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Retraction

Retracted: Analysis of Brand Communication Influence of Professional Sports Clubs Based on Complex System Discrete Model

Discrete Dynamics in Nature and Society

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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) Manipulated or compromised peer review

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] H. Zhang, "Analysis of Brand Communication Influence of Professional Sports Clubs Based on Complex System Discrete Model," *Discrete Dynamics in Nature and Society*, vol. 2021, Article ID 1477924, 10 pages, 2021.

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Research Article

Analysis of Brand Communication Influence of Professional Sports Clubs Based on Complex System Discrete Model

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In recent years, because the complex system discrete model has brought good results in the application of many research directions such as human management analysis, control system prediction, and animal group prediction, how to combine the complex system discrete model with the prediction of enterprise brand communication effect has become a current research hotspot. Based on this, this paper studies the application of the discrete model based on the complex system in sports club to enterprise brand communication and designs a model of the impact of professional sports club on enterprise brand communication based on the SIR model and PSO algorithm. Firstly, this paper analyzes the research status of the impact on enterprise brand communication at home and abroad and optimizes and improves the impact of professional sports clubs on enterprise brand communication and the shortcomings of big data analysis technology in the current research. The complex system discrete model can accurately analyze the enterprise brand communication and conduct big data mining analysis with known professional sports clubs to achieve accurate calculation. The results show that in the process of analyzing the impact of professional sports clubs and enterprise brand communication, the communication mode design of professional sports clubs based on SIR-PSO algorithm can not only effectively deal with various complex discrete data evaluated by club users but also analyze and evaluate the impact of professional sports clubs on enterprise brand communication.

1. Introduction

With the proposal of China's sports power policy in recent years, sports has become popular in China [1]. China Evergrande group, Luneng Group, Lifan Group, and other enterprises have established professional sports clubs. The existing intelligent algorithm model system can realize the complex discrete operation of enterprise brand communication. Help enterprises evaluate the impact of professional sports clubs on enterprise brand communication in the operation process of professional sports clubs. Timely adjustment of the publicity strategy of professional sports clubs and enterprise brands has become a hot spot in the research of enterprise professional sports clubs [2]. In addition, in the active process of operation, competition, and team member management, as well as in the passive process of accepting public evaluation and club ranking, each attribute of enterprise professional sports clubs will have an impact on enterprise professional sports clubs, which may indirectly affect the dissemination of enterprise brand [3]. Moreover, the operation of professional sports clubs in most enterprises is complex, and its operation status is affected by many aspects, such as club revenue, club ranking, club evaluation, star players, advertising titles, peripheral products, sports property rights, and social responsibility [4]. In the daily operation process of professional sports clubs, there is almost no professional computer model analysis tool at this stage to carry out information-based and high-precision intelligent analysis paradigm for the impact of professional sports clubs on enterprise brand communication [5]. Therefore, if the impact of professional sports clubs on enterprise brand communication is simulated and predicted, the communication mode and characteristics of enterprise brand can be systematically divided, and the business strategy and business plan of professional sports clubs play an important role [6].

Aiming at the problems of poor quantifiable ability and backward evaluation methods in the process of studying the impact of professional sports clubs on enterprise brand communication, based on the characteristics of professional sports clubs, this paper establishes a complex system discrete model for enterprise brand communication, which is based on the SIR communication model and optimized by PSO algorithm after the model is established. It provides a solution for the management of professional clubs. This paper is organized as follows. Section 1 introduces the research background and content of this paper. Section 2 briefly introduces the research status of complex discrete system model, enterprise professional club, and enterprise brand influence and points out its pain points. Section 3 analyzes and constructs the SIR model of the impact of professional sports clubs on enterprise brand communication in detail and optimizes it by using PSO algorithm. Section 4 uses the public dataset to carry out the specific experimental design and result analysis of the complex system discrete model constructed in this paper.

At present, the mainstream media and network marketing used in the research of enterprise brand communication have a single image, and their evaluation or emotion analysis methods emerge one after another [7]. The innovation of this paper is to select professional sports clubs as the research entry point and use the SIR communication method to establish a complex discrete model system. By studying and analyzing the influence of professional sports clubs on enterprise brand communication, this paper quantitatively expresses and qualitatively analyzes the factors of professional sports clubs in enterprise brand communication.

2. Related Work

Although researchers from various countries have studied the communication effect of enterprise brand communication for many years, most of the previous studies only analyzed the users' emotions based on the brand publicity factors, not the factors of professional sports clubs, and there is a certain singleness in the analysis model [8].

