Grey prediction model-based 2014 fencing world championship chinese team performance prediction in applied research

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ABSTRACT

In recent years, fencing competitive level has been rapidly developed in China, fencing event has already become Chinese competitive sports development strategy's potential advantageous event, and it gains excellent results in a series of contests, while individual kinds of fencing have also been in the front rank of the world. In Beijing Olympic Games, Chinese delegation has totally taken 51 gold medals, 21 silver medals and 28 bronzes medals such excellent results, ranked in the gold medal standings first and in the medal table second, which has achieved historical breakthrough. Gold-seizing events have also increased from 28th session's 14 events to 16 events. Zhong Man took men's individual saber gold medal is one of most attracting breakthrough. Olympic Games and individual event world championship are always competitions which every country pays most attention to, therefore the two competitions are highest in 2014 fencing world championship Chinese fencing event performance prediction levels, they are also the competitions which can test a country each individual event true level to the greatest extent, therefore the paper mainly analyzes today's world fencing new pattern from recent four years' world championships and Beijing Olympic Games in 2008 the fencing event medal table distribution status, it applies grey prediction model to predict Chinese fencing event performance in 2014 fencing world championship.

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KEYWORDS

Fencing world championship;
Performance prediction;
Grey model;
Statistical analysis.

INTRODUCTION

World fencing powers have always focused on talents selection, training, every kind of technique and tactics as well as apparatus manufacturing and using aspects special research for many years, and applied research results into practice, it brings rapid progress in fencing techniques. Fencing scientific research has received more and more attention from every country

fencing circle, though Chinese fencing scientific research started late and basis was poor, it achieved good results.

In recent years, with competitive sports development, researches with regard to sports performance prediction have also become more and more, which should be regarded that prediction major sporting events performance has received more and more attention from every country's sports workers, it has guiding signifi-

cance for every country sports strategies establishing and preparation measurements forming,reasonable deploying as well as arranging strategic priorities, therefore more experts have also proceeded with prediction and researching work. And with scientific development, prediction methods are developing accordingly, accuracy and diversity in sports competition prediction have also developed. Rey system theory after 20 more years' development, it has basically established one newly-developed structural system, its researching contents mainly include grey system modeling theory, grey system control theory, grey correlation analysis method, grey prediction method, grey programming method, grey decision-making method and so on.

And the paper mainly adopts grey system modeling theory and grey sequence prediction. Grey sequence prediction refer to use dynamic GM model, to make prediction on systematical time sequence quantities, which is predicting on systematical main behavior statistic feature or some indicators, development changes in future special time appeared values. Do data handling with original sequence data according to some requirements is called generation, common used grey system generation ways are accumulated generation, inverse accumulated generation, mean generation, ultimate ratio generation and so on, the paper will adopt accumulated generation for data handling, which is to get new data and sequence by sequences' every time data accumulating one by one. Sequence before accumulation is called original sequence; sequence after accumulation is called Get Sequence. Accumulated generation is a method let grey process change from grey to white; it takes an extremely important role in grey system theory, grey accumulation process development trend can be seen by accumulated generation, which let scattering original data contained integral property or rule explicit. Accumulated generation is a way that accumulates original sequence every time data successively to generate new sequence.

PREDICTION MODEL ESTABLISHMENT AND SOLUTION

At first, analyze recent four years' world championships and Olympic Games in 2008 every country medal performance and total medals, refer to TABLE

1-TABLE 5.

From which, France Team ranks the gold medal standings first and medal table second with achievement of 11 gold medals, 6 silver medals and 5 bronze medals, and Italy ranks the gold medal standings second and medal table first with achievement of 8 gold medals, 9silver medals and 15 bronze medals, besides two traditional powers Russia and Germany respectively achieve impressive results of 8 gold medals and 6 gold medals, the traditional four powers position still

TABLE 1: Fencing world championship medal table in 2006

Rank	Country	Gold medal	Silver medal	Bronze medal	Total
1	France	4	1	1	6
2	Russia	2	0	3	5
3	China	2	0	1	3
4	Italy	1	3	3	7
5	America	1	2	1	4
6	Hungary	1	1	2	4
7	Germany	1	1	1	3
8	Estonia	0	1	1	2
8	Ukraine	0	1	1	2
10	Spain	0	1	0	1
10	Portugal	0	1	0	1
11	South Korea	0	0	3	3
12	Canada	0	0	1	1

