

Retraction

Retracted: Evaluation of Scientific and Technological Innovation Ability of Free Trade Zone Based on Random Forest Weighting Method

Mobile Information Systems

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] L. Y. Meng, "Evaluation of Scientific and Technological Innovation Ability of Free Trade Zone Based on Random Forest Weighting Method," *Mobile Information Systems*, vol. 2022, Article ID 8769703, 11 pages, 2022.

Research Article

Evaluation of Scientific and Technological Innovation Ability of Free Trade Zone Based on Random Forest Weighting Method

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The scientific and technological innovation ability of the economic free trade zone is crucial to the depth and breadth of its economic development. There are too many subjective factors in the evaluation of the scientific and technological innovation ability of traditional economic free trade zones. In order to objectively evaluate the scientific and technological innovation ability of the free trade zone, this paper uses the random forest weighting method and the weighted linear combination to construct the evaluation index system, designs the evaluation model of the scientific and technological innovation ability of the free trade zone, and makes a specific analysis and evaluation based on the operation data of the economic and technological innovation ability of China's four key free trade zones in 2020. The results show that the scientific and technological innovation ability of Guangdong economic free trade zone is the strongest, followed by Guangdong economic and trade zone, Shanghai economic and trade zone, Zhejiang economic and trade zone, and Tianjin economic and trade zone; Guangdong free trade zone has strong scientific and technological innovation ability. Compared with other free trade zones, Guangdong's main advantages lie in the integration and aggregation ability of the industrial chain, strong policy support, and talent attraction. The scientific and technological innovation ability forms a virtuous circle. The analysis of the model example shows that the introduction of the random forest weighting method into the scientific and technological evaluation of the free trade zone can more objectively compare and analyze the scientific and technological innovation ability of the free trade zone, which is of great significance to help the free trade zone find out the problems and shortcomings in the scientific and technological innovation ability and improve the level of scientific and technological innovation.

1. Introduction

There are several definitions of the concept of an economic free trade zone in academic circles. According to the Kyoto Convention (1973), some regions in a certain country and region do not need to be supervised and constrained by the relevant customs system when goods are transported across the border, and these regions can be called free trade zones. This stage took place at the end of World War II. In the second stage, the economic free trade park includes services and investment trade. With the deepening of trade liberalization and the continuous standardization of rules of origin. The third stage of the economic free trade park began with the global financial crisis. With global integration, the main mode of economic free trade park is a transnational

trade zone, which gradually moves closer to the form of transnational economic integration, and tariffs and transnational investment barriers disappear. Foreign economic free trade parks have been established for a long time with rich experience, and foreign economists' research on economic free trade parks is also relatively mature. Some scholars believe that the establishment of economic free trade parks will reduce domestic welfare, lack the protection of relevant tariff policies, and the final transaction price of some goods or services produced within the region will decline due to lack of competitiveness, which will damage the relevant interests of the country to a certain extent [1]. The lack of a good business environment and strong government support in developing countries leads enterprises to passively accept the new trade model brought by the

economic free trade park, which is easy to lead to the reduction of business efficiency of the company in the economic free transaction park. The liberalization of intermediate trade brought about by the construction of the economic free trade park will strengthen the transaction relationship between local enterprises and foreign-funded enterprises and increase the purchase of imported parts and components by local enterprises. Due to the strength gap between local enterprises and foreign-funded enterprises, it is easy to lead to a trade deficit in the long run [2]. However, most scholars have expressed positive views on the economic free trade park policy. Different from the trade deficit view of Seyoum, Broda et al. research on Indonesia show that developing countries can improve production efficiency through “importing secondary schools.” When the trade liberalization of domestic enterprises is better developed, domestic enterprises will face more intense international competition [3]. The construction of the economic free trade park can bring foreign investment, which will promote the influx of international multinational companies into the economic free trade park for investment and production. The construction of the economic free trade park has reduced the operating costs of enterprises, attracted more foreign investment, increased the opportunities for foreign exchanges of local enterprises, and made the construction of enterprises’ international trade network more convenient [4]. After entering the economic free trade park, multinational companies will establish branches or branches in the economic free trade park. These enterprises and institutions will communicate and cooperate with local the company in the economic free trade park. The business of foreign-funded enterprises is concentrated in the technology and service industries. For production weaknesses, local enterprises will choose outsourcing according to their comparative advantages. When intermediate products are professionally divided into different stages of the value chain. Reducing enterprise costs and allocating intermediate products to better enterprises for production can improve the quality of final products so that the market competitiveness of enterprises and the market sales volume of products can be improved [5].

At present, China is building 18 free trade zones, involving 31 countries, regions, and organizations. Among them, 12 free trade agreements have been signed, involving 20 countries and regions, including the free trade agreements between China and ASEAN, Singapore, Pakistan, New Zealand, Chile, Peru, Costa Rica, Iceland, and Switzerland, the closer economic and trade partnership arrangement (CEPA) between Mainland China and Hong Kong and Macao, and the Cross-Strait Economic Cooperation Framework Agreement (ECFA) between Mainland China and Taiwan. Except for the free trade agreements with Iceland and Switzerland, which have not yet taken effect, Others have been implemented; there are six free trade agreements under negotiation, involving 22 countries, regions, and organizations, including China’s free trade negotiations with the Republic of Korea, the Gulf Cooperation Council (GCC), Australia and Norway, as well as the China-Japan-Korea free trade area and the regional comprehensive economic cooperation partnership (rcfp).

One, in addition, China has also joined the Asia-Pacific trade agreement. [6]. Deepening the reform of the economic free trade park and stimulating scientific and technological innovation in free trade economic parks is a necessary condition for participating in the international industrial division of labor, and inevitable requirements to promote the economic free trade park to play an important role in building a new economic pattern with economic internal circulation as the main body.

