

Research Article

Evaluation Model of Sports Culture Industry Competitiveness Based on Fuzzy Analysis Algorithm

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Received 15 March 2022; Revised 8 April 2022; Accepted 12 April 2022; Published 28 April 2022

Academic Editor: Punit Gupta

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Since reform and opening, our country's sports and cultural industries have grown from nothing. Due to the complexity of the evaluation factors and methods used to determine the competitiveness of the sports cultural industry, this paper establishes a seven-dimensional sports cultural industry competition based on the integration and development of the sports tourism industry and national culture, drawing on the theory and methods used to determine the tourism industry's competitiveness. Based on a fuzzy analysis algorithm, we developed a system for evaluating strength and a model for evaluating the competitiveness of the sports culture industry. According to the results of the evaluation of the competitiveness of the sports culture industry in numerous regions of China, the evaluation method proposed in this paper is superior to the traditional evaluation method and has contributed to the development of China's sports culture industry.

1. Introduction

Sport industry must invest in high-quality development to fulfill its mission in the new millennium. It is also the most important means by which the sports industry can overcome the pressures of reality. The Central Economic Work Conference in December 2017 stated that creating and improving the institutional environment is necessary to promote high-quality development. As shown above, the indicator system promotes high-quality development of the sports business [1–6]. However, the sports sector in our nation is now in the early stages of high-quality development, and a somewhat systematic theoretical system has not yet been established, in addition to a temporary lack of an indicator system and a mechanism for performance evaluation. The development of a high-quality development index evaluation system for the sports industry is an important method to standardize the goals and processes of high-quality development in the sports industry in the new era, according to relevant scholars; designing index standards realistically and carrying out static and dynamic monitoring in a timely and feasible manner is an important

way to promote the development of the sports industry. A critical component of the industry is high-quality development process. A mechanism analysis—indicator system construction—exponential model design—empirical test approach is followed as a result, guided by high-quality development theory and based on this information [7–9]. An empirical test is conducted in Shanghai to evaluate the index system and index model of high-quality development in the sports industry in this new era, with the goal of improving the institutional environment for high-quality development in the sports industry in general and for high-quality development in particular [10, 11].

This theory states that a product's competitive advantage is not in serving the market's basic functions, but in fulfilling unique core functions that other products cannot fulfill. In plain English, this means you have advantages over others, such as technical, managerial, market, and other competitive advantages. The concept of core competitiveness emerged in the 1990s. It once sparked the imaginations of countless businesses seeking growth and expansion [12, 13]. Core competitiveness is now one of the most powerful tools a country or a nation can use to achieve

prosperity. After more than 40 years of reform and opening, our country's sports business has grown significantly. However, it is still in its infancy, with a small industrial scale and low level of development. Due to a lack of global competitiveness, the industrial structure must be optimized and updated. Let us face it: our country's sports industry clearly lacks core competitiveness in the face of fierce international sports industry competition, and it clearly does not reflect our overall economic progress [14, 15]. Enhancing the core competitiveness of the sector is therefore critical to the long-term development of the sports industry in our country and its involvement in worldwide competition.

Recent years have seen a resurgence in the discussion over the integration and development of the sports business and the tourism industry. Sports tourism is a new tourist product that is on its way to become the primary tourism product in the future. A growing sports tourism industry can help to increase the level of market consumption while also creating jobs and encouraging the growth of nontrade foreign exchange earnings in the region. In recent years, sports fever has progressively gained popularity as a phenomenon [16–18]. The quick development of the sports sector has aided in the development of the sports tourism business as a result of this rapid development. The sports tourism sector brings together the benefits of both sports and tourism, and as a result, sports tourism has emerged as the most important trend in the growth of the modern tourism industry [19, 20]. Due to the expansion of the sports sector, the influence of sports stars and sporting events has constantly expanded, particularly with the conducting of large-scale international sporting events, which has garnered widespread public interest and created a significant commercial potential. Sports tourism is a new cross-industry phenomenon characterized by dual characteristics that have emerged as a result of the merging of the tourist and sports industries. In this way, visitors can take part in sports tournaments, visit sporting sites, and participate in a wide range of fitness and sports activities, as well as entertainment and adventure activities, while on the road [21–29].

