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Network Public Opinion Prediction Based on Improved Particle Swarm Optimization and BP Neural Network

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Abstract: The prediction of network public opinion can help to understand the development law and progress direction of network public opinion. It is helpful for relevant departments to deal with public opinion in a timely manner and has important value for the benign development of social public opinion. In order to provide a more effective forecasting method, this paper introduces the sample data and parameter setting of the prediction model on the basis of discussing the related technology of prediction model establishment. Finally, the IPSA-BP combined prediction model designed in this paper was compared with IPSA and BP model on the prediction results of five kinds of public opinion events. Experimental data showed that the error between the prediction results of IPSA-BP and the real value was about 2%. However, the error between the prediction results of IPSA and BP model and the real value is about 5%, so it is verified that the prediction ability of IPSA-BP has achieved the expected test effect.

1. Introduction

Online public opinion events reflect some social phenomena in the country and have a certain relationship with the vital interests of the people. Therefore, accurate prediction of public opinion through platform and technology can spread the influence of public opinion more effectively.

Nowadays, many scholars pay attention to the research of various technologies and system tools in public opinion prediction, and through practical research, they have also achieved certain research results. Venieris S I focus on four key parts of public opinion. First, the definition of public opinion is discussed from computer technology, and the chivalry model of forecasting is described. Secondly, it discusses how to predict events on different platforms, and introduces various computer methods to collect network public opinion data. Venieris S I also introduced the public

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opinion data with different characteristics in the network public opinion prediction method. Finally, Venieris Si proposed various technical tools for using prediction to test the authenticity of platform data [1]. Pulkit investigates and analyzes the reasons for the release of public opinion on Weibo according to the characteristics and nature of food safety events. Pulkit summarizes predictors of food safety incident releases. The prediction model of food safety event release times was constructed by combining BP neural network, and the experimental test was carried out by obtaining the microblog data of food safety events. The results show that user activity has a great impact on the number of security event releases, and the prediction effect of this method is good [2]. Karami A made a prediction of public opinion by analyzing the development trend in big data processing, thus providing A prediction model for statistical analysis. An Internet prediction model based on statistical analysis was constructed, and the development characteristics and types of public opinion in big data analysis were mastered by using statistical methods to predict public opinion on the Internet, and the prediction model of clustering algorithm was formed [3]. Although there are a lot of existing researches on network public opinion prediction, there are still shortcomings in the research on prediction based on IPSA and BP neural network.

So in order to enrich the defects of the existing prediction methods, first introduced the functional equation and network training steps of the algorithm and the public opinion of the concept of life cycle, then discusses the forecast model design of experiment parameter Settings and sample data, and finally designed the model architecture, and through the design of the model test, effect of the specific application The final experiment shows that the prediction technology designed in this paper can make accurate prediction, and can save the cost and time of prediction in practical application.

2. Network Public Opinion Prediction Based on Improved Particle Swarm Algorithm and BP Neural Network

2.1. Improved Particle Swarm Algorithm

This algorithm has the advantages of certain operation speed and better global search ability [4].

Assuming that the predicted network range is within n dimension, A public opinion prediction population is composed of M flying particles, in which the content and type of the u TH public opinion prediction within the network range can be expressed as A vector of dimension [5].

The optimal network public opinion data predicted by the u-th particle is the individual predicted extreme value, which is recorded as:

$$f_u = [f_{u1}, f_{u2}, \cdots f_{un}]^M \tag{1}$$

(2) The predicted optimal network public opinion data of the entire particle population is the overall predicted extreme value, which is:

$$f_u = [f_{u1}, f_{u2}, \cdots f_{un}]^M \tag{2}$$

(1) When these two extreme values of prediction are found through iterative optimization, each prediction updates the content and type of public opinion prediction according to the following formula:

$$s_{un}^{r+1} = zs_{un}^r + b_1 c_1 (f_{un}^r - l_{un}^r) + b_2 c_2 (f_{kn}^r - l_{un}^r) \tag{3}$$

In the above formula, z is the network public opinion event; b_1 and b_2 are the data learning

factors; c_1 and c_2 are the network public opinion constants within the network; s_{un}^r represents the data predicted by the particle in the u th prediction process; f_{un}^r is The individual predicted extreme value of the u th dimension of particle r in the n th prediction process; f_{kn}^r is the overall predicted extreme value of the r th dimension of the population in the n th prediction [6].

2.2. BP Neural Network

There are four main steps in BP neural network training:

(1)The initialization of BP network parameters, including the initial threshold of the network model, learning rate and other parameters, determines the number of nodes in each layer [7].

(2) Input the training sample data, train the network model, successively calculate the input and output of each layer of the network model, and obtain the error of each layer of the model [8].

