The Establishment of Sorts Performance Prediction Model Based on BP Neural Network and Solution by SPSS

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Abstract. Since there are various factors affecting the sports scores and difficulties for traditional sports prediction method to get a satisfactory prediction results, this thesis by using the correlation of the Long Jumpers achievements and the level of quality training wielding the powerful nonlinear mapping ability of the BP neural network, proposes a neural network model for predicting the long jump Jumpers' scores. Compared with traditional methods, this model makes a full use of the information contained in the data. Therefore the prediction accuracy has been greatly improved. This model also is a innovation of both ideas and methods to solve those complex posers which are difficult to be solved by using traditional mathematical, and it provides a theoretical basis of the scientific training for athletes.

Introduction

There are many factors affecting the results of sports competitions and the most important is the athlete's physique. Howere at the same time the athlete's body, technical characteristics, mental state, and external environment also will affect the athlete's sports performance to some extent [1-2]. Traditional forecasting methods guide the day-to-day training of the athletes by taking advantage of individual athletes training quota to predict Specific Performance to a certain degree, but these models have relatively harsh conditions and range of application, for example, in the usage of multiple linear regression model to make predictions, Specific Performance achievements and all relevant factors need to obey the normality and homogeneity of variance , multiple linear relationship and other stringent conditions. Besides the grey system forecasting model which belongs to linear modeling has a certain effect on the short-term forecast accuracy, but for complex nonlinear relationship, it is difficult for the grey system forecasting model to obtain an acceptable prediction error [3] . In reality, there may be a complex nonlinear relationship between specific performance accomplishments and quality training levels, which is hard to meet the conditions of traditional prediction model. Therefore, using the multiple linear regression or gray traditional model to predict athletes' specific perfoemance results may has some errors, which will result in reducing prediction accuracy and fail to show reasonable features[4-6].

Comparing with the traditional prediction methods, BP neural network has no strict conditions of pplications. Variables are not required to meet the conditions: linear, independence, normality and homogeneity of variance etc. This network has self-organization, self-adaptability, strong fault tolerance and other features which can carry on nonlinear mapping of data if the traditional forecasting model can't achieve or the forecast result is inaccuracy, this model can achieve a accurate prediction.

Study Object

Part of the domestic first-class level long jumpers.

Study Method

Artificial neural network is a information processing system composed of a large number of connected processing units, with the characteristics of nonlinear, self-adaptability and so on. The neural network originated from the modern neuroscience research, the main purpose is to try to

process information by simulating the way how the brain network processes memory information. The artificial neural network is a parallel distribution systems, using a completely different principle from the traditional artificial intelligence and information processing technology to overcome the defects of traditional logic symbol-based artificial intelligence in dealing with intuition, unstructured information. The netwok has a series of advantages: good fault-tolerant memory, association, self-adaptability, good robustness and anti-interference ability etc [7].

According to the network topology structure the artificial neural network can be divided into feedforward type network and feedback type network. The feedforward type network mainly about function mapping is used for pattern recognition and function approximation. It has been approved that multilayer feedforward network can approximate any continuous function, in other worlds, by using multilayer feedforward network the athletes performance prediction system can establish any function relationship between the specific performance and quality training indicators and reflect their inner characteristics. As a result, this network will overcome the deficiencies of multiple regression model and grey model [5]. The function can be expressed as:

$$f(x) = 1/[1+\exp(-x)]$$

The BP neural network, namely back propagation, has been applicated more at present. The basic idea is the usage of the gradient search theory to get the minimum mean square of the actual output and the expected output. The input variable X_i vias intermediate node to influence the output node through a complex non-linear transformation process to generate the output variable Y_K. If the difference between the response variable and the model output variable is higher than the previously set standard error values, then re-set the weights and re-establish the model. Stope training until the error value is less than the previously set error value.

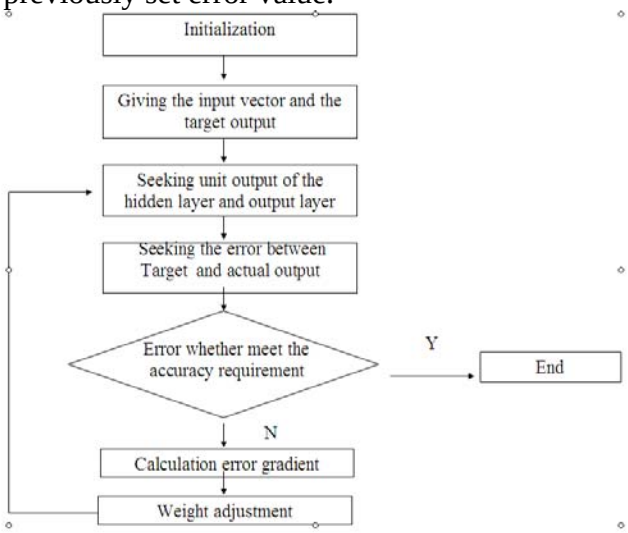

Figure 1. BP neural network calculation procedures

Specific Performance forecast and the BP neural network model

A. Independent variables screening

Because of the correlation strength differences between the quality training index and specific performance, the influence coefficients of prediction also will be different. Those quality training indicators which have greater influences should be picked out. Using 2008-2009 long jump athletes data collected by General Administration of Sport to analyse the correlation of long jump athletes training quality indicators and Specific Performanc, Calculating the correlation coefficient (r) respectively(table 1). According to Table 1, it is known that in the standing triple jump, 30-meter run, initially body jumping speed at the moment leaving the plate, speed of last five meters run-up, 100 -meter run, the differences between the quality of training indicators and Specific Performance are quite strong. So the five training iteams are selected for athletes special performance prediction factors.

