ISSN : 0974 - 7435 Volume 10 Issue 3

BioTechnology
An Indian Journal

FULL PAPER

BTAIJ, 10(3), 2014 [493-498]

Chinese and foreign excellent long jumper performance influence factors research based on GRA model

Zhiqiang Zhao
Teaching Department of Physical Education, Dalian Medical University, Dalian, (CHINA)

ABSTRACT

Long jumpers athletic ability is up to body shape, coordinate ability, sport technique, physical and psychological quality as well as external training conditions, its performance judgment is measured by jumping distance. Now, athletes' scientific selection proportion and status in physical training technique has become more and more high, its way also become more and more advanced, and human body athletic ability comprehensive evaluation method also gets more and more close to athletes themselves actual potentials. This paper makes research on long jumper performance correlation factors, extracts four indicators and analyzes each indicator factor effects. Apply grey mathematical model, solve indicator and performance correlation degree, and initialize data based on Matlab software. And accordingly solve weight and establish performance and factors equations. By comparing Chinese and foreign different excellent athletes' parameters, through analyzing and researching, it gets each factor importance in performance that is weight and verified. By mathematical model establishment, it further analyzes performance influence factors, and proposes relative training suggestions.

KEYWORDS

Long jump performance;
Weight analysis;
Grey relational analysis;
Matlab software.

INTRODUCTION

Current excellent men's long jumpers are mostly from America and Europe, they repeatedly exhibit abundant strength with advantageous physical ability in world level competitions, and their performance and play are remarkable. Chinese men's long jump has made constant progress in 1990s; seen from recent 20 years' performance, Chinese athletes take the leading positions in Asia, but they still keep paces with American and European countries by comparing, and they still not yet arrive at world advanced level. In the 19th Olympic Games, athlete Beamon created 8.90m men's long jump world record, in the following, in Tokyo track and field world championships athlete Powell set a new world record with 8.95m performance. World long jump overall performance has been constantly climbing, since 1990s, by above 20years'development, Chinese men's long jump performance has remarkable improvements, and keeps Asian long jump records, which takes leading position in Asia.

With application of high technology, researches on long jump go more and more deep, experts and scholars take how to change techniques let long jump per-

formance move to the next level as research direction. By searching documents, it finds by consulting that there are lots of scholars have made research on long jump performance influence factor analysis, through numerical analysis, data comparison, regression analysis and other methods researches, they get some conclusions. Among them, Sun Qiang concluded after analyzing and comparing Chinese and foreign excellent long jumpers' parameters that further increased absolute speed ability on the basis of improving stepping and jumping strength was one of effective methods to improve long jump performance; Li Yi-Rong regarded long jump as oblique projectile physical movement, by kinematic analysis of horizontal speed and vertical speed as well as soaring angle to long jump performance influences, she thought takeoff speed and takeoff angle were the key factors; Liu Yan-Qiu analyzed and handled with Chinese and foreign excellent men long jumpers performances and speed parameters, established performances and parameters mathematical regression equation. The uppermost two speed parameters were final two steps speed and soaring vertical component speed, the conclusion provided guidance for training. Lv Guo-Dong analyzed long jump four motions: run-up, takeoff, flight and landing, which provided certain theoretical basis for athletes' performance improving and long jump training.

By previous researching, this paper on that basis, further researches long jump performance as well as its relative factors connection. Based on previous research, define researched factors, and go deeply into theoretical analysis. On the basis of traditional numerical analysis, regression equation and other mathematics, apply grey mathematical theory establishing mathematical model, and define different factors affect long jump performance to which degree. Define each factor and performance correlation degree, by normalization, it gets factors contribution rate in performance, and by example verification, it defines model feasibility. Factors contribution rate sizes decide athletes training direction as well as training indicators emphasis problems. It can provide basis for further improving athletes' performance.

LONG JUMP EVENT

Long jump is also called as running broad jump; it was listed as formal competition event in 1896 the first Olympic Games. Athletes ran-up along straight line, used hop before take-off board and after moving along straight line, through flight phase, and then used two legs landing into sandpits that was composed of run-up, takeoff, flight and landing as well as other motions. In competition, jumping distance decides ranking. In order to better takeoff, generally it needs to go through some distance accelerated running, let human body get maximum horizontal speed. Takeoff leg's three phases in pedal are respectively footing, buffer, pedaling and stretching. When takeoff leg pedaling away from ground, meanwhile swinging arms and swinging legs should coordinate and cooperate to make swinging motion, its key points are raising head, chest out, lifting shoulders, protruding peplum. Air postures generally divides into 1.hang style 2.knee-tuck type 3. Stride-in –the-air type. Graphic is as following Figure 1 show.