For the research on the communication power of enterprise brand, Broucker et al. carried out language fuzzy recognition for the traditional vocal communication model, combined it with the research on brand communication, and discussed the application of the model in the research on evaluating consumers' attitude towards enterprise brand [9]. Zarouali et al. analyzed WhatsApp's corporate brand communication through questionnaires. The study found that with the expansion of corporate brand communication, APP gradually strengthened the protection of users' privacy and information security [10]. Anees ur Rehman and others analyzed the impact of corporate brand communication on the financial performance of small and medium-sized enterprises and found that the relationship between them was positively correlated [11]. Hendriks and Strick explored the impact of alcohol advertising with humor on alcohol brand communication through questionnaire adjustment, providing a new idea for the brand communication mode of alcohol enterprises [12]. Ilhan et al. provided a specific leverage model by analyzing the social community language emotions of various enterprise brands. According to the model, enterprise managers can regulate the behavior of enterprise fans on social media, so as to have a positive impact on the enterprise brand communication [13]. For the research of enterprise professional sports clubs, Andrade et al. analyzed the training methods, training variables, and training injury risk of enterprise professional sports club members and successfully analyzed the training data of athletes and predicted the results of sports competitions [14]. Weir et al. measured the 3D peak knee torque of athletes in enterprise professional sports clubs based on kinematics through 2D video screening tools, providing an efficient and convenient method for the strength analysis of enterprise professional sports clubs [15]. Cook et al. classified and analyzed several noises in the competition of enterprise professional sports clubs through unsupervised machine learning method and formulated specific field strategies according to the classification results, which can improve the competition efficiency of enterprise professional sports clubs to a certain extent [16]. Roh et al. used SPSS21.0 software to analyze the qualitative and quantum factors of enterprise professional sports clubs and determined the relationship between their relationship quality subfactors and club fan loyalty [17]. Song and Seo used SPSS win23.0 and Amos 23.0 software to process and analyze the image data of professional sports clubs and found that competition ticket prices, store stalls in club venues, and corporate CSR activities have a great impact on the image of professional sports clubs [18]. For the research of complex discrete model system, Roberts et al. discussed its application in financial model [19]. Ferreira et al. discussed the co-evolution process of heat enhanced drugs and target tissues after they were injected into the human body through a complex discrete coupling model [20]. Sangdo and Jun-Ho developed a real-time monitoring system for preventing network intrusion of nuclear power plant through discrete complex system based on big data. The use of the system can enable us to plan effective network security measures and strengthen the safe operation of nuclear power plant control system [21].

To sum up, it can be seen that the current corporate brand communication, corporate professional clubs, and complex discrete models have been fully studied in their respective fields, but there is no coupling between these three research directions. The complex discrete model analysis system has not been combined with this, and there are guiding opinions. Based on this, this paper will combine the complex discrete model, enterprise professional club, and enterprise brand communication to build a trinity analysis network.

3. Methodology

3.1. Application of SIR Model in the Construction of Enterprise Brand Communication Model by Professional Sports Clubs. The transmission model can find various characteristics of things mathematically. The association network of the model can analyze the transmission process and characteristics of

things [22–25]. The transmission model in [22–25] is usually built for the transmission of viruses, only for fixed medical analysis application scenarios or a single dataset of a single virus. In fact, dynamic data with rich scenes are often used as the research object in solving various practical engineering problems. In recent years, as major enterprises have established their own professional sports clubs, various elements produced in the business process of enterprise professional sports clubs have gradually become one of the many reasons affecting enterprise brand communication. The problem of enterprise brand communication is similar to the problem of virus communication in communication path and mode.

Based on this, in order to solve the complex problem of the impact of professional sports clubs on enterprise brand communication, this study introduces the traditional virus propagation SIR model to build a complex discrete model for this problem, proposes improvements through PSO algorithm, and constructs a big data integration system integrating collection and analysis. Based on complex discrete data, a new dynamic model is constructed between enterprise professional sports clubs and enterprise brand communication. Figure 1 shows the calculation flowchart of the complex discrete model constructed in this paper.

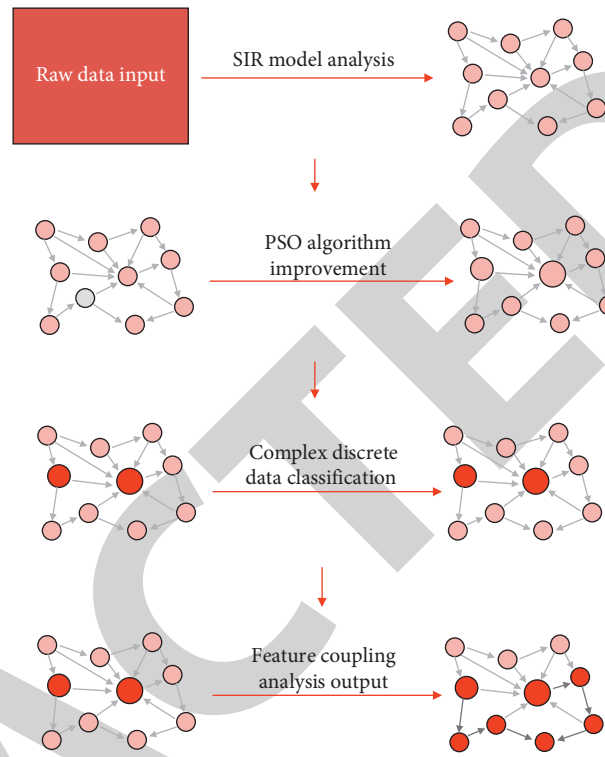

Figure 1: Computational flowchart of complex discrete model.

