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Decision Classification Tree Based Track and Field Athletes Training Evaluation Model

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Abstract
For the features of nerve type are often the key factors that decide athlete's emotion regulation ability to face competition and the performance of competitive level on spot, which ultimately affects the success or failure of the final game. This paper discusses the relationship and laws between the neural types of athletes and high level sports, and obtains track and field athlete nerve type group index test data from the "Athlete Nerve Type Group Index Database". Secondly, it applies the data mining decision tree algorithm and association rules analytical test data to identify the correlation index feature between the nerve type of athletes and the sports they are engaged in, to build the track and field athlete nerve type group traits evaluation model. The experimental results show the validity of the model, which can provide evaluation for the training of track and field athletes.
Key words: NEURAL TYPE, TRACK AND FIELD ATHLETE, DATA MINING, DECISION TREE ALGORITHM, INDEX FEATURE, EVALUATION MODEL

1. Introduction

The nerve type of athlete has significant effects on the training strategy and competition achievements, especially for high-level athletes in critical games, the influence is particularly evident. The identification of the features of nerve types of each high-level athlete, the reveal of the features of nerve types required for athletes in different sports groups and the development of the nervous type evaluation system for athletes in different sports groups is bound to be deeply welcomed by coaches, athletes and all levels of management, and to plays an important role in improving the training efficiency and competition results of athlete, thus having high research value and broad application prospects. Types of nervous system (TNS), a well-known theory founded by the former Soviet physiologist Pavlov in the twenties of the last century, is an important part of higher nervous activity theory. In sports, especially in high-level sports, the nerve types of athletes often affect the effectiveness of training and competition results. There are many methods to test the nervous types, currently the most widely used internationally is Uchida – Kraepelin addition algorithm, i.e. using a simple digital addition to determine the three basic features of strength, flexibility, balance in the neural processes of the test takers[1-2].

WZ test method retains the design ideas of the simple addition algorithm, while adding the test requirements of minus "2" for every "3", which shortened the test time (6 minutes per test, total three tests), adding the simple cancellation test (no need for calculation, cancel the word on sight), to determine the strength features of the athlete neural processes; at the same time, WZ test method subdivides the strength features of neural process into two indicators of excitement and tolerability, and divides the flexibility into two indicators of start-up speed and flexibility, and retains the balance index, adds the addition process to reflect the intelligence index, therefore, WZ test method has a total of six indicators, which conforms to the need of identification of athlete nerve types [3].

The nervous type test of athletes is originated from clinical psychology and experimental psychology, primarily completed through instrument and equipment (EDG, EEG, RT, etc.) and text questions (questionnaire, paper cancelation test, etc.), and the evaluation and modeling of the test data is often by means of statistical tools, which have some limitations [4]. From the test point of view, the main problem is that the test subject is fixed, and easy for the tested athletes to learn, which is unfit for repeated tests; some athletes will have fear for the test equipment, and even more intensified fear for the test with injury, so that deviation may occur in the test result; during the testing process, questionnaire test in the form of text is easy to make athletes unconsciously generate the "Excellence option" selection tendency or not understand the contents of the test and have inappropriate operation, with strong influence of subjective factors; in addition, after the completion of many traditional test means, the test results cannot be immediately obtained, and the information feedback is not timely [5].

On the evaluation methods, currently mainly mathematical statistical method is applied, namely looking for the optimal model parameter values in fitting the predetermined test and data hypothesis, although the final structure of the data can be found, but based on its mathematical foundation it has higher requirement on the accuracy of the methods and processes, emphasizes the accuracy and objectivity of data collection, focuses on the experimental design and hypothesis, and each process must be proved in advance, which is relatively complicated. With the rapid development of computer and network technologies in recent years, all businesses and industries including the world of sport generate and store huge amount of data at all times and places. If the information utilization cannot be improved, to discover useful knowledge in data information as soon as possible data, and converted the data to resources, and services in the decision-making and control of the field, there will be excessive data and information and waste of resources, while serious lack of useful information [6]. Because although the traditional statistical method has its unique features and status, it neither has the capacity to process the massive data today, nor can it obtain the evaluation results quickly and easily.

