Research Article

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The impact of public health emergency governance based on artificial intelligence

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Abstract: To optimize the data clustering effect of public health emergencies, an application research on social governance ability under public health emergencies based on artificial intelligence is proposed. First, the firefly optimization algorithm is used to collect the information data of the social governance ability of public health emergencies, establish a unified format, and save it. Then, artificial intelligence technology is used to mine the correlation of clustering data, and on this basis, a learning model integrating global structure information and local structure information is established. Finally, the social governance model under public health emergencies is established. The experimental results show that the design method has high clustering accuracy, regularization cross index, and adjusted rand index (ARI) index. This shows that the design method can improve the social governance ability of data fusion clustering and improve the social governance ability.

Keywords: artificial intelligence, public health emergencies, social governance capacity

1 Introduction

Public health emergencies refer to uncertain, infectious, and systematic emergencies that cause or may cause serious damage to public health, such as epidemic situations of infectious diseases, group unexplained diseases, food poisoning, and occupational poisoning [1]. With the promotion of new communication technologies such as big data, artificial intelligence, and Internet of things, information construction has gradually become an important part of public health emergency management [2]. With the increasing complexity, destructiveness, and sustainability of public health emergencies, it is particularly necessary to improve the prediction and response ability of public health emergencies with the help of emerging information technology and finally realize the accurate management of public health emergencies.

Collins et al. [3] pointed out that due to the rapid increase of COVID-19 epidemic and national cases, federal and state attention has rapidly shifted from overdose to COVID-19 transmission. All jurisdictions have implemented rapid public health measures, including large-scale closure of enterprises, transition to telemedicine, temporary closure of parks, and social isolation orders. Although these public health methods are necessary to flatten the epidemiological curve of the pandemic, they basically do not take into account the unintended consequences of these policies on structurally vulnerable populations, including drug users. However, this method has not been really applied to the management of public health emergencies, but its technical aspects can be used as the guidance of this article. Liang et al. [4]

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believed that China's current platform governance system has not yet been adapted to the transformation challenges brought by the application of emerging technologies such as artificial intelligence in terms of concept, theme, goal, field, content, and tools. Based on this, this article preliminarily constructs the platform governance system under the background of artificial intelligence application from the three dimensions of governance subject, governance object, and governance tool. On this basis, this article puts forward the governance suggestions of "agile adaptation, multi governance, scenario driven and technology authorization." However, this method has not been really applied to the management of public health emergencies, but its technical aspects can be used as the guidance of this article. Onan and Korukoğlu [5] proposed an integrated feature selection method, which aggregates multiple individual feature lists obtained by different feature selection methods, so as to obtain a more robust and efficient feature subset. To aggregate a single feature list, a genetic algorithm is used. Collins et al. [6] reviewed the existing global pandemic preparedness framework to highlight the governance challenges of addressing the dual agenda of non-communicable chronic disease (NCD) and chinese diabetes society (CDs) in public health emergencies. It proposes a key strategy to strengthen multilevel governance and support countries to better respond to public health emergencies by involving a wide range of stakeholders in all sectors. The research results of responding to CD and NCD pandemics during public health emergencies need a new framework to unify the narrative and overcome the fragmentation of services and systems; a multisectoral and multistakeholder governance mechanism that authorizes and provides resources to include cross-sectoral stakeholders; and a priority research agenda to understand the political economics of epidemics, the roles of different political systems, and actors and implementation challenges, and to identify joint strategies to address the convergence of CD and NCD agendas. Onan [7] made an extensive comparative analysis of different feature engineering schemes, such as the features used in author attribution, language features, character n-graph, part of speech n-graph, and the frequency of the most discriminating words, as well as five different basic learners: nave Bayes, support vector machine, logistic regression, k-nearest neighbor and random forest, boosting Bagging, and random subspace. On the basis of empirical analysis, an integrated classification scheme is proposed, which combines the random subspace integration of random forest with four characteristics: author attribution, character N-element, part of speech N-element, and the frequency of the most discriminating words. For lexus future advance corpus, the highest average prediction performance obtained by this scheme is 94.43%. Based on the aforementioned analysis, artificial intelligence technology is one of the most promising technologies in this century. Chen et al. [8] expounded the development of Fangfang hospital and expounded its three characteristics (rapid construction, large scale, and low cost) and five basic functions (isolation, diversion, basic medical treatment, frequent monitoring and rapid referral, necessary life, and social participation). Countries with coronavirus diseases, as well as future epidemics and public health emergencies, can become a strong part of the country. Santibañez et al. [9] pointed out that in 2005, Hurricane Katrina exposed disturbing gaps in areas with insufficient resources, which also highlighted the ability of communities and faith-based organizations (CFBOs) to quickly respond to the needs of vulnerable communities. Since then, relevant countries have made a significant progress in integrating CFBO into public health preparedness, response, and recovery, and outlined the cooperation between the Centers for Disease Control and Prevention (CDC) and CFBO in domestic response to pandemic influenza (2009), Ebola (2014), and Zika (2016).

