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Basketball field –goal percentage prediction model research and application based on BP neural network

Jijun Guo

Department of Physical Education, Shenyang Ligong University, Shenyang 110159, Liaoning, (CHINA)

ABSTRACT

Through ability analysis of NBA team members, utilize BP neural network to make prediction on basketball field-goal percentage. Extract 50 feature vectors from 16 members' stats to take training, it finds that outputs well conform to actual values, indicates that the received connection weight can reflect actual status. It mainly on the basis of time series statistical data, basketball competition statistical technique, back propagation neural network used model BP network, adopt rolling prediction to predict China athletes' basketball field-goal percentage. Difference between prediction results and actual are relative small, it shows prediction feasibility of using BP neural network to define basketball field-goal percentage.

KEYWORDS

BP neural network;
Basketball field-goal percentage;
Rolling prediction;
Statistical analysis.

INTRODUCTION

Sports scientific prediction is one of indispensable important factors in future sports strategy researches, a country sports stable development objective cannot do without sports scientific prediction. Therefore, sports prediction has played more and more important roles in actual, in modern sports development and sports scientific management, it also causes sports leader decision-making, paying high attentions to managers and researchers. Apply modern prediction method into sports scientific researching, with statistics theory and method as main basis, and through sports mathematical penetrating and effecting, computer technology and other disciplines knowledge, so that let sports scientific prediction methods application level and application fields gradually get improvement and expansion. Predict future performance in Olympic Games such huge sports meeting is the focus of sports researchers' concerns, it is related to sports development national objectives defining and decision management.

In order to build correct development strategy objective system, reasonable and strategic items, therefore many experts and scholars go in for prediction researches deployment planning. So, neural network and artificial intelligence predicting sports complicated system has opened widely development prospect.

BP NEURAL NETWORK PREDICTION MODEL

Because data collecting is very difficult, only when making prediction on field-goal percentage, it can select NBA seasons from 2005 to 2006 Houston Rockets technical statistics, Athens Olympic Games in 2004, the 14th world basketball championship, intercontinen-

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tal cup basketball game in 2006, historical data statistics China men basketball team in the 15th basketball men's world championship as training samples. According to model existing statistical data, and consider actual basketball competition, shooting input variable as shooting.

BP network design

Through using three layers' network shooting prediction model, that input layer has 1 nerve cell representing field-goal percentage input values, numbers of hidden layer nerve cell is 20, and output layer nerve cell is a prediction value representing shooting. While hidden layer used activation function is tang in, output layer is prelim.

Rolling prediction implementation process

Rolling prediction on shooting percentage is period and gradually predicting value period through a group of historical data and prediction data predicting future values time continuously taken as historical data.

(l) Neural training

Use NBA seasons in 2005 and 2006 as network input technique statistical data Houston Rockets, Athens Olympic Games in 2004, the 14th world basketball championship, and intercontinental cup basketball game in 2006, the 15th basketball men's world championship as training samples.

(2) Neural prediction

Utilize well trained network, input Athens Olympic Games in 2004, the 14th world championship, and intercontinental cup basketball game in 2006, the 15th world championship China's men basketball technical statistics, output prediction data of China's men basketball field-goal percentage in 2008 Beijing Olympic Games. China's men basketball technical statistics data as outputs, train sample set to train the network, cultivate good China network ability.

Field-goal percentage rolling prediction analysis

1 Network data input

Synthesize season Houston Rockets technical statistics, the six groups data are respective Athens Olympic Games in 2004, the 14th world basketball championship, and intercontinental cup basketball game in 2006, the 15th basketball world championship China's men basketball technical statistics, it gets film-on-set statistical numbers and list them into TABLE 1.

In TABLE 1, from the first group to the fifth group is composed of Houston Rockets technical statistics data in NBA2005 to 2006 seasons, the sixth group data is derived from Athens Olympic Games in 2004, the 14th world basketball championship, and intercontinental cup basketball game in 2006, the 15th basketball world championship China's men basketball technical statistics

TABLE 1: Relative technical statistical data

Group Sequence	1	2	3	4
The first group	0. 4328	0. 4255	0. 4252	0. 4082
The second group	0. 4612	0. 4467	0. 3610	0. 4638
The third group	0. 3844	0. 4507	0. 4268	0. 4326
The fourth group	0. 4371	0. 4584	0. 4215	0. 4597
The fifth group	0. 4296	0. 5138	0. 4395	0. 4257
The sixth group	0. 3915	0. 4908	0. 4459	0. 4596

In order to make network weights all in proper intervals, it should carry out normalization on input data, standardized basic method are generally as:

The first type: Adopt MATLAB provided functions;

The second type: it can let data divide 10^n (n is top digit in data);

The third type: it can adopt following formula to calculate:

$$S_i = \frac{x_i - x_{min}}{x_{max} - x_{min}} \quad (1)$$

Among them: x_{max}, x_{min} respectively are original data x maximum value and minimum value.

