Based on the Data Curve Fitting Field Events Forecast Application in Research Achievements

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Abstract: Today's overall grasp and prediction of the trend changes in sports scores, led this study to carry out the discussion that the athletes' obtaining reasonable suggestion is particularly important to fundamentally improve the comprehensive quality of track and field athletes performance. The Olympic Games is the big games, and the 'stand or fall' of achievements is the only measure of players performance. This study used Chinese sports yearbook collection of 28 sessions of four major jumping events of track and field events, respectively for the high jump, long jump, triple jump, pole vault and other 28 Olympic Games track and field sports performance analysis of the results using the least squares curve regression. A change curve is drawn, so as to describe the performance change trend, and forecast the coming Olympic Games performance. The regression curve is a simple and feasible way to forecast results.

Keywords: Curve fitting, least-square method, performance prediction, track and field sports.

1. INTRODUCTION

With the development and progress of the society, sports have become an indispensable aspect of human civilization. Track and field sports as the most popular sport are adored by people. Led by Olympic Games, all kinds of sports activities have sprung up, in order to improve the level of the national track and field sports. The Olympic Games is a great sporting event; people all over the world like track and field sports which is the most common and the most popular worldwide. Grades will be refreshed in every Olympic Games, in order to maintain track and field sports scores overall integrity for the developing trend of carrying out the forecast, to give athletes an overall training goal, which will improve the quality of our country's competitive sports [1].

In the study of the method of curve fitting and forecast sport achievements, many predecessors have made a lot of effort; it is because of these predecessors' efforts, that make science and sports career progress continuously at a pace of high speed. Some predecessors put forward their own views. For example, Zhuang Chong (2006) proposed a time series model by integrating GM (1, 1) model of grey system with BP neural network model for the comparative study of sports performance prediction [2]. This method is used for obtaining more classic and mature prediction of the actual effect [3].

Liu Jiajin (2006) explored the field of competitive sports by the new method of grey envelope prediction model. He established that the forecasting results that this method offers is a possible point of understanding the existing predictive value area. Especially, in raw data the fluctuation is too large and when the modeling precision of GM (1, 1) grey model is low, it can't realize the prediction [4].

In this paper, on the basis of forefathers' research and the use of the Chinese sports yearbook based on 28 sessions of the high jump, long jump, triple jump, pole vault crown and third grade, it has been concluded that the average scores may predict the project's performance in the Olympic Games. Multiple regression analysis using the least squares method, draws a graph, which describes the past, present and future overall trend of athletic performance. Regression function is then used to predict the coming Olympic Games achievement, and the use of performance prediction error range, makes the prediction more accurate.

2. PREDICTION OF FIELD PERFORMANCE

Track and field sports refer to the athletic games. Track and field has a very long history, as being one of the most popular sports in the world, and it is also creating a sports game. Track and field sports is closely related to life, as it is simple and wide and it can promote physical and mental health, *etc*., make the track and field sports is more and more loved by humans, and can spread so far. In order to better study the track and field sports scores, and based on the prediction result for track and field athletes performance, a reference for training goals is provided. From the track and field data of the 28 Olympic Games statistics and processing, the top three scores data average is given in Table **1**.

It is seen from Table **1** that, due to the influence of two world wars, 3, 12, 13 games data is missing, as the Olympic Games were interrupted. On the whole, it can be seen that sports scores are gradually a rising trend. Due to the improvement of quality of modern human life, track and field sports started attaching great importance to the scientific rational development of training methods, track and field sports took a leap progress, and it also showed a continuous rising trend. However, every time increase in the degree of each is not identical. This paper presents data of the curve respectively, for the high jump, long jump, triple jump, and pole vault by using the SPSS multiple regression

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Table 1.   Summary of 28th sessions' athletics performance.

Session	High jump	Long jump	Triple jump	Pole vault
1	1.703	6.213	12.976	3.133
2	1.810	7.103	14.026	3.250
3	1.786	7.036	14.041	3.455
4	1.888	7.218	14.686	3.666
5	1.910	7.330	14.480	3.883
7	1.910	7.108	14.418	3.796
8	1.950	7.326	15.440	3.933
9	1.920	7.570	15.163	4.083
10	1.970	7.563	15.386	4.271
11	2.010	7.890	15.720	4.283
14	1.960	7.641	15.263	4.233
15	2.100	7.466	15.906	4.493
16	1.960	7.663	16.210	4.530
17	2.153	8.090	16.623	4.616
18	2.173	8.030	16.756	5.050
19	2.220	8.416	17.293	5.400
20	2.216	8.150	17.236	5.416
21	2.230	8.160	17.123	5.500
22	2.326	8.310	17.270	5.693
23	2.330	8.340	17.103	5.666
24	2.366	8.493	17.516	5.850
25	2.340	8.550	17.710	5.783
26	2.370	8.343	17.803	5.920
27	2.339	8.450	17.546	5.900
28	2.340	8.460	17.606	5.900

analysis; a curve review model is given, and the results obtained for the track and field sports provide basis for a scientific and reasonable prediction.