(3) Adjust and correct the weight and threshold parameters of the output layer and hidden layer according to the calculated training error of the network model [9]. Make the modified network value close to the expected value until the error of the network output meets the set error value, otherwise continue the training [10].

(4) Finish the training process and use the trained model to predict the output [11].

2.3. Network Public Opinion Prediction

Its life cycle has the following four stages: germination stage, outbreak stage, heat stage and extinction stage [12].

(1) Germination period

This stage is the embryonic stage. The event has begun to appear, but it did not explode due to insufficient heat or lack of stimulation [13]. In essence, online public opinion is the mapping of contradictions and problems arising in the real society in the cyberspace [14].

(2) Outbreak period

This stage is the formative stage. It is the gathering stage of opinions, emotions and attitudes of online groups [15]. When a network event is a social public issue that netizens pay attention to, the exaggerated reports of the media and the rumors on the Internet may become the stimulus point of the event, and the event will be quickly spread on the Internet to attract more netizens to participate in the discussion.

(3) Heat phase

This is a period of contagion. Public opinion has begun to take shape, and the mainstream online public opinion has been formed through three stages. Network public opinion presents a greater degree of differentiation and is recognized by a small number of groups, and its spread scope continues to expand, becoming an opinion that is commonly recognized by most netizens [16].

(4) Regression period

This is the phase of extinction. The new network public opinion will replace the old one, and the old one will gradually fade out of the scope of public discussion over time [17]. However, the demise of online public opinion does not represent the end of the event, and the subsequent influence of the event will more or less cause positive or negative effects on the real society. Therefore, this stage is a process in which the network public opinion reacts with the real society [18].

3. Investigation and Research on Network Public Opinion Prediction Based on Improved Particle Swarm Algorithm and BP Neural Network

3.1. Parameter Settings

Through technical analysis and investigation, it is found that particle swarm optimization and neural network have good use value and training effect in prediction, but the model parameters need to be set and adjusted during the prediction training, and the neural network model includes the network model parameters. The characteristic of improved particle swarm optimization algorithm is that it needs to adjust the population number. Detailed parameters are shown in Table 1:

Table 1. Parameter settings

Parameter item	Parameter value
Number of network layers	5
The layer number	3
The layer number	12
Node	2
Training function	Train
Number of iterations	500
Learning rate	0.01
Population size	20-40

3.2. Sample Data

The data in this paper come from user comments related to network public opinion on Weibo platform. Select 5 online public opinion events with wide spread since 2020, and use Python to crawl the user comments about the 5 online public opinion events on the mobile end of Weibo, and obtain the relevant fields as scheduled on 2022-08-17, including user name, comment time, and microblog body. A total of 7900 pieces of valid data have been removed. Data distribution is shown in Table 2:

Table 2. Sample data distribution

Serial number	Event	Quantity
1	Nanny Arson	425
2	Women's toilet childbirth incident	352
3	Maternal jumping off the building	78
4	Jiangge Incident	2145
5	Luo Yixiao incident	2200

4. Application Research on Network Public Opinion Prediction Based on Improved Particle Swarm Algorithm and BP Neural Network

4.1. Construction of Network Public Opinion Prediction Model

Combined with the discussion of mathematical models and basic training steps of related

technologies in this paper, the framework of the prediction model is established as shown in FIG. 1:

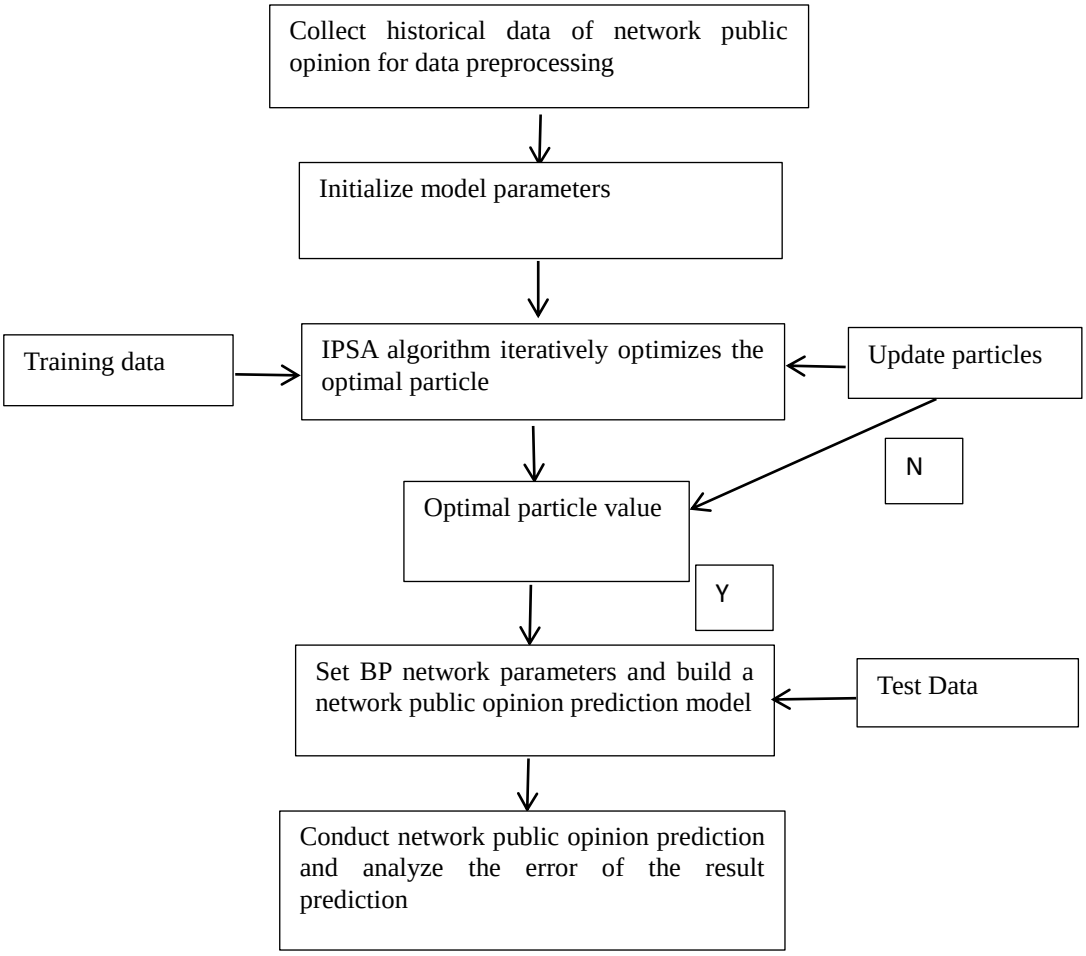

Figure 1. Prediction model diagram

The specific steps of the network public opinion prediction model are as follows:

(1) Input historical data of network public opinion (including user name, comment time, microblog text historical data, etc.), establish sample data, divide them into training and testing samples, and normalize the sample data.

(2) Initialize parameters of the model. Initialize the parameters. It includes the BP network algorithm training times, learning rate, the number of population, training times and other parameters.

(3) Calculate and compare the optimal value of each particle, use the optimization algorithm to get the particle with the optimal fitness, and determine the best initial parameters of the model.

(4) Use network public opinion test set to test data. The BP model with optimal parameters is used to realize the prediction, and the error analysis of the results is carried out.

4.2. Application of Network Public Opinion Prediction Model

In order to verify and analyze the prediction effect under the relevant technology proposed in this paper, five kinds of network events are predicted by combining the collected sample data. Improved Particle swarm optimization model (IPSA),BP neural network model (BP) and IPSA-BP are respectively used to compare and predict five network events in sample data. The network public opinion prediction results of three different prediction methods are shown in Table 3:

Table 3. Predicted outcome data

Model	BP	IPSA-BP	IPSA	Actual value
Event1	253.2	259.8	250.4	260.5
Event2	270.6	278.9	271.5	280.9
Event3	281.7	288.6	279.2	290.6
Event4	250.8	255.9	248.9	256.8
Event5	245.7	249.5	242.6	250.9

Figure 2. Comparison of prediction results

As can be seen from Figure 2, the overall fitting effect of IPSA and BP model on training data is similar to the prediction effect of the proposed combined model (IPSA-BP). In terms of the prediction results of five network events, the fitting results of (IPSA-BP) are closer to the real predicted values, while the gap between the fitting results of IPSA and BP model is relatively large. Among the three prediction models, the prediction results of this paper (IPSA-BP) are more accurate for five kinds of network events. Through comprehensive analysis, it can be concluded that the prediction accuracy of this paper (IPSA-BP) is better than that of traditional IPSA and BP neural network models. The combination of IPSA and BP can optimize the parameters and effects of its network training, so as to improve the efficiency and accuracy of its prediction.

5. Conclusion

This paper introduces the realization technology of the prediction model, covers the concept of mathematical model, training process and network public opinion, as well as the parameter design and data survey of the prediction model under the technology, and focuses on the design of the flow

structure of the prediction model. The prediction model (IPSA-BP), IPSA and BP models were used to compare the test results and real values of five events. The experimental results prove that the prediction ability of (IPSA-BP) is better than the traditional prediction model.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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