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Based on BP neural network prediction research in the shot put athletes success

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ABSTRACT

With the rapid development of undertakings of physical culture and sports, especially the success of the Beijing 2008 Olympic Games held, made all the undertakings of physical culture and sports, much attention has been paid to the shot put movement has become the focus of the problem, many scholars research on and the project is. This article is based on the use of neural network model to forecast the shot put athletes performance, after the account of the BP neural network theory combined with concrete practice, it is concluded that the prediction of future trends, and proves the validity and rationality of this model.

KEYWORDS

Neural network; Prediction model; Sports performance; Shot putter; Physiological factor.

INTRODUCTION

On the basis of previous achievements of the athletes of prediction not only impact on small sports games, and aimed at the Asian games and national games and the Olympic Games have a irresistible enormous positive role, in addition he also provide reference to the training of the coaches and athletes, therefore prediction model has significant effect on the sports competitions of calendar year.

On the various sports prediction correlation study of the project, the efforts of many scholars, and provided the impetus for development of the scientific prediction. Such as: zhangyu, sports scores for the neural network based prediction is put forward in several athletics performance such as the men's 100 m as sample, by applying the BP algorithm and correlation software for data processing, sports scores and forecast for the next two years, it is concluded that the applicability and feasibility of the algorithm, and summed up the BP neural network have strong applicability and high accuracy; Wang Zong equality, in 2006 through the neural network to man swimming is forecasted and high precision are obtained.

In this paper, it is on the basis of previous studies, by using the least square method, the method of multiple regression and neural network, finally it is concluded that the neural network prediction effect is one of the best scientific conclusion.

NEURAL NETWORK THEORY CONSTITUTIONS

Achievements about sports can be divided into two categories, generally is the general quality of the athletes performance and special performance, but both often appear jagged present situation, the BP neural network model is required to detect the relationship between them, thus formed the neural network model, after the relevant training as long as we are going to the sports performance prediction in the neural network model which can calculate the total grade, through this way to improve the prediction accuracy.

Neural network consists of monolayer and multilayer neural network, neural network through the connection between them is through the neurons, which are shown in Figure 1 below:

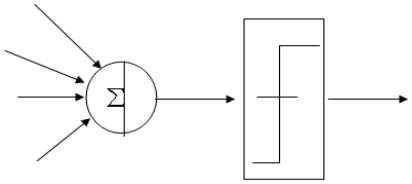

Figure 1 : Neuron model

Establish output layer, input layer and hidden layer three kinds of patterns BP neural network model, its structure is as Figure 2 show:

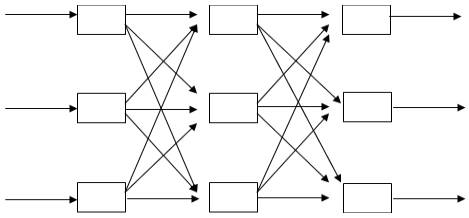

Figure 2 : Process of neural network theory

Though there are no any connections among them, their nerve cells are mutual correlated. The algorithm learning process is composed of two directions that are respectively forward direction process and reverse two propagation processes, from which, forward propagation is:

$$net_{jk}^{l} = \sum_{j} \omega_{jk}^{l} o_{jk}^{l-1} \tag{1}$$

In above formula, $l-1$ represents number of layers,is expressed by o_{jk}^{l-1} ,and when output j pieces of units nodes,the input is the k sample,then:

$$o_{jk}^{l} = f(net_{jk}^{l}) \tag{2}$$

Reverse propagation:

①If input unit node is j ,then

$$o_{jk}^{l} = \bar{y}_{jk} \tag{3}$$

Among them, use j as actual output unit which is expressed by $\bar{y}_{jk}$

$$\delta_{jk}^{l} = -(y_k - \bar{y}_{jk}) f'(net_{jk}^{l}) \tag{4}$$

② If input unit node is not j ,then:

$$\delta_{jk}^{l} = \sum_{m} \delta_{mk}^{l+1} \omega_{mj}^{l+1} f'(net_{jk}^{l}) \tag{5}$$

$$\frac{\partial E_k}{\partial \omega_{ij}} = \delta_{jk}^{l} o_{jk}^{l-1} \tag{6}$$

Revise weight

$$\omega_{ij} = \omega_{ij} - \mu \frac{\partial E}{\partial \omega_{ij}}, \mu > 0$$

Here

$$\frac{\partial E}{\partial \omega_{ij}} = \sum_{k=1}^{M} \frac{\partial E}{\partial \omega_{ij}} \tag{7}$$