1.1. Current Situation of China’s Economic Free Trade Park.

In 2002, China started the structure process of the free trade area. After more than ten years of development, China has initially formed a network framework of free trade areas based on the surrounding areas and facing the world [7]. It has signed 19 free trade agreements, involving ASEAN, South Korea, Pakistan, New Zealand, Chile, Switzerland, Mauritius, as well as 26 countries and regions such as Hong Kong, Macao, Taiwan, and China, and is cooperating with Norway, Israel, and other countries which carried out negotiations or upgraded negotiations on 11 free trade agreements, and carried out joint feasibility studies or upgraded joint feasibility studies on 8 free trade agreements with Nepal, Canada, and other countries, that part is crucial for expanding foreign economic and political relations, see Table 1. In 2020, with the extended spread of COVID-19, China’s economic free trade park construction still made positive progress. In October, China and Cambodia signed a free trade agreement, which is the first free trade agreement negotiated and signed between China and the least developed countries, and also the first free trade agreement to establish independent chapters for the cooperation of the under the background of the “the Belt and Road.” In November, 15 member countries of RCEP signed an agreement [8], which will inject strong impetus into regional and global economic growth. From an international perspective, there is still a large gap between the number of China’s economic free trade zones and the developed countries such as the United States and Japan. See Figure 1 for details.

In terms of trade volume, the trade between China and its free trade partners (excluding Hong Kong, Macao, and Taiwan) accounted for 27% of China’s be-all foreign transactions in 2019. Meanwhile, the trade between the United States and its free trade partners accounted for about 40% of its total foreign trade and about 52% of Japan’s total foreign trade. Even after the RCEP agreement came into force, the trade coverage between China and its free trade partners has only increased to about 35%.

In terms of the number of economic free trade parks, as of January 28, 2021, there were 337 regional trade agreements still in force in the world, and the number of negotiations signed by China was only 16 (excluding 3 noneffective free trade agreements), which was far lower than that of the European Union (44), and also lower than that of Singapore (26), Mexico (22), Turkey (23), South Korea (19), Japan (18), and other countries and regions. Japan has also reached the cptpp, signed the economic partnership agreement (EPA) with the European Union, and

TABLE 1: Average results of index scores of 5 experts on 6 target levels of 4 economic free trade parks.

Free economic and trade zone	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
FTZSH	[9, 9, 8, 7, 8, 10]	[10, 10, 6, 7, 9, 8]	[9, 10, 8, 8, 8, 1]	[9, 10, 7, 7, 8, 8]	[10, 9, 6, 7, 9, 8]
FTZTJ	[9, 8, 7, 6, 6, 10]	[8, 6, 5, 5, 6, 8]	[9, 5, 5, 6, 8, 8]	[9, 5, 4, 4, 7, 8]	[8, 5, 5, 6, 8, 8]
FTZGD	[9, 9, 8, 9, 7, 6]	[8, 10, 8, 10, 6]	[9, 9, 8, 8, 6, 7]	[10, 8, 10, 10, 8, 8]	[9, 10, 8, 10, 7, 7]
FTZZJ	[8, 9, 8, 6, 6, 9]	[7, 8, 8, 7, 5, 10]	[6, 10, 8, 7, 5, 8]	[7, 10, 9, 5, 6, 8]	[8, 8, 8, 8, 8, 9]

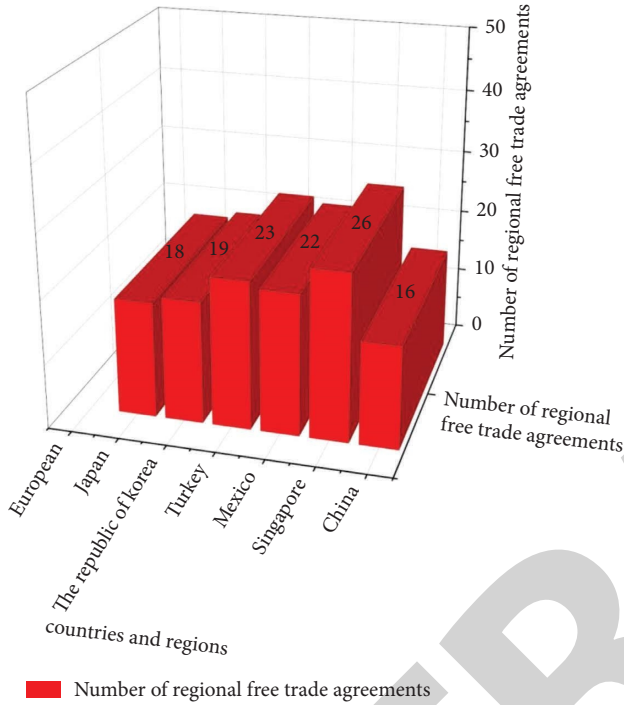


FIGURE 1: Number of regional trade agreements in some countries.

signed a trade agreement with the United States, while none of China’s free trade partners in the agreements that have entered into force are among the world’s top ten economies; The degree of liberalization of the economic free trade park is not high. China basically accounts for 90% or even more in terms of the proportion of tariff-free products in the total tax items and the proportion of imports of tariff-free products. The RCEP agreement was signed in November 2020, more than 90% of the commodity trade in these regions will achieve zero tariffs within 10 years so the RCEP economic free trade park is expected to fulfill all the commitments of trade liberalization in goods in a relatively short time. In comparison, the international high-standard free trade agreement can basically reach the proportion of zero tariff products of more than 99%.

