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Shot physical training item correlation degree analysis based on grey system theory model

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ABSTRACT

For shot exercise, training items have a variety of types. Combines with grey system theory, it analyzes shot putter physical training each training item, with an aim to reasonable arrange training items, reduce unnecessary training items, further optimize training items. By analyzing excellent shot putters physical abilities data in 2004 to 2008, making research on each training item and shot total result relationship by utilizing grey correlation degree, using Matlab programs so as to get each physical ability training item and shot total result correlation degree, it is clear that shot putters performance maximum influences eight training items are full squat, 3kg glide, power clean, 4kg on site, clean& jerk, standing long jump, 30m take-off, 100m performance.

KEYWORDS

Shot technique;
Grey correlation degree;
Physical training;
Matlab.

INTRODUCTION

Shot is one of athletics throwing events, with sports undertakings development, athletes' competition is also more and more fiercely; scientific reasonable physical training way is important guarantee to improve shot putters' performance. Chinese shot undertakings started late, its developing was relative slow. Though recent ten years, investment in sports shot event building has been enlarged, and achieved certain progress, it is still far from international developed level. China national game men athletes average level is 19.50m, compared to world average level 20.50m, it still has larger gap. To propel to China shot level progress, utilize grey system theory finding out each physical training item to shot total result influence degree. With an aim to optimize shot physical training items, reasonable allocate each physical training item.

For shot physical training, lots of scholars have made large quantities researches, from which Yan Hai-Feng made three dimensional kinematics parameters analysis of Chinese excellent men shot putters' back forward glide shot put technique, he proposed lots of effective improvement suggestions on technical motions. He provided shot putters' left knee swinging speed maximum value and body gravity center speed maximum value remarkable relation expression, and shot speed maximum value remarkable relation expression, which effective proves glide phase left leg swinging affects body gravity center speed. In the article "Discuss shot putter special physical training", professor Yang Hong-Wei clearly mentioned shot put is typical speed, strength exercise event. Yang Hong-Wei in the article "Discuss shot putter special physical training", he pointed out that

shot put is typical speed, strength exercise event, from which theoretical quality is shot putter most important physical quality, of course is also each item body quality basis. To achieve the purpose of increasing muscle strength, it should follow scientific training principles; implement scientific, systematical training to realize the purpose. Ji Ming made research on Chines men excellent shot putters' training ways collocation arrangement, to sports apparatus, he proposed requirements and pointed out light apparatus training mainly used to improve special speed ability aspect, heavy apparatus training was used to develop special strength ability aspect, but the two improvement degrees were different, the former was larger than the latter; maximum power method is athlete selecting best weight apparatus common method, when throwing a group of heavy apparatus, throwing should follow the rule from light to heavy; when throwing a group of light apparatus, throwing should follow the rule from heavy to light.

Apply grey system theory, make research from shot putters physical training perspective, establish grey correlation degree model, carry out grey correlation degree analysis of one athlete data, find out the athlete each physical training item and shot total result correlation degree, and further optimize its physical training plan. After that, promote the model to all shot putters even other sports events, which make contributions to Chinese shot undertakings and sports progress.

SHOT PHYSICAL TRAINING ANALYSIS BASED ON GREY SYSTEM THEORY

Objective world is changing, everything, every factor are mutually related to each other and mutually restrict each other, and construct one entity, is called as system. Many practical problems in the system, their features, structure, parameters, distinguishing criterion and others haven't fully understood by people, therefore researchers cannot clearly research their internal mechanism like solving screen problems, only according to deduction, logic conclusions and other methods to construct relative mathematical model, in this way, system that handles with unknown or not fully known information here is called grey system.

Grey system theory proposes a kind of new analysis method—correlation degree analysis method, adopts grey correlation degree analysis, it analyzes shot each physical training item and shot performance relationship. Define each factor to shot performance correlation degree that is shot performance influence ability relative sizes, so that find out shot performance larger influences some physical training items, targeted strengthen these training items' training in future physical training.

Grey system theory is deduced according to objective system brand new understanding, though in deduction, some systematical information is not sufficient, is unknown or not fully known, as system it similarly possesses their specified functions and orders, only their internal rules haven't been found and displayed their reserved property. While many random, disordered interference information or unorganized data series from them, from the perspective of grey theory view, it is thought these information is still valid not in vain. To the paper, shot physical training has varieties of items, roughly it includes above 20 items, each training item has different impacts on shot performance, every physical training item and shot total result relationship is as Figure 1 show.