The birth and development of artificial intelligence technology not only promotes the realization of social computing, expression, and governance based on data-related technology but also provides a practical basis for the application of artificial intelligence technology in the governance of public health emergencies. Therefore, on the basis of artificial intelligence, this article studies the application of social governance ability in public health emergencies, promotes the construction of public health emergency risk management system in China, and improves the auxiliary ability of data information in public health emergency decision-making.

2 Social governance method of public health emergencies based on artificial intelligence

2.1 Collect the information data of social governance ability of public health emergencies

In the early days, the information of public health emergencies was mostly stored in the form of paper documents in newspapers, magazines, and other physical media. With the development of media technology and the explosive growth of information, the information of public health emergencies is stored in the database after text digitization. Although the digitization of public health emergencies information is realized, the content resources in the database cannot be processed in depth. This is because the media cannot achieve efficient batch processing of massive text in the data acquisition link, especially cannot mine the relevant text based on the specific subject needs, so it can only simply store the original paper text after digitization. The computer has natural advantages in collecting and processing massive data. Therefore, when extracting information data of public health emergencies, using the concept of "human–computer cooperation" to design the whole information processing process will achieve twice the result of half the effort The data extraction process of social governance ability of public health emergencies designed in this article is shown in Figure 1.

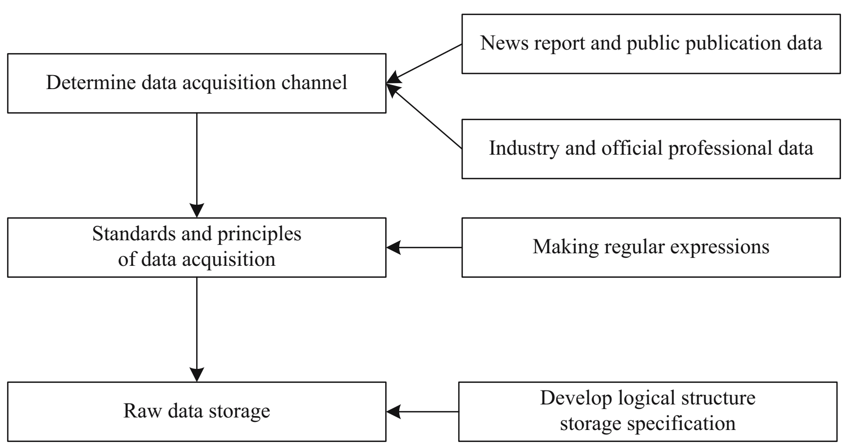

Figure 1: Data collection process of social governance capacity of public health emergencies.

The following is a detailed description of the data collection process of social governance capacity of public health emergencies. First, the standards and principles of public health emergency information data collection should be formulated. Although the computer has the ability to capture specific data in massive data, this kind of capture is not aimless, and it is based on the existing rules. Where to collect data, how to collect data, and what kind of data to be collected completely depend on the thinking decisions of the people behind the computer. The real reliability of data sources is a prerequisite for effective data mining. There are two main channels for information on data collection of public health emergencies: One is news report and public data, and the other is industry and official professional data. After the data source is determined, the regular expression of public health emergencies is formulated. The purpose of making regular expressions is to provide keywords to describe emergencies for crawler software, so as to find and capture the most semantically relevant information data. In this study, we designed regular expressions with two logical structures of "and" and "or" to cover all kinds of keywords related to public health emergencies as far as possible: in the first level, "and" is used to connect "subject" and "verb"; in the second level, "or" is used to connect different expressions of subject or verb. Each regular expression corresponds to its ontology to improve retrieval accuracy. This study uses focused crawler technology to capture historical and real-time news data, and its advantage is that it can capture web pages related to specific topics. We can remove the irrelevant links according to the analysis algorithms such as minimum data set and keyword filtering analysis, keep the useful links of relevant rules, and record the URL of the link in the database. The original data of public health emergencies captured by web crawler tools need to be stored according to a certain logical structure to facilitate the next step of data processing. Data storage is to record the data information generated in the process of data stream processing in a certain format on the storage medium of the computer. According to the characteristics of the original data acquisition process of public health emergencies, the original data crawled are stored in a unified format, such as serial number, title, web address, data source, and key words. Through the aforementioned three links, the data collection is screened, entered, and inspected, which provides the basis for subsequent data mining and analysis.