1.2. *Significance of Evaluation on Innovation Ability of Economic Free Trade Park.* In this study, the evaluation index system of scientific and technological innovation capability of the economic free trade park, aiming at the problem of the interweaving and confusion of the index system, this study adopts the random forest weighting method, aiming to clarify the existing core indicators at all levels in an objective statistical and quantitative way, and provide a mainstream

model reference for the selection of indicators, to make a theoretical discussion on the evaluation model of the scientific and technological innovation ability of economic free trade park [9]. The maximum utility of evaluation model of the scientific and technological innovation ability of the economic free trade park lies in that the evaluation subject can complete the evaluation of the object with the help of the evaluation index system, and get real and reliable evaluation results, so as to clarify the advantages and disadvantages of the development of the economic free trade park and point out the direction for further improving the scientific and technological innovation ability of the economic free trade park. However, in the process of practical application, there are various evaluation index systems available for selection, and it is sometimes difficult for the evaluation subject to make a scientific judgment, which is easy to cause the same research object to produce different evaluation results due to the selection of evaluation index system [10].

This study uses the random forest weighting method to establish an evaluation model of the scientific and technological innovation ability of the economic free trade park, which helps to provide an operable evaluation index system for the evaluation subjects who study the relationship between the scientific and technological innovation ability of the economic free trade zone and the scientific and technological independent innovation ability of the economic free trade park and explores the development shortcomings of the economic free trade zone. It is important to evaluate the scientific and technological innovation ability of the economic free trade park and to help the economic free trade park develop more stably, it is of great significance to make more contributions to economic development.

2. Main Problems of Scientific and Technological Innovation Capacity Evaluation in Traditional Areas

Up to now, the academic circles have made rich theoretical research achievements in the evaluation of regional scientific and technological innovation ability, mainly in three aspects [11]. The abovementioned research achievements have to build a good theoretical foundation for the formation of the evaluation index model of this study. The evaluation model of regional scientific and technological innovation level constructed by foreign academic circles has become an important measurement standard to measure regional or national scientific and technological innovation, which has a strong representative and provides a basis for the comparison of horizontal scientific and technological competitiveness between different regions [12]. Influenced by

foreign innovation theories, and in recent years, China has introduced a series of macro strategic measures to promote scientific and technological innovation, the research results of Chinese academia are relatively prominent. It is mainly divided into two points: first, the establishment of a regional scientific and technological innovation model is relatively complete, which is mainly divided into 2-3 index levels, most of which are 3 index levels, of which the first level usually involves climate for scientific and technological innovation, innovation foundation input, output and benefit of scientific and technological innovation; on the other hand, the evaluation and analysis method of regional scientific and technological innovation ability is relatively objective, mainly quantitative analysis method, which is conducive to the scientific processing and analysis of data [13].

However, in the process of selecting the evaluation model, the domestic academic circles, generally speaking, it is limited by the research in their respective fields, which makes the constructed evaluation indicator systems show great differences on the whole [14]. First, the indicators are expressed in a similar way, such as the number of scientific researchers and the number of scientific researchers per 10000 people. If we choose to retain more representative indicators, it may be helpful to ensure the reliability of the final evaluation results; second, the definition of indicators is general, such as enterprise technology innovation index, science, and technology human resources training, etc., the specific direction of indicators is vague, which needs to be further refined and explained; third, the level of indicators is misplaced, such as the level of indicators such as R&D investment intensity in different indicator systems is inconsistent; and fourth, the index structure is poor [15]. For example, the construction of some supplements is too simplified, and the construction of some indicators is too cumbersome. For example, if the indicators with a low correlation of forest coverage equal to technological creation l innovation ability are included in the evaluation, it may be detrimental to the key analysis of the final evaluation results, this needs to be selected in the mode of the evaluation model. Therefore, the current domestic and foreign evaluation research of regional technological creation capability has many references, but at the same time, there are also some areas that need to be further improved, which are worth discussing in future research. This paper is based on the above-mentioned research background to re-explore the random forest weighting method to build the evaluation system of technological creation capability of economic free trade parks.

3. Basic Principle of Forest Weighting Method

3.1. Random Forest Principle. Random forest (RF) is a combined intelligent classification algorithm based on statistical learning theory, which mainly includes classification and regression. [16]. This study mainly adopts the radio frequency classification method, RF classification includes various decision tree classification models, A combined distinguish model composed of $\{h(X, \Theta), k = 1, \dots\}$, and the data set $\{\Theta\}$ set an independent distributed random vector,

under the given lambda parameters, each decision tree classification model has to choose the most appropriate voice sorting method.

The fundamental principle of RFC is to extract key indicators from multiple indicator samples. These index samples are from the basic samples, and the data of each sample is the same as the original sample. [17], random forest weighting model is shown in Figure 2.

3.2. Random Forest Weighting Method. Gini index method is used to calculate the random forest weight. If a set t contains k types of data, the Gini index is given as follows:

$$\text{Gini}(T) = 1 - \sum_{j=1}^k p_j^2. \quad (1)$$

p_j^2 expresses the frequency of T appearing in j group. When $\text{Gini}(T)$ is at least 0, in other words, the information recorded at this node is basically the same, which indicates that useful information can be extracted at this time; at this time, the effective data in the node is evenly distributed in the node, when the value is the maximum, it means that the effective information in the node is the minimum. The set t is divided into m parts, $T_i (i = 1, 2, \dots, m)$. In order to calculate the Gini coefficient conveniently, it is necessary to calculate the reduction of the Gini coefficient of each segmented node. Then calculate the subGini index as follows:

$$\text{Gini}_{\text{split}}(T) = \frac{\sum_{i=1}^m \text{Gini}(T_i) N_i}{(N)}. \quad (2)$$

Among them: number of child nodes m ; N_i is the number of samples collected from subnode T_i ; N is the number of data in the parent node set T . the basic idea of Gini number is: if the minimum Gini spectrum, that is, the maximum purity of impurities, can be provided, it can be used as a criterion for node separation, and the attribute value can be divided into molecular trees, which is the best branch; this is achieved by splitting the corresponding attribute values and creating branches based on the attribute values; the next step is to separate the samples until the stop condition is met. It is usually the purity threshold of a specific leaf node. If the threshold is greater than or equal to, the segmentation ends [18].