2. Decision tree algorithm application in the construction of the evaluation model

2.1 Decision Tree Algorithm

Data classification based on decision tree algorithm is the most common and one of the main methods in research and application [7], which divides the data into several branches in tree structure in data processing, each branch contains data tuple class common attribute, constructed into a decision tree, each leaf and node of which represents a category, and the highest level of the tree is the root node. The path from the root to leaf node forms the category prediction for the corresponding object, and thus it is easy to find the data classification rules implied in the data from the tree. The core content of the decision tree is how to construct a highly precise and small-scale decision tree.

ID3 algorithm is the most commonly used specific algorithm to generate a decision tree. The algorithm was proposed by R.Quinlan in 1977, which was based on information theory, using the information gain to determine the attribute category measurement at all levels of the nodes of the decision tree, so that the resulting decision tree has the smallest number of branches and minimum redundancy. ID3 algorithm is fast, and the decision tree obtained is in optimized form, suitable to handle large-scale classification issues, and is the core of the decision tree algorithm.

Wherein, "Di" is a concept in the information theory that Shannon proposed in 1948, which is a measure [6] to evaluate the degree of system order. The more the system is in order, the more consistent the distribution of information will be, and the less information entropy there will be; on the contrary, if the system information is in chaotic distribution, the information entropy is high, while the reduction in the amount of information entropy is the information gain. The purpose of classification is to enable the extraction of information in a more orderly, more organized direction. The best tree branch division program is to maximize the reduction amount of entropy. Therefore, if comparing the change before and after each attribute information entropy splits, and selecting the information entropy attribute towards the minimum change direction, we can reach the leaf nodes of the decision tree, and quickly construct a compact decision tree.

In ID3 algorithm, the calculation method to calculate decision attribute information gain is: S is the training sample data set, which contains m separate category attribute values, corresponding to m different categories $Ci, i \in \{1,2,3,\cdots,m\}$. Assume Ri is the subset of category Ci, Rl is the number of tuples in subsets Ri, then the expected amount of information of set S in the category is:

$$I(r_1,r_2,\cdots r_m) = -\sum^{m} pi\log_2(p_i) \quad (1)$$

Where Pi is the probability of any sample belonging to the category Ci, $Pi = Ri/|S|$. $|S|$ is the number of tuples in the training sample data set. Suppose an attribute A has v distinct values $\{a1, aZ\cdots av\}$, using the attribute A can divide the data set S into v subsets $\{S, 52\cdots Sv\}$, in which SJ contains the data set S subset of AJ values for attribute A, $j = 1,2,\cdots,v$..

If attribute A is selected as the decisive attribute,

Assume S_{ij} is the number of tuple samples in subset S_j with attribute $C_i(i=1,2,\cdots m)$. Then the use of attribute A to divide the information (entropy) required for the current data set can perform the calculation as follows:

$$E(A) = \sum_{j=1}^{v} \frac{S_{1j}+S_{2j}+\cdots S_{mj}}{|S|} I(S_{ij},\cdots S_{mj}) \quad (2)$$

Where, $\frac{S_{1j}+S_{2j}+\cdots S_{mj}}{|S|}$ is taken as the weight value for the j set, which is the total of sample data of all subsets with aj taken for attribute A and divided by the total number of samples in set S. The smaller the calculation result of E (A) is, the better the subset division will be. For a given subset Sj, the expected amount of information is as follows:

$$I(S_{ij},\cdots,S_{mj}) = -\sum_{i=1}^{m} P_{ij}\log_2(P_{ij}) \quad (3)$$

Where $P_{ij} = \frac{S_{ij}}{|S_j|}$, the information gain of attribute A obtained by dividing the corresponding sample set for the current branch nodes is:

$$Gain(A) = I(r_1,r_2,\cdots,r_m) - E(A) \quad (4)$$

This algorithm needs to calculate the information gain for each decision attribute, and the attribute with greatest information gain attribute is selected as the decision attribute node of set S, to establish branches drawn from this node through each value of the attribute.

