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Research on Constructing Target System of Competitive Sports Physical Training Based on Data Mining

Jian Li[1,a], Zhou Zhou[1,b,*]

[1]*College of Physical Education and Health, Guangxi Normal University, Guilin, Guangxi, 541000, China*
[a]*281792143@qq.com*, [b]*3842919@qq.com*
[*]*Corresponding author*

Abstract: *Data Mining is the process of obtaining effective data from massive amounts of data and forming understandable patterns. Based on important technologies and methods such as logistic regression, and cloud theory, the analysis and research of massive data are realized. And then digging out important and valuable information and knowledge to provide more scientific and reasonable theoretical basis and hormone support for the decision-making analysis process. According to the training status of competitive sports talents in Chinese universities and colleges, China's competitive sports will be improved based on data mining. A competitive sport in China is dominated by the government. The government has absolute control over the resources of these events. It is difficult for social sports competition organizations to participate. Through data mining technology, a large number of competitive sports participants can be accommodated, and the training can be monitored and cultivated to better serve the competitive sports players. Through the four algorithms in the cloud theory, the error rate can be reduced to less than 0.5, and the data can be integrated fully and efficiently.*

Keywords: *Data Mining, Logistic Regression, Cloud Theory, Competitive Sports, Talent Training*

1. Introduction

1.1 Background

With the widespread use of smart phones and social networks, unstructured and semi-structured data are currently growing exponentially, gradually surpassing the processing capabilities of traditional relational databases. Data mining technology processes and analyzes a large number of rich and growing data types, and big data is becoming more and more important. The relationships and rules in the data are difficult to be discovered, and data mining has solved this problem well. The main characteristics of modern competitive sports are competition, limit, standardization and fairness, openness, grouping, appreciation and practicality. Competitiveness is the most important feature of competitive sports. Participants continue to improve their physical, technical, tactical, psychological, intellectual and knowledge skills through sports training to maximize their potential to defeat their opponents. It requires superhuman physical strength and skilled skills to reach the limit of the human body, which is unmatched by any sports. Competitors of competitive sports have formulated standards and codes of conduct for the events, time, location, venue equipment, qualifications and other aspects of the competition. There is no absolute fairness in competitive sports, but people have created conditions to improve the fairness of the game. A competitive sport is a collective behavior composed of multiple athletes, so it requires a certain number of athletes to participate in order to form a competitive event. Therefore, a competitive sport is a social behavior involving the large community system.

1.2 Significance

At present, the country has inadequate absorption of social and market resources, frequent corruption and various violations of laws and regulations, conflicts between local and national interests. It leads to structural imbalance in the development of competitive sports. It is necessary to break down

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administrative barriers, fully stimulate the vitality of social organizations and market organizations, and build a new pattern in which subjects participate together. Social and market organizations are important participants and practitioners in strengthening and perfecting the reform of China's competitive sports competition system. It breaks the pattern of "individual performances" by sports administrative departments, and fully mobilizes the enthusiasm, initiative and creativity of social organizations and market organizations to participate in the organization and management of events.

Cultivating competitive sports talents is conducive to solving the problems of "import" and "export" in training. Reforming the single mode of training sports talents is conducive to promoting the reform and innovation of sports talents training. The formation of high-level sports teams is not only conducive to promoting athletic talented student athletes to realize their own value, but also can add luster to the development of national sports. The state should continue to reform the rules and regulations not conducive to the training of competitive sports talents by the physical education department so that China's competitive sports cause can embark on the track of healthy development as soon as possible.