If all T samples belong to the same category for regression tree sorting, or there is only one T data, then the T node is an atypical node. If the separator of variable Gini is randomly replaced, the classification of regression tree i is divided by, $\text{Gini}_{\text{split}}\chi_i - \text{Gini}_{\text{split}}\chi_{ig}$. Later, the important index of the same category G in the corresponding fractional regression tree can be expressed as. Importance of variable $G \Delta - j$ calculate the average value of element Gini index in the model, namely, the declining value of the average Gini index is given as follows:

$$\bar{\Delta}_j = \frac{(\sum_{i=1}^B (\text{Gini}_{\text{split}}(\chi_i) - \text{Gini}_{\text{split}}(\chi_{ij})))}{B}. \quad (3)$$

This study chose to use $\bar{\Delta}_j$ to the importance of analysis of index variables as follows:

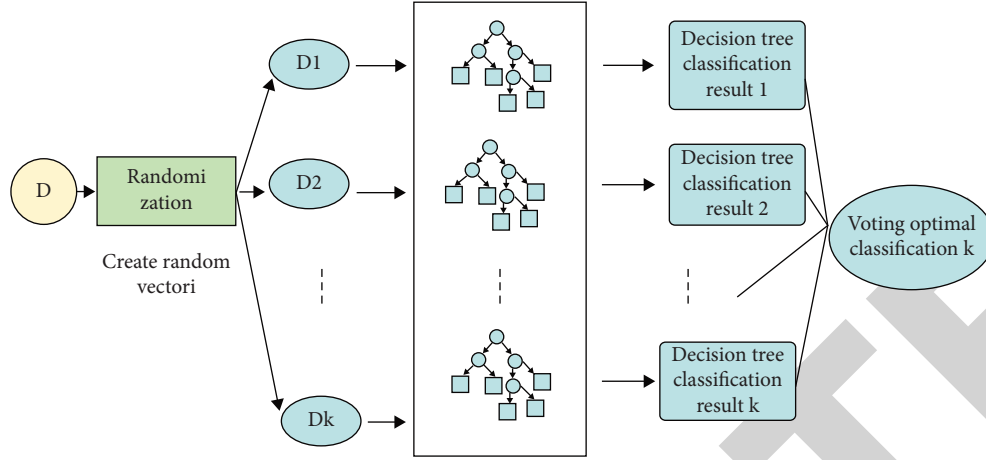


FIGURE 2: Random forest algorithm model.

$$w_j = \frac{\bar{\Delta}_j}{\sum_{j=1}^n \bar{\Delta}_j}. \quad (4)$$

In the formula, n is the number of index elements; W_j is the importance index of the j th index element, right here meets $\sum_{j=1}^n w_j = 1$.

3.3. Weighted Linear Combination. Linear weighted combination model also called “addition” comprehensive analysis method or weighted arithmetic average method operator, application of linear computing system for comprehensive evaluation. Its calculation is simple, easy to understand, and easy to combine with GIS technology, and the effect is good because it is widely used [19]. In view of the advantages of the linear weighted combination method, this study uses this method to build a landslide risk assessment system. The specific calculation formula of the weighted linear combination method is given as follows:

$$y = \sum_{j=1}^m w_j x_j. \quad (5)$$

In this formula, y is the overall analysis index of the system or the analysis objectives; m is the quantity of indicators variables; w_j is the specific gravity coefficient corresponding to the index variable x_j , which is determined by (4), and needs to meet $0 < w_j < 1$ ($j = 1, 2, \dots, m$), and $\sum_{j=1}^m w_j = 1$; x_j is the normalized value of each index variable. The purpose of normalization is mainly to eliminate the influence of data range and dimension of different index variables. The normalization formula is given as follows:

$$x_j = \frac{x - x_{\min}}{x_{\max} - x_{\min}}, \quad (6)$$

$$x_j = \frac{x_{\max} - x}{x_{\max} - x_{\min}}.$$

Where: x is the original value of each index variable, x_{\min} and x_{\max} are the minimum and maximum values of the original values of each index variable, respectively. Formula (6) the

former is suitable for improved data, that is, the larger the index, the contribution to risk; the latter is suitable for negative indicators, that is, the smaller the index value, the greater the contribution to the important coefficient.

3.4. Weight Estimation of Eigenvectors. Suppose a random forest consists of a series of trees $h_1(X), h_a(X), \dots, h_k(X)$, and two random vectors X (input vector) and Y (output vector). $I = (h(X) = Y)$ represents the number of votes of Y that correctly classifies the eigenvector X . The weight estimation link of the eigenvector is as next:

Next link 1: reliability analysis of eigenvector weight estimation.

- (1) Convergence estimation of random forest classification tree: define $mg(X, Y)$ as the edge function of sample points (x, y)

$$mg(X, Y) = av_k I(h_k(X) = Y) - \max_{j \neq Y} av_k I(h_k(X) = j), \quad (7)$$

Y represents the clustering vector of content, $I(\cdot)$ represents the special display function, and $av_k(\cdot)$ averages the take effect of values. This edge function represents the extent to effective equilibrium assignment number classified Y of vector X exceeds that of other votes of the same type. Therefore, the higher the value of edge function, the stronger the reliability of effective classification, and the better the effect of the classifier in the algorithm.