Shopping for sports memorabilia is just one example of a collection of actions. A well-developed sports tourism business may breathe fresh life into a city, allowing more people to get to know and understand themselves better, allowing them to take the initiative in urban competition and win the first opportunity they are presented with [30–32].

As a result, in light of the foregoing, this study provides a model for evaluating the competitiveness of the sports and cultural industries that are based on a fuzzy analytic algorithm, as well as a seven-dimensional sports and cultural industry competitiveness evaluation index system. This research assesses the competitiveness of the sports culture industry in a number of different Chinese locations. Based on the findings of this study, the assessment method provided in this paper outperforms the old evaluation approach and has made significant contributions to the growth of China's sport and cultural industries in general.

2. Background

2.1. Current Situation

2.1.1. History of China Sports Industry. Historically, China's sports industry was viewed as a national welfare initiative rather than an industry in the traditional economic sense. In the absence of a market system, state-owned sports goods producers had to compete with one another. There is no competition between them and no linkage between upstream and downstream connected firms in the sense of an industrial chain. As a result, the sports industry in our country has not really developed since the reform and opening. During the last 40 years of reform and opening, my country's economic structure has changed significantly. The most important task is to move from a planned to a market economy, gradually increase private sector participation in the economy, and create a market competitive system that is fair and free. People's demand for sports consumption is increasing, resulting in a rapid increase in the number and scale of sports product manufacturers, and the links between enterprises are becoming increasingly crisscrossed, forming the prototype of the industrial network. In the 1980s, China's sports industry began to take shape, and by the 1990s, it had mostly industrialized. It also spawned sports business rules, sports competition, sports betting, and athletics as we know it today. Tourism and related industries have grown significantly during this time period.

China has established a sports industry system with a wide range of categories, as planned by the State Sports General Administration. However, the structure is not logical and the development is not uniform. As a result, China's sports industry remains highly competitive globally. It is young, but it has the inherent ability to compete globally and maturely into a strong organization over time. Here are the reasons: First, China has the world's largest sports consumption market, which has enormous potential to support the Chinese sports sector's rapid expansion. Second, China has made the most progress in competitive sports. As a result of early state investment in competitive sports, China's sports industrialization has a strong foundation in terms of talent, sports infrastructure, and market influence. The Chinese sports culture is inclusive. For forty years of reform and opening, foreign sports and well-known brands have made their way to China, where they have thrived. On the surface, this type of inclusion appears to facilitate foreign product entry into the Chinese market. In the long run, it may help our country's sports industry innovate and grow, allowing it to expand abroad and enter the global sports industry market and take up residence somewhere. In the context of cultural tolerance, there has always been an introduction, digestion, invention, and renewal process. Fourth, the 19th National Congress of the Communist Party of China defined the path to socialism with Chinese characteristics, ensuring the rapid development of China's sports industry in the years to come. Some academics have confirmed the importance of core competitiveness to the development of the local sports industry in evaluating core competitiveness. The core competitiveness of these areas will

merge in the future to form a joint force that will compete in a global sports industry.

2.1.2. Competition Situation. From a worldwide viewpoint, the sports industries in North America, Western Europe, and Japan are the most developed regions in terms of development. This region's annual production value of sports has risen to become one of their country's most important pillar industries; the total output value of sports amounts to more than 1.5 percent of GDP, making it the country's most important pillar industry. The United States is the most powerful of these countries, and it is also the country with the most prominent manifestations of the characteristics of diversification, commercialization, and globalization. It is also the country with the most competitive sports sector in the world. There are dozens of sports brands that we are all familiar with from our daily lives, and this number is growing. To give you an example, consider sports apparel and supplies. Companies such as Adidas, Nike, and Reebok are popular. Other popular sports clothing and supplies brands include Under Armour, New Balance, North Face, Patagonia, and Columbia. The United States is the dominant force in the world, not to mention in the production of high-tech sports equipment and supplies. Aside from the United States and Japan, other countries with world-renowned sports brands include Germany, the United Kingdom, France, and Switzerland. In comparison to the United States, these countries have relatively tiny economies, which means that the GDP generated by their well-known sports brands is a modest proportion of their total GDP. In addition, the proportion is significant. Even though China's gross domestic product (GDP) has consistently ranked second in the world for many years, it appears that the country's sports business does not yet have a globally recognized brand. As a result of the large increase in labor costs in China as well as the high land price in recent years, we have lost our position as the world's factory. However, this is a temporary phenomenon due to the substantial increase in labor costs in China and the high land price in recent years.