2.2 Design a multisource heterogeneous data clustering algorithm for social governance capability

After the completion of data acquisition, the collected data needs to be processed. The data format of social governance information of public health emergencies is not uniform, and the data format has great structural differences. Therefore, it is necessary to transform unstructured and semi-structured data such as text, pictures, video, and audio into structured data that can be recognized and calculated by computer [10]. Multisource heterogeneous data are a collection of data resources with diverse data sources, and there are associations among data sources. By using the association, intersection, and fusion of multisource heterogeneous data, we can find the rules and knowledge with potential value in the data with various types, complex structures, and dynamic changes, so as to assist in more scientific prediction and decision-making. At the same time, we can also maximize the value of data and obtain multiscale information, which is of great value to the social governance ability of public health emergencies [11]. Because clustering can identify different categories of data without prior knowledge, it has a high ability to process data flexibly and autonomously. Therefore, aiming at the problem of multisource heterogeneous data clustering with mixed attributes, this article proposes a clustering algorithm to provide effective support for the data management. The basic idea of the algorithm mainly includes the following: first, the initial distribution of firefly population in GSO (Group Search Optimizer) group search optimizer is optimized by using good point set theory, so that the distribution of the initial population in the solution space is more uniform; second, the population is distributed in the data space limited by the clustering data set, and the improved firefly algorithm is used to optimize the initial clustering center; third, a new method is designed for the comprehensive distance calculation of mixed attribute values. The numerical attribute values are standardized, the distance calculation strategy of K-Prototypes algorithm is optimized, the initial clustering center is generated, and the K-Prototypes algorithm is executed to obtain the clustering results of mixed attribute data set [12]. The algorithm flow is shown in Figure 2.

In Figure 2, the specific steps of the algorithm are as follows:

Step 1: initialization. The best point set is used to solve the limited data space to obtain the best point as the initial position of the firefly in GSO algorithm, and the relevant parameters such as firefly step size, initial value of fluorescein, volatilization rate of fluorescein, domain change rate, initial value of decision domain, and domain threshold are initialized.

Step 2: fluorescein update [13]. Aiming at the characteristics of multisource heterogeneous data clustering problem with mixed attributes, the fitness of firefly is described as the density of data object points in the perception domain and the number of data object points per unit distance. The updating method of firefly fluorescein can be expressed as formula (1):

$$g_i(n+1) = (1-m)g_i(n) + \alpha f(i). \tag{1}$$

In formula (1), g_i $(n+1)$ represents the updated fluorescein value; g_i (n) represents the fluorescein value during iteration; i represents the firefly; m represents the density of data object points; and $\alpha f(i)$ represents the fitness of firefly.

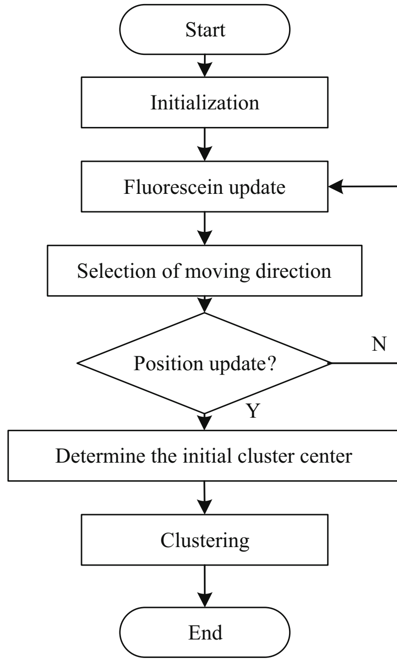

Figure 2: Algorithm flow.

Step 3: selection of the moving direction. When the firefly moves to a higher value of fluorescein in the sensing field, the location update probability can be expressed as formula (2):

$$p(\Delta d_i) = \max(p_1, p_2, \dots, p_a). \tag{2}$$

In formula (2), $p(\Delta d_i)$ represents the probability of position update; Δd_i represents the position of update; and $p_1, p_2, \dots, p_a$ represent the set of positions with higher fluorescein.

Step 4: position update. Fireflies move in the direction of renewal. It is expressed as follows:

$$\Delta d_i = d_i + \frac{l}{|\Delta d_i - d_i|}. \tag{3}$$

In formula (3), d_i represents the position before updating and l represents a step in the direction of movement.

