The change of groundwater quality in shallow layer based on parameter estimation and tennis physical fitness recovery

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Abstract
This paper mainly studies the parameters of active panel data. According to the activity panel data to create a balance model, through the use of two improved GMM evaluation algorithm and according to the original GMM evaluation algorithm, the activity panel regression model creation, and dynamic activity panel parameter evaluation creation process. Based on the research and analysis of groundwater exploitation and other related literature, this paper believes that the reasonable development and utilization of groundwater resources in the island is a major problem to be solved in the development process of groundwater resources. Therefore, in the shallow groundwater area, it plays a very important role in the protection of groundwater resources. There is a very close relationship between surface water and groundwater, and surface water and groundwater can interact and influence each other, making the water quality change to a certain extent. Groundwater is the main source of water supply in China. According to the literature, athletes have good physical fitness, which can help athletes get better results in the competition. Through the research and analysis of high-level tennis players’ physical fitness, we can find more scientific and effective training methods, and make the high-level athletes’ physical energy supply more comprehensive and reasonable, so as to improve the sports level and competitive ability of athletes. In this paper, through the study of traditional GMM evaluation algorithm, the parameters of regression model and data model can be accurately estimated by activity panel.

Keywords Parameter estimation · Shallow groundwater · Water quality change · Tennis sports · Physical recovery

Introduction
Panel data can also be called mixed data, mainly refers to a group of data forms obtained by integrating panel data and time series. There are two aspects of time and space in panel data. From the panel section, panel data is the data obtained by observing only multiple individuals on the cross-section of a certain time node. The creation of data model and parameter evaluation of the activity panel are the problems that experts and scholars in the related fields and professions pay attention to (Neretnieks and Moreno 2003). But because the dynamic panel data model has some endogeneity, the original OLS evaluation algorithm cannot evaluate the model accurately and efficiently. Therefore, the evaluation of dynamic panel data model has been evaluated by GMM evaluation algorithm for a long time. The research on dynamic panel has made great progress with the development of research. In modern society, the mining of coal mine is mainly carried out by the way of coal mining workers going deep into the mine. Because this mining method has some destructive effect on the rock and soil above the coal seam, and it is not conducive to the stability of the upper layer (Morales et al. 2017). The groundwater flows according to the direction of water flow, and it is transformed into vertical infiltration due to mining of the mine, and then discharged out after it flows into the pit. This leads to the problem of water supply around coal mines which is obvious. Groundwater has been greatly reduced. A groundwater funnel with the core of mine is formed around the coal mine. The water flow and water circulation in the corresponding area have changed to a great extent. The problems of groundwater supplement flow and discharge are destroyed in each depth. The groundwater level has been greatly reduced, not only makes the groundwater environment change greatly, but also...
causes the groundwater environment around the mining area to be polluted and destroyed, even some pollution, and damage is permanent and irreparable (Nguyet and Goldscheider 2006). Compared with surface water, it can be found that groundwater is generally affected by weather and season, and the circulation of water supply is relatively stable and efficient. Generally, under normal conditions, the quality of groundwater is obviously better than that of surface water, and groundwater is also the main source of the best water quality. But because of the different hydrological conditions and geographical location in different places, and excessive exploitation of soil and groundwater, groundwater is also polluted to a great extent (Obianyo 2019). But because groundwater cannot be observed and discovered directly, the protection of groundwater is not enough in many parts of the world. However, the lack of monitoring data for groundwater development and utilization leads to various problems and contradictions in the development and utilization (Ramos et al. 2011). Tennis is a major sport in China. So far, there is a great gap between the overall level of tennis in China and the overall level of tennis in developed countries in the world. Especially for the men’s tennis in China, there are many technical problems and technical difficulties such as technical defects, and there are also very big deficiencies in the physical fitness of athletes. Therefore, it is difficult to improve the overall level of tennis in China (Serres-Piole et al. 2012). Physical training is a main training item in the process of athletes’ sports. Good physical ability can ensure that athletes can play better technical actions and tactical essentials in training and competition, so as to make athletes get better results in the competition. Athletes are high-intensity overload training in ordinary training. If they lack physical ability, they will make the effect of sports training greatly reduced, so that athletes’ sports skills and skills cannot be effectively improved. The sufficient physical ability and scientific physical training can help athletes improve the efficiency and extend the time of sports. When the athletes are trained, the content, time, and methods of training are studied, which can make the training more accurate and scientific. In the process of physical recovery after exercise, athletes can be quickly recovered by stretching and massage (Tahershamsi et al. 2018). This paper studies and analyzes the physical fitness of athletes, and finds more scientific and effective training methods to improve athletes’ sports skills and physical fitness.

