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Research Article

Sports Achievement Prediction and Influencing Factors Analysis Combined with Deep Learning Model

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Scientific sports training plans are only possible if you can accurately predict a player's performance. Accurate prediction of sporting performance not only is useful for athletes, but also helps to guide the development of sports. Research methods used in traditional forecasting include the time series method, analogy method, regression analysis, and other methods of analysis. Most of the data used to make these projections are derived from a relatively small set of static problems. A sports performance prediction model based on deep learning is proposed to address the current model's low prediction accuracy. Deep learning models are more accurate at predicting sports performance than traditional methods, and the difference between the two is greater in this study. Also, it performs well when it comes to both convergence and robustness.

1. Introduction

Sports performance prediction can help schools, sports teams, and sports training institutions develop scientific training methods that reflect the changing trends in sports performance [1]. Thus, athletes and coaches will be able to use these opinions as a basis for reforming physical education and training. The level of sports training is reflected in a person's ability to perform well in sports. In order to improve sports training and teaching, accurate prediction of sports achievement can be used to uncover the regular factors and characteristics of human training [2]. Because of this, the prediction of sports performance has always been a hot topic in the study of sports. There are many factors that influence a player's performance, and these factors interact and interact with each other in complex ways, making it difficult to predict a player's performance accurately using traditional methods [3]. At the same time, it is of great significance to study the prediction model of sports performance in promoting scientific training and improving sports performance [4].

Sports is the most attractive activity in modern society. As a special cultural phenomenon, its development has a profound and extensive influence on the development of sports culture, which in turn affects the development of other related cultures in society [5]. In light of the growing interest in sports development, this paper proposes a method for accurately predicting sports performance based on deep neural networks (DNN) [6–8]. Training and preparation goals are directly affected by accurate sports performance prediction, as well as the discovery of performance development rules. There is, however, a great deal of uncertainty in the data because of the small amount of data on which the current forecast is based, as well as the large randomness and hidden influence factors in the data generation process. Predicting sports performance is complicated because of the numerous variables involved (changes in human characteristics, age, various environmental factors, etc.). Sports performance prediction models are built using multivariate and multi-parameter statistical analysis. Statistics, information processing, and modern mathematics are among the topics covered in the course. Forecasting success hinges on selecting an appropriate and highly precise method. A sports performance prediction model based on DNN is proposed in order to improve the

scientific guidance of sports training and predict sports performance.

The traditional method of predicting sports performance has some problems, such as high computational cost and poor adaptive anti-interference of parameters in the process of prediction, which leads to low prediction accuracy. Neural network (NN) is generally used in uncertain input-output function mapping, which can determine the linear correspondence. It has stable effectiveness and adaptability, forward propagation signal, and backward propagation error, and is often used in various fields [9]. It can accurately assess the athletes' physical quality level and make the key points and objectives of athletes' training content clear so as to have targeted and scientific training. Based on this, this paper puts forward a sports achievement prediction model based on deep learning. The quantitative evaluation system of special movement techniques has been established. This system can scientifically monitor and evaluate the development level of each athlete's athletic ability so that athletes can get scientific training. The performance test of the model proposed in this paper shows that the model improves the accuracy of sports performance prediction, and the prediction error can meet the requirements of practical application.