Step 5: determine the initial cluster center. In the first step, the extreme point corresponding to firefly with the highest fluorescein value in the extreme point is selected as the first cluster center point. The second step is to select the maximum distance from the existing cluster center point as the next cluster center point in the remaining extreme points. Repeat the second step until k extreme points are taken out, and then k extreme points are the initial cluster center [14].

Step 6: clustering. The distance between each data point and the initial cluster center is calculated, and K disjoint clusters are divided according to the minimum distance. The classification value with the most repeated times is updated to the cluster center point. So far, the design of the clustering algorithm is completed.

2.3 Building a data fusion learning model of social governance capability based on artificial intelligence technology

After the clustering of social governance ability data in public health emergencies, it is necessary to collect and integrate multisource heterogeneous data. Compared with single-source data, multisource heterogeneous data come from multiple different data sources, including different data representation, different data density, different data dimension, and different data scale, which is called multimodality of multisource heterogeneous data. On the one hand, the multimodality of multisource heterogeneous data mean that multisource heterogeneous data have more information and knowledge. On the other hand, it increases the difficulty of building a multisource heterogeneous data fusion learning model [15]. Artificial intelligence technology is used to establish the corresponding relationship of large samples among data sources to mine the association of multisource heterogeneous data, so as to build the fusion learning model of multisource heterogeneous data. Currently, multisource heterogeneous data fusion mainly extends the single category method to the field of multiclustering by fusing the global structure information of data [16]. However, in practical applications, the global structure of multisource heterogeneous data is often very similar and lack complementarity. Ignoring the local structure information leads to the lack of learning ability of existing data fusion models. To make full use of the consistency and complementarity of multisource heterogeneous data, it is necessary to combine global structure information and local structure information in fusion [17]. Based on this, this article proposes a fusion learning model to solve the aforementioned problems by fusing multiple structural information clusters. First, aiming at the representation problem of multisource heterogeneous data learning, a spectral density representation method is proposed to obtain the consistent representation of the local density of different sources of data. For a group of clustering data points, the calculation formula of spectral density can be expressed as formula (4):

$$q(t) = \sum_{t=-\infty}^{+\infty} \delta(k)\mathrm{e}^{-nkt}. \tag{4}$$

In formula (4), $q(t)$ represents spectral density; t represents time; $\delta(k)$ represents the autocompatibility matrix of data points; k represents cluster number; n represents the number of data points; and e^{-nkt} represents the base function. When the data points are projected into the local space, their mean and variance will not change systematically and can still be regarded as stationary series. The local density of data points is expressed as formula (5):

$$q(a) = \sum_{b=1}^{n} \delta(h)\mathrm{e}^{hb}. \tag{5}$$

In formula (5), a and b represent two data points, $q(a)$ represents the local density of data point a, and h represents the distance between two data points. Based on the uniform representation of local density in each data source, the fusion model is established by using the consistency and complementarity of data. By maximizing the similarity between the target value and the medium density representation of different sources, the fusion parameters of each sample point are solved, and the fusion model of spectral density representation of multisource heterogeneous data under unsupervised condition is proposed. The calculation formula is shown in formula (6):

$$r = \max \lambda(a)\frac{\sum\langle\lambda(a), q(a)\rangle}{\sum\lambda(a)^2}. \tag{6}$$

In formula (6), r represents the optimal density vector and $\lambda(a)$ represents the data point fusion parameters. According to the Rayleigh quotient inequality, the optimization problem of the fusion model is transformed into the eigenvector corresponding to the maximum eigenvalue of the vector r. After obtaining the optimal parameters, the optimal spectral density is obtained. Each sample is used to obtain the optimal density feature vector, and then the multisource heterogeneous data fusion is realized by combining the peak density.

2.4 Establishing social governance model of public health emergencies

By effectively collecting, clustering, and integrating social governance capability information, we can make social governance decisions technically. Based on the aforementioned analysis of social governance data, a social governance model under public health emergencies is established [18].

First, a risk monitoring module is established. Accurately monitoring social governance risk is the basis and premise of improving social governance ability. Through massive, dynamic, diverse, and multidimensional "diachronic" data and "consensus" data, including structured, semistructured, and unstructured data, information technology, simulation model, and data fusion are adopted. Multidimensional, full sample, and heterogeneous data involve the Health Commission, public security, transportation, housing construction, human resources and social security, civil affairs, education, housing construction, ecological environment, and other departments. It reveals the internal logic between major public security emergencies. The key factors affecting the prevalence of New Coronavirus pneumonia were determined accurately. It provides information sources and scientific methods for social governance risk monitoring [19]. After the occurrence of public health emergencies, a large amount of data are used for scientific modeling, and artificial intelligence and in-depth learning