1.3 Related Work

In recent years, the development of data mining has penetrated into various industries and supported the development of various industries. Black E W uses the limited available data set before or after the first semester of study as a predictor variable, and academic remediation as an outcome variable. He adopted a data mining model of random forest trees and compared it with traditional predictive analysis methods and logistic regression. He determined whether machine learning is more effective than logistic regression in predicting the remedial state of students [1]. Gleason P T discusses the normal physiological and hemodynamic changes that occur during exercise, and the subsequent cardiac remodeling patterns induced by different exercises. He addressed the association between high-intensity exercise and a relative decrease in overall mortality, an increased risk of atrial fibrillation, arrhythmic heart remodeling, and accelerated coronary calcification [2]. Fan studies how to build a humanistic quality education system for competitive sports reserve talents. Based on the combination of theory and demonstration, he built a humanistic quality education system for high-level sports reserve talents through field research and expert interviews. The results show that reconstructing the target system, strengthening the implementation system, and establishing the content system will help the construction of China's competitive sports reserve talents. In this way, people-oriented, with the all-round development of young athletes as the goal, through humanistic quality education, and ultimately promote the coordinated development of physical and mental reserve talents [3]. Pexa B uses the subjective well-being test before, during and after seasonal football games to determine the difference in daily health indicators before, during and after each game. A method in subject-to-subject analysis of variance is used to compare subjective well-being variables between each time point [4]. Landry C H analyzes the incidence of cardiac arrest through data, and can identify at-risk athletes during preliminaries to prevent cardiac arrest during physical activities [5]. Alsuwaiket MA proposes different data preparation processes by investigating more than 230,000 student records. The data is processed in different stages to extract classification factors, which are used to refine students' module scores in the data preparation stage [6]. He described key literature on network analysis machine learning (ML) and data mining (DM) methods used to support intrusion detection. Buczak A provides a short tutorial description of each ML/DM method. He identifies, reads, and summarizes papers representing each method based on the number of citations or the relevance of emerging methods. He solved the complexity of ML/DM algorithm, discussed the challenges of using ML/DM for network security, and provided some suggestions on when to use a given method [7]. These studies have great reference value for this article, but the time span of related studies is small and the sample size is insufficient, which leads to certain problems in the results.

1.4 Innovation

This article organically integrates artificial intelligence, database technology, probability theory, statistics, and parallel computing, and selects an appropriate model according to the purpose of data mining and the characteristics of the data. This article screens, sorts, and groups according to the data footprint of end users of sports competitions, so as to better understand users and make reasonable decisions.

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2. Methods of Data Mining

Through logistic regression, time series, etc. to classify, by showing the current development of data mining applications in various fields at home and abroad, this article further reveals the development trend of data mining technology [8]. Data mining functions do not exist independently, they are related to each other and play a role in data mining [9-10].

It is undeniable that data mining has become an indispensable part of all modern industries today. However, the relevant person in charge must be soberly aware that the current development of data mining algorithms is not perfect. The controversy in this area has not yet been concluded, and the relevant industry system is not sound, far from meeting human needs [11]. All in all, the era of big data has brought unlimited opportunities and challenges to the modern society.

2.1 Logistic Regression

Logistic regression is a type of generalized linear model, which is often used for classification prediction. For some things, the probability of occurrence needs to be more accurately predicted. It can be predicted based on the relevant data footprint of competitive sports players, and the relevant state can be predicted [12].

2.2 Cloud Theory

Due to the uncertainty of the time series data generation and distribution process, taking into account the characteristics of this uncertainty, this paper proposes a cloud model-based time series feature representation method. And it uses the corresponding similarity measurement function to determine its similarity. The function sequence survey results show that the time series similarity measurement method based on the cloud model cannot adhere to the lower bound, but considers the volatility and uncertainty of the time series from a local and global perspective. It has a higher level of similarity measurement quality and improves the performance of time series data mining [13].

In view of the high time overhead required for the traditional dynamic time synchronization method to measure unequal long time series, this paper proposes two distortion measurement methods [14]. First, from the balance between calculation speed and measurement accuracy, it proposes a time series similarity measurement method based on piecewise linear approximation and derived dynamic time synchronization. This method can quickly and effectively measure the distortion of the time series. Secondly, in order to solve the problem that the dynamic time synchronization method has to spend a lot of time in the similarity search process and narrow the search interval of the ideal curve, this paper terminates the optimal curve calculation strategy in advance. It improves the efficiency of its similarity search application on time series. Time series feature representation and similarity measurement methods are applied in engine data mining. According to the actual project requirements and the data characteristics of the engine parameter time series, combined with the main content of this research, this paper further discusses the use of time series feature representation and similarity measurement methods to realize engine parameter data mining, and then obtain relevant information and knowledge. Its main content includes two aspects, namely the method of identifying the characteristics of engine parameters and the algorithm of detecting engine faults. Through the research of engine parameter data mining technology, this paper advances to verify the role and significance of time series feature representation and similarity measurement methods in the field of competitive sports. It provides a reference for the management and guarantee of the training of participants in competitive sports [15].