2. Related Work

Using a deep learning network, literature [10] predicts South Korea's daily comprehensive stock price index better than BPNN and case-based reasoning. Fernandez Molanes et al. [11] combines deep learning network and empirical mode decomposition to predict the error sequence of the initial prediction set and use this prediction value as a correction to correct the original prediction. In order to create a scientific, practical, and effective evaluation system for journals, literature [12] used DNN to build a dynamic evaluation model of journals. Neural network (NN) technology is employed in the literature [13] to model the project's value. It improves the back-propagation algorithm, which supervises and trains samples to obtain the weight factor, in order to determine the value of a project and help the decision-maker in project evaluation and decision-making. Biochemistry is a field where NN is used in the literature [14]. The biomolecular feature data matrix is obtained by extracting molecular features from biological structure analogs and selecting gene bonds and functional groups as discriminant factors. Multiple layers of NN structure have been proposed in the literature [15] as the basis for DNN architectures. Layer-by-layer training is typically used to abstract the data's unique characteristics before optimizing the network model as a whole. An artificial neural network (ANN) can be used to evaluate the total economic benefits of an enterprise, according to reference [16]. The economic indicators of enterprises are taken as the input of artificial NN, and the classification function of the network is used to classify enterprises. Literature [17] proposed a pattern integration operator based on the NN model. Compared with the mean operator, it is found that for multi-level time series, the prediction accuracy of the NN model can be greatly improved by using the pattern inheritance operator. Liu [18] proposed that the NN model has a three-layer NN structure. An input layer, hidden layer, and output layer. Each layer is connected with each other, and the connection weights are repeatedly learned and trained through error back-propagation until the corresponding weights can meet the requirements of the training mode. Literature [19] proposed that the DNN structure containing multiple hidden layers can be obtained through certain feature extraction and training methods. Literature [20] established a DNN prediction model based on the annual best performance data of the world women's heptathlon. Literature [21, 22] describes how to apply the NN method to the prediction in the field of market evaluation, enterprise evaluation, and economic management. The system block diagram of how to implement it in the language environment is given. The steepest gradient descent method is used to modify the weight and threshold. Literature [23, 24] pointed out that nonlinear sports models mainly include NN, grey model, Markov chain, and support vector machine. Literature [25] proposed that the combination of multi-population genetic algorithm and NN can consider the global optimization solution and local optimization solution at the same time. Literature [26] verified the prediction effect of a deep learning network on five financial time series data. The experimental results show that the prediction of mean square error and mean absolute error of deep learning network samples are better than back propagation neural network (BPNN). This paper establishes a sports performance prediction model by using the method of DNN and analyzes the reliability and error of the model. The test shows that the performance prediction model established by DNN can predict sports performance and evaluate the development level of physical quality more accurately than traditional prediction methods. This model can bring great convenience to the prediction of sports performance, and further improve the efficiency of modeling and the accuracy of prediction performance.

3. Methodology

3.1. Principles of Sports Performance Prediction. Changes in various natural conditions have an important impact on sports performance. The change of temperature, humidity, and atmospheric pressure will affect the change of ball speed. Natural conditions, such as the intensity of sunshine and the change of wind direction, will affect the individual achievements of players. This directly affects the players' technical level. Sports performance is related to many factors, and various factors interact with each other, which leads to very complicated changes in sports performance. The linear model assumes a periodical or rising trend of sports performance, which is inconsistent with the actual change characteristics of sports performance, and its application scope is limited [27]. Considering the influence of environment and weather on the accuracy of sports performance prediction, in the process of building the mathematical model of sports performance, according to fractional Fourier transform, a class of fractional generalized integrodifferential equations with distributed time delay is

obtained, which represents the solution space model of sports performance prediction.

NN has the nature of biological NN type, and it can improve its own performance and understand the environment through learning. After the artificial NN is stimulated by the external environment, it can adjust the parameters of the NN to make the NN respond to the external environment in a new way [28]. DNN is mainly aimed at improving the shortcomings of traditional artificial NN. The artificial NN is prone to fall into local minimum and gradient disappearance when using gradient descent. The DNN divides training into two parts, namely, feature extraction and parameter optimization. Feature extraction is an unsupervised learning method, which can be completely based on unlabeled data, which is especially important for scenes with severe training data, and features and feature weights learned by automatic methods. Finally, the tagged data is used to fine-tune the parameters, which has achieved good results in the actual scene [29]. It truly reflects their inherent characteristics, thus overcoming the shortcomings of the multiple regression model and grey model. In this paper, the self-similar regression model of sports achievement is constructed, empirical mode decomposition and factor analysis are carried out on the time series of sports achievement, and the feature information clustering and information fusion processing of sports achievement are carried out by using the DNN classification model, so as to optimize the prediction model.