In Figure 1, W represents shot total result $r_1 \cdots r_{16}$

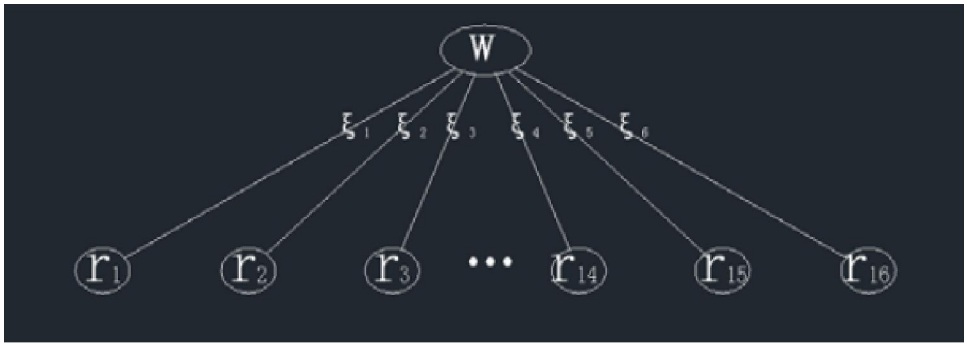

Figure 1 : Physical training items and shot result relationship diagram

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represents shot each physical training item, ζ represents each physical training items and shot total result correlation degree.

By tracking survey on one master-level woman shot putter, it gets her every year best result and 16 items' special quality and physical quality time series information from 2004 to 2008 as TABLE 1 show.

Table 1 data handling

To guarantee established model accuracy and system analysis reliability, firstly make transformation and handling with collected original data, then further eliminate dimension by new data, so that let data have comparability after handling.

Given it has series: $x = (x(1), x(2), \cdots, x(n))$

TABLE 1: Each item sports performance (one master-level woman shot putter)

	2004	2005	2006	2007	2008
Shot special performance x_0	13.6	14.01	14.54	15.64	15.96
4kg forward cast x_1	11.5	13	15.15	15.3	15.02
4kg back cast x_2	13.76	16.36	16.9	16.56	17.3
4kg on site x_3	12.41	12.7	13.96	14.04	13.46
Standing long jump x_4	2.48	2.49	2.56	2.64	2.59
Power clean x_5	85	85	90	100	105
Clean & jerk x_6	55	65	75	80	80
Bench press x_7	65	70	75	85	90
3kg forward cast x_8	12.8	15.3	16.24	16.4	17.05
3kg back cast x_9	15.3	18.4	18.75	17.95	19.3
3kg on site x_{10}	12.7	14.5	14.66	15.88	15.7
3kg glide x_{11}	14.78	15.54	16.03	16.87	17.82
Standing triple jump x_{12}	7.64	7.65	7.76	7.54	7.7
Full squat x_{13}	120	125	130	140	140
Clean jerk x_{14}	80	85	90	90	95
30 meters starting x_{15}	4"2	4"25	4"1	4"06	3"99
100 meters x_{16}	13"1	13"42	12"85	12"72	12"56

Then call map: $f: x \to y$, $f(x(k)) = y(k), k = 1,2,\cdots n$ is series x to series y data transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k)}{x(1)} = y(k), x(1) \neq 0} \quad \textbf{(1)}$$

It is called f is initial value transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k)}{\bar{x}} = y(k), \bar{x} = \frac{1}{n}\sum_{k=1}^{n} x(k)} \quad \textbf{(2)}$$

It is called f is average value transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k)}{\max\limits_{k} x(k)} = y(k)} \quad \textbf{(3)}$$

It is called f is percentage transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k)}{\min\limits_{k} x(k)} = y(k), \min x(k) \neq 0} \quad (4)$$

It is called f is times transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k)}{x_0} = y(k)} \quad \textbf{(5)}$$

From which x_0 is some value that above 0ÿit is called f is normalization transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k) - \min\limits_{k} x(k)}{\max\limits_{k} x(k)} = y(k)} \quad \textbf{(6)}$$

It is called f is range maximum value transformation.

When:

$$\mathbf{f(x(k)) = \frac{x(k) - \min\limits_{k} x(k)}{\max\limits_{k} x(k) - \min\limits_{k} x(k)} = y(k)} \quad \textbf{(7)}$$

It is called f is interval value transformation.

Correlation analysis

Select TABLE 1 reference series:

$$\mathbf{x_0 = \{x_0(k) | k = 1,2,\cdots,n\} = (x_0(1), x_0(2), \cdots, x_0(n))}$$

Among them, k represents time. Assume that it has m pieces of comparison series:

$$\mathbf{x_i = \{x_i(k) | k = 1,2,\cdots,n\} = (x_i(1), x_i(2), \cdots, x_i(n)), i = 1,2,\cdots m}$$

Then it calls:

$$\mathbf{\xi_i(k) = \frac{\min\limits_{s}\min\limits_{t}|x_0(t) - x_s(t)| + \rho \min\limits_{s}\min\limits_{t}|x_0(t) - x_s(t)|}{|x_0(k) - x_i(k)| + \rho \min\limits_{s}\min\limits_{t}|x_0(t) - x_s(t)|}} \quad \textbf{(8)}$$

That is x_i to x_0 in the k moment correlation coefficient, from which $\rho \in [0,1]$ is resolution coefficient. It calls formula (8) $\min\limits_{s}\min\limits_{t}|x_0(t) - x_s(t)|$, $\min\limits_{s}\min\limits_{t}|x_0(t) - x_s(t)|$ are respectively two-level minimum difference and two-level maximum difference. Generally speakingÿthe bigger resolution coefficient ρ is, the bigger resolution ratio would beÿthe smaller ρ is, the smaller resolution ratio would be.