2.2 Decision Tree Based Data Preparation

Data preparation phase includes the collection and pre-processing of data, that is to collect all internal and external data and information related to the business object, from which to choose the data applicable to data mining, perform research on the quality of data, preprocess the raw data, and combine with business demand to carry out data conversion, to determine the type of mining operation to be performed, so as to prepare for further analysis.

This article selects from the "Athlete Nerve Type Group Index Database" the track and field (short hurdle) group with 12,528 data information of 543 athletes of master athlete level, first level and second level. Firstly perform data cleansing, remove empty values, noise and irrelevant data, handle missing data field; then based the database relational tables, carry out compression, removal and summary to various attributes, and obtain two relational data tables of "Athletes Basic Information Table" and "Nerve Type Indicator Test Data Table" for each group. Athlete nerve type group traits evaluation model and system construction Chapter 3 athlete nerve type group traits evaluation model construction. Table 1 and Table 2 are the examples of test data table.

Table 1. Athlete Basic Information Table

No.	Sex	Age	Training Years	Athlete Level
1001	Male	22	11	Master Athlete
1002	Male	21	8	First Level
1003	Female	17	4	First Level
1004	Female	26	16	Master Athlete
1005	Male	24	10	Master Athlete
1006	Female	17	5	Second Level

Table 2. Athlete Nervous Type Indicator Test Data Table

No.	Intelligence Degree	Excitability	Start-up Speed	Flexibility	Tolerability	Balance	Curve Type	Functional Characteristics	Athlete Level
1001	Very High	High	Fast	Moderate	High	Relatively Balanced	V	Double Excellent	Master Athlete
1002	Relatively High	High	Moderate	Flexible	Very High	Balanced	W	Excellent excited	First Level
1003	Moderate	Relatively Low	Fast	Flexible	Relatively High	Not Balanced	И	Double Excellent	First Level
1004	Low	Moderate	Fast	Moderate	High	Not Very Balanced	W	Non-excellent	Master Athlete
1005	High	Relatively High	Slow	Flexible	Relatively Low	Relatively Balanced	V	Smart Excellent	Master Athlete
1006	Relatively High	Very High	Moderate	Very Flexible	Moderate	Balanced	W	Double Excellent	Second Level

2.3 Decision Tree Based Data Conversion

Data conversion is mainly performed before data mining, to convert the data into a description form suitable for data mining, and perform data normalization operation. ID3 algorithm cannot handle continuous attributes and must be perform discrete processing. For example: dividing continuous data of "Age" and "Training Years" attribute into three intervals; convert the "Curve type" attribute into four categories of "Ascending", "Fluctuation", "Mix", "Descending" etc.

2.4 Construction of Decision Trees

Through the converted data table, applying the "TANAGRAI.4" software, using ID3 algorithms for mining, a total of 10 decision trees are obtained. Take track and field group, for example, input the converted data table into the "TANAGRAI.4" software, and two decision trees on elite athletes are obtained:

Elite Track and Field (Short Hurdle) Athlete Basic Information Decision Tree (See Figure 1).