High Jump Performance Curve Regression Model

High jump one of the field events of track and field sports, which consists of rhythmic run-up, single foot take-off, clearing the bar, and complete the ground movements, such as with athletes jumping over rail on the edge at a given height, to calculate the result of events. The high jump is the height of the human conquest of sports, sports is the customer service of its own gravity, and the gravity of human sports is the human perseverance, courage to challenge the nature and the symbol of scaling new heights. The high jump is a popular sports all over the world, as one of the children's favorite sports. There are many kinds of high jump positions including movement by leaps and bounds, the scissors, front and back, *etc*. High jump movement is an ancient sport. In order to meet high quality requirements of an athlete, high jump athletes should be

trained from various respects. Fosbury style high jump physical training is based on improving the quality of the athlete's technical movement, if only have a strong and high quality body to lay a foundation for improving the performance. The fundamental technology training is only to improve the performance of athletes, and have superb skills to get good grades. Psychological training is very necessary; since the athletes' psychological condition directly affects the results of the competition, therefore only having a sound psychological condition can maintain a higher competitive state. As the training intensity increases, the athletes' training gets particularly important.

By using the method of curve regression for three successive Olympic Games high jump grades and time results, some representatives have observed high practical performance of the high jump, with the best curve fitting linear model that is the conic model. From Table **2** a similar conclusion can be drawn, in which the parity between the slope of a linear and a quadratic curve model is 0.937; Second best is the logarithmic model. From the point of

Table 2.   High jump model summarizing and parameter estimation.

Equation	Model summarizing					Parameter estimation value		
	R square	F	df1	df2	Sig.	constant	b1	b2
linear	.937	342.599	1	23	.000	1.735	.024	
logarithm	.813	100.125	1	23	.000	1.572	.213	
quadratic	.937	164.352	2	22	.000	1.741	.022	-0.125

value, the linear and quadratic linear model is the best, because its value is up to 342.599. The probability value of the three models is 0.000, so all the three models are significant.

To sum up, from the perspective of fitting degree or F value and probability value, the current linear model has the best fitting degree, and thus is considered the most significant fitting model. So, the linear model is selected for the data analysis. According to the linear fitting and constant coefficient, the regression equation is shown below:

The Long Jump Performance Curve Regression Model

Long jump is a track and field sports with a long history, requiring three components of speed, technique and strength to achieve the maximum distance. It is made up of four parts including run, take off, jump, and land to the ground suspension. The four parts are closely linked to make a complete unified whole. So, correctly completing each part of the long jump action, and realizing the combination of each part of the action, is the key to learning the long jump technique. There are many factors influencing the jumping performance of athletes, including: the standardization of the technique, which is the major factor; athlete's adaptation to the field; the athletes' mental state; and so on. In order to achieve the best grades in the game, in the daily training, coaches should standardize the athletes' movement technology, and prioritize the need for athletes training time and carry out the reasonable arrangements for an intensive training plan. In addition, the coaches should also be aware of athletes psychological state, neither they should be too excited nor too negative, in order to keep the best state of mind to meet the challenge.

By using the method of regression analysis and curve fitting, successive games grades and time results for the Olympics long jump performance is analyzed based on three regression curve models, in which we can see that the quadratic curve fitting model is the best. Table **3** shows the value of model of quadratic curve is 0.883, and the second best is curve fitting linear and logarithmic model whose value is 0.868. From the point of value, the linear and logarithmic model is the best, because its maximum value is 151.705 and 151.462 respectively. The probability value of the three models is 0.000, so all the three models are significant.

In conclusion, the best and the most significant quadratic fitting function model should be selected. According to the linear fitting and constant coefficient, the regression equation is shown below:

The Curve of Triple Jump Performance Regression Model

The triple jump athletes need the organic combination of speed, strength and balancing ability. With the triple jump an athletes' physical quality requirement is higher. The jumping technique is relatively complex and, as the technology is constantly changing, so the triple jump in entering the competitive sports. It requires the athletes to have a rapid run-up ability and a very good jumping ability. Triple jump athletes' leg strength must be strong enough, only in this way they can well blend speed and strength together to complete the triple jump movement and get good grades. Triple jump needs explosive force training, jumping ability training and and lumbar muscles training of athletes. The speed is the main factors that affect performance results of athletes in the triple jump, that's why they need not only to have a good run-up speed, but also have good movement speed and jumping speed. Athletes rise after each run with the same initial velocity and the degree of balance achieved by posture angle made in the air will affect the achievement of the triple jump. Cohesion, degree of proportion and rhythm and so on all play important role in improving the jumping performance.

Also by adopting the method of curve and regression analysis, the triple jump Olympic results fit with the grades and time results that show practical performance of triple jump. Among the three models, the quadratic curve fitting model is the best followed by the logarithm model and linear model; Table **4** shows the parity is 0.951. From the point of value, the linear model is the second best, because its value is the largest. The probability value of the three models is 0.000, so all the three models are significant.