Among them, the process from input layer to hidden layer and then transfer to output layer is information forward direction propagation, but once end cannot get corresponding output result, it will automatically turn to reverse propagation, one nerve cell k is expressed by following formula:

$$u_k = \sum_{i=1}^{n} w_{ki} x_i \tag{8}$$

$$y_k = f(u_k + b_k) \tag{9}$$

In above formula, nerve cell unit threshold value is b_k, in linear combination, input signal output is u_k, output signal is y_k, protruded weight is w_{ik}, input signal is x_k,and meanwhile activated function is $F()$, corresponding function formula is as following:

$$f(v) = \frac{1}{1+e^{-v}} \quad \textbf{(10)}$$

Due to BP neural network nerve cell does not change; Corresponding model is as Figure 3:

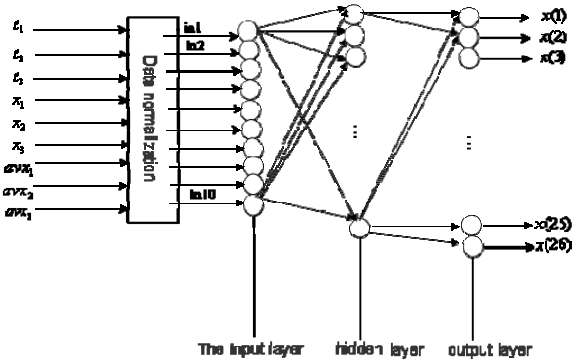

Figure 3 : Neural network operation process

For BP nerve cell, its input end is:

$$net = x_1 w_1 + x_2 w_2 + \cdots + x_n w_n \quad \textbf{(11)}$$

In above formula, connection weight value: $w_1, w_2, \cdots, w_n$, input value: $x_1, x_2, \cdots, x_n$. These nerve cells all activated functions use S type function; the function not only is continuous but also can derive.

BP NEURAL NETWORK LEARNING PROCESS

Neural network is mainly up to two aspects: model parameters, features, from which parameters include stopping, hidden layer, learning rate and other criterions, and the learning process is as Figure 4 show:

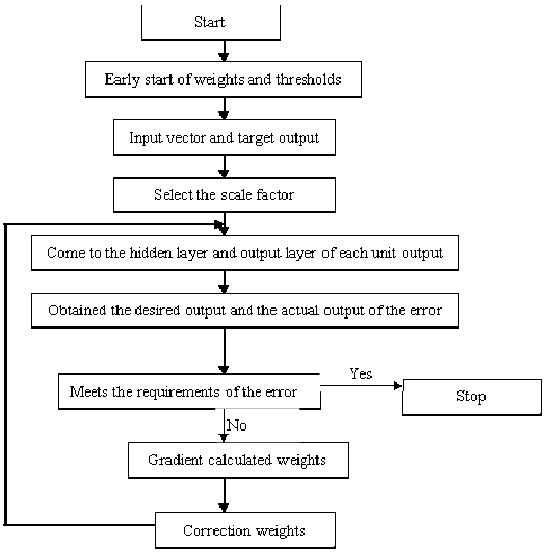

Figure 4 : Learning neural network model

Neural network learning process starts implementing form initialized network, and then inputs the input layer into a training corresponding mode, after network transitive signal recognition, it defines output value size and automatically sets a matching minimum value, if error is out of the value, and then system will automatically circulate the function till error reduces to range.

Original data standardization process

Define that between 0 and 1 is BP neural network node value, if input information hasn't arrived at hidden layer, then the node is 0, therefore to avoid the fault status, we adopt standardization handling with these original data, adopt:

$$1 = \sqrt{m - n} + a \tag{12}$$

Hidden point initial number values can be defined by formula (2),that is:

$$1 = \sqrt{0.43mn + 0.12n^3 + 2.54m + 0.77n + 0.35 + 0.51} \tag{13}$$

Among them, in above two formulas, a is a constant,and is a number between 1and 10, n, m are the number of output and input nodes. We work out an initial value by formula (1), and then solve it step by step.

Define error

Assume when outputs network, error value is:

$$E_K = \frac{1}{2}\sum_j (y_{jk} - o_{jk})^2 \tag{14}$$

We assume that $E = \sum E_K$ is the sum of the model whole process generated output errors, and in above formula, actual output value is o_{jlk} ,ideal output value is y_{jk} .