From the path of each root node to leaf node of the decision tree shown in Figure 1, the classification rules can be derived as follows:

IF "Age IN <20", THEN "Athlete Level = Non-excellent";

IF "Age IN> 25", THEN "Athlete Level = Excellent";

IF "Age IN20 - 25", THEN:

IF "Sports Years IN <10", THEN "Athlete Level = Non-excellent";

IF " Sports Years IN10—15AND>15", THEN "Athlete Level = Excellent.",

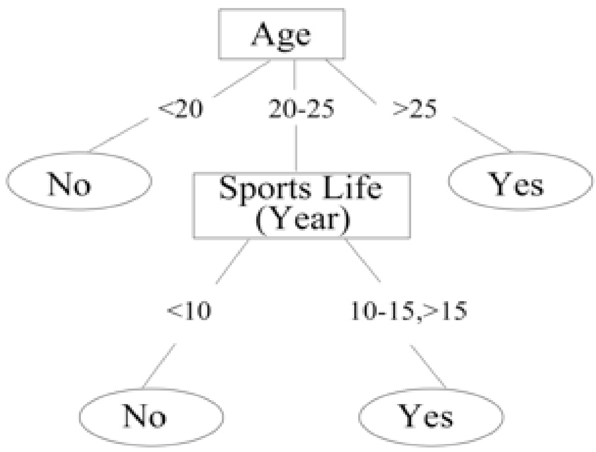

Figure 1. Basic Information Decision Tree for Elite Track (Short Hurdle) Athlete

From the path of each root node to leaf node of the decision tree shown in Figure 2, the classification rules can be derived as follows:

IF "Functional Feature = Intelligence Excellence", THEN "Athlete Level = Excellent";

IF "Functional Feature = Non-excellence", THEN

"Athlete Level = Non-excellent";

IF " Functional Feature = Double Excellence", THEN:

IF "Balance=Balanced", THEN:

IF "Flexibility = Strong", THEN "Athlete Level = Excellent";

IF "Flexibility = Moderate AND Low", THEN "Athlete Level = Non-excellent";

IF "Balance= x unbalanced", THEN "Athlete Level = Excellent";

IF " Balance=Y unbalanced", THEN "Athlete Level = Non-excellent";

1F "Functional traits = Excitability Excellent", THEN:

IF "Curve Type = Fluctuation AND Mix", THEN "Athlete Level = Excellent";

IF " Curve Type = Ascending AND Descending", THEN "Athlete Level = Non-excellent";

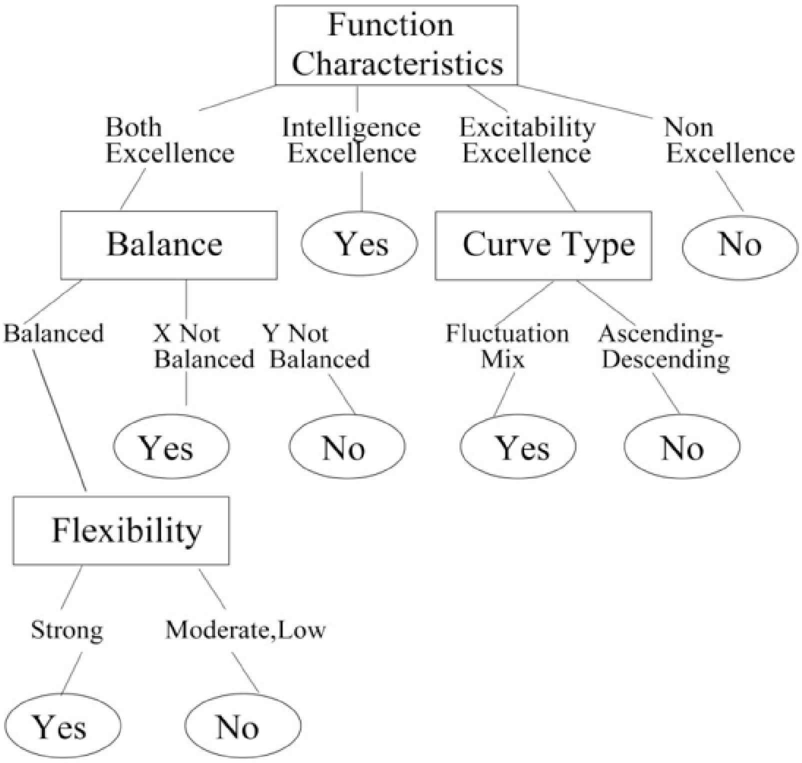

Figure 2. Elite Track and Field (Short Hurdle) Athletes Nerve Type Indicator Test Tree