Materials and methods

Data selection and collation

In this paper, the monitoring data of coal mine outfall in different months and groundwater around the coal mine in a city of China in the past few years are selected. The main detection items are the pH value of groundwater, sulfate, *Escherichia coli*, and other different data indicators (Tan et al. 2016).

Parameter estimation method design

BFGS method

BFGS method is the most effective near Newton method in all optimization, because Newton method usually uses Taylor expansion of objective function, so every iteration must calculate Hessian matrix of objective function so BFGS method is very complicated, because there are some errors in parameter data period estimation, because measurement data usually show measurement error. Using statistical methods can generally reduce the adverse effects of measurement errors, and can also be regarded as a control method. Unknown parameters are often used as common variables in the model (Zhang et al. 2020). In parameter evaluation, this method is based on Bayer theory and can replace Hessian matrix with approximate matrix $B_k$:

$$g_{k+1} = g_k - B_k p_k$$

where $a$ is the repetition number and 4 is the step length, and the linear search technology is usually used to obtain the step length. The most commonly used linear search technology is Wolfe and armijo, which are two inaccurate linear search technologies. In general, the formula obtained by search is as follows:

$$B_k p_k = -\nabla S(g_k)$$

The following is a gradient equation which can be obtained by differentiating the unknown parameter $g$:

$$\nabla S(g_k) = [J(g_k)]^T [U(g_k) - Y]$$

The sensitivity matrix here is defined when we use the inexact linear search pattern armijo to obtain the step size. In order to ensure the definition of Hesse’s approximation matrix, the following correction forms can be used:

$$B_{k+1} = \begin{cases} B_k, & y_k^T s_k \leq 0 \\ B_k - \frac{B_k s_k y_k^T B_k}{y_k^T s_k B_k s_k}, & y_k^T s_k > 0 \end{cases}$$

where $s_k = g_{k+1} - g_k$ is displacement, $y_k = \nabla S(g_{k+1}) - \nabla S(g_k)$.

Groundwater quality assessment method

This time, the single-factor index method is used to evaluate the underground water in coal mine. This method is simple
and easy to realize. It is very convenient to see the excess of single factor and the limit of pollution control. It is the most commonly used method to reflect the environmental quality of groundwater, which can reflect the pollution degree of specific pollutants in groundwater. The actual monitoring data are used to compare and analyze the groundwater quality indicators, and the selection of the worst water quality is the last type of water quality assessment. A simple method to determine water pollution by control is given.

\[ P_i = \frac{C_i}{S_j} \]  

(5)

In the formula, \( P_i \) is the pollution index of the \( i \)th assessment factor, \( C_i \) is the monitoring value of the \( i \)th pollution index, and \( S_j \) is the limit value of the class III standard in the class I pollution index.

The normal pH index is as follows:

\[ s_{PH} = \frac{(7.0 - PH_j)}{(7.0 - PH_{su})} PH_j \leq 7.0 \]  

(6)

\[ s_{PH} = \frac{(7.0 - PH_j)}{(7.0 - PH_{su})} PH_j \geq 7.0 \]  

(7)

In the formula, \( s_{PH} \) is the pH standard SPH index of pH value at point \( j \), \( PH_j \) is the critical value at point \( j \), \( PH_{su} \) is the pH lower limit value indicated in groundwater quality, and \( PH_{su} \) is the indicated in groundwater quality. If \( P_i \) is not greater than 1, it indicates that it meets the requirements; If \( P_i \) is not less than or equal to 1, it means that the water quality assessment factor exceeds the standard value, thus causing harm to human body.