3. Experiments on Data Mining Methods

In order to achieve the research goal, the specific research content of this paper is to start from the overall characteristics of the equal-time sequence, and propose a feature representation and similarity measurement method based on orthogonal polynomial regression coefficients [16]. By using the segmentation method to segment the longer time sequence, and perform feature extraction on each segment sequence, the feature representation and data dimensionality reduction of the time sequence can be achieved [17]. At the same time, the distance metric function proposed for the segmented feature sequence needs to meet the lower bound to avoid underreporting in the retrieval of similar items [18]. According to the feature sequences of different dimensions used in the segment sequence, this paper proposes a small segment aggregation approximation method based on a two-dimensional statistical

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feature table and a segment symbolized representation method based on two-dimensional morphological feature representation. It further improves the application efficiency of the traditional segmented aggregation approximation method in time sequence data mining. At the same time, the dimensional morphological feature representation of the segmented sequence is extended to the higher dimensional morphological feature representation. This improves the performance of the corresponding distance function with higher dimensionality of the segmented feature table small method under the condition of higher data compression rate [19].

3.1 Use Logistic Regression to Judge Unknown Data

Logistic Regression (LR) is one of the widely used classification methods in data mining [20]. The goal of regression analysis is to estimate the relationship between variables. Since then, regression has become an important tool for data mining. Its learning process is to derive a suitable prediction function h, which is used to classify unknown data. That is, for each input sample $X=\{X_1,X_2,\cdots,X_i\}$, the fitting function can be defined as:

$$h(x)=h_\theta(x)=\theta_0+\theta_1x_1+\theta_2x_2+\cdots+\theta_ix_i=\theta^Tx \tag{1}$$

Where $\theta^T=[\theta_0,\theta_1,\cdots\theta_i],x^T=[x_1,x_2,\cdots,x_i]$ is the final vector expression learning process is to find an optimal parameter, so an evaluation criterion is defined, namely the loss function. It is defined as follows:

$$Cost(h_\theta(x),y)=\begin{cases}-\log(h_\theta(x)), & if y=1\\ -\log(1-h_\theta(x)), & if y=0\end{cases} \tag{2}$$

Because $h_\theta(x)$ is a function whose output is between (0,1), if the true value y=1, the closer the predicted value $h_\theta(x)$ is to 1, the smaller the loss, that is, the more accurate the prediction. Similarly, if the true value is y=0, the closer the predicted value $h_\theta(x)$ is to 0, the smaller the loss, that is, the more accurate the prediction. The loss function can be changed to the following form:

$$Cost(h_\theta(x),y)=-y\log(h_\theta(x))-(1-y)\log(1-h_\theta(x)) \tag{3}$$

The final cost function is:

$$J(\theta)=-\frac{1}{m}\sum_{i=1}^{m}\left[y^{(i)}\log(h_\theta(x^{(i)}))-(1-y^{(i)})\log(1-h_\theta(x^{(i)}))\right] \tag{4}$$

3.2 Spatial Comparative Analysis of Quantitative Data Based on Statistics Using Cloud Theory

Cloud theory is a theory based on statistics and fuzzy mathematics. It is mainly used to test the uncertainty conversion model between quantitative data and qualitative concepts. This model is called the cloud model [21]. By using the segmentation method to represent the time series with the cloud model, this paper proposes a similarity measurement method for the feature sequence of the segmented cloud model. And it applies it to the field of time series data mining to test the performance of cloud model feature representation and similarity measurement methods [22].

The time series $Q=\{q_{1,}q_{2,}\cdots,q_m\}$ is equally divided into w sequence segments, $Q(i:j)=\{q_i,q_{i+1},\cdots q_j\}$ is the sub-sequence segment in the time series Q and i<j. The cloud model is used to express the features of these sequence segments, and finally the feature sequence $Q^C=\{q_1^c,q_2^c,\cdots,q_w^c\}$ of the time series in the low-dimensional space is obtained, and the feature sequence elements:

$$q_i^c=Back\_Cloud(Q(k(i-1:ki)) \tag{5}$$

Where $k=\frac{m}{w}$ is the compression ratio.

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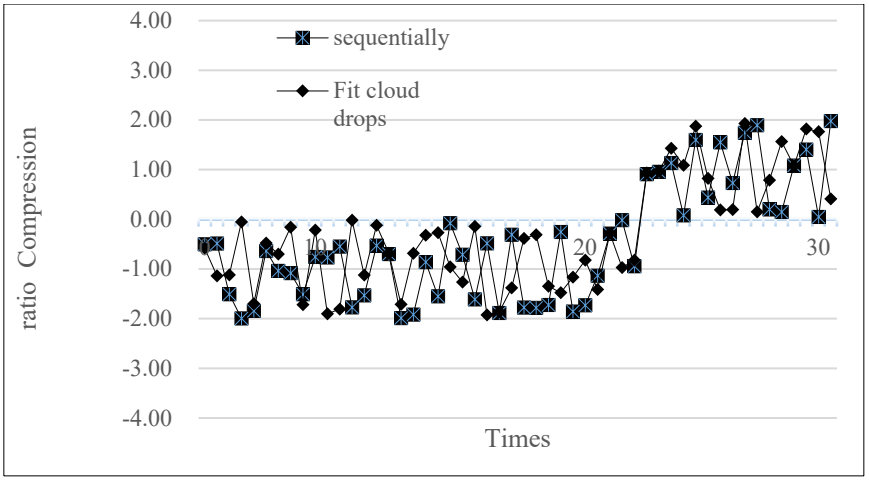