3.2. Analysis of SIR Model in the Construction of Enterprise Brand Communication Model by Professional Sports Clubs. The prototype of the SIR model is the SI model, in which S represents the vulnerable group. This group is not infected at present, but it is likely to be infected in the future. I represents the infected group. Assuming that there are only S and I groups, we obtain the following:

$$S(t) + I(t) = Z, \tag{1}$$

where $S(t)$ is the number of individuals in the susceptible population at t time and $I(t)$ is the number of individuals in the infected population at t time. If t_0 is defined as unit time, then

$$nt_0 = t\,(n = 1, 2, 3\ldots). \tag{2}$$

If the average probability of transmission from an individual in an infected group to an individual in an uninfected group in t_0 is the infection rate θ, then

$$\frac{dI(t)}{dt} = \theta I(t)S(t), \tag{3}$$

$$\frac{dS(t)}{dt} = -\theta I(t)S(t). \tag{4}$$

When $I_0 = I(0)$, synthesize equations (1)–(3) to obtain the following formula:

$$I(t) = \frac{N}{1 + (N/I_0 - 1)e^{-\theta N t}}. \tag{5}$$

When using formula (4), if the value of t is continuously enlarged until it reaches a certain range, $I(t)$ will be equal to N, which means that all people will be infected after a certain time. Therefore, the SIR model is proposed based on the SI model. This study combines the complex discrete model, enterprise professional club, and enterprise brand communication to build a trinity analysis network. Its basic network framework is shown in Figure 2.

Similar to the SI model, s and I in the SIR model still represent vulnerable groups and infected groups, respectively, while R represents removed groups. Then, the comprehensive model of SIR can be expressed by the following formula:

$$\begin{aligned} S(t) + I(t) + R(t) &= Z, \\ \frac{dI(t)}{dt} &= \theta I(t)S(t) - \varepsilon I(t), \\ \frac{dS(t)}{dt} &= -\theta I(t)S(t), \\ \frac{dR(t)}{dt} &= \varepsilon I(t). \end{aligned} \tag{6}$$

When $I_0 = I(0)$, $S_0 = S(0)$, and $R_0 = 0$, according to the analysis of the above formula, if $S_0 > \varepsilon/\theta$, the curve of the whole $I(t)$ will increase first and then decrease, and its maximum value is ε/θ. At the same time, the $S(t)$ curve will show a downward trend, its minimum value is a positive number or 0, and the model as a whole shows a diffusion trend. If $S_0 > \varepsilon/\theta$, the $I(t)$ curve will drop until its value is approximately equal to 0. At the same time, the $S(t)$ curve will also show a downward trend, its minimum value is a positive number or 0, and the model shows a convergence trend as a whole. Combining the above model with the

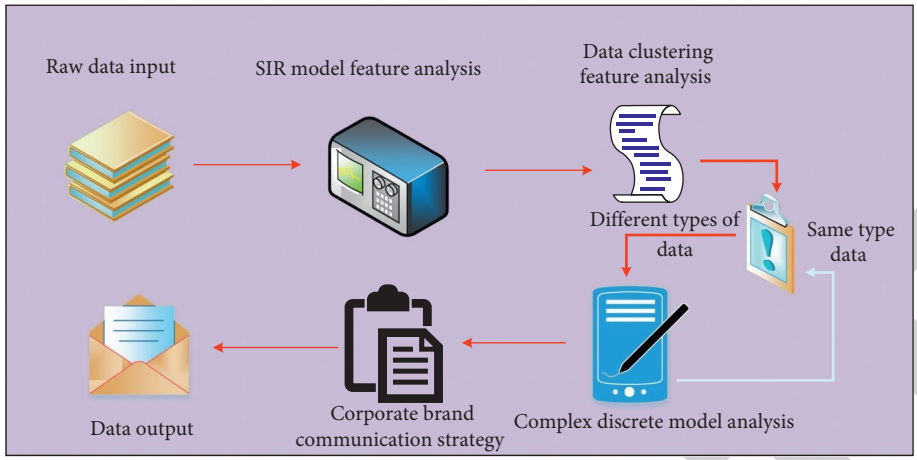

Figure 2: The basic network framework of the trinity analysis network based on the SIR model.

characteristics of the impact of professional sports clubs on enterprise brand communication, we get the communication mode of professional sports clubs in enterprise brand communication. The simulation analysis results of the impact of the rule data of enterprise professional sports clubs on the enterprise brand communication model under different infection rates are shown in Figure 3.