For describing comparison series and reference series correlation degree problems at some time, above proposed correlation coefficient is an important indicator to describe, but due to information is too scattering, it is relative difficult when comparing, based on above consideration, it can put forward:

$$\mathbf{r_i \frac{1}{n}\sum_{k=1}^{n} \xi_i(k)} \quad \textbf{(9)}$$

That is series x_i to reference series x_0 correlation degree. It is clear that correlation degree is an average value, it is every time correlation coefficient concentrate reflection, it can concentrate excessive scattering data and information to process and handle. Making use of correlation degree the concept, we can implement factor analysis of each problem.

According to above theory, before using formula(8) and formula(9) to calculate correlation degree, firstly initial process data in TABLE 1, due to TABLE 1 different series have different dimensions, while calculating correlation coefficient, it requires dimensions should be same. Therefore, firstly carry out dimensionless process with TABLE 1 data. Concrete transformation for given TABLE 1 data is as following.

Given series $x = (x(1), x(2), \cdots, x(n))$, it is called:

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$$\bar{x} = \left(1, \frac{x(2)}{x(1)}, \cdots, \frac{x(n)}{x(1)}\right) \quad (10)$$

That is original series X initialized series.

In this way, make initial process with TABLE 1's 17 series. For the former 15 series, with time increasing, values increasing means sports level progress, while to the later 2 series, with time increasing, value (seconds) is decreasing means sports level progress. Therefore, when making initial process with series x_{15} and x_{16}, adopt following formula:

$$x_i = \left(1, \frac{x_i(1)}{x_i(2)}, \frac{x_i(1)}{x_i(3)}, \frac{x_i(1)}{x_i(4)}, \frac{x_i(1)}{x_i(5)}\right), i = 15.16 \quad (11)$$

According to problems requirements, naturally select shot putters special performance as reference series, input TABLE 1 each series initialized series into formula(1) and (2), by Matlab, programming according to above steps it is easier to work out each physical training item to shot performance correlation degree as following TABLE 2 show.

According to TABLE 2, it can get Figure 2.

TABLE 2 : Correlation degree calculation result

r_1	r_2	r_3	r_4	r_5	r_6	r_7	r_8
0.588	0.663	0.854	0.776	0.866	0.502	0.657	0.582
r_9	r_{10}	r_{11}	r_{12}	r_{13}	r_{14}	r_{15}	r_{16}
0.683	0.696	0.896	0.705	0.933	0.847	0.745	0.762

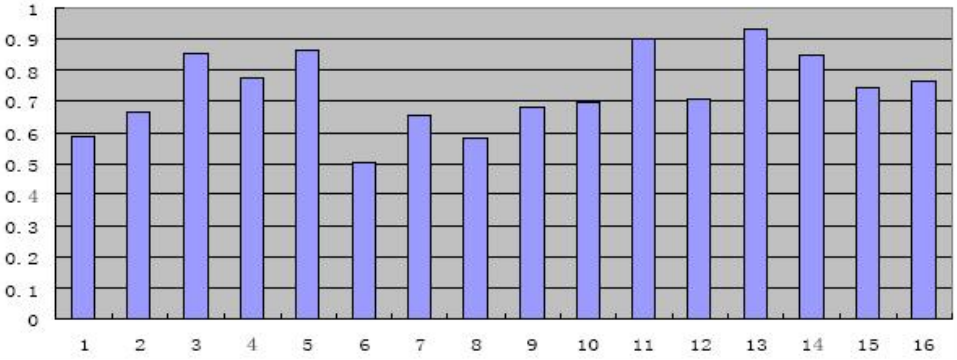

Figure 2 : Every physical training item correlation degree

In Figure 2, subscript 1~16 are respectively corresponding to TABLE2 $r_1 \sim r_{16}$. From Figure 2, it can clearly find every physical training item to shot performance correlation degree scale. It is easily known that shot special performance influence top eight main factors are successively as full squat, 3kg glide; power clean, 4kg on site, clean & jerk, standing long jump, 30m take-off, 100m performance. Therefore, in training it should put emphasis considering on these eight indicators training arrangement. So that can reduce blind training and improve training result.

CONCLUSIONS

By grey correlation degree analysis, it established grey correlation degree model based on shot physical training item evaluation system, the model can be promoted to other sports item physical training. For shot physical training, it finds out the master-level shot putter total result maximum influences top eight physical training items that are respectively full squat, 3kg glide, power clean, 4kg on site, clean & jerk, standing long jump, 30m take-off, 100m performance; therefore, in future physical training, it should strengthen the eight items training, so that optimize the athlete training item plan. Reasonable reduce unnecessary training items, strengthen key items training and arrive at double benefits to make contributions to Chinese shot undertakings' development.

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