- (2) Error rate of weight estimation of feature vector: Let PE^* is the generalization error of classifier in random forest algorithm, which reflects the classification effect of the classifier.

$$PE^* = P_{X,Y}(mg(X, Y) < 0). \quad (8)$$

It is used to measure the error rate of OOB weight estimation. For the random forest model, if there are enough trees in the forest, the abovementioned equation will satisfy Bernoulli’s laws:

$$\lim_{k \rightarrow \infty} PE_k^* = P_{X,Y} (P_{\Theta} (h(X, \Theta_k) = Y) - \max_{j \neq Y} P_{\Theta} (h(X, \Theta) = j) < 0). \quad (9)$$

The formula: k represents the number of trees in the forest.

Next link 2 (weight estimation of feature vectors): assume that the formula of OOB estimation in the random forest is given as follows:

$$P_K = \frac{\sum_{(x_i, y) \in O_k} I(h_k(x_i) = y)}{\sum_{(x_i, y) \in O_k} I(h_k(x_i))}. \quad (10)$$

P_K is calculated as OOB number of $P(h_K(x) = y)$ according to weight reassessment, and the weight of the feature vector can be selected for the minimum error rate obtained.

4. Development of the Evaluation Model of the Scientific and Technological Innovation Capacity of the Free Trade Area Based on the Forest Weight Method

4.1. Structure of Index Systems. The development mechanism, driven by national innovations in the free trade area, is primarily intended to strengthen the capacity for independent innovation and overcome existing institutional barriers. Promote the development of the free trade area and maximize the great potential of science and technology as a primary productive ability [20]. Due to the particularity of the intellectual property rights of scientific and technological achievements, there is no fully applicable evaluation method. At present, the evaluation results of different evaluation institutions in the intellectual property rights market of scientific and technological achievements are too different, the recognition of the evaluation results is not high, and no normative documents have been issued by relevant departments. In this regard, this paper studies the intellectual property rights of scientific and technological achievements, the characteristics of the value evaluation of intellectual property rights of scientific and technological achievements, the evaluation environment, and the factors affecting its value. On this basis, it studies in detail the application of the income method in its value evaluation, including the determination of parameters such as the prediction of income, contribution rate, income period, and discount rate [16, 21, 22]. Based on the evaluation index selection method, the evaluation index system of 3 primary indexes and 16 secondary indexes as shown in Figure 3 is constructed.

4.2. Establishment of the Empowerment Model. According to the nature of random forest weighting, the algorithm model of a random forest weighting method for establishing the update and development of the science and technology capacity of the economic free trade park is shown in the following Figure 4.

The advantages of the algorithm model designed in this study are given as follows:

- (1) By introducing the random forest weighting method, the application scope of the competition model is widened, and the scoring selectivity of experts is more scientific and objective.
- (2) Compared with the general method, the scheme designed in this paper can save computation. The combination of expert scoring and historical data makes the calculation results more reliable and provides a valuable reference for decision-makers.

5. Case Analysis of Scientific and Technological Innovation Capacity in the Economic Free Trade Park

This paper takes Shanghai (FTZSH), Tianjin (FTZTJ), Guangdong (FTZGD), and Zhejiang (FTZZJ) economic free trade parks as the research objects to the evaluation of science and technology upgrading ability capacity of these regions. The data are from the 2020 China statistical yearbook and the statistical data bulletins and statistical yearbooks of the provinces and cities of the abovementioned economic free trade parks .

5.1. Analysis of Random Forest Weighting Method

- (1) This paper simplifies and optimizes the target level indicators of the scientific and technology update and upgrades the capability of the economic free trade park according to the rough set method, discretizes the 16 indicator data in Figure 3 according to the model established above, and carries out dimensionless quantitative processing. See Figure 5 for specific results.
Rough set Rosetta software is used to calculate the data in Figure 5, and the core of the knowledge system is: $\{C1, C3, C5, C7, C9, C11\}$, that is, six indicators [23]. As the target layer for evaluation of science and technology upgrading level of the economic free trade park.
- (2) Determine the weight. Input the coefficient data of the target layer of the 4 economic free trade parks that need to be evaluated into the algorithm program of RFW, to the weight of each index of each evaluation project, get the important coefficient of each index of each assessment economic free trade park according to the minimum error rate, and calculate the normalized weighted average value as the important coefficient of each index. See Figure 6 for details.
- (3) Determine the average result set (g) of each index score. Experts determine the evaluation index value GJ (AJ) by scoring according to the location of each economic free trade park and the characteristics of the original data of the evaluation index. Among them, $\forall a_j \in K$ is the average score of experts on each project and index. The scoring results of 5 experts on the indicators of 6 target levels of 12 economic free trade parks, see Table 1 for details.