**Research methods of tennis physical fitness recovery**

This paper studies and analyzes the live videos of the world famous tennis competitions and the top tennis players in the world, and read a lot of literature and related reports about the physical fitness situation and the supply characteristics of physical fitness systems in our country. For different sports, the theoretical basis and training methods of physical training are reported. This paper refers to the relevant theoretical basis and practical training methods of many experts and scholars in sports medicine and sports kinematics as the main literature of this paper. In this paper, the statistical analysis mainly includes two points: one is the length of time needed for each ball from serve to end. For the serve number and batting situation of one point ball in 7 s, the serve number and batting situation of one point ball in 7~9 s are counted. The second is to count the number of service and batting of one point ball in more than 9 s. Before the research and analysis of these statistical data, we should first carry out model training, so that the statisticians can master the statistical methods and methods, and timely record the relevant data, so as to enhance the accuracy of statistics. When the statisticians can use the statistical methods very skillfully and accurately, the statistical work is formally implemented. In order to ensure that the statistical data has a high degree of accuracy and rationality, all the data after the statistics are analyzed to find out some of the rules to give further research.

**Results**

**Impact of coal mining on shallow groundwater quality**

The monitoring data of the drainage outlet and groundwater around the coal mine in different months a few years ago were selected. The content of monitoring data includes pH value, sulfate, *Escherichia coli*, and other different indicators. The main form of coal mine groundwater affected is in the process of coal mining, which makes the groundwater from the natural form. The horizontal form changes and eventually becomes vertical form, or the groundwater changes disorderly between horizontal and vertical forms. In this way, the contact surface between water, soil, and rock increases, and various metal components or other harmful substances in soil and rock enter into the water body, causing groundwater pollution. This paper mainly carries out data monitoring for sulfate, *Escherichia coli*, and other chemical indicators in the groundwater around the coal mine, and evaluates the groundwater quality in different areas, so as to understand and analyze the impact on the groundwater quality in the process of coal mining. The details are shown in Tables 1 and 2.

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Draw the graph curve of sulfate, *Escherichia coli*, and other indicators in groundwater, as shown in Fig. 1.

It can be seen from Fig. 1 that the COD value in underground water of coal mine has different trends of decreasing, increasing, decreasing, and increasing. During the 3 years, the trend gradually tends to be stable or rising slowly, and then decreases slightly in the later stage.

It can be seen from Fig. 2 that the change of sulfate concentration curve in underground water of coal mine is relatively large, showing a trend of first decreasing, then increasing, and then decreasing.

It can be seen from Fig. 3 that the fluctuation curve of chloride in groundwater around the coal mine also changes greatly, with different degrees of rise and fall.

It can be seen from Fig. 4 that the curve change of nitrate in the groundwater around the mine is also relatively large, which indicates that the concentration of nitrate has a great fluctuation, showing a trend of shrinking, increasing, and shrinking.
Impact of coal mining on safety change of shallow groundwater quality

The analytic hierarchy process is used to measure the precipitation. So as to determine the precipitation, groundwater velocity, and water content index of three different evaluation indexes, because each evaluation index has a certain relevance, so the index data of groundwater resources are drawn to get the index under the condition of groundwater, as shown in Fig. 5.

Through Fig. 5, it can be found that in the change chart of groundwater condition index, with the change of time, the index has an upward and downward trend, but the groundwater condition is generally in an upward state.

Through the calculation of precipitation, groundwater velocity, and water content index, the graph of groundwater quality index changing with time is drawn, as shown in Fig. 6.

It can be found from Fig. 6 that the groundwater quality index decreases first, then increases, and then decreases slightly with time. Generally speaking, the groundwater quality decreased the most in 2014, and then improved significantly.

According to different indexes such as precipitation, groundwater velocity, and water content index, the curve of groundwater carrying capacity with time is drawn, as shown in Fig. 7.