Figure 3 shows the impact of enterprise professional sports clubs on enterprise brand communication model under the condition of different infection rate a (0.1/0.5/1.0). It can be seen from the figure that the change of a has a crucial impact on the fitting of the overall model. Therefore, it is necessary to optimize the selection rules of a and its related parameters. This is because according to the audience group character of a specific professional sports club, it can be roughly divided into three parts. If the user pays attention to the professional sports club of the enterprise, the user pays attention to the brand products of the enterprise. Such users are called the first type of users and belong to the infected population. Users related to this category belong to vulnerable groups. They are called secondary users, and the infection probability is a. Such users usually have strong curiosity. They want to know the founding enterprise of professional sports clubs and its specific situation. The established probability of this idea is b, and the probability of paying attention to the enterprise brand is c. Figure 4 shows the simulation results of PSO algorithm for optimization analysis and solution of 10 groups of data with different dimensions under different coupling factors. Figure 5 shows the particle swarm optimization simulation results for a, b, c, d, e parameters. The abscissa is the number of iterations and the ordinate is the value of the objective function.

It can be seen from Figures 4 and 5 that under the PSO algorithm with different coupling factors, the influence degree of enterprise brand communication model corresponding to different number of thresholds is different and shows different changes in the law of rise and fall within a certain range. This is because of the continuous attention to a professional sports club of an enterprise. It is determined that the probability of this idea is d. Then,

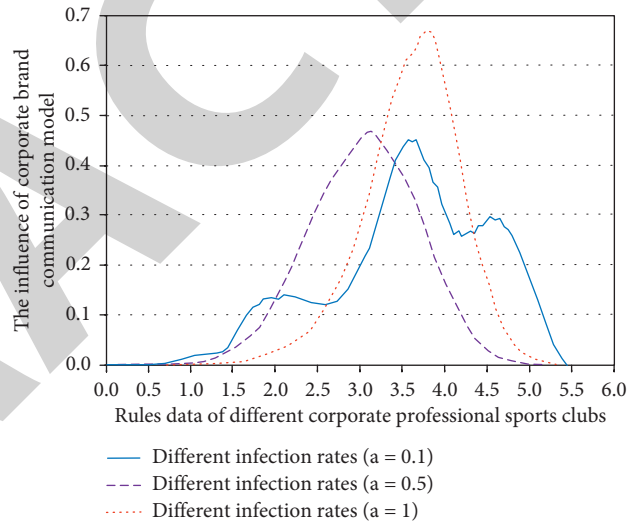

Figure 3: Simulation analysis results of the influence of corporate professional sports clubs on corporate brand communication model.

the probability of changing the focus on the enterprise professional sports club to the enterprise brand is e. Users who do not care about an enterprise and users who pay attention to an enterprise become the removed groups. The probability of their removal is b. According to the above definition, for vulnerable groups, we get the following formula:

$$\begin{aligned} b + d &= 1, \\ a &= \frac{(S(t) * b * c + S(t) * d * e)}{S(t)}, \\ \Delta I(t) &= (S(t) * b * c + S(t) * d * e), \\ R(t) &= (\Delta I(t) + I(t)) * \theta, \end{aligned} \tag{7}$$

where $\Delta I(t)$ is the number of individuals in the infected population which increased at time t and $R(t)$ is the number of individuals in the removed population which increased at

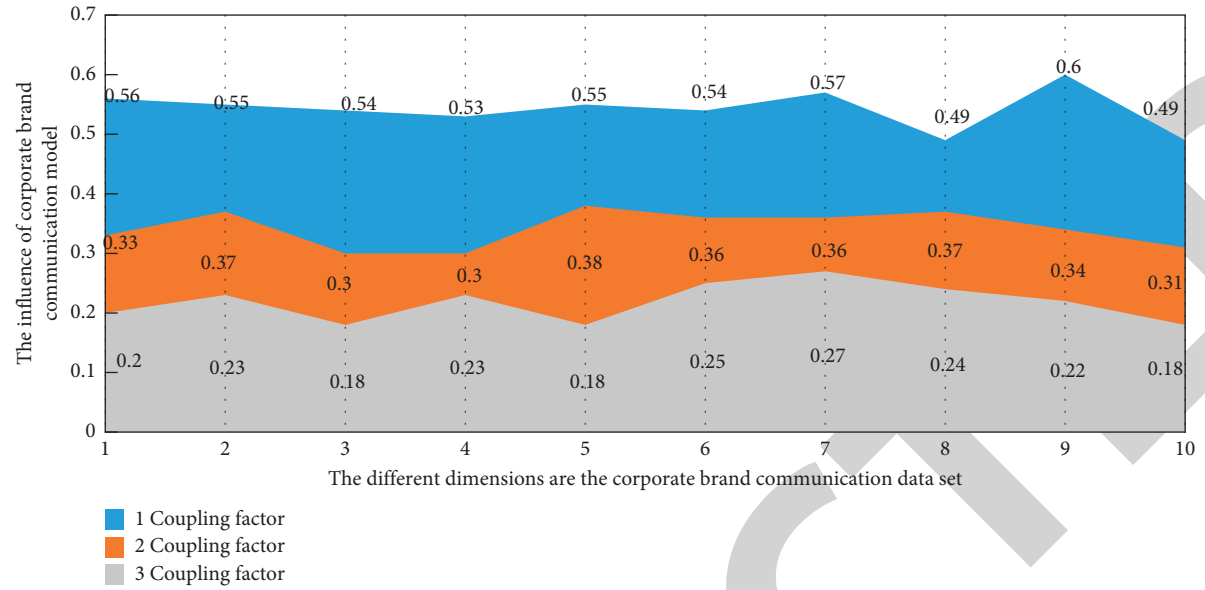

Figure 4: The simulation results of PSO algorithm for optimization analysis and solution of 10 groups of data with different dimensions.