The number of nodes in the hidden layer is not only related to the number of nodes in the input and output layers but also related to the complexity of the problems to be solved, the types of transfer functions, and the characteristics of sample data. Suppose the collected sports scores form a sequence $\{y_1, y_2, \ldots, y_n\}$. Since the current sports score y_1 is related to its impact factor, there is a certain nonlinear relationship between them, namely,

$$y_i = f\left(x_1, x_2, \ldots, x_d\right), \tag{1}$$

where d is the embedding dimension of the input vector, which is selected by principal component analysis. F () is a nonlinear mapping function. The analysis of formula (1) shows that the fitting of the nonlinear mapping function f () is the key in the process of sports achievement modeling. Based on deep learning, this paper establishes a sports achievement prediction model. The workflow of deep learning for sports performance is shown in Figure 1.

The DNN model is extensible and can be optimized. The data in the sample library can be enriched by accumulating historical samples. The DNN's performance and prediction accuracy can be steadily improved over time by adding to and perfecting the expert sample data. Athletes' perceptions of the value of their sports training can be shaped by the public. By looking at the quality parameters of athletes who have achieved the expected value, a sports plan can be created. Improve the training plan's clarity and efficiency by adjusting the target parameters during the stage training effect test. Sports performance is modeled using the DNN model. In terms of chronology, previous sporting

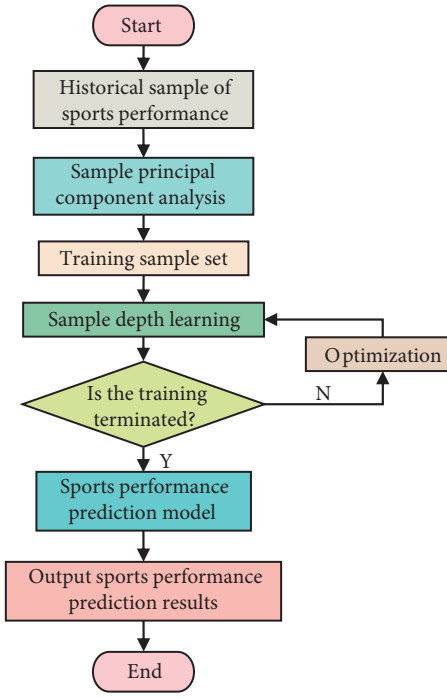

Figure 1: Deep learning workflow for sports performance.

accomplishments are typical. The training set is used to train the combination kernel function correlation vector machine, and the adult prediction model of correlation vector scores based on the combination kernel function is established, and the test set is predicted to output the prediction results of sports scores based on the combination kernel function.

3.2. Sports Performance Prediction Model Based on Deep Learning. The existing prediction models of athletes' special performance generally establish the functional relationship between special performance and quality training level through multiple regression methods and grey model and then predict athletes' special performance. The linear fitting feature space of sports performance is established, and the prediction model is constructed by the multiparameter constraint reconstruction method, which has a good prediction effect. To a certain extent, these prediction models reflect the relationship between special performance and training indicators and provide appropriate guidance for athletes' training [30]. However, these methods have some problems, such as high computational cost, poor adaptive anti-interference of parameters in the process of prediction, etc. And the determination of these models is based on certain assumptions. They need to set the mathematical expression of the special performance prediction model in advance. In fact, the functional relationship between special achievements and related factors is quite complicated, and the mathematical expression assumed in advance can't fit the relationship well. As a result, the prediction model of sports performance caused great errors and the prediction accuracy was low.