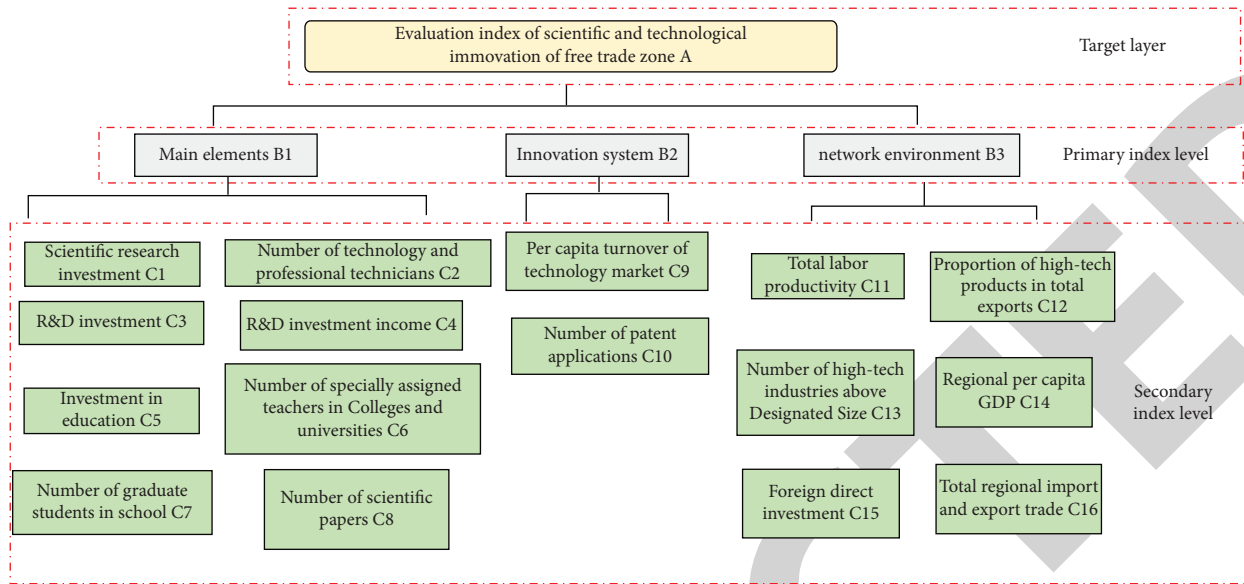


FIGURE 3: Evaluation index system of the scientific and technological innovation capacity of economic free trade park.

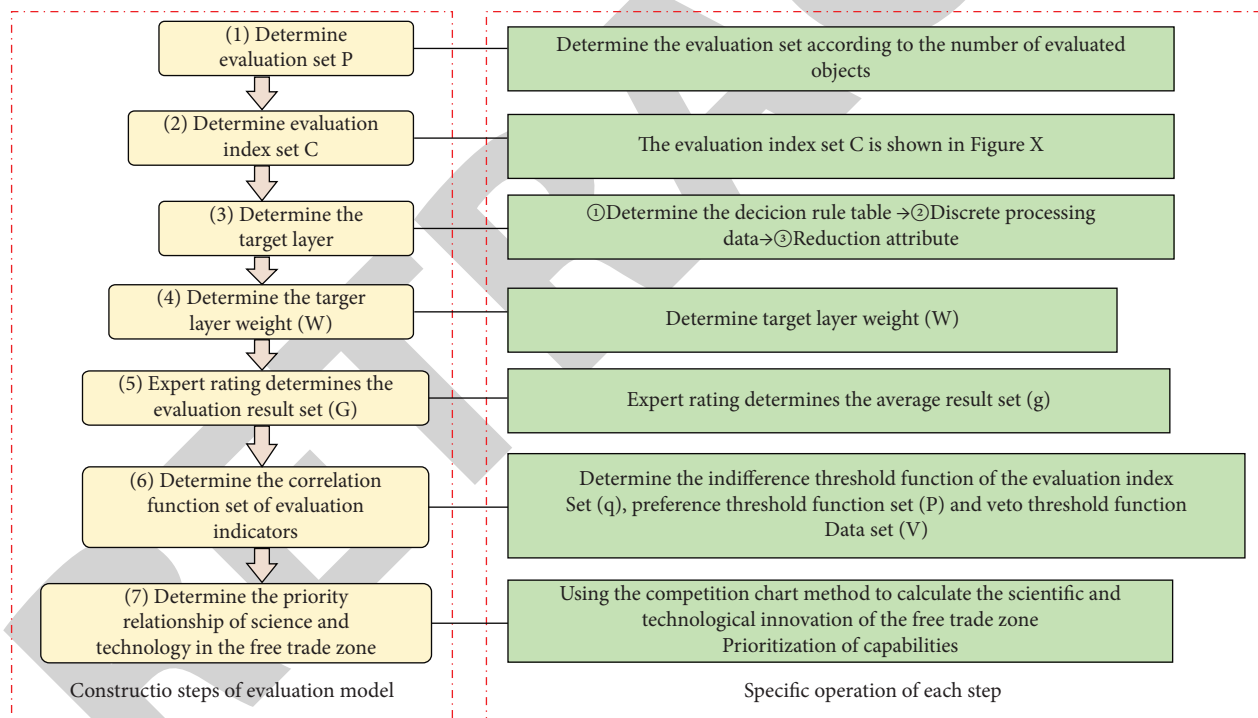


FIGURE 4: Algorithm model steps of a random forest weighting method for scientific and technological innovation capability of economic free trade park.

(4) Determine the indifference threshold function set Q , preference threshold function set P , and veto threshold function set V . The results obtained by dimensionless quantification of $\{C1, C3, C5, C7, C9, C11\}$, see Table 2 for details.

5.2. Competition Chart Method to Evaluate the Scientific and Technological Innovation Ability of the Economic Free Trade Park. A tournament graph refers to a graph in which any

two vertices are connected by a directed edge. The direction of the directed edge refers to the priority relationship between the two vertices, and the priority of the starting vertices is arranged before the pointed vertices, as shown in Figure 7.

The ranking method of bidirectional connected tournaments with the number of vertices ≥ 4 is as follows: the adjacency matrix of the tournaments $A = (A_{ij})_{n \times n}$ is defined as follows:

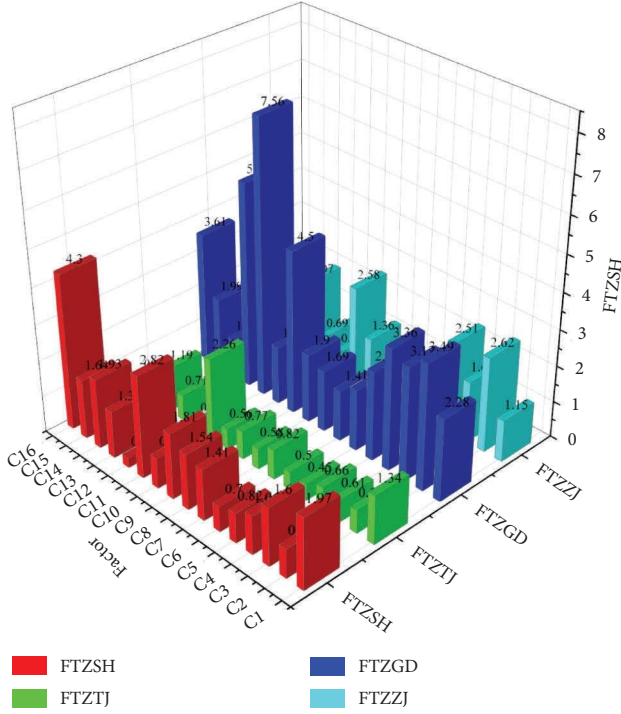


FIGURE 5: Dimensionless quantitative data diagram.

$$A = (A_{ij})_{n \times n} = \begin{cases} 1, & \text{There is a directed edge from } i \text{ to } j, \\ 0, & \text{There is no directed edge from } i \text{ to } j. \end{cases} \quad (11)$$

Let the score vector of vertex $s = (s_1, s_2, \dots, s_n)^T$, where s_i is the score of vertex i (that is, the number of directed edges derived from point i). Let:

$$\begin{aligned} s(k) &= As^{k-1} \\ &= As^k, \end{aligned} \quad (12)$$

Where: $k = 1, 2, \dots, N$; $e = (1, 1, \dots, 1)^T$. for a two-way connected graph, there is an integer r . if a satisfies $A_r > 0$, then A becomes a prime matrix. According to peron Frobenius theorem, the maximum characteristic root of a prime matrix is a positive root (λ) When the corresponding eigenvector is s , there are:

$$\lim_{k \rightarrow \infty} \frac{Ae}{\lambda^k} = s. \quad (13)$$

In formula (13), the normalized level score vector converges to the maximum characteristic positive root (λ_{Max}), whose corresponding eigenvector is used as the basis for ranking the limit score vector. When $k \rightarrow \infty$, $s(k)$ converges to a limit score vector, which is used as the basis for reasonable ranking after normalization.

In this paper, this method is applied to the systematic evaluation of scientific and technological upgrading achievements ability of China's economic free trade park. The evaluation indexes representing different aspects of the scientific and technological innovation ability of the

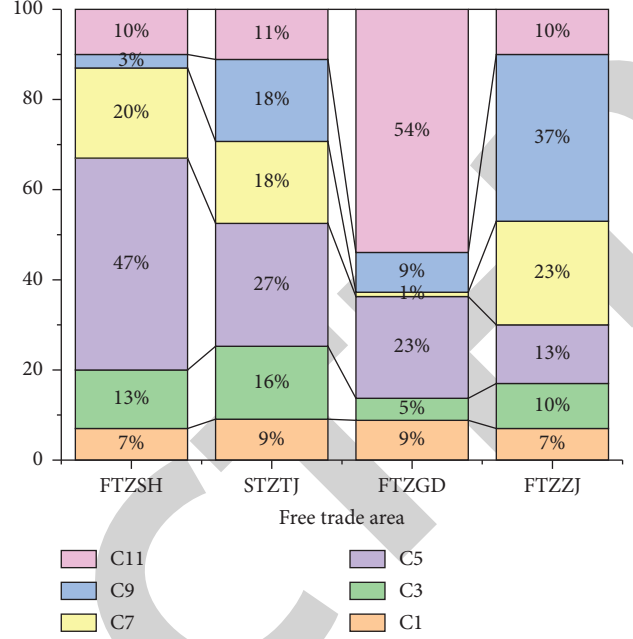


FIGURE 6: Weight index of minimum error determination.

economic free trade park are taken as the objectives of the multiattribute decision-making problem, and the importance coefficient (W) of each evaluation index is obtained by the random forest weighting method as the weight of each objective of the multiattribute decision-making problem; then take the upgrading level of science and technology of each economic free trade park as the scheme to be sorted for the multiattribute decision-making problem; finally, the competition chart method is used to calculate the advantages and disadvantages of the scheme, and the scientific and technology upgrading ability of the economic free trade park is ranked.

Substitute the data of table x into equations (12) and (13) successively, and substitute the zik data calculated according to the construction model into equation (24).

$$\begin{aligned} a &= (x, y), \\ &= \{a \in A \mid f(x, a) \neq f(y, a)\}, \\ \Delta &= \prod_{(x,y) \in U \setminus U} \sum a(x, y), \end{aligned} \quad (14)$$

$$\omega(x_j > x_k) = \sum_{x_i > x_j} \omega_j.$$

(14)–(16), the values of Qi are respectively 0.15, 0.19, 0.18, 0.16, 0.19, and 0.13, that is, the weight values of the six research objectives. Priority ranking: according to the abovementioned calculation results and modeling, the original data are used as follows:

$$W = (w_{ik})_{n \times n} \quad (15)$$

See Table 3, for details[25].

Calculate the available weight matrix $W = (w_{ij})_{4 \times 4}$.