This paper adopts the third type data handling, normalization method of data after handling: as following TABLE 2 states.

Apply the first four data to predict next data, so

TABLE 2 : Normalization data handling result

Group Sequence	1	2	3	4
The first group	0. 4699	0. 4025	0. 4202	0. 3089
The second group	0. 6558	0. 5609	0. 0000	0. 6728
The third group	0. 1793	0. 5870	0. 4306	0. 4686
The fourth group	0. 4980	0. 6374	0. 3960	0. 6459
The fifth group	0. 4490	1. 0000	0. 5137	0. 4234
The sixth group	0. 1996	0. 8495	0. 5556	0. 6452

input node list is 4, then output node is 1, S type function node optional function: $f(x)=\frac{1}{1+e^{-x}}$; Research shows that four layers network that beyond three layers network is easier to fall into local minimum, so here is using three layer network models, it adopts single-hidden layer BP network.

Network training

For network initial value, according one's own demand, given a group of initial value, if is not given, network will have an initial default, adopt trainlm function training, which is gradient descent and original gradient momentum and adaptability reduction training functions, by using learngdm learning function, the function of momentum gradient reduction learning function and momentum constant can be set by learning disc parameters. Now, realize above model through programming. In the moment nerve number adjusts parameters and stated middle layers, it finds out one better model in BP network.

The first type setting: sample data is 16, it is 50 pieces training, training objective steps maximum number is 0. 001. When middle layer nerve number is 5, and learning speed ratio is 0. 1.

Through 20 steps' training, mean square error MSE network is equal to 0. 0005659 and less than 0. 001that arrives at network training requirement. From Figure 1, it is clear that network training process is slower, it needs longer time to achieve training objective.

The second type setting: sample collecting data is 16, it is 50 pieces training with 0. 001, when training objective steps get maximum number, middle layer nerve number is 10, and learning speed ratio is 0. 1.

Through 13 steps training, network mean square error MSE is equal to 0. 00026806 less than 0. 001that arrives at network training requirement, and from Figure 2, it is clear that network curve is more steep than previous kind of setting that network training speed is faster than previous setting.

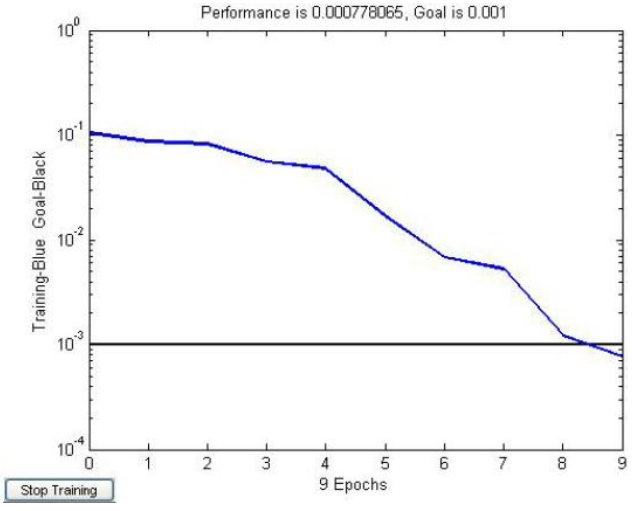

Figure 1: Training objective steps' maximum number is 0. 001

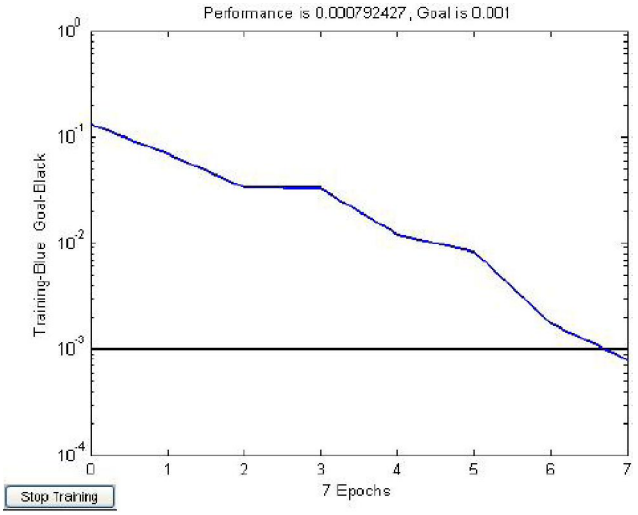

Figure 2: Numbers of nerve middle layer is 10

The third type setting: sample data is 16, training maximum step number is 50, and training objective is 0. 001, middle layer nerve number is 15, and learning speed ratio is 0. 1.

Through running results, it is clear that by 23 steps training, network mean square error MSE is equal to 0.00089698 less than0. 001 that arrives at network

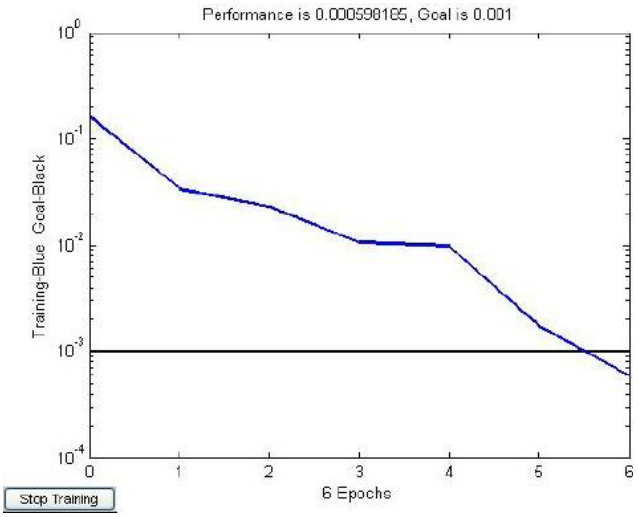

Figure 3: Numbers of middle layer nerve is 15

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training requirement, but from training Figure 3, it can see that running speed is not as good as the second type setting which reduces again by comparing with convergence speed.

For the three types setting, network convergence speed is firstly increasing and then start to reduce, which indicates BP neural network middle layer numbers of nerve is not the more the better, sometimes more hidden layer nerve cell will generate fillers, on the contrary it will reduce training speed, therefore, BP neural network hidden layer nerve cell numbers selection has great influences on network functions, however, hidden layer nerve cell selection has no fixed methods, only setting different parameters to select optimal setting model.

In above three settings, when hidden layer nerve cell is 10, network training speed is fastest, performance is the best. In the following, it adopts such type setting model as predicted network model, using previous collected data to test it prediction function.

Select 6 pairs of data from training samples to test, verify whether network training is good or not. Error curve after testing is as Figure 4:

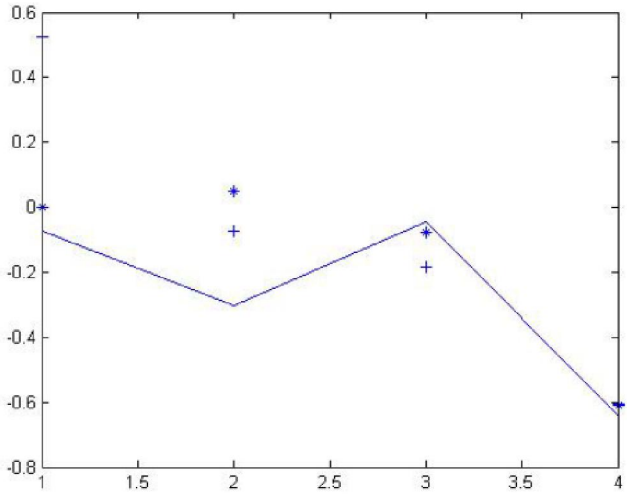

Figure 4: Error figure

From Figure 4, it is clear that prediction error is relative small; network arrives at appointed error that completes network training. It is mainly because test samples are selected from training samples, due to training precise is higher, network can make relative precise fitting on every group of data.

CONCLUSIONS

Take TABLE 1 the first group data as network input, network calculates and outputs the second group the first data prediction value; then network whole output as new input, it gets the second group the second data prediction value. It rolls successively that can predict China's men basketball field-goal percentage normalization data is 0.6486 in 2008 Olympic Games. At last reverse normalize the prediction value as 0. 4601.

In the practice of applying BP neural network method into basketball field-goal percentage prediction, it is thought BP neural network method application and field-goal percentage prediction have certain features. Advantages of BP network are through adjusting connection weight and threshold value, it has stronger adaptation ability, because it has stronger playback ability on non-linear problems. But BP network cannot get formula concrete forms, and when input original variable changes, original connection weight and threshold values are disorganized, it needs to train again that its disadvantages. For BP network relaxation coefficient appointing, former generally thinks that it would be better between 0.01 and 0.3, it including calculation speed and stability factors consideration here. BP network training method is a kind of greedy algorithm, whole samples error is reducing gradually, it almost keep unchangeable till small to certain degree, at this time initial connection weight influence is far larger than iteration times influence, therefore when making programming, it should consider the case, when whole sample error set a very small value range let calculating stop and output results. If it iterated to total times still cannot arrive at the limit value, it is thought that BP network training fails this time, training should restart.

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