TABLE 2 : Fencing world championship medal table in 2007

Rank	Country	Gold medal	Silver medal	Bronze medal	Total
1	France	4	2	2	8
2	Russia	2	2	1	5
3	Germany	2	1	3	6
4	Hungary	2	1	2	5
5	Italy	1	4	4	9
6	Poland	1	0	1	2
7	China	0	2	1	3
8	South Korea	0	0	2	2
9	Estonia	0	0	1	1
9	Ukraine	0	0	1	1
9	Japan	0	0	1	1

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TABLE 3 : Beijing olympic games medal table in 2008

Rank	Country	Gold medal	Silver medal	Bronze medal	Total
1	France	2	2	0	4
2	Italy	2	0	5	7
3	Germany	2	0	0	2
4	America	1	3	2	4
5	China	1	1	0	2
6	Russia	1	0	0	1
6	Ukraine	1	0	0	1
8	Romania	0	1	1	2
9	Japan	0	1	0	1
9	South Korea	0	1	0	1
9	Poland	0	1	0	1
12	Spain	0	0	1	1
12	Hungary	0	0	1	1

TABLE 4 : Fencing world championship medal table in 2009

Rank	Country	Gold medal	Silver medal	Bronze medal	Total
1	Italy	4	2	3	9
2	Russia	3	1	2	6
3	Germany	1	1	3	5
4	France	1	1	2	4
5	Ukraine	1	1	1	3
6	Romania	1	1	0	2
7	America	1	0	0	1
8	Hungary	0	1	3	4
9	China	0	1	1	2
9	Poland	0	1	1	2
11	Canada	0	1	0	1
11	South Korea	0	1	0	1
13	Spain	0	0	1	1
13	Holland	0	0	1	1

TABLE 5 : Total medal table

Rank	Country	Gold medal	Silver medal	Bronze medal	Total
1	France	11	6	5	22
2	Italy	8	9	15	32
3	Russia	8	3	6	17
4	Germany	6	3	7	16
5	America	3	5	3	11
6	China	3	4	3	10
7	Hungary	3	3	8	14
8	Ukraine	2	2	3	7
9	Poland	1	2	2	5
10	Romania	1	2	1	4
11	South Korea	0	2	5	7
12	Estonia	0	1	2	3
12	Spain	0	1	2	3
14	Canada	0	1	1	2
14	Japan	0	1	1	2
16	Portugal	0	1	0	1
17	Holland	0	0	1	1

remain firmly. But from the perspective of tendency, Italy has surpassing tendency to France, not only in the number of medals that already shrugged off France, but also its aggressive tendency is just opposite to France, Italy from original 1 gold medal to Beijing Olympic Games 2 gold medals achievements the same as France, then to 4 gold medals achievements in 2009 world championship, which can be thought that Italy is moving forward steadily on the original basis; while France only gets one gold medal in just finished world championship, world fencing has already got further away from France standing alone era; in addition, two powers Russia and Germany are relative stable, they keep their traditional power position. While as an old fencing power, Hungary is obvious in the deceasing trend, even already been surpassed by China and America; other some European countries Ukraine, Poland, Romania and so on continue to use results proving that they still occupy a position in world fencing.

On a whole, fencing as European countries' hereditary event, its development in European countries always stays ahead of other countries, though it not forms monopoly position on the event, their comprehensive levels and strength are still far ahead of other countries.

In the following, analyze recent several sessions' fencing contests Chinese fencing team each individual event performance tendency Figure 1:

By Figure 1, it is clear that individual event men's foil and team event women's sabre are two events with best and most stable results in recent year, in addition, for individual event, though Zhong Man has become dark horse and achieved champion in Beijing Olympic Games, it actually is not outstanding in overall tendency
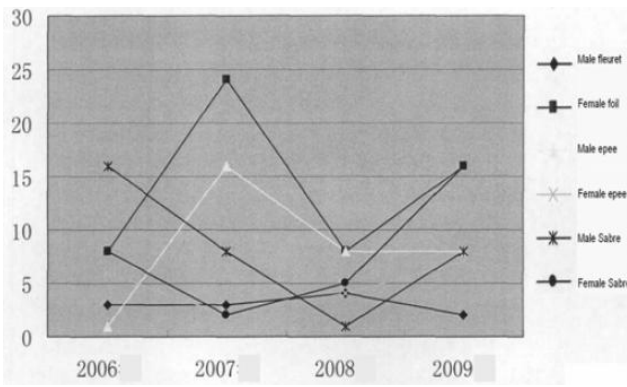
Figure 1 : Recent several sessions contests Chinese fencing team individual event personal performance tendency Figure
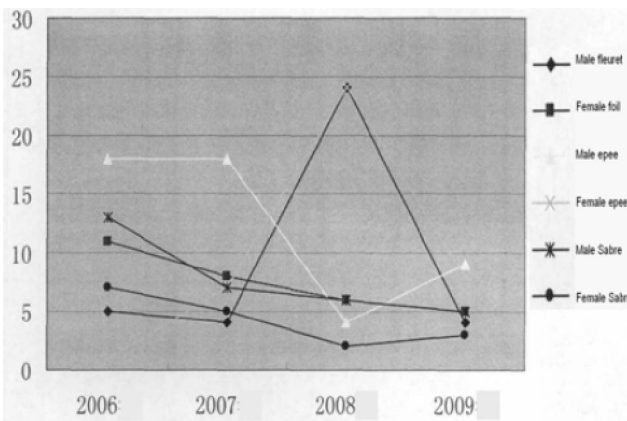