Table 1: Statistical table of groundwater chemical parameters in mining area from 2013 to 2020

| Years | pH  | COD | Sulfate | Chloride | Nitrate | Fluoride | Ammonia | Total Escherichia coli | Iron | Yi |
|-------|-----|-----|---------|----------|---------|----------|---------|------------------------|------|----|
| 2013  | 7.67| 1.89| 295     | 0.0176   | 6.3     | 1.63     | 0.34    | 24                     | 0.04 | 0.02|
| 2014  | 8.44| 0.73| 79      | 2        | 2.8     | 0.13     | 64      |                        | 0.054| 0.02|
| 2015  | 7.96| 1.85| 68.8    | 39.14    | 1.08    | 3.76     | 0.164   | 21                     | 0.076| 0.038|
| 2016  | 7.98| 2.33| 98.3    | 39.37    | 0.88    | 3.53     | 0.12    | 5.2                    | 0.044| 0.068|
| 2017  | 7.62| 2.25| 101.3   | 46.358   | 0.868   | 3.383    | 0.03    | 0                      | 0.04 | 0.02|
| 2018  | 7.87| 1.9  | 140.5   | 51.56    | 0.13    | 2.903    | 0.19    | 0                      | 0.09 | 0.06|
| 2019  | 7.49| 0.85| 198.8   | 29.206   | 0.282   | 1.349    | 0.03    | 0                      | 0.04 | 0.0|
| 2020  | 7.8 | 0.73| 122.8   | 41.439   | 0.332   | 2.734    | 0.04    | 0                      | 0.04 | 0.02|

Table 2: Statistical table of groundwater chemical parameters in gongniergei gully from 2013 to 2020

| Years | pH  | COD | Sulfate | Chloride | Nitrate | Fluoride | Ammonia | Total Escherichia coli | Iron | Yi |
|-------|-----|-----|---------|----------|---------|----------|---------|------------------------|------|----|
| 2013  | 7.12| 1.09| 61.2    | 15.26    | 2.18    | 0.59     | 0.03    | 0                      | 0.04 | 0.02|
| 2014  | 7.75| 0.77| 68.97   | 13.55    | 1.94    | 0.32     | 0.2     | 23                     | 0.04 | 0.03|
| 2015  | 7.8 | 0.78| 46.3    | 13.2     | 1.2     | 0.62     | 0.18    | 17                     | 0.34 | 0.02|
| 2016  | 7.8 | 1.03| 73.2    | 16.7     | 4.2     | 0.59     | 0.09    | 0                      | 0.19 | 0.02|
| 2017  | 7.68| 1.09| 49.2    | 15.16    | 0.83    | 0.46     | 0.022   | 2.3                    | 0.35 | 0.09|
| 2018  | 7.52| 0.68| 77.64   | 18.88    | 0.75    | 0.48     | 0.15    | 0                      | 0.07 | 0.02|
| 2019  | 6.98| 1.7 | 48.02   | 18.72    | 0.47    | 0.46     | 0.08    | 0                      | 0.04 | 0.02|
| 2020  | 6.98| 1.3 | 81.27   | 26.2     | 0.79    | 0.34     | 0.02    | 0                      | 0.04 | 0.02|

Discussion

Analysis of the characteristics of athletes’ energy supply system in tennis competition

By using the ATF rule, there is a certain time interval in the middle of each game. And in the interval of time can make athletes have a short rest. At the end of each game, there will be a certain period of rest in the interval of changing the venue. According to the statistical data obtained from the competition, we can see that the activity time in the competition is about 20 min, and other time is scattered in different intervals. For high-level athletes in sports competition, there will be a long time of confrontation, and the batting time will be completed in an instant (Baazi et al. 2020). At the same time, there will be a lot of running and forward, backward,
pause, and other situations in the field, so the athletes’ sports activities are relatively large, the intensity of the movement is relatively high, and there are more time to rest. Generally speaking, the time of high-level tennis competition is relatively long. The muscle is always in the state of use in the process of exercise, the energy supply to the muscle is mainly ATP, so in high-intensity exercise, the time of ATP supply to the muscle is very short, within 2s. In aerobic exercise, the energy provided by the physical supply system is the main source of athletes’ physical fitness (Fig. 9). According to the above table, in general, the supply of phosphate is very important in high-level sports (Bailey et al. 2013).