Globalization has accelerated the expansion of the sports sector in recent decades, particularly in the United States. In an era when competitive sports and leisure sports have had a significant impact on people's sports consumption, the sports consumption market has grown significantly, resulting in intense competition in the international sports sector. It may be claimed that worldwide competition in the sports sector is all-encompassing, long-term, and far-reaching because of the availability of talent on the market. In the past, the sports sector was primarily concerned with design. Fashionable design is no longer sufficient in today's world. Take, for example, sportswear as an illustration. In order to reach the perfection of sportswear, high-tech textiles, such as breathable, light, quick-drying, waterproof, windproof, and other application levels, are used in conjunction with reasonable and fashionable design to create products with a large market share. Both are aesthetically pleasing and useful. It can be claimed that the technological content of outdoor sports products is higher than that of

indoor sports products. Mountaineers of the 1950s and 1960s used equipment that was significantly inferior to that used by today's mountaineers. Their lightweight, water-resistant thermal apparel, light, and robust carbon trekking poles, antiglare polarized eyewear, and other products are made with the most up-to-date material technology available anywhere in the world.

Finally, the market environment of the sports sector is also a critical component of worldwide competition in the field of sports. In the sports industry, a mature and active market is the primary driving factor behind the development and expansion of the sports sector. On the contrary, if the market is chaotic and counterfeit items are prevalent, it will surely have a negative impact on the overall health of the sports business. Because of the low cost of counterfeiting, development has a fatal lethality; as a result, it can take advantage of the attractiveness of treasures to draw attention to itself in the marketplace. If people are willing to pay low costs for indistinguishable brand-name knockoffs, it is inevitable that genuine items will find it difficult to compete in this market. Fake items, on the other hand, suffocate the creativity and originality that is the driving force behind the sports sector. Ultimately, the sports sector will have to survive in a low-end and chaotic market in order to continue to exist. As a result, it is necessary to develop a standard. Due to the fact that practically all developed countries have formed their mature and standardized market environments, a healthy sports industry market is the competitive advantage of today's developed and emerging countries, particularly China's sports industry. The market order in our country is incapable of providing a strong foundation for the rapid development of the sports business in our country.

2.2. Strategies to Enhance Competitiveness

2.2.1. Independent Intellectual Property Rights. Brands with independent intellectual property rights must first be established in China before they may be developed elsewhere in the world. Currently, China is the world's largest market for sports consumption. Upon regulation, this market will become the most important source of competitiveness for our country's sports business. The establishment of brands with autonomous intellectual property rights must therefore begin with the regulation of the general public and begin by creating your own market, enforcing strict anticounterfeiting measures, and demonstrating a zero-tolerance policy for intellectual property infringement, so that domestic businesses can devote more time, energy, and financial resources to developing their own brands and actively investing in research and development and innovation. Only property owners can utilize their R&D results as capital to operate, for example, by engaging in production and operation through technology equity, technology transfer, and other means. This allows entrepreneurs and researchers to collaborate in the most effective way possible. When it comes to autonomous intellectual property rights, many individuals believe that our country must have its own ideas, creations, and brands in order to compete with foreign

brands. In fact, every company should have its own set of intellectual property rights that are distinct from those of other companies. Intellectual property rights are distinct from one another. A feeling of business, when it comes to a business environment backed by the entire society, is a crucial requirement for success. It is important that intellectual property protection is prioritized while developing a mature and regulated sports sector market.