2.5 Decision Tree Based Results Analysis

The decision tree in Figure 1 is elite track and field (short hurdle) athlete basic information decision tree, i.e. athlete level above first level, including national and world-class master athlete. As can be seen from this tree, the age of elite track and field athletes (short hurdle) is generally old, with long sports life, indicating that the training of this group of elite athletes cannot be achieved through an overnight quick way, but need many years of training and cultivation, to make an elite track and field (short hurdle) athlete; moreover, in the group, male and female elite athletes are not much different in the information, which further explains the arduous and lengthy training cycle for elite track and field (short hurdle) athletes.

Figure 2 is elite track and field (short hurdle) athlete nerve type test indicator decision tree, from which the following aspects of information can be seen:

1). Extremely high requirements on the intelligence level of elite track and field (short hurdle) athletes, indicating that the training process for such athletes cannot rely on the huge amount of exercise and stiff training, but rather needs to train with the mind, in the training, the intelligence elements of the athletes should be fully mobilized and engaged in the training, so as to achievement double effects with half efforts.

2). In addition to relatively high levels of intelligence indicators, the excitability of elite track and field (short hurdle) athletes is also generally high; with high excitability, the curve type "Fluctuations and Mix" shows that their start-up speed and tolerability indicators are also high, which are very consistent with the track and field (short hurdle) sports feature;

3). In respect of balance, elite track and field (short hurdle) athletes are basically balanced and unbalanced excitatory type; at the same time, they are required to have very high flexibility level, and even moderate level of flexibility is unable to meet the requirement for elite track and field (short hurdle) athlete.

Thus, the decision tree algorithm has important significance for the analysis of the nerve types of elite track and field (short hurdle) athlete. As can be seen from both decision trees, the age of track and field (short hurdle) athletes is generally old, with relatively long training years; their basic features of nerve types are: high level of intelligence, strong excitability, fast startup speed, high tolerability and high flexibility. In other words, all indicators of the nerve type of an elite track and field (short hurdle) athlete shall be comprehensive and balanced, and therefore requires relatively long training period.

3. Construction of the nerve type group traits evaluation model for track and field athletes

Process and Steps of the Construction of Evaluation Model.