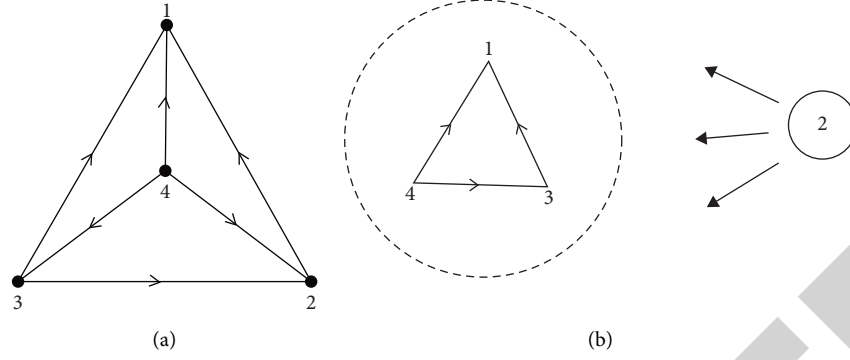


FIGURE 7: Four point competition chart. (a) Four point competition chart. (b) Tournament decomposition.

$$W = (w_{ik})_{4 \times 4} = \begin{bmatrix} 0 & 1.00 & 0.13 & 0.84 \\ 0.00 & 0 & 0.13 & 0.66 \\ 0.16 & 0.47 & 0.00 & 0.63 \\ 0.87 & 0.87 & 0 & 1 \end{bmatrix} \quad (16)$$

It can be concluded that the priority relationship of science and innovation capacity in the economic free trade park see Figure 8 for details[26].

The fixed points in the figure represent each economic free trade park, and the arrows between the fixed points indicate the relationship between advantages and disadvantages.

Science and technology upgrading capabilities in the economic free trade park are: Guangdong economic free trade park, Shanghai economic free trade park, Zhejiang economic free trade park, and Tianjin economic free trade park.

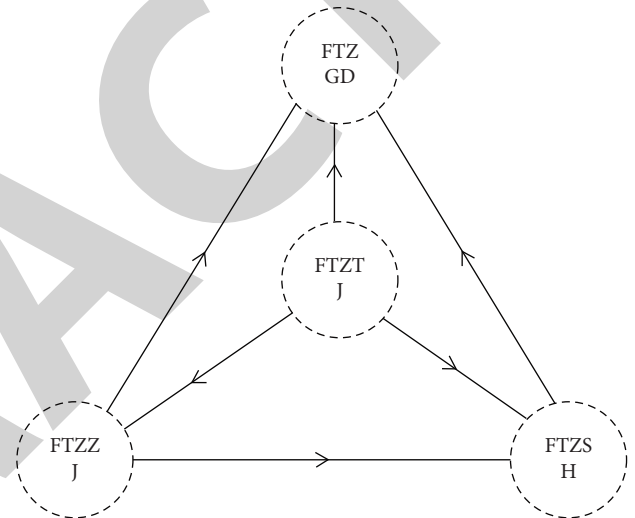


FIGURE 8: Competition chart of scientific and technological innovation ability in the economic free trade park.

5.3. Result Analysis. The case analysis using the random forest weighting method shows that among the Guangdong economic free trade park, Tianjin economic free trade park, Shanghai economic free trade park, and Zhejiang economic free trade park, Guangdong economic free trade park has the strongest scientific and technological innovation ability, and there are great differences between Guangdong and Shanghai economic free trade parks. The main reasons are given as follows:

- (1) The scientific and technological innovation ability of the economic free trade park is more strongly reflected in the industry, which can reflect the objectivity of measurement. The differences in the second economic development of different economic free trade parks have been better complemented [27].
- (2) Advantages and differences of the economic free trade park. For example, Zhejiang is adjacent to Shanghai. Shanghai is an international shipping center, international financial center, international logistics center, and manufacturing center under construction, which has great attraction for scientific and technological talents and is very beneficial to the

TABLE 2: Expert evaluation indicators after dimensionless quantitative processing.

Factor	FTZSH	FTZTJ	FTZGD	FTZZJ
C1	1.97	0.57	1.15	0.42
C3	0.81	0.84	2.65	1.09
C5	1.60	0.72	1.68	0.77
C7	1.06	0.47	2.51	0.72
C9	0.82	0.81	1.42	1.41
C11	0.70	0.73	1.00	1.74

TABLE 3: Schemes are sorted by objectives.

Factor	Priority of the program to the objectives			
	1	2	3	4
C1 (0.17)	FTZGD	FTZSH	FTZTJ	FTZZJ
C3 (0.19)	FTZGD	FYZSH	FTZSH	FTZTJ
C5 (0.18)	FTZGD	FTZGD	FTZTJ	FTZSH
C7 (0.16)	FTZTJ	FYZSH	FTZSH	FTZGD
C9 (0.19)	FTZZH	FTZTJ	FTZGD	FTZSH
C11 (0.13)	FTZSH	FTZZJ	FTZGD	FTZZJ

development of the region. This reasonably explains the differences in regional GDP and scientific and technological innovation between Zhejiang economic free trade park and Shanghai economic free trade park [28]. The reasons for the abovementioned results are various [29–31], such as the time when the economic free trade park was established, the introduction and implementation effect of policies, science and education investment, infrastructure support, national management and service concept, etc.

6. Conclusion

With the development of the global economy, economic globalization and scientific and technological innovation ability become more and more important. In order to evaluate the scientific and technological innovation ability of the free trade zone, this paper uses the random forest weighting method to screen and establish the evaluation indicators of the scientific and technological innovation ability of the free trade zone, uses the weighted linear combination to determine the evaluation weight and score, constructs the scientific and technological innovation ability evaluation model of the free trade zone, and carries out the actual simulation evaluation for the current mainstream free trade zones in China. The results show that among Guangdong economic free trade park, Shanghai economic free trade park, Zhejiang economic free trade park, and Tianjin economic free trade park, Guangdong economic free trade park has the strongest level of scientific and technological renewal and development, while the indicators of Guangdong economic free trade zone and Shanghai economic free trade park are quite different, which shows that the evaluation model of scientific and technological innovation ability of the economic and trade zone designed this time has strong practicality. The evaluation model designed this time has important pioneering significance for the evaluation research of regional scientific and technological innovation capacity. However, since the number of free trade zones evaluated is still small, the evaluation of other free trade zones will be added in the next study. Through the evaluation, the problems in the model will be found and repaired in time.

Data Availability

The dataset used in this paper can be obtained from the author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest regarding this work.

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