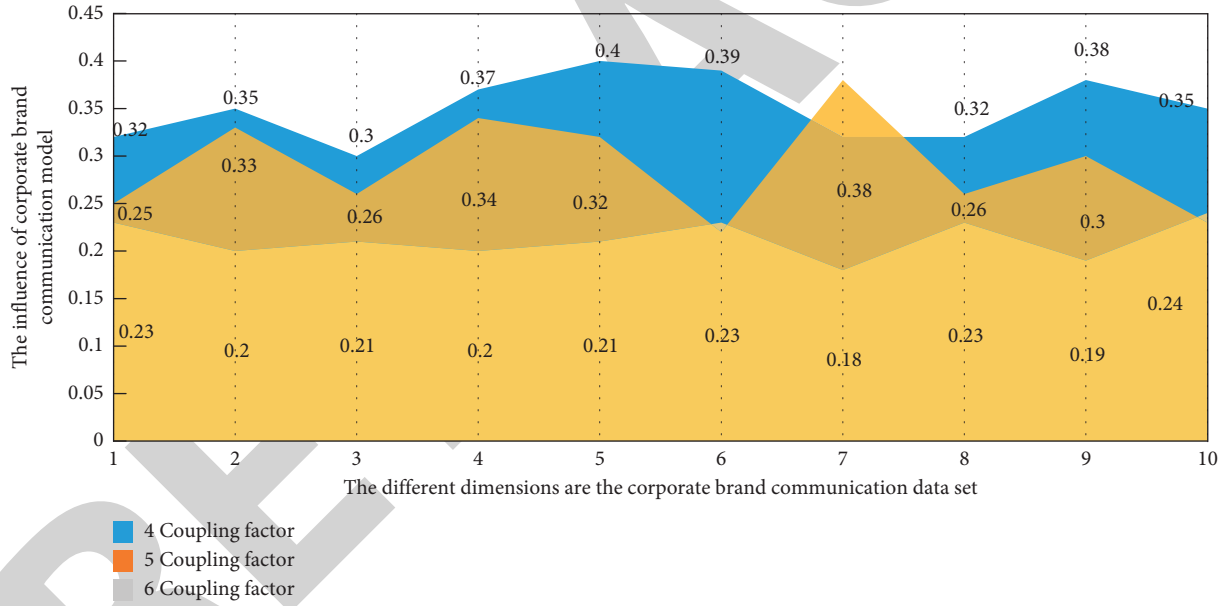

Figure 5: Simulation results of optimized PSO algorithm for solving optimization analysis.

time t. Through the above model, we can judge the impact of professional sports clubs on enterprise brand communication based on user thinking.

3.3. The Optimization Process of SIR Model in the Construction of Enterprise Brand Communication Model by Professional Sports Clubs. According to the basic model of the impact of professional sports clubs on the enterprise brand communication model obtained in Section 3.2, this study needs to use PSO algorithm to optimize its parameters a, b, c, d, e. In particle swarm optimization, the physical meaning of particles is the solution of the model. Each particle can use xy as the subscript. For the position L of particles, the number of particles is defined as x and the dimension of particles is defined as y. For the particle velocity V, the particle number is defined as x and the particle dimension is defined as y. Each particle is affected by its own best past position P and the best past position g of the whole group or its nearest neighbor. Then, each particle is optimized by the following methods:

$$V_{id}(t) = V_{id}(t-1) + a_1 * \text{rand} * \left(P_{id} - L_{id}\right) + a_2 * \text{rand} * \left(P_{g\,d} - L_{id}\right). \tag{8}$$

Among them, a_1 and a_2 are the determinants, and

$$X_{id}(t) = X_{id}(t-1) + V_{id}(t),$$
$$V_{id} \in [V_{\min}, V_{\max}], \quad (9)$$
$$\text{rand} \in [0,1].$$

The simulation analysis process of error change law in the quantitative analysis of enterprise brand communication impact of particle swarm optimization algorithm under different data analysis completion degrees is shown in Figure 6.

Firstly, the whole model is initialized, and then the values of particle position and velocity are given randomly. Next, the fitness value of each particle is evaluated and updated, and then the particle position and velocity are updated until the termination condition is reached.