Figure 1: The original time series of cloud drop fitting generated by the feature sequence of the cloud model

The w cloud models in the PWCA feature sequence can randomly generate k cloud drops through the forward normal cloud generator Cloud (.). Finally, m=kw cloud drops are generated according to the data distribution of the cloud model, and these cloud drops are ambiguous to the semantics of the cloud model. Arranging these cloud drops in the order in which they were generated, a new sequence that fits the original time sequence is formed. As shown in the figure 1, each of the 6 cloud model sequences randomly generates 10 cloud drops. These cloud drops can fit the change trend of the original time series well, as shown in Figure 1.

Through the time series cloud model feature representation methods PWCA and APCA, two time series Q and C of length m can be represented by a set of cloud model feature sequences of length W, which are respectively denoted as:

$$Q^C = \left\{q_1{}^c, q_2{}^c, \cdots, q_w{}^c\right\} \tag{6}$$

$$C^c = \left\{c_1{}^c, c_2{}^c, \cdots c_w{}^c\right\} \tag{7}$$

Where $a_i{}^c$ represents the cloud model representation of the i-th segment sequence in the time series A. Then the feature sequence after dimensionality reduction through the data reflects the similarity of the original time series as:

$$ECM(Q,C) = \sqrt{\frac{1}{W}\sum_{i=1}^{W} S_{ECM}(q_i{}^{c,}, c_i{}^c)} \tag{8}$$

$$MCM(Q,C) = \sqrt{\frac{1}{W}\sum_{i=1}^{W} S_{MCM}(q_i{}^c, c_i{}^c)} \tag{9}$$

These two cloud model-based time series similarity calculation formulas can quickly and effectively calculate the similarity of feature sequences. In practical applications, different similarity measurement formulas can be selected according to needs. The ECM-based cloud model feature sequence similarity calculation method can measure the similarity of the original time sequence more effectively than the MCM-based method.

In order to check the accuracy and time efficiency, the system's data recording control is also used to uniformly use the nearest neighbor classification algorithm, so as to use the ECM, MCM, LCM or SCM algorithm for classification experiments. Finally, the classification accuracy of the four algorithms is evaluated by the classification error rate. At the same time, according to the dimension $W = \{20,30,50,100,150,200\}$ after dimensionality reduction, the segmented cloud approximate representation method is used to express the cloud model features of the time series, and the similarity of the cloud model feature sequence is calculated in four ways. Finally, their classification results under different segment numbers (dimensions) are shown in Figure 2.

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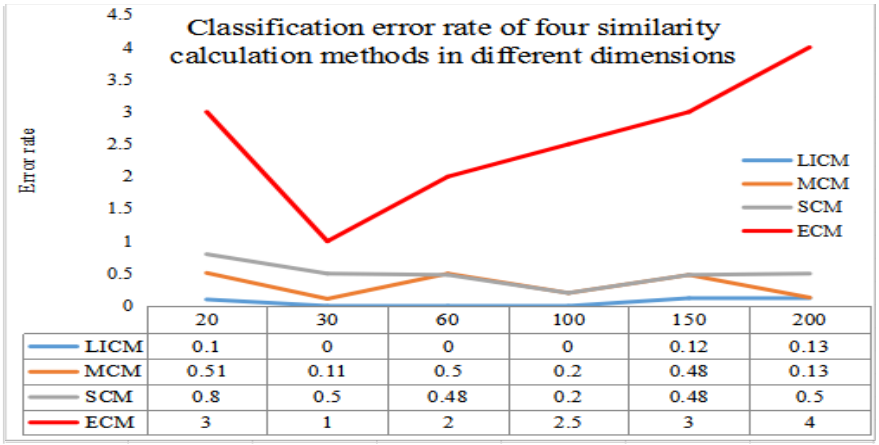