2.2.2. The Innovation and Development Vitality of the Sports Industry. Linkage mechanism was initially a professional word for financial institutions, and it simply indicates that credit funds provide credit support to connected projects or adjacent industrial links in the industrial chain, as defined by the International Organization for Standardization. The project, as well as the entire industry, will have a good impact on the environment. This connection mechanism, for financial institutions, unquestionably protects the security of their cash while also significantly reducing credit risks. Every link in the industrial chain is responsible for maintaining and improving the health and safety of its members, which is impossible to achieve without ensuring the health and safety of all those involved. The linkage mechanism has also been actively introduced in the large scope of the industrial economy to ensure orderly development; that is, in our industrial policy, we must not only support those large and influential enterprises but also support those related enterprises that have an impact on large enterprises. The development status of our country's sports industry is precisely due to the lack of a linkage mechanism at the policy level of the government. It has been discovered by certain academics that the sporting industries in our nation have not yet developed a strong core competitiveness, which is mostly due to the lack of development of industrial clusters and the lack of overall industries. The development plan, a lack of industrial policy support and guidance, a major lack of industry-related management systems, and a lack of an effective incentive mechanism for industrial innovation are all issues that need to be addressed. In fact, one of the most serious shortcomings of our industrial policy is the absence of a connection mechanism, which makes the growth of industrial clusters as well as the general development of the industry extremely difficult.

2.2.3. Strengthen Cooperation with Internationally Renowned Enterprises. The most significant benefit that Chinese sports industry businesses have is that they are familiar with, if not in control of, the world's largest consumer market. They are also familiar with their own legislation, regulations, culture, and habits, which gives them a competitive advantage. This is, without a doubt, a problem for those large international corporations seeking to enter the Chinese market. And some international enterprises are known for their innovative designs, high-tech materials or fabrics, cutting-edge business approaches, and global recognition. The two individuals

mentioned above appear to have a great deal of room and opportunity for collaboration. If Li Ning and Nike can work together to develop in China, the prospects for both Li Ning and Nike might be significantly greater than their current development situations. Strangely, despite the fact that nearly all of the world's leading sports brands have established factories in China over the past few decades, no Chinese company has entered into brand strategic cooperation with any of these foreign corporations. Today, when big foreign corporations relocate their plants out of China, it will have a negative impact on us. A considerable number of people were laid off, and the resulting economic downturn in the surrounding cities where the processing plants were concentrated exacerbated the situation. Chinese sports firms should aggressively go out and take advantage of the advantages of well-known foreign enterprises in order to grow and strengthen their own enterprises in today's economic globalization process characterized by the international collaboration that is spreading around the world. With its emphasis on inclusion, Chinese sports culture has established a solid foundation for this type of international cooperation.

3. The Proposed Method

Evensen created the Ensemble Kalman Filter (EnKF) to tackle the computing resource difficulty that the classic Kalman filter approach encountered when calculating the prediction error covariance. The EnKF is currently commonly utilized in strongly nonlinear systems to calculate the prediction error covariance. The EnKF state update formula is as follows:

$$x = \frac{1}{m} E1,$$

$$P = \frac{1}{m} AA^T, \quad (1)$$

$$K = P^f H^T (HP^f H^T + R)^{-1},$$

$$A = E \left(I - \frac{1}{m} ll^T \right),$$

where E is the set of model states, x is the estimated state value, P is the state error covariance matrix, A is a singular matrix, A^T is the transposed matrix, P^f is the prediction of P , m is the size of the set, K represents the Kalman gain matrix, H represents the observation matrix, and R represents the observation error covariance matrix.

In the practical application of EnKF, the problem of misleading correlation between spatial observation points and state points, as well as the problem of set nonfull rank, frequently arises, and localization analysis technology is given as a solution to the difficulties mentioned before.

The update equation in the local scope of the i -th state variable is

$$\begin{aligned}
 x_i^a &= x_i^f + K_i^l(y^l - H^l x_f^l), \\
 A_i^a &= A_i^f(I + S^l S^{lT})^{-0.5}, \\
 K_i^l &= \frac{A_i^f S^{lT}(I + S^l S^{lT})^{-1} R^{-0.5l}}{\sqrt{m-1}}, \\
 S^l &= \frac{R^{0.5l} H^l A_i^f}{\sqrt{m-1}}.
 \end{aligned} \tag{2}$$

As is customary in the classical localization analysis procedure, the localization coefficient matrix is often constructed by considering the localized clipping function to be the localization function in the first place. The local clipping function is a piecewise rational function of fifth order that is related to the length scale parameter and changes as the distance between two points increases. It is based on fuzzy mathematics and imitates human thinking by using fuzzy sets, fuzzy relationships, and fuzzy reasoning to judge, synthesize, reason, and process problems that are difficult to solve using conventional methods. Fuzzy analysis theory is used to judge, synthesize, reason, and process problems that are difficult to solve using conventional methods. In the real data assimilation process, the observation error grows as a result of the false correlation in the physical distance between the observation point and the state update point. As a result, the assimilation effect becomes poor as a result of the increased observation error. As a result, this study provides a competitive evaluation model for the sports culture industry that is based on the fuzzy analysis algorithm and is based on the idea of fuzzy analysis.