4. Result Analysis and Discussion

4.1. Discussion on the Design of Professional Sports Clubs Based on the Model in the Process of Brand Communication Influence. In order to analyze the correlation between the performance differences of professional sports clubs among different users and the impact of enterprise brand communication, considering the randomness factors, this study constructs a big data integration system based on Hadoop framework, which can import complex discrete data in real time. By means of questionnaire survey, the framework model predicts and analyzes the user group of enterprise professional sports clubs and inputs these discrete data into the big data system to estimate all such users. The core of this system is to combine the SIR model improved by PSO algorithm, set the initialization parameters of multiple PSOs, analyze the effect of users with different personalities of enterprise professional sports clubs, and calculate the infection probability and removal probability of users with different personalities. Then, through the comparative analysis of the calculated probability parameters, this paper quantitatively calculates the impact of professional sports clubs on enterprise brand communication. Figure 7 shows how to calculate the changes of users who pay attention to the enterprise due to professional sports clubs over time when using the improved SIR model based on PSO algorithm proposed in this paper and compare the traditional SIR model with the actual data. The actual data are the reference data obtained from the results of the questionnaire survey. The abscissa of Figure 7 is the time, the unit is month, and the ordinate is the number of users.

It can be seen from Figure 7 that the enterprise professional sports club had a great impact on the enterprise brand communication at the beginning of its establishment. The number of people paying attention to the enterprise because of the enterprise professional sports club showed a steep upward trend. With the increase of months, the number of people paying attention to the enterprise because of the enterprise professional sports club has basically remained unchanged 27 months later. This means that the number of loyal users of the enterprise's professional sports club has basically remained unchanged, and the impact on the enterprise brand communication has been basically fixed. At the same time, it can be seen from Figure 7 that the trend of the SIR model designed in this paper is relatively consistent with that of real data. The main reason for distortion is that the predicted value of the SIR-PSO model curve is larger than the actual value in the initial stage due to the overoptimization of PSO algorithm. With the continuous simulation, the predicted value and actual value tend to be unified gradually. The traditional SIR model has not been optimized by PSO algorithm, so it is unable to optimize and analyze the user's ideas, which makes the deviation between the predicted data of the model and the actual data more and more large in the later stage of simulation.

4.2. Results and Analysis of the Impact of Professional Sports Clubs on Enterprise Brand Communication Based on SIR Model. In order to make an in-depth result analysis of the impact of enterprise professional sports clubs on enterprise brands proposed in this study, it is necessary to compare and analyze the root mean square error and absolute value error of the predicted results and the actual results. Whether root mean square error or absolute error, the smaller the error value, the better the performance of the model. The calculation formula of root mean square error is as follows:

$$J = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(X_t - Y_t)^2}, \quad (10)$$

where X_t is the actual value at t time and Y_t is the predicted value at t time. The absolute error values of the SIR-PSO model proposed in this paper and the mainstream SIR model (SIR model based on greedy iterative algorithm) in three data analysis stages are shown in Figure 8.

Figure 9 shows the comparison between the number of people who pay attention to an enterprise brand over time calculated by the questionnaire method and the number of people who pay attention to the enterprise because of the enterprise's professional sports club over time analyzed by the SIR-PSO model.

As can be seen from Figures 8 and 9, the trend of absolute error value of the SIR-PSO model and SIR model shows a completely opposite trend with the increase of months. The model proposed in this paper has a large error in the prediction of enterprise brand communication at the beginning of the establishment of enterprise professional sports club, which is due to the overfitting phenomenon caused by the previous PSO algorithm, which continues to advance with time. The absolute error between the predicted value and the actual value of the model proposed in this paper decreases gradually. The SIR model is just the opposite. With the advance of time, the absolute error between the predicted value and the actual value tends to become larger and larger as a linear function. Through equation (10), it can be calculated that the root mean square error of the model proposed in this paper is about 53, while the root mean square error of the

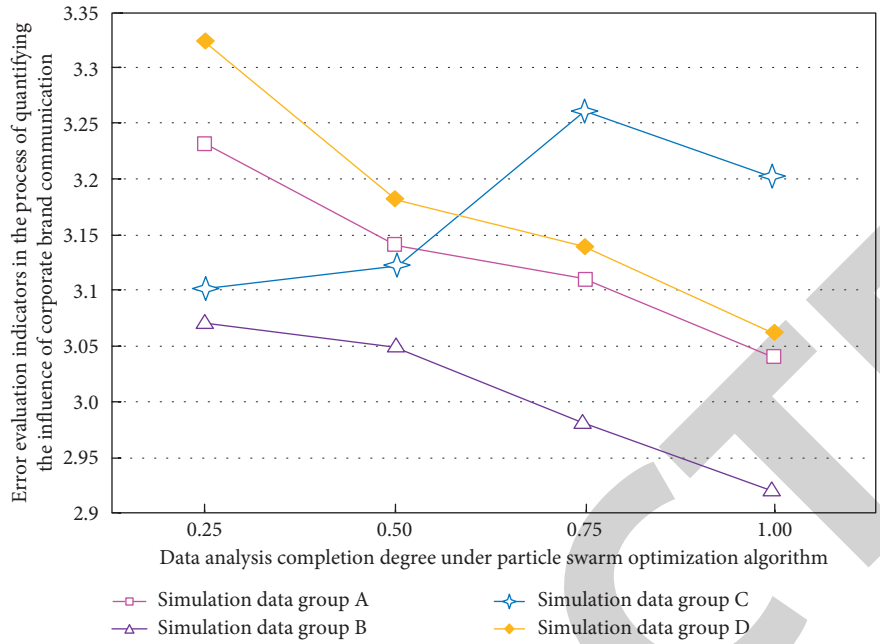

Figure 6: Simulation analysis of the influence error of PSO algorithm on corporate brand communication under different data analysis completion degrees.