	20	30	60	100	150	200
LICM	0.1	0	0	0	0.12	0.13
MCM	0.51	0.11	0.5	0.2	0.48	0.13
SCM	0.8	0.5	0.48	0.2	0.48	0.5
ECM	3	1	2	2.5	3	4

Figure 2: Classification error rate of four similarity calculation methods in different dimensions

It can be seen from Figure 2 that the classification error rate of ECM is significantly lower than that of LCM, and the classification error rate is even close to zero. Although the classification error rate of SCM is lower than that of LCM, it is still higher than that of ECM. MCM classification error rate is between SCM and LICM, but closer to SCM, even in some dimensions, MCM and SCM have the same classification accuracy. The LCM algorithm regards the digital feature of the cloud model as a feature vector. So the cosine angle is actually used because the feature representation in time series data mining is very abstract and hyper-entropy compared to the similarity measurement method. If it thinks that the other two digital resources are too important, it is easy to neglect the other two digital resources. In addition, ECM and MCM can keep the classification accuracy stable with the change of dimensionality reduction, which shows that these two algorithms have good scalability and robustness.

In terms of classification accuracy, although SCM is closer than ECM even when the dimension is 200, the classification accuracy of the two is the same. As shown in the figure, with the exception of SCM, the other three cloud model similarity measurement algorithms have relatively small differences in unit time. The SCM algorithm has the largest complexity and is not conducive to time series classification. The reason for this is that in the SCM algorithm process, in order to more accurately measure the similarity of the cloud model, the Dharma cloud generator not only needs to generate enough cloud drops, but also needs to combine and classify these cloud drops. This is a time-consuming process. Therefore, the SCM algorithm is not suitable for comparing the similarity of large-scale data such as time series.

From the experiments, we can know that ECM among the four algorithms not only has advantages in the accuracy of time series classification results, but also has almost the same time complexity as LCM. Therefore, ECM is a fast and effective method for calculating cloud model similarity, and MCM is also a relatively fast and effective method for calculating cloud model similarity, as shown in Figure 3.

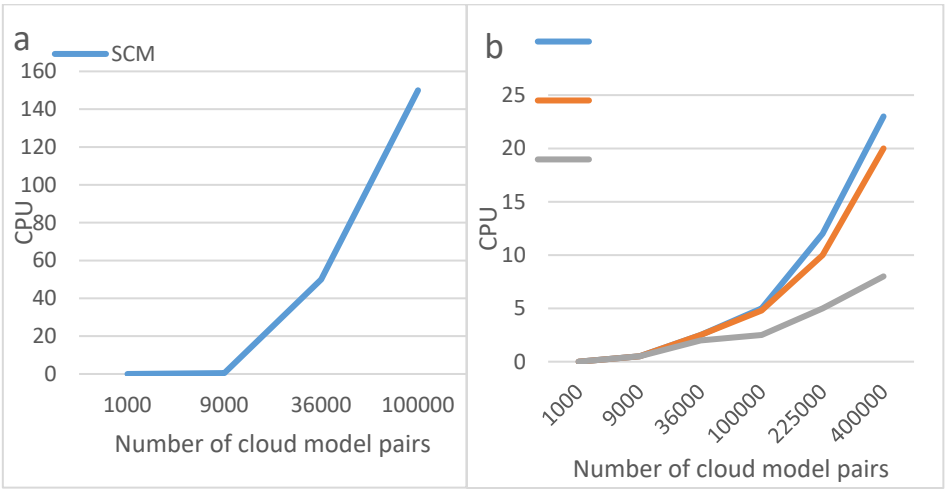

Figure 3: CPU time cost of four cloud model similarity calculation methods

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From the experimental results of time series data mining, by combining the segmented cloud model representation method, it can distinguish the difference in data distribution between time series from a local and global perspective. It can effectively improve the performance of time series data mining related algorithms.

4. The Development of Competitive Sports Groups Based on Data Mining

Under the national policy of combining sports with education, the cultivation of competitive sports talents in Chinese colleges and universities has begun to focus on the cultivation of high-level competitive sports talents in colleges and universities. At that time, there were only a few colleges and universities that tried to run high-level sports teams. After years of development, more and more colleges and universities have set up high-level sports teams. By the end of the year, the number of colleges and universities has doubled. At present, China's competitive sports has been at the forefront of the world. The development of high-level sports teams in Chinese colleges and universities is in good shape, as shown in Figure 4.