First and foremost, it is important to construct a fuzzy logic controller in order to perform the assessment process. The database, rule base, fuzzy quantification, reasoning mechanism, and fuzzy discrimination are all components of a general fuzzy logic controller's composition frame, which contains the following: Each component contributes to the fuzzy control process in a unique way. First and foremost, the database serves as a storage bin for all subsets of all input and output fuzzy variables, as well as the membership value of all subsets of all input and output fuzzy variables. Second, the rule base contains a variety of rules in the form of preset language that can be used to infer fuzzy outcomes in the future. Input fuzzy variables that have been determined are quantified using a membership function, and the fuzzy inference process is finished with the help of a rule table that has been built. At the end of the day, fuzzy discrimination is

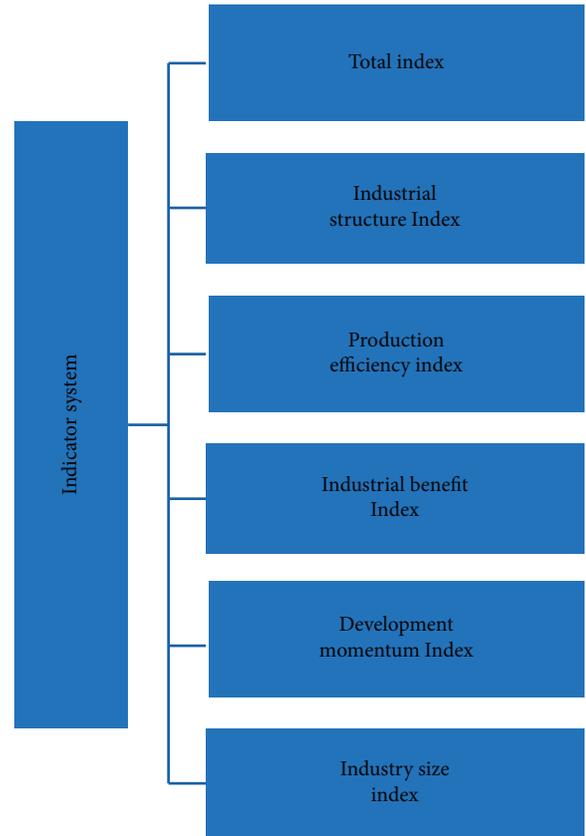


FIGURE 1: Index system.

primarily concerned with converting the inferred fuzzy subsets into accurate weight values that can then be used directly for data assimilation.

The Euclidean distance d between the observation position and the state update position is employed as the input fuzzy variable in this paper, and the equivalent weight coefficient w of the observation data is used as the output fuzzy control variable. As a second step, based on actual experience and system requirements, define the basic world and quantitative universe of each variable, in order to calculate the quantitative scale factor of input variable deviation and the scale factor of output control quantity. And the coordinate formula is

$$x = \sqrt{(o_i - v_i)^2 + (o_j - v_j)^2}. \tag{3}$$

The Gaussian membership function expressions for input and output are as follows:

$$d_i(x) = \begin{cases} e^{-x^2/2\sigma^2}, & 0 < x \leq 1, \\ e^{-(x-1.5)^2/2\sigma^2}, & 1 < x \leq 2, \\ \dots \\ e^{-(x-20)^2/2\sigma^2}, & 19 < x \leq 20, \end{cases} \quad d_i(x) = \begin{cases} e^{-(x-1)^2/2\sigma^2}, & 0 < x \leq 1, \\ e^{-(x-0.95)^2/2\sigma^2}, & 1 < x \leq 2, \\ \dots \\ e^{-x^2/2\sigma^2}, & 19 < x \leq 20. \end{cases} \tag{4}$$