The innovation of applying common methods of physical training to tennis physical training

Comparatively speaking, there are some similarities in the function and physical training of table tennis and badminton. According to the physical characteristics and conditions of the athletes in these sports, the relative energy supply characteristics are used for energy supply. In sports training, we should not only increase the supply intensity of phosphate, but also adjust the supply of sugar, so as to improve the aerobic metabolism ability of athletes. In the training activities of table tennis, it usually includes aerobic training and anaerobic training. In the usual training, aerobic training and anaerobic training are often carried out alternately, such as aerobic training within three minutes, and then a few minutes of anaerobic training, and players on both sides of the table for a few minutes of training (Chen 2014). This will enhance the endurance of athletes. This kind of energy supply technology strengthens the energy supply system, and carries on the scientific energy supply according to the characteristics of table tennis. The daily training of badminton is mainly a way of variable speed running and interval training (Elbaz et al. 2018). In the daily training, athletes should first run several variable speed runs of different lengths and different times, and then rest for a few minutes and then repeat the variable speed running. This way and method of training physical fitness can also be applied to the process of tennis sports training, because the physical training of tennis is usually alternating between aerobic training and anaerobic training, and there is no certain periodicity. By combining the characteristics

Fig. 1 Evolution characteristics of COD with time

Fig. 2 Evolution characteristics of sulfate concentration with time
and situation of table tennis and badminton skills training, aiming at the characteristics of tennis such as high physical consumption, we develop special training methods. In the phosphate energy supply capacity, athletes need to sprint, run, and stop in a variety of ways, using the way of high intensity and large amount of training (Dewaide et al. 2016). The specific way is that the coach will hit the ball to the left and right two different areas according to the way of singles line and doubles line. The athletes run from the midpoint, and at the same time use reasonable technology and dexterous pace to hit the coach’s dribble. The player’s ball should have a certain technical content, be able to rotate, and the accuracy of hitting the ball should be high. In dribbling training, the main purpose is to train the athletes’ running speed, not to stop. Generally, taking 20 balls as a group, this kind of training can not only improve the energy supply ability of phosphate in the human body, but also greatly improve the accuracy of hitting (Estabragh et al. 2014).

The glycolysis energy supply should also be strengthened, usually to make athletes maintain high-intensity exercise in a few minutes. According to the running situation of tennis players and the characteristics of not being able to have a full rest, we use high-intensity intermittent running and variable speed running to exercise the glycolysis function. The specific method is as follows: first, let the athletes run several different lengths of variable speed running, and then rest for a few minutes, and then repeat the last variable speed running, a total of three times. Glycolysis function will make muscles emit lactic acid in the process of exercise. A large amount of lactic acid will make muscles feel very tired. This kind of high-intensity short rest exercise mode can make human muscles have high milk acid resistance. The ability to resist lactic acid can be strengthened by running at different speeds for many times, that is to say, by enhancing the ability of glycolysis to improve the anti-milk acid. Because in the tennis match, the time is long and there is uncertainty, so after the fierce match, we should use some medium intensity and slow rhythm dribbling training. The specific method is as follows: the coach sends the ball to the left and right two different areas according to the way of singles line and doubles line, the players can hit the ball in enough time, and the accuracy of hitting the ball is...
improved, under normal circumstances, 100 consecutive strokes as a group, a total of three groups. In this way, the ability of aerobic metabolism can be improved and the endurance of athletes can be enhanced (Goldscheider et al. 2008).

In the physical training of athletes, through the organic combination of the above three ways and reasonable order, the movement can be intermittent. This training method can enhance the ability of glycolysis and aerobic metabolism, and improve the speed and body endurance of athletes. In the daily training of athletes, this training method will be trained for many times. When the heart rate of athletes is determined to return to normal during the training interval, the next group of training will be started. Generally, five groups of training will be carried out continuously (Huan et al. 2015). Of course, it should be adjusted according to the physical condition of the athletes.