GREY MATHEMATICAL MODEL CORRELATION DEGREES

In practical life, to a practical problem, we cannot fully seize its internal relations, structure and other features. Only establish their relations by some unclear connection. We call system with partial known information and partial unknown information as grey system. The paper starts from grey system original feature grey, researches on information greatly lacking of clear correlations system. Grey system can better fit and find out things grey relations, and accordingly solve and handle with practical problems. Especially things cannot exactly aware relations practical problems.

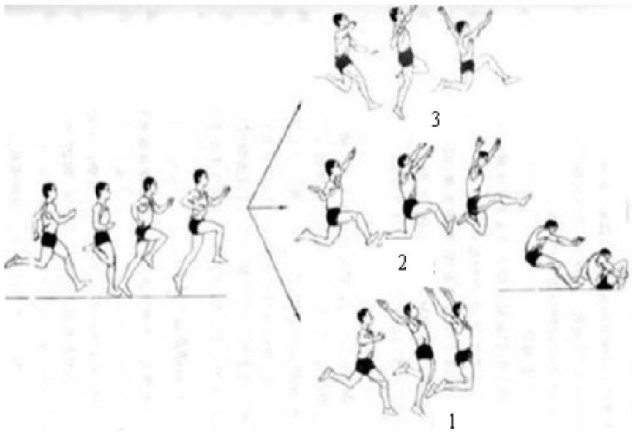

Figure 1 : Long jump air techniques graphic

Correlation analysis and solution

Correlation degree analysis method is put forward by grey system theory. Different from regression equation, it has unique advantages. Grey correlation degree, according to factors development states similarity or difference degree to judge factors correlation degree, it reveals factors dynamical correlation features and degrees. Correlation degree geometric significance is similarity degree after factor converted into function images. Its calculated amounts are less and not prone to appear correlation degree quantization result and qualitative analysis inconsistent status.

Correlation analysis

In long jump, performance influence factors tend to be heavy and complicated. We need analyzing which factors will affect performance, and in these factors, which factors are the main influences that cause performance changing, and which factors are the secondary ones. And which needs to be developed, which needs to be restrained, which is the potential one, and which is the obvious one. To improve long jump performance, factors importance is problems with great concerns. In fact, how do factors correlations like and how to quantify correlation degree and other problems are key and starting points of system analysis. Correlation analysis, which is also system's each factor relative statistical data geometric relations comparison. As a developing and changing system, correlation analysis actually is dynamical process development trend quantization comparative analysis. World excellent athletes' relative movement parameters refer to TABLE 1, in the following, it makes relative analysis.

In TABLE 1, x_0 represents long jump performance, x_1 represents absolute speed, x_2 represents jump angle. Athletes respectively sort from left to right$_{1,2,\cdots 10}$.

According to TABLE 1 data, Excel draws Figure 2 as following.

From above Figure 2, it is easily seen that curve x_0 trend is relative smooth, and equal to curve x_1, two curves development trends are relative smooth, while they have big differences with curve x_2 as well as other two curves, therefore we can get conclusion that the performance is affected by absolute speed, and it should above factor jump angle. That is to say, geometric graph gets more similar, correlation degree would also get bigger. But it cannot provide defined quantization values. Therefore, it needs to get factors correlation degrees sizes by calculation.

TABLE 1 : Sports performance and parameters

Name	Powell	Lewis	Beamon	Amy Yang	Mannix	Huang Geng	Liu Yu- Huang	Chen Zun-Rong	Wang Shi-Jie	Pang Yan
x_0	8.95	8.91	8.9	8.86	8.74	8.38	8.14	8.01	8.01	7.99
x_1	11.61	12.05	11.41	10.78	10.7	10.64	10.59	10.47	10.59	10.71
x_2	23.1	18.1	24	24.9	22.1	20.1	18.7	19.4	19.2	19.1

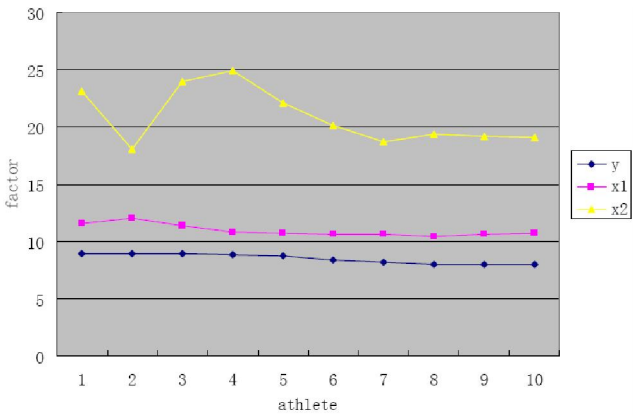

Figure 2 : Performance run chart

Correlation degree solution

By collecting data, the paper makes investigation on excellent athletes, and gets long jump performance and parameters statistical result, performance and influence factors are as TABLE 2 and TABLE 3 show. It will make factor analysis of long jump performance according to correlation degree calculation. At first calculate foreign excellent athletes' correlation degree.