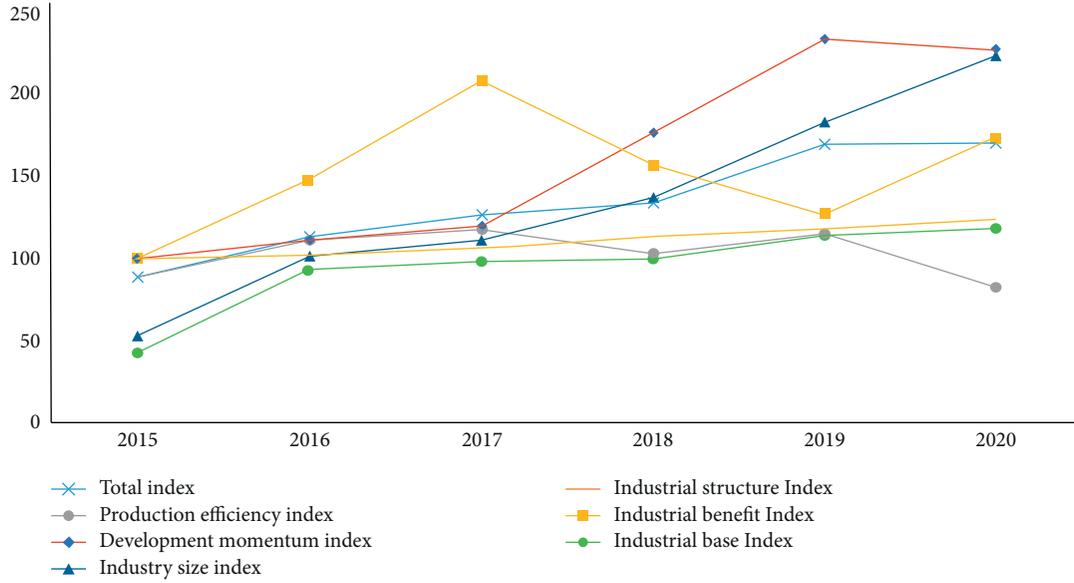


FIGURE 2: Various indicators of Shanghai sports culture industry.

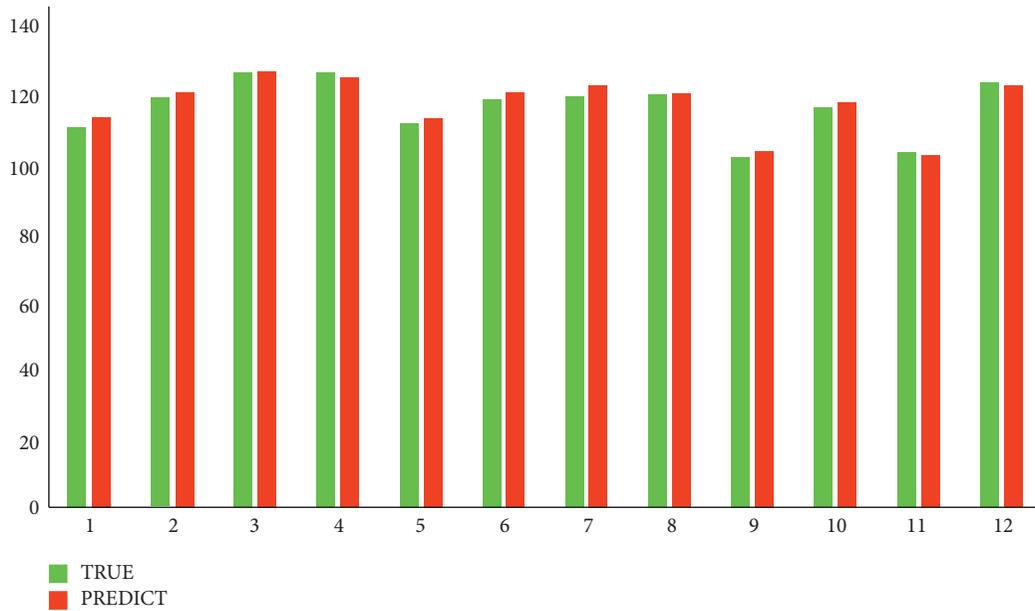


FIGURE 3: Evaluate algorithm prediction performance of our method.

The fuzzy relation matrix is as follows:

$$R = (d_1 \times w_1) \cup (d_2 \times w_2) \cup \dots (d_i \times w_i) \cup \dots (d_m \times w_m). \quad (5)$$

For fuzzy inference, we use the max-min principle as follows:

$$w = d \circ R = \frac{\int \vee_{x \in X} (\mu_d(x) \wedge \mu_R(x))}{x} \quad (6)$$

Finally, we perform fuzzy discrimination and data fusion to give the final score of the evaluation.