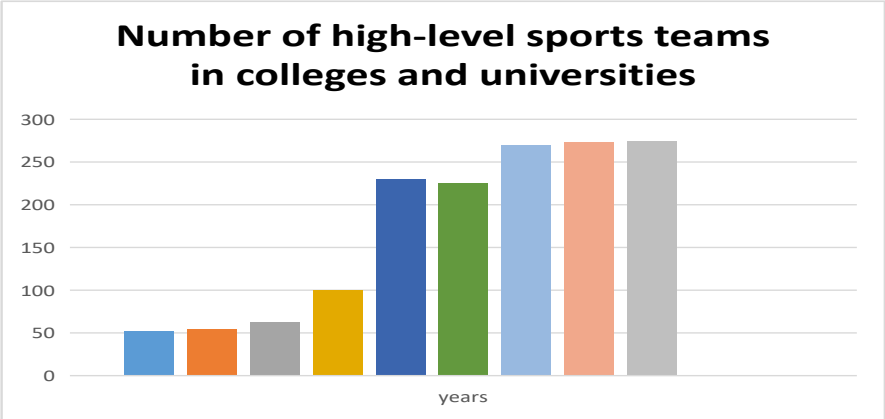

Figure 4: The development and change of the number of ordinary colleges and universities that pilot high-level sports teams in China

It can be seen from Figure 4 that the development of China's competitive sports industry is showing a clear upward trend. However, compared with the development model of competitive sports in developed countries, there are still relative limitations. It can refer to the distributed management model of competitive sports in other countries to analyze and deal with the characteristics of China's own development. Table 1 is a comparison of the characteristics of sports competition between China and other countries Data mining technology can be combined to optimize the integration of the environment for the cultivation of Chinese competitive sports talents, which can better promote the development of competitive sports [23]. According to related literature surveys, the comparison table of the characteristics of competitive sports among Chinese and foreign college students is shown in Table 1.

Chinese universities are directly related to primary and secondary education. In the spare time, students with the best physical abilities and development potential are selected to form the school team. Through the implementation of scientific and effective education and training-the observation and evaluation mechanism during the studyperiod, students are allowed to go straight to specific colleges and departments to graduate after class, forming a "one-stop" model. "One-stop" is an important way to train competitive sports talents in schools, which lies in the close cooperation of the school, family and society. Such a talent training network is conducive to the comprehensive and high-quality training of students. It realizes the coordinated development of comprehensive quality and trains students into society-oriented modern competitive sports talents.

According to the Table 1, the data mining technology is integrated with the sports participants of each school, detailed records and continuous tracking of the participants. In science and technology competitions, by submitting competition information data, it reflects and utilizes information resources. Information exchange and sharing provide services for all aspects of the competition, which promotes the improvement of competition organization and management. The data mining technology makes full use of information technology and information resources in the preparation, organization, operation, and effect evaluation of the competition. It gradually improves the standardization and order of sports

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competitions, the accuracy and fairness of referees, and the fairness and appreciation of competition [24]. It is specifically implemented to realize informatization in the aspects of competition registration, qualification review, and competition organization scheduling information statistics, results announcement inquiries, and competition broadcasts. The simplicity of improving the efficiency of the competition highlights the transparency and openness of the competition. It spreads the influence of the competition through informatization, and it serves the vast number of social groups.

Table 1: Comparison table of the characteristics of competitive sports among Chinese and foreign college students

Comparison of the characteristics of competitive sports between Chinese and foreign college students				
Features	China	America	Japan	Russia
Institutional background	Government-led	Social dominance	Society + government	Government + society integration
Management subject	General Association	University Sports Federation	University Sports Committee	No specialized agency
Management goals	Organize and participate	Combination of physical education and education	Educate people	Gold medalism
Degree of marketization and socialization	Lower	Higher	generally	Lower
Government role	Management and supervision	coordination	Coordination and management	Management and support
Management status	The level of competition is not high	The level of competition is high	High level of competition	The level of competition is not high

5. Conclusions

By collecting basic data from the experimental time series data mining results, a segmented cloud model representation method. While distinguishing the difference in data distribution between time series from a local and global perspective, it can effectively improve the correlation between time series data and algorithm mining. Combining artificial intelligence, database technology, probability theory and statistics, and parallel computing through logistic regression and cloud computing, it allows sports participants to integrate, communicate, discuss and learn from each other. Data mining technology has penetrated into all areas of life and has a good prospect of practical application. It should be noted that data mining is a powerful tool and cannot replace top analysts and managers. Therefore, data mining and teams are more complementary and indivisible than their competitors.

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