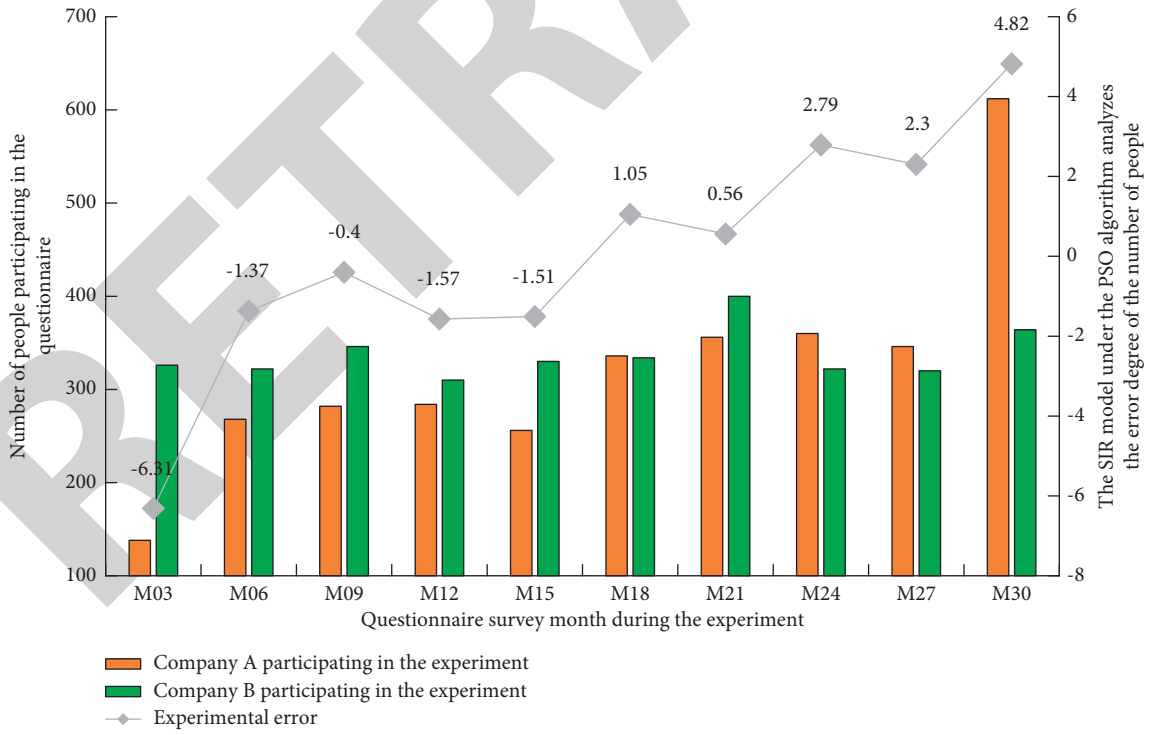

Figure 7: The judgment and analysis results of the changes of enterprise users based on the improved SIR model under the PSO algorithm.

traditional SIR model is about 514, which is nearly ten times different. In addition, according to the data in Figure 9, it can be calculated that in the process of enterprise brand communication, about 18% of users pay attention to the enterprise due to the enterprise professional sports club of the enterprise.