TABLE I. The correlation degree between quality of training indicators and special performance

quality of training indicators	correlation degree
100-meter run (S)	0.6748
300-meter run (S)	0.6469
150-meter run (S)	0.6972
standing triple jump（m）	0.9876
speed of last five meters run-up（m/s）	0.8362
the average landing speed of body center（m/s）	0.5624
legs swinging speed(m/s)	0.5968
initially body jumping speed at the moment leaving the plate(m/s)	0.6286
Squats barbell（kg）	0.4136

B. The establishment of BP neural network prediction model

1) The determination of the network structure

The basis of the neural network model's establishment is to determine the structure of the neural network . The Kolmogorov theorem states [8-9] , any given continuous function f : [0,1] → RJ , f can accurately achieved by using a three-layer BP neural network which contain one neurons in the input layer and 2I+1 neurons in the middle layer. In the study, five Jumpers closely related predicting factors were selected and five input neurons were set. Then according to the Kolmogorov theorem , a hidden layer were selected and its neurons number is 11 . The output layer is used for collecting specific achievement data.

2) The study of network

Five training quality indicators as well as special achievement data are selected as the training samples (table 2). Inputing the five quality of training indicators data as predictors, the corresponding specific achievements act as output data. BP neural network model is quite sensitive to the numbers among (0,1), the original data need to be normalized to the range of (0,1). The specific approach is as follows:

$$x_i^{'} = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}$$

x^i is the original value , x'i is the normalized value, X_{min} and X_{max} denote the minimum and maximum values respectively. Puting the normalized data into BP neural network then studying the training samples, minimizing the network output error to an acceptable level, thus setting up the best mapping between the training quality indicators and specific achievements, which will help to achieve a accurately specific achievementsin prediction. This is a complex study procedure, the SPSS19.0 statistical software is adopted for the BP neural network trainng study .

TABLE II. Neural network input layer and output layer data

sample	Input sample					Output sample
	standing triple jump（m）	speed of last five meters run-up （s/m）	100-meter run （s）	30-meter run（s）	initially body jumping speed at the moment leaving the plate（s/m）	Long jump results（m）
1	9.98	11.36	10.3	4.0	9.68	7.89
2	10.13	10.92	9.8	3.8	9.70	7.73
3	9.68	10.00	9.7	3.9	9.59	8.46
4	9.95	10.22	8.9	3.8	9.67	8.01
5	10.10	9.98	9.0	4.1	9.51	8.10

3) The results of BP neural network model

Firstly, selecting Long Jumpers' quality training indicators data from 2008 to 2009 and normalizing the data then substituting them into the neural network model and getting the specific achievement predictive value through the software analysis processing. Using the multiple linear regression model to express the quality training indicator and specific achievements of 2008 -2009 and combine with the usage of the least squares fitting , finally the mathematical model is fonuded:

$y=0.35X_1+0.2X_2-0.18X_3-0.26X_4+0.29X_5+7.6$

X_1, X_2, X_3, X_4, X_5 respectively represent the quality training indicators which were previously selected i.e. the standing triple jump, the 30-meter run,the speed of last five meters run-up,the 100 -meter run and the initially body jumping speed at the moment leaving the plate. Calculating the predicted value of specific performances for the athletesby taking advantage of the multiple linear regression model from 2008 to 2009. The calculation results are shown in Table 3.

TABLE III. fitting accuracy of the prediction model

No.	Actual value（m）	BP neural network model		The Multiple linear regression model	
		Predictive value（m）	Error（m）	Predictive value（m）	Error（m）
1	7.89	7.92	-0.03	8.24	-0.35
2	7.73	7.69	0.04	7.61	0.12
3	8.64	8.62	0.02	8.57	0.07
4	8.01	8.10	0.09	8.11	-0.10
5	8.10	8.04	0.06	7.84	0.26

It can be seen from the Eerror column in Table 3, the prediction error of BP neural network forecasting model is much less than that of the multiple linear regression model. By calculating the errors of the various methods BP neural network model average relative error is 0.048, the average relative error of multiple linear regression model is 0.188. In other words the neural network model prediction is better than that of multiple linear regression model, BP neural network model is more suitable for the the Long Jumpers' results prediction.

Conclusion

The prediction method based on the BP neural network's prediction for long jump athletes' specific performance has the strong nonlinear mapping ability, generalization ability, and higher prediction precision ability. This network also overcomes the shortages of the existing traditional prediction method for long jump athletes: subjectivity, haphazardry, and harsh conditions of usage which means the prediction model and mathematical expressionprior must be selected in advance. For athletes, this network can provide a foundation for reasonable arrangement of scientific training plan and athletes selection. This network worth a further study.

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