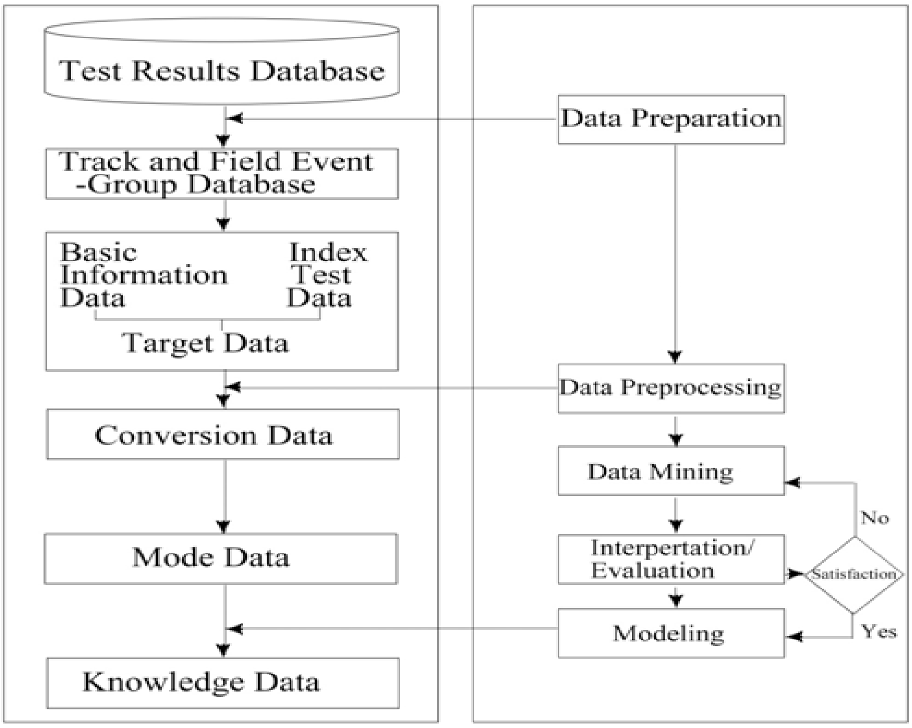

Figure 3. Construction of Evaluation Model Diagram

Through the process description of the previous data preparation and preprocessing for the track and field athlete nerve type group indicators, data mining algorithms application and result analysis, further clarify the construction of athlete nerve type group traits evaluation model methods and steps. Specifically:

Firstly, from the "Athlete Nerve Type Group Index Database", choose track and field (short hurdle) data information, and perform data cleaning and pretreatment, to obtain the "Athlete Basic Information Table" and "Nerve Type Indicator Test Data Table" for each group. Among them, the basic information data includes the athlete No., sex, age, training years and sports level of five categories; nerve type test data includes excitability level, start-up speed, flexibility, tolerability, balance, intelligence degree and functional traits of seven indicators test results and additional curve type indicators. Meanwhile, perform discrete processing to the two data tables of each group, to make the data into standard form suitable for mining; secondly, apply decision tree data mining algorithm and association rule to explore the basic information and nerve type indicator data feature for each group of athletes, after iteration and evaluation, establish the nerve type evaluation model data indicator system for each group of athletes; and thirdly, according to the obtained mode data indicator system, construct the knowledge data of the nerve type evaluation model for each group of athletes, and perform testing and evaluation on individual athlete. See Figure 3 for Evaluation Model Construction Process.

The evaluation results indicate that elite track and field (short hurdle) athlete model: high level of excitability in the neural processes, fast start-up speed; high flexibility, high or relatively high tolerability, curve type is mostly V-shaped (one of the strong types of fluctuation) and w (mixed type), mainly balanced or excitement type for balance, high or very high level of intelligence, functional traits are double excellence and athlete nerve type evaluation model group traits evaluation model and system construction Chapter three athlete nerve type group traits intelligent evaluation model construction.

4. Design and implement of athlete nerve type test and evaluation system

The system adopts modular design method, with the development tool visua1C # .Net, operating environment windowsNT/windows2000/windowsXP, both for the convenience of various combinations and modifications of system functionalities, and the supplement and maintenance of design and maintenance staff who are not involved in the development. The system has database maintenance function, which can perform timely data addition, deletion, modification, backup and other operations according to user needs.

The system testing process and test data management system meets the need of testing and management personnel for daily use, and reaches requirements of intuitive, easy, practical and safe operation. The features of the system to be completed are:

1)System data initialization;

2)Testee basic information input, modification and deletion;

3)Creation of test content, data modification and deletion;

4)Barium g trial data saving;

5)Test result statistical analysis, report printing, graphs generation, Excel export;

6)Data reconstruction.

On the basis of system function analysis, according to the features of C# program, the system functional module diagram is generated as shown in Figure 4. For example, for this paper it requires to select the track and field in the test items for testing.