**Recovery after physical training**

Athletes in the process of training physical recovery refer to the end of the exercise, some restorative exercise to make up for the loss of the body and strengthen. In the recovery process after training, special deployment is needed. The recovery process mainly includes four parts: transient recovery, complete recovery, complete recovery, and effective recovery. The main purpose of training for athletes is to make the body function adapt to the high-intensity training, and make the function quickly return to the normal state after the training. In specific circumstances, the greater the intensity of athletes, the greater the physical consumption, the longer the recovery time required (Hussain and Abed 2019). And the ultimate complete recovery will be more vivid. Because the recovery situation in the process of exercise will not completely recover to the previous state and level in a short time, so it is necessary to carry out complete recovery. After the end of physical training, how to quickly remove the sense of fatigue, make the physical recovery as soon as possible, and even to reach the state before sports, are another major aspects of physical training (Koestel and Larsbo 2014). In the process of recovery after sports competition, the main way to eliminate fatigue is to supplement some nutrition and energy for athletes. According to relevant information reports, athletes...
after the end of the game, increase the intake of glucose, will make the energy consumed in the process of sports and competition get a rapid supplement, so that the energy of liver sugar can be effectively supplied, and quickly meet the requirements of blood glucose supply, so that the fatigue caused by lactic acid can be restored as soon as possible (Khosronejad et al. 2016). At the same time, the athletes can be soaked in some warm water. After the end of competition and training, athletes soak in warm water. The warm effect of hot water can accelerate the blood circulation in the human body, so as to help the metabolites quickly excrete out of the body. Massage is also a way to quickly eliminate fatigue. After a long time and a lot of tense application of muscles, some muscles can be effectively relaxed by massage. This method is the most common method to eliminate fatigue. After sports and competitions, athletes can quickly get rid of their fatigue by slowly kneading and beating their body muscles for a long time with appropriate strength. Enough sleep can also effectively eliminate fatigue. If you cannot get enough sleep, people’s fatigue cannot be completely eliminated. Therefore, in daily training and competition, athletes should have enough sleep time and excellent sleep environment. Sufficient sleep can make the human body function recover quickly, and even reach super recovery state. And athletes in the process of daily training and competition, muscle sugar, and liver sugar in the muscle will be a lot of loss, so timely injection of glucose can make the body’s energy get rapid supplement. And because of the high intensity and long-time training and competition, the muscle will release a lot of lactic acid, making the body feel very tired, so the elimination of lactic acid as soon as possible, such as jogging to reduce the accumulation of lactic acid after exercise (Liang et al. 2016). In addition, after sports training and competition, the intake of green substances such as vegetables can also reduce the accumulation of lactic acid in the body, because vegetables are generally alkaline substances, which can neutralize lactic acid. The recovery process after training and competition should be carried out in the following order: supplement glucose for warm water bath, and massage

![Variation of groundwater carrying capacity index with time](image)

**Fig. 7** Variation of groundwater carrying capacity index with time

| Years | Groundwater environmental safety value | Grade | The groundwater environment is basically safe |
|-------|----------------------------------------|-------|-----------------------------------------------|
| 2013  | 2.72                                   | Three | Safety                                        |
| 2014  | 2.95                                   | Three | Safety                                        |
| 2015  | 2.55                                   | Two   | Safety                                        |
| 2016  | 2.45                                   | Three | Not safe                                      |
| 2017  | 2.61                                   | Two   | Safety                                        |
| 2018  | 2.49                                   | Three | Not safe                                      |
| 2019  | 2.69                                   | Three | Safety                                        |
| 2020  | 2.58                                   | Three | Safety                                        |

**Table 3** Safety grade and safety status of groundwater environment in mining area in each year

| Number of boards | Below 3 boards | 3 to 7 boards | 8 to 15 boards | 15 boards or more |
|------------------|----------------|---------------|----------------|-------------------|
| Time ratio       | 17.3% within 4 s | 4 to 9 s 57.5% | 11 to 21 s 16.9% | 8.7% over 21 s    |

**Table 4** Time statistics of the number of opposing boards in 2010 Tennis Singles
the athletes at the same time, strengthen the nutritional balance of food, so that athletes can ensure adequate sleep.

**Conclusion**

According to the theory and research methods of ecological risk assessment, a theoretical framework for land ecological risk analysis and assessment is established. Based on the characteristics and risk analysis of urban water and soil resource loss, this article discusses soil and water conservation management measures and the content of management measures in urban construction. Based on the urban development plan and the status of soil and water protection, protection measures are implemented according to the regional conditions. The quadratic structural equation model affects the economic mechanism of public services based on digital technology. The application of digital technology and the efficiency of public services play an important role in digitization, network, intelligent society, and more and more public service processes, and are directly related. The form of high-level alliance provided across borders between the government, enterprises, society, and citizens has even formed an independent choice in the public service market.

**Declarations**

**Conflict of interest** The authors declare no competing interests.

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