{align*}
\]

When predicting Chinese sports system institution staff development changes in future five years after 2012, only need to input \( t \) value into above formula, as predict \( y_{2013} \), then it has \( t = 2013 - 2004 + 1 = 10 \). Then it can get following TABLE 12 prediction results:

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional sports school</td>
<td>6135</td>
<td>6219</td>
<td>6258</td>
<td>6301</td>
<td>6325</td>
</tr>
<tr>
<td>Sports school</td>
<td>9413</td>
<td>9725</td>
<td>9997</td>
<td>12105</td>
<td>13297</td>
</tr>
<tr>
<td>Amateur sports school</td>
<td>11579</td>
<td>13683</td>
<td>14432</td>
<td>16837</td>
<td>18693</td>
</tr>
</tbody>
</table>
Draw above predicted staff amount into following broken line Figure 11, it is better analyzing sports system institution staff amount trend:

![Figure 11: The number of sports system institutions](image)

By above broken line statistical Figure 11 analysis, it gets conclusions that national football athletes amount sharp increases in five years after 2014, which drives Chinese football to rapidly develop, from which China further strengthens professional players training to make preparation for China training a great deal of dominating players.

**CONCLUSION**

(1) The paper firstly makes specific investigation and analysis of Chinese football athletes’ dominating players heights, average age, average weight, it gets that Chinese dominating athletes ages are averagely 22 years old, weights are 75 kg, heights are 183cm, by investigating and studying on relevant articles, it thinks the result conforms to international professionals evaluation criterion.

(2) Secondly, the paper researches on Chinese coaches status, it gets that Chinese coaches account for around 80%, and among them, most of people instruction years are around 15 years, which indicates Chinese coaches instructing levels have already arrived at international standard, which provides faculty guarantee for Chinese football development.

(3) Finally, by data table after logistic curve changes, it gets that Chinese professionals amount is constantly increasing, and technical levels have qualitative leap, which provides talents guarantee for Chinese football development.

**REFERENCES**