In conclusion, the quadratic function model should be selected.

Pole-Vault Performance Curve Regression Model

Pole vault athletes require a long flexible pole support to lift a leg and body upright, and repeated pull-ups pole action over a certain height determined by placing a bar, to calculate the results. The women's pole vault record holder athlete is Russia's Yelena Isinbayeva, and Sergey Bubka maintained Italy's pole vault record. Pole vault is based on the athletes' physical condition, speed, strength and its special technical requirements are very high. At present, the United States is one of the top most countries in terms of pole vault popularity, but as far as the standard is concerned, China's level of pole vault is listed first in the world. However, there is still a gap between China and the United

Table 3.   Long jump model summarizing and parameters estimation.

Equation	Model summarizing					Parameter estimation value		
	R square	F		R square	F		R square	F
linear	.868	151.705	1	23	.000	6.812	.066	
logarithm	.868	151.462	1	23	.000	6.255	.631	
quadratic	.883	83.013	2	22	.000	6.645	.100	-.001

Table 4.   Triple jump model summarizing and parameters estimation.

Equation	Model summarizing					Parameters estimation value		
	R square	F	df1	df2	Sig.	constant	b1	b2
linear	.938	345.304	1	23	.000	13.662	.159	
logarithm	.894	194.431	1	23	.000	12.399	1.496	
quadratic	.951	212.849	2	22	.000	13.291	.237	-.003

Table 5.   Pole vault model summarizing and parameters estimate.

Equation	Model summarizing					Parameters estimation value		
	R square	F		R square	F		R square	F
linear	.965	633.839	1	23	.000	3.096	.107	
logarithm	.827	109.681	1	23	.000	2.372	.956	
quadratic	.965	305.256	2	22	.000	3.129	.101	.000

Table 6.   Curve model prediction value of the 29th and 30th Olympic Games athletic items performance

Sessions	High jump			Long jump			Triple jump			Pole vault		
Item	Predict	Actual	Error	Predict	Actual	Error	Predict	Actual	Error	Predict	Actual	Error
29th	2.43	2.33	4.15	8.70	8.26	5.37	17.6	17.6	0.42	6.20	6.18	0.31
30th	2.46	2.36	4.03	7.75	8.20	5.64	17.3	17.4	0.83	6.31	5.96	5.81

Note: Unit of error values is %, as 4.15 in Table represents 0.0415=4.15%.

States. In order to close the gap unceasingly, the coaches and athletes have made great efforts. Therefore, many scholars and researchers involved in a variety of sports, provided a lot of scientific research for pole vault. With the continuous efforts of athletes and coaches, combined with the scientific training methods, the improvement of pole vault in China is just around the corner.

By fitting the curves of the above three regression curve models to pole vault grades and the time, we can find the best fitting linear model that is the conic model; as shown in Table **5**, its parity is 0.937. The second best is the logarithmic model. From the point of value, the linear model is the best, because its value is the highest that is 633.839. The probability value of the three models is 0.000, so all the three models are significant.

Performances Forecast of the Field Events

On the basis of the above findings, the distribution of scores point for each track and field event, respectively, is obtained by the curve fitting, and SPSS is used to verify the curve fitting degree of high and low. With the increase of the time length and the development trend of various track and field athletics, various considerations and research results can help to get through the good grades/scores. The high jump and pole vault score has a linear relation with the time, whereas the long jump and triple jump has a quadratic function relation with the time. As the change of curve can be expressed in scores point position, so the curve fitting function is a good way to predict future performance and administrations.

In conclusion, the fitting curves of the high jump, long jump, triple jump, and pole vault respectively, as type (1), (2), (3) and (4) are shown using the fitting curve model based on the track and field prediction results of the 29th and the 30th Olympic Games; the error value and actual value are given in Table **6**.

CONCLUSIONS

In this paper, track and field sports scores of four events of 28th Olympics Games i.e. the high jump, long jump, triple jump, pole vault are gathered and processed, and based on the research of the results, the distribution of the data is obtained. According to the study of track and field data of 28th Olympics Games sessions, using the curve regression model, the prediction of the annual number of grade distribution values for the high jump, long jump performance are obtained. The regression curve equation is used to predict the scores of the next two Olympic events of 29th Beijing Olympic Games and 30th London Olympic Games to carry out the error analysis. Through the data obtained for the Chinese sports yearbook, for the 29th Olympic Games the high jump performance prediction value is 8.704, the actual value is 8.275, and the error is 5.18%. Similarly, for 30th Olympic Games high jump actual performance value is 2.63, the predicted value is 2.455, and the error is 4.02%. Thus, the curve fitting function is found to be very feasible to predict the results of track and field, since the prediction results of this study match with the actual result with 4% - 5% error rate.

The error is likely due to the athletes' physical and mental state. So the curve given in this paper to forecast the performance of track and field is one of simple and feasible method.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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