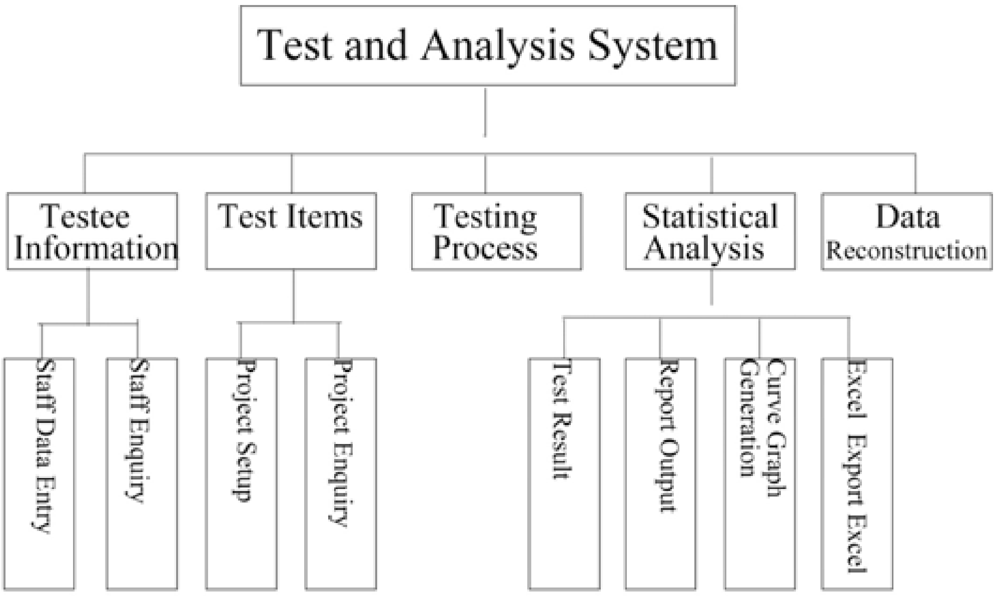

Figure 4. System Function Module Diagram

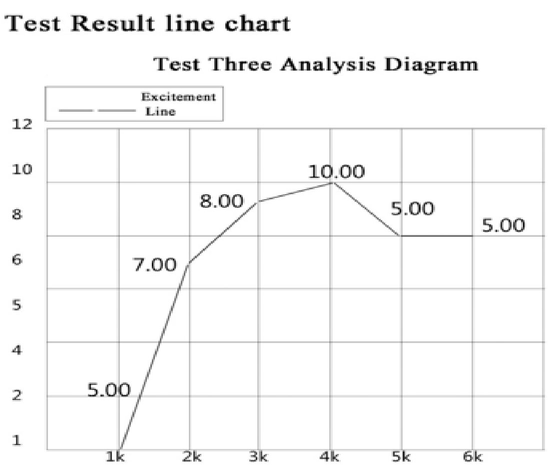

Figure 5. Curve Graph

As shown in Figure 5, track and field athlete excitability can be tested, to prepare for the training of athletes, with the testing results shown in Figure 5.

5. Conclusion

1). This paper adopts decision tree and association rules and other data mining techniques to build the track and field (short hurdle) athlete nerve type group traits evaluation model, and provide an effective, simple evaluation and decision-making tool for athletes, coaches and managers.

2). Apply .net platform to realize the construction of the athlete nerve types test and evaluation system. Through this system, we can achieve real-time test result evaluation and real-time remote transmission of test results, and can manage the data resources safely and effectively, so as to inspect, modify and improve the system itself in time.

3). Introduce data mining techniques to build the athlete nerve type group traits evaluation model and test system, involved in sports training, competition command and athlete selection, broaden the field of data mining technology and services, and facilitate the pace of China's sports into the information age.

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A Time Series is Approximated Parameter Control Algorithm

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Abstract

In order to improve the efficiency of time series data mining, to better serve the community activities; the use of effective methods of data simulation study proposed an approximate representation of the decomposition technique based on discrete wavelet transform key multi-scale; the results showed that: compared to the existing approximate representation, it retains the original scale representation of the approximate coefficients, get rid of the user precise control of the operating parameters to achieve the key point sequence is approximated approximate wavelet coefficients of each scale; this method both retain the main characteristics of time series data sequences, but also greatly to achieve an effective reduction