The establishment of the algorithm model of DNN requires seven steps: (1) Collection and grouping of sample

data, (2) preprocess the data, (3) determining the number of hidden layers, (4) determining the number of hidden layer nodes, (5) training of DNN, (6) determining the initial weights of the network, and (7) testing the performance and generalization ability of the network algorithm model. Because of the huge amount of calculation, this algorithm requires high computer configuration, especially memory. Therefore, in the earlier period, many people advocated other algorithms to replace the problem of less network weights. However, with the rapid development of computer science and technology, there is no need for this concern, and the advantages of this algorithm are fully demonstrated. The training process consists of 10 modules, as shown in Figure 2.

Using the method of DNN, the nonlinear evaluation model of motor skill level, body shape, basic quality, and special quality is established, fitted, and predicted. Sports achievement data can be regarded as a set of nonlinear time series. The nonlinear time series method is used to analyze the trend of sports achievements, and the sports achievements are statistically analyzed. The fitting state model of using a multivariate statistical characteristic equation to describe sports performance is as follows:

$$\begin{pmatrix} X \\ P(X) \end{pmatrix} = \begin{Bmatrix} a_1, a_2, \ldots, a_m \\ p(a_1), p(a_2), \ldots p(a_m) \end{Bmatrix}. \tag{2}$$

In the formula $0 \le p(a_i) \le 1\,(i = 0, 1, 2, \ldots, m)$ and $\sum_{i=1}^{m} p(a_i) = 1$, representing the autoregressive statistical characteristic parameters.

Through the covariance matrix decomposition of the solution vector of the statistical equation, the principal component of the statistical characteristic information a_{ii} is obtained.

Research into the relationship between sports performance and body shape, function, basic quality, and special quality is extremely difficult in sports. This model is based on a functional relationship between sports performance and a variety of indexes of body shape, function, basic quality, and special quality. Regression based on logic can be thought of in the same way that neural networks are thought of in the same way that NNs are thought of. Because of its better parameter tuning and parallelization capabilities and higher feature magnitude than NN, logical regression is preferred over NN for large-scale feature estimation and analysis. Logic regression is a linear model, while DNN is a non-linear model, so it is necessary to double process features in order to get the best results.

(1) A non-zero random number is set whose V_{kl} is small, and the setting range is the weight coefficient of each layer.

(2) $A = (a_1, a_2, \ldots, a_m)$ is the input sample, and $E = (e_1, e_2, \ldots, e_m)$ is the corresponding expected output.

(3) The output of the k^{th} neuron is located in the h layer, as shown in formula (3).

$$\begin{aligned} G_k^h &= \sum V_{kl} A_k^{h-1}, \\ A_k^h &= s\left(G_k^h\right). \end{aligned} \tag{3}$$

Usually, formula (3) will be expressed as a sigmoid function:

$$s(a) = \frac{1}{(1 - \exp(-a))}. \tag{4}$$

(4) Evaluate the learning error d of each layer, and $h = n$ in the output layer:

$$f_k^n = A_k^n (1 - A_k^n)(A_k^n - E_k^n). \tag{5}$$

The remaining layers, there are

$$f_k^h = A_k^h \left(1 - A_l^h\right) \sum V_k f_k^{h+1}. \tag{6}$$

(5) Modify the weight coefficient V_{kl}:

$$V_{kl}(p + 1) = V_{kl} - q \cdot f_k^h \cdot A_l^{h-1}. \tag{7}$$

(6) Judge whether the calculated weight coefficient of each layer can meet the requirements. If it can meet the requirements, the calculation can be finished; otherwise, the process has to be repeated from step (3).

On the basis of the statistical analysis model of sports achievement, a prediction model of sports achievement is established by using DNN. Empirical mode decomposition and factor analysis are carried out on the time series of sports achievements in DNN. The logical regression is better for discrete features. Therefore, it is necessary to discretize the normalized features. There are many ways to discretize features. Usually, continuous features are mapped to fixed values. Generally, the feature value domain is equally divided into fixed intervals, and the intensity of each interval can be customized.