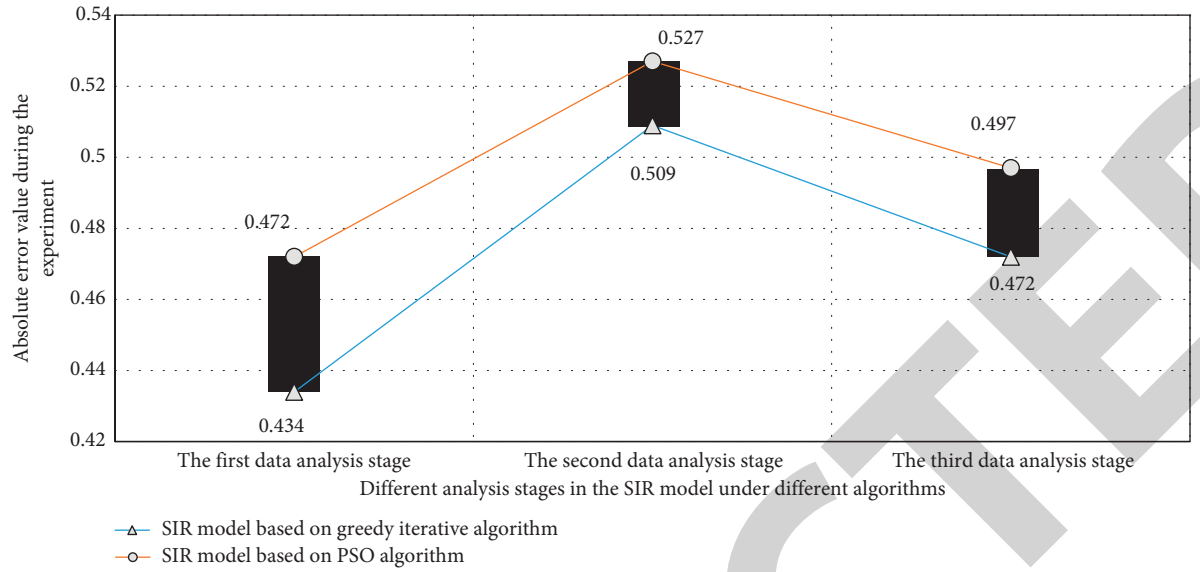

Figure 8: The absolute error values corresponding to different analysis stages in the SIR model under different algorithms.

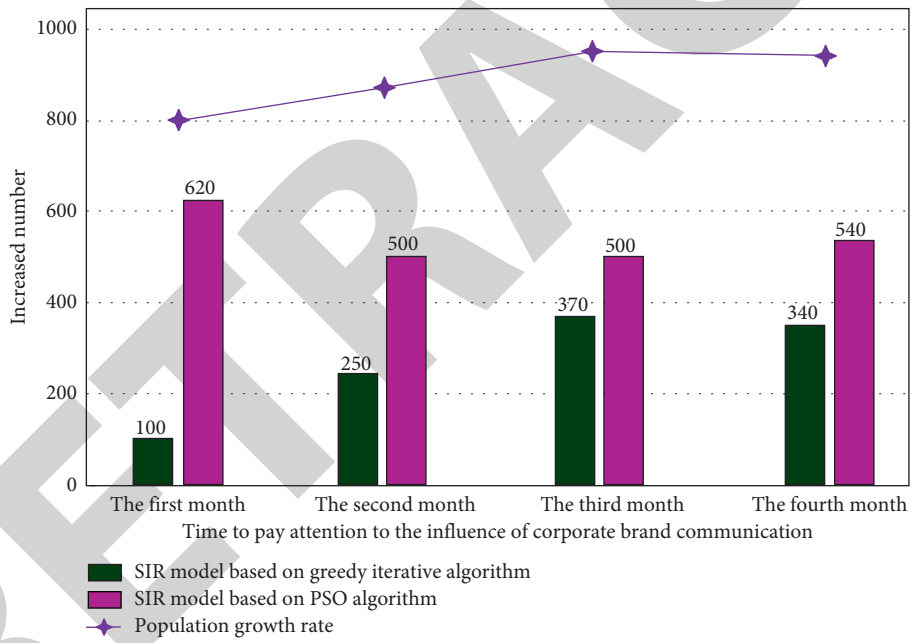

Figure 9: A comparison of the increase in the number of people who pay attention to the influence of corporate brand communication over time.

To sum up, the SIR-PSO model proposed in this paper considers the ideas and characteristics of enterprise users, so the model has obvious high fitting performance for the prediction of enterprise brand communication compared with the traditional SIR model. The model proposed in this paper plays an important guiding role in analyzing the impact of professional sports clubs on enterprise brand communication.

5. Conclusion

This paper studies the quality evaluation model of the impact of complex discrete system based on the SIR model on enterprise professional sports club communication and enterprise brand communication and optimizes it by PSO algorithm. Firstly, it briefly summarizes the research status of complex discrete systems, enterprise professional clubs, and enterprise brand communication. Then, according to the communication characteristics of enterprise professional clubs and enterprise brands, this paper constructs a specific SIR model. Using PSO algorithm to optimize five parameters, an evaluation method based on the SIR-PSO model is proposed, and a more scientific evaluation model is constructed to calculate the impact of enterprise professional clubs on enterprise brand communication. Finally, through

the questionnaire survey data of professional sports clubs and brand communication in an enterprise, this paper calculates and quantifies the impact of professional sports clubs on enterprise brand communication and verifies the reliability of the evaluation model constructed in this paper. The results show that in the process of analyzing the impact of professional sports clubs and enterprise brand communication, the communication mode design of professional sports clubs based on the SIR-PSO algorithm can not only effectively deal with various complex discrete data evaluated by club users but also analyze and evaluate the impact of professional sports clubs on enterprise brand communication. However, this paper only focuses on the impact evaluation model of professional sports clubs and enterprise brand communication of a single enterprise and does not consider the personalized customization analysis for different enterprises. Therefore, before enterprises adopt the model proposed in this paper for analysis, we can deeply study the multidimensional influencing factors of enterprise professional clubs.

Data Availability

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

Conflicts of Interest

The author declares that there are no conflicts of interest.

Acknowledgments

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