APPLY NEURAL NETWORK INTO SHOT PERFORMANCE PREDICTION THEORY RESEARCH MODEL

The paper selects world juvenile champion Mr. Lee as research object, the athlete physical quality and performance as following TABLE 1 show:

TABLE 1 : Quality training level and special performance table

Years	2007	2008	2009	2010	2011	2012
Power clean/kg	56	60	77	90	95	99
Full squat/kg	82	100	130	140	145	155
Bench press/kg	52	60	80	87	89	105
Snatch/kg	42	52	55	61	65	70
4kg forward cast/m	14.50	13.78	14.80	16.40	17.10	17.80
4kg back cast/m	13.20	14.10	16.00	17.80	18.60	18.50
4kg in situ/m	12.50	12.80	14.10	15.40	16.00	16.40
3kg glide/m	15.60	16.80	18.50	19.20	19.80	20.90
30m/s	4.26	4.18	3.95	3.92	3.85	3.82
100m/s	14.17	13.77	12.91	12.70	12.60	12.40
Standing triple jump/m	7.30	7.20	7.50	7.85	8.20	8.30
Standing long jump/m	2.30	2.35	2.47	2.52	2.75	2.80
Special performance/m	13020	13.56	15.40	17.88	18.47	18.96

According to above TABLE 1 data, it makes relational degree analysis and correlation analysis on the athlete performance and quality training indicators, its corresponding result is as following TABLE 2 show:

TABLE 2 : Quality training indicator and special performance correlation coefficient and relational degree

Quality training indicator	Correlation coefficient	Relational degree
Power clean/kg	0.9730	0.8711
Full squat/kg	0.9356	0.8302
Bench press/kg	0.9732	0.8206
Snatch/kg	0.9704	0.9125
4kg forward cast/m	0.9200	0.8521
4kg back cast/m	0.9028	0.8590
4kg in situ/m	0.9880	0.9702
3kg glide/m	0.9650	0.7633
30m running/s	-0.8960	0.8805
100m running/s	-0.8965	0.7412
Standing triple jump/m	0.9854	0.8695
Standing long jump/m	0.8863	0.9096

Establish neural network structure model

Firstly select 12 items physical quality training as input nerve cell amount, then use 1 to represent performance as output nerve cell amount, and nerve cell hidden layer is 20 that takes one layer, they are using linear function to transfer.

Take athlete previous performance as BP algorithm samples, utilize BP algorithm to carry out corresponding correlation learning, its essence is a process that optimizes neural network weights, so we design program for shot putters' neural network prediction model, input above previous data into the model, it gets the athlete special item performance, and then by utilizing least square method, it makes

fitting between previous special performance and physical quality training, and get corresponding function relations :

$$y = 0.07x_1 - 0.29x_2 + 9.84x_3 - 3.57x_4 - 0.03x_5 - 0.06x_6 + 0.04x_7 + 0.21x_8 + 3.27x_9 - 0.01x_{10} - 0.94x_{11} - 1.48x_{12} = 17.55$$

Input TABLE 1 performance into above model, it gets prediction model fitting precise table, as following TABLE 3 show:

TABLE 3 : Prediction model fitting precise

Year	Actual value/m	Neural network model		Multiple regression model	
		Predicted value/m	Error/m	Predicted value/m	Error/m
2010	13.40	13.363	0.037	13.567	-0.167
2011	14.90	14.903	-0.003	15.208	-0.308
2012	15.65	15.641	0.009	16.095	-0.544
2013	17.80	17.805	-0.005	17.416	-0.384

For athlete corresponding sports performance in 2014 and 2015 such two years, apply multiple regression way to handle with predicted performance, meanwhile input the two years data into neural network above model, it can get the two years corresponding prediction performance and then get prediction precise as following TABLE 4 show:

TABLE 4 : Prediction model predicted precise

Actual value/m		Neural network model		Multiple regression model	
		Predicted value/m	Error/m	Predicted value/m	Error/m
Year 2014	18.42	18.358	0.062	18.716	-0.296
Year 2015	18.63	18.790	0.160	18.98	-0.350

By above TABLE 4, we can see that multiple regression model is worse than BP neural network, so by comparison, it can see neural network model prediction precise is high that highlights neural network superiority.

CONCLUSION

(1) analysis of shot put the grade of the athlete is affected by many factors, we use the method of using BP neural network for prediction and analysis overcomes the relative to the least squares method and the multivariate regression model, the shortcomings and the insufficiency, showed it has obvious advantages.

(2) because the neural network has himself's ability to store, organize, and learning and he will bring great convenience for the prediction of shot put results beneficial to improve the computation efficiency of the improved model.

(3) in this paper, by using neural network to forecast, this method will grasp of the coaches and athletes and reasonable development of its result provides a favorable evidence, therefore to set scientific and reasonable athlete's training program provides an important reference

(4) this paper not only introduces the shot put athletes performance prediction of BP neural network algorithm, but also application specific example verification, the result display structure the rationality and accuracy of the model.

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