Sports performance prediction can help schools, sports teams, and sports training institutions develop scientific training methods that reflect the changing trends in sports performance. We can monitor the progress of athletes' physical fitness and sports performance during training, comparing the results to theoretical expectations and making adjustments to the training plan as needed, thus keeping the entire training process in check. One of the most important features of the NN is its ability to learn on its own, as well as its ability to generalize. This paper's deep learning model outperforms both the multiple regression model and the grey model in terms of performance. The mathematical expression of an athlete's unique performance prediction model does not need to be determined in advance. Fitting and prediction accuracy can be improved by more objectively mapping the correlation between athletes' quality training levels and their performance.

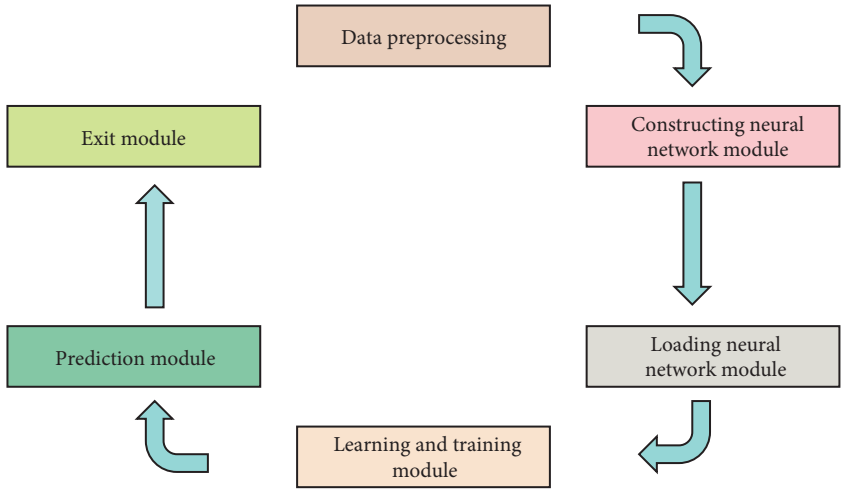

Figure 2: Training prediction process.

4. Result Analysis and Discussion

The problem of performance prediction is characterized by the strong randomness of data, many influencing factors, complex interaction and relationships among factors, etc. Therefore, the research results of sports performance prediction obtained by traditional prediction research methods are not ideal. Through sports, survival of the fittest and ranking, we can test the technical level of sports, select talents, motivate backward players, and attract more people to participate in sports.

A large amount of measured data needs to be filtered and filtered in order to conform to a sample set of effective patterns. Sample libraries can be built up over time as more historical data is accrued, allowing the model's inputs and outputs to be filtered based on the reality of a given situation, as well as the results from statistical calculations. The principal component analysis (PCA) is performed on these variables because there are some recurring relationships between athletic performance and things like height, weight, vital capacity, 50-meter running, sitting and bending forward, 800-meter running, and one-minute sit-ups. Figure 3 depicts the time domain waveform description of the sample data as described by the simulation settings and used to design the sports performance prediction model.

After many training and prediction tests, it is found that the addition of some test data will affect the convergence speed and prediction accuracy of the model. For example, athletes with insufficient training years or athletes whose test results in deviation of some indexes due to some special conditions. Therefore, this kind of data is excluded. Taking the collected statistical samples of sports performance as the test set, the simulation analysis of the sports performance prediction model is carried out, and the comparison results of prediction errors of different methods are shown in Figure 4.