4. Simulation Results

The sports culture industry in Beijing and Shanghai between 2015 and 2020 was chosen for index measurement and extensive evaluation in order to validate the viability of the created index system and the designed evaluation model in the real application.

First and foremost, this paper constructs an assessment index based on [14, 21, 26], which is depicted in Figure 1, and Figure 2 depicts the change in the law governing Shanghai's sports culture industry index between 2015 and 2020, using the city as an illustration. It can clearly be observed that the

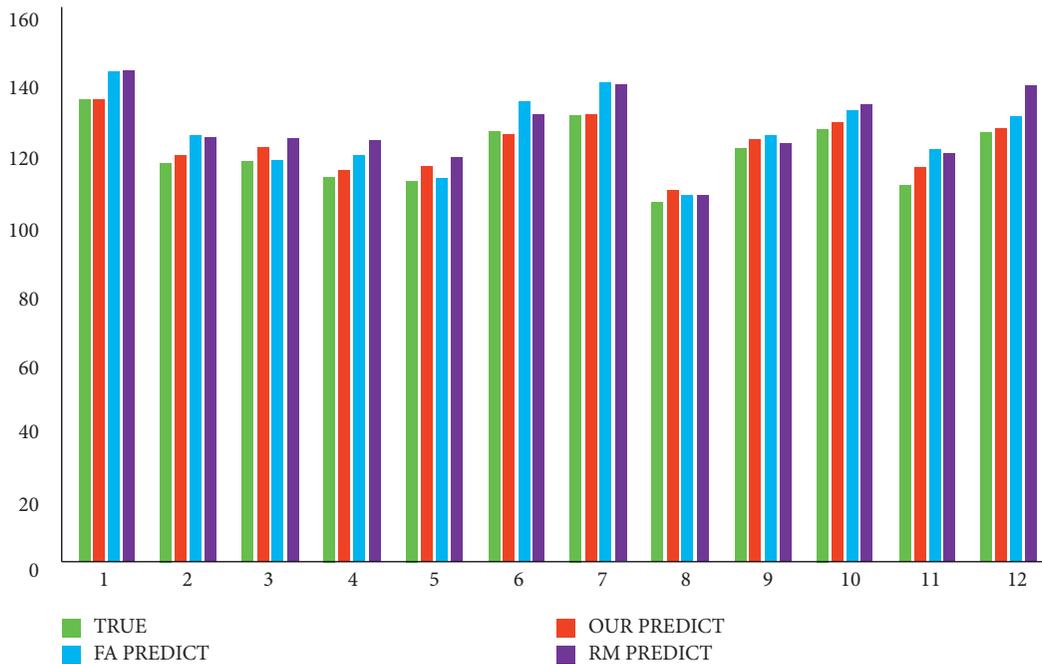


FIGURE 4: Evaluating algorithm prediction performance of OUR, FA, and RM.

competitiveness of Shanghai's sports culture industry as a whole is increasing in importance.

Additionally, the proposed fuzzy analysis technique is evaluated in this article. This research selects an existing expert data set from the cultural industry for use in training the model. The comparison between the output value of the evaluation algorithm in this research and the real value is depicted in Figure 3.

Last but not least, the algorithm developed in this paper is compared with the classic fuzzy analysis algorithm FA and the regression model RM, and the results of the comparison are depicted in Figure 4. As illustrated in Figure 4, the method described in this paper performs much better than the standard evaluation method.

5. Conclusion

This study provides a model for evaluating the competitiveness of the sports and cultural industries that are based on a fuzzy analysis algorithm, and it builds a seven-dimensional sports and cultural industry competitiveness evaluation index system that is based on previous research. The experimental data set in this study is drawn from the sports culture industry of representative cities in China, and the superiority of the algorithm suggested in this work is demonstrated by the results. In the future, we will continue to dig into the complexity of the evaluation factors of the competitiveness of the sports cultural industry and explore more effective indicators to evaluate the competitiveness of the sports cultural industry.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

This study was supported by Supporting Fund for Teachers' Research of Jining Medical University, no. JYFC2019RW001.

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