Figure 2 : Recent several sessions contests Chinese fencing team individual event team performance tendency Figure

and being quite up and down.

From Figure 2, it is clear that team event men's foil should also not be neglected, except for its disorder playing in 2008 Olympic Games, it steadily ranks in the top five in other sessions contests, and the performance is stable. In addition, women's foil, men's sabre performance has also done quite well that steadily made progress.

Take 2006, 2007,2009 three sessions fencing world championships as well as 2008 Olympic Games fencing game performance as evidence to analyze, making transformation as gold medal is 4 scores, silver medal

is 2 scores, bronze medal is 1 scores, combine them and calculate into total scores, refer to TABLE 6.

Due to medal and meal score belong to time sequence data, their interval time is fixed, original data sequence is less, it is difficult to find rules from its distribution, therefore it adopts accumulated generation then can establish GM(1.1) model to predict, as TABLE 7.

Note: $x^{(0)}(k)$ represent number of medals and total score, $x^{(1)}(k)$ represents sequence $x^{(0)}(k)$ accumulated generation value, $\hat{x}^{(1)}(k)$ is calculation value after modeling.

Take total numbers of medals as an example, then it has:

GM (1.1) modeling sequence $x^{(0)}$

$$\mathbf{x^{(0)} = (x^{(0)}(1), x^{(0)}(2), x^{(0)}(3), x^{(0)}(4)) = (3,3,2,2)}$$

Then $x^{(0)}$ AGO sequence $x^{(1)}$

$$\mathbf{x^{(1)}(k) = \sum_{m=1}^{k} x^{(0)}(m) = (x^{(1)}(1), x^{(1)}(2), x^{(1)}(3), x^{(1)}(4)) = (3,6,8,10)}$$

Then $x^{(1)}$ mean sequence $z^{(1)}$

$$\mathbf{z^{(1)}(k) = 0.5(x^{(1)}(k) + x^{(1)}(k-1))}$$

$$\mathbf{z^{(1)}(2) = 0.5(x^{(1)}(2) + x^{(1)}(1)) = 4.5}$$

$$\mathbf{z^{(1)}(3) = 0.5(x^{(1)}(3) + x^{(1)}(2)) = 7}$$

$$\mathbf{z^{(1)}(4) = 0.5(x^{(1)}(4) + x^{(1)}(3)) = 9}$$

Solve middle parameter:

$$\mathbf{C = \sum_{k=2}^{n} z^{(1)}(k) = 4.5 + 7 + 9 = 20.5}$$

$$\mathbf{D = \sum_{k=2}^{n} x^{(0)}(k) = x^{(1)}(4) - x^{(1)}(1) = 10 - 3 = 7}$$

$$\mathbf{E = \sum_{k=2}^{n} z^{(1)}(k)x^{(0)}(k) = 4.5 * 3 + 7 * 2 + 9 * 2 = 45.5}$$

$$\mathbf{F = \sum_{k=2}^{n} (z^{(1)}(k))^2 = 4.5^2 + 7^2 + 9^2 = 150.25}$$

TABLE 6 : Medal and corresponding score status

Name	Gold medal (score)	Silver medal (score)	Bronze medal (score)	Total(score)
World championship in 2006	2(8)	0(0)	1(1)	3(9)
World championship in 2007	0(0)	2(4)	1(1)	3(5)
Olympic Games in 2008	1(4)	1(2)	0(0)	2(6)
World championship in 2009	0(0)	1(2)	1(1)	2(3)
Total(score)	3(12)	4(8)	3(3)	10(23)

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TABLE 7 : Medal and medal score sequence