Each node in a DNN's input layer is defined as a feature, and nodes in the same layer are mutually independent. Features must be normalized before they can be compared in logistic regression or deep neural networks (DNN). The

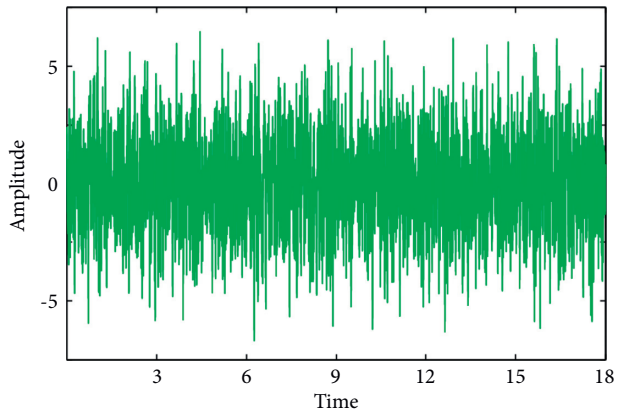

Figure 3: Time-domain waveform of sports performance statistics.

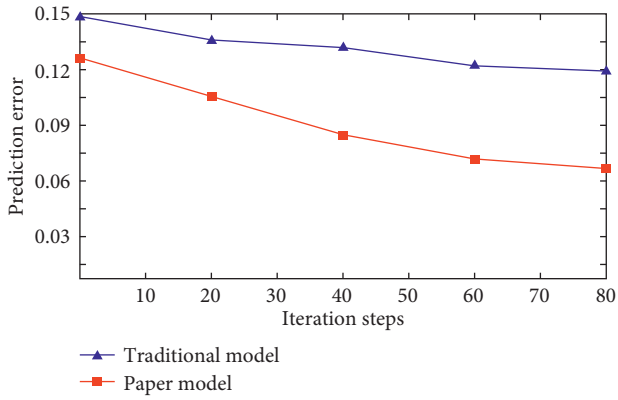

Figure 4: Forecast error analysis.

model jitter will not deviate when the normalized features are trained in the model, and the weights of the features will be more stable. In order to make predictions about an athlete's special performance, models that use multiple regression and a grey model establish a functional relationship between special performance and quality training level. The statistical distribution of unified samples and the unification

of basic measurement units can be achieved by normalization. The trend of deep learning neural training in this paper is shown in Figure 5.

More samples in the input layer mean more computation, more hardware requirements, and longer time consumption when using a DNN to train samples repeatedly. That's why cutting down on the number of training indicators is essential. For calculating the correlation coefficient and figuring out the degree of correlation between each index and the level of movement technology, we use the correlation analysis method. Multiple indicators with significant and conclusive impact on the level of motor skill have been eliminated using cluster analysis. Pictured in Figure 6 is a curve that shows the relationship between expected and actual deep learning outcomes. It can be seen in Figure 6 that the predicted long jump value and the actual long jump value are very close. A great deal of research has led to excellent standing long jump results. There was a significant improvement in prediction accuracy with the prediction model.

Filter and screen a large number of measurement data to make them conform to the sample set for establishing effective patterns. Because there are some rules and relationships between the input and output of the model, which data should be retained and filtered are mainly determined by the actual situation, experience, and statistical calculation results. This sample library can be gradually supplemented and improved with the increase of historical data. The model has a small error range and high prediction accuracy for athletes' performance, which shows that the model is accurate and effective. In some practical problems, no standard function model or function analytic model is highly nonlinear, so we can use DNN to predict the approximate value. The change curve of prediction deviation of deep learning is shown in Figure 7. It can be seen in Figure 7 that the deviation between the predicted value and the actual value of sports performance is relatively small. And the variation amplitude of the prediction deviation is also small. The results show that it is feasible and effective to introduce the deep learning model into the standing long jump performance prediction.

Sports achievement is an important manifestation of sports training levels. Through the accurate prediction of sports performance, we can dig out the regular factors and characteristics of human training, thus promoting the improvement of sports training and sports teaching. Sports have a special activity flow, clear purpose, distinctive competitive features, and a complete set of competition rules and methods. At the same time, it is of great significance to study the prediction model of sports performance to promote scientific training and improve sports performance. As a new algorithm in current machine learning, the DNN is excellent in model representation and data processing ability. The DNN can produce better results in data representation through complex network structure and deep network layers. Using the hierarchical structure of the DNN can realize