FULL PAPER

At first carry out data transformation. Because collected original data with different dimensions that have no comparability, to ensure modeling result accuracy, it should proceed with data transformation. Method is as following:

(1) Ordered sequence

$x \quad (x(1), x(2), \quad x(n))$

And then call map:

$f : x \rightarrow y$

$f \ x \ k \quad y \ k), k \quad 1,2,\cdots n$

Sequence y data transformation is got by sequence x. Corresponding data transformation are respectively: interval values transformation, percentage transformation, normalization transformation, multiple transformation, mean transformation, maximum range transformation, initialization transformation and so on. Here adopts transformation:

$$(\ (\ )) \quad \frac{(\ )}{(1)} \quad (\ ), \quad 1,2, \qquad (1) \quad 0$$

That is f initialization transformation. Data after respectively initializing and transforming TABLE 2, TABLE 3 original data as following TABLE 4 and TABLE 5.

(2) Correlation coefficient

Select reference sequence. In the paper, reference sequence is athlete long jump performance x_0 .Other

It is comparison sequence x_i to reference sequence long jump performance x_0 at t moment correlation coefficient, from which $\rho \in [0,1]$ is resolution coefficient. In above formula, $\min\min|\ _0(\ ) \quad (\ )|$, $\max\max|\ _0(\ ) \quad (\ )|$ are respectively two-level minimum difference and two-level maximum difference.

Generally speaking, the bigger resolution ratio is, then the bigger resolution coefficient ρ would be; the smaller resolution ratio is, and then the smaller ρ would be, here the calculation takes $\rho = 0.5$.

(3)Correlation degree

Due to each point has a correlation coefficient, and it is a kind of indicator describing reference sequence and comparison sequence at some time correlation degree, therefore it is not convenient to compare, we give correlation degree definition as following:

$$\mathbf{r_i} \quad \frac{\mathbf{1}}{\mathbf{n}} \sum_{\mathbf{k\ 1}}^{\mathbf{n}} \ \mathbf{_i(k)} \qquad \mathbf{(2)}$$

Above formula (2) is reference sequence x_0 correlation degree as sequence x_i .Then it can analyze and research long jump performance influence factors.

The solution, input initialized TABLE 4 data into formula(1), (2),it can get each sequence correlation degree by calculating, similarly input TABLE 5 data to

FULL PAPER

TABLE 6 : Correlation degree

Correlation degree	r_1	r_2	r_3	r_4	r_5
Foreign	0.52	0.51	0.62	0.72	0.53
Domestic	0.58	0.34	0.60	0.75	0.42

performance main influence factors have some differences due to Chinese and foreign athletes' differences, the cause may be takeoff ways difference, but the obvious point is that speed use ratio and last step speed are the key factors to long jump performance. Besides, it should also notice that jump angle in foreign athletes' factor analysis has higher correlation degree, therefore in training; it should take speed use ratio, jump angle and last step rhythm training arrangement into account.

Judge each factor contribution rate

It should highlight one point that domestic and foreign correlation degrees are values during respectively relations calculation, it can only make qualitative comparison, and cannot precise compare where Chinese player's gap with foreign player is as well as how many gap is. Therefore, normalize respective correlation degree let it can under unified scale and further compare factors influence degrees.

Solve factors to performance contribution rate, and make normalization, which takes correlation degree adding sum:

$$R = \sum r_i$$

Call any correlation degree value and entirety ratio as contribution rate:

$$\eta_i = \frac{r_i}{R}$$

By calculation, it can get contribution rate table as following TABLE 7.

By TABLE 7, it is clear seen that Chinese athletes and foreign excellent athletes' long jump performance parameters contribution rate comparing, Chinese athletes have advantages over opponents both in absolute speed and speed use ratio, but their performance always are in lagging phase, mainly because Chinese ath-

TABLE 7 : Contribution rate

Contribution rate	η_1	η_2	η_3	η_4	η_5
Domestic contribution rate	0.18	0.17	0.21	0.25	0.18
Foreign contribution rate	0.21	0.13	0.22	0.28	0.16