Medal/Total score	Variable	1(06)	2(07)	3(08)	4(09)
Total numbers of medals	$x^{(0)}(k)$	3	3	2	2
	$x^{(1)}(k)$	3	6	8	10
Medal total scores	$x^{(0)}(k)$	9	5	6	3
	$x^{(1)}(k)$	9	14	20	23
Number of gold medals	$x^{(0)}(k)$	2	0	1	0
	$x^{(1)}(k)$	2	2	3	3
Number of silver medals	$x^{(0)}(k)$	0	2	1	1
	$x^{(1)}(k)$	0	2	3	4
Number of bronze medals	$x^{(0)}(k)$	1	1	0	1
	$x^{(1)}(k)$	1	2	2	3

TABLE 8 : Accuracy examination level reference table

Model accuracy level	Little error probability P
First class (good)	$0.95 \le P$
Second class (qualified)	$0.80 \le P < 0.95$
Third class (barely)	$0.70 \le P < 0.80$
Fourth class (unqualified)	$P < 0.70$

Solve GM (1.1) parameters a, b

$$a = \frac{\Delta a}{\Delta}, b = \frac{\Delta b}{\Delta}$$

$$\Delta a = CD - (n-1)E = 143.5 - 137.5 = 6$$

$$\Delta = (n-1)F - C^2 = 450.75 - 420.25 = 30.5$$

$$\Delta b = DF - CE = 1051.75 - 932.75 = 119$$

$$a = \frac{\Delta a}{\Delta} = 0.19672131,$$

$$b = \frac{\Delta b}{\Delta} = 3.90163934,$$

Then $\dfrac{b}{a} = 19.8333335$

GM (1.1) whitening response formula is:

$$\hat{x}^{(1)}(k+1) = (x^{(0)}(1) - \frac{b}{a})e^{-ak}$$

$$+ \frac{b}{a} = (-16.8333)e^{-0.1967k} + 19.8333$$

$$\hat{x}^{(0)}(k+1) = \hat{x}^{(1)}(k+1) - \hat{x}^{(1)}(k)$$

It further gets

$$\hat{x}^{(1)}(1) = x^{(0)}(1) = 3$$

$$\hat{x}^{(1)}(2) = -13.8006 + 19.8333 = 5.9773,$$

$\hat{x}^{(1)}(3) = 8.4749$, $\hat{x}^{(1)}(4) = 10.5031$, $\hat{x}^{(1)}(5) = 12.1691$

Then, $\hat{x}^{(0)}(2) = 2.9773$, $\hat{x}^{(0)}(3) = 2.4976$, $\hat{x}^{(0)}(4) = 2.0282$,

Residual examination:

$$\varepsilon(k) = (x^{(0)}(k) - \frac{\hat{x}^{(0)}(k)}{x^{(0)}(k)})\%,$$

Then

$\varepsilon(2) = 0.7567\%$, $\varepsilon(3) = -24.88\%$, $\varepsilon(4) = -1.41\%$

Average residual: $\varepsilon(avg) = \dfrac{1}{n-1}\sum_{k=2}^{n}|\varepsilon(k)| * 100\%$, $n = 4$

By calculation, it can get: $\varepsilon(avg) = 9.0115\%$

Then average accuracy: $\rho \circ = 90.9845\% \Rightarrow 0.80 < 0.95$, so it is qualified, accuracy examination level can reference Table 8.

When known data is few, lots of uncertain factor exist, prediction results is relatively reasonable, it predicts that medal in 2014 is around 2 to 3 pieces.

CONCLUSIONS

The largest advantage that China makes preparation for world championship is Chinese "the whole nation system", under long-term whole nation system influence, Chinese team is making progress in every session Olympic Games, the achieved gold medals, number of medals are in the rise session by session, it arrives at peak in Beijing Olympic Games that achieves result of ranking gold medal standings first, therefore other countries make research on Chinese whole nation system in succession, following the example of China, so as to propel their countries' competitive sports development. Chinese fencing has achieved greater progress under whole nation system influence, let fencing event become Chinese potential advantageous event, from which whole nation system has made undeniable contributions. After the whole nation system proposing "Concentrate Resources and Do Big Things, Give a boost to Sports undertakings", one group of Chinese poor organized events have been rapid developed, like fencing, rowing these event their progress can be reflected by performance, and after these events become

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potential advantageous events, whole nation system "Develop potential advantageous events" policy would surely become accelerator for these events Olympic Games gold seizing. The whole nation system promoting effects on fencing event development reflects on human resource, finance and materials full supports from central to local and full cooperation from all walks of life.

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