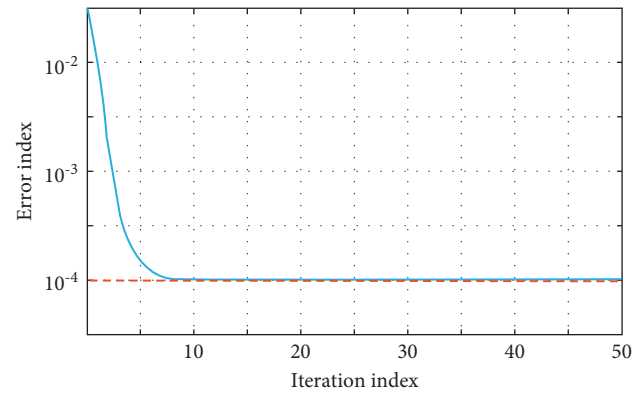

Figure 5: Trends in DNN training.

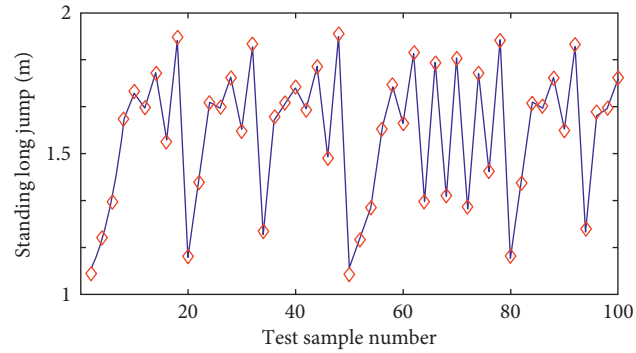

Figure 6: Fitting curve of predicted value and actual value of deep learning.

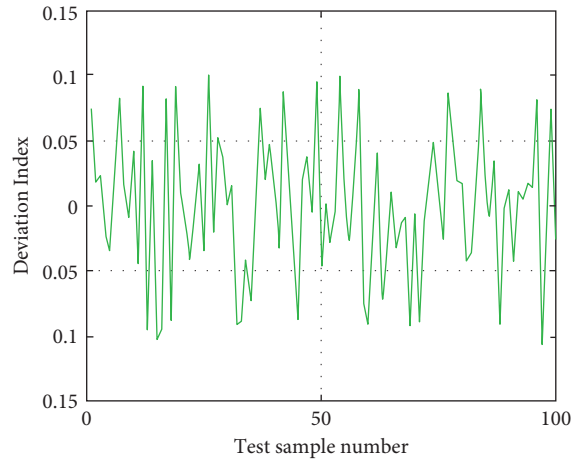

Figure 7: The prediction deviation curve of deep learning.

the nonlinear intersection of features. Compared with the simple combination intersection of discrete features, the DNN can learn features more fully and accurately. This model shows the mapping relationship between athletes' performance and various factors. And the convenience

and accuracy of sports performance prediction are realized. Furthermore, it improves the efficiency of modeling and the accuracy of performance prediction.

5. Conclusions

People today place a high value on participating in sports. A lot of time and money was also invested in the collection of sports performance data. For the future direction of sports teaching, it is important to analyze historical sports achievement data and predict future sports achievement. There is a synergistic relationship between scientific research and the project's development. For coaches on the front lines, a lack of theoretical research will inevitably stifle the development of movement technology. Sports performance and related factors must be studied quantitatively, using interdisciplinary approaches, as soon as possible. The multivariate and multiparameter statistical analysis is used to build a model for sports achievement prediction. Statistics, information processing, and modern mathematics are among the topics covered in the course. In this paper, a sports performance prediction model based on deep learning is developed using the nonlinear modeling advantage of NN, and the model's performance is thoroughly tested and analyzed through several prediction examples. Using this model, the sports performance prediction accuracy has increased and the prediction error has decreased, compared to traditional methods. The model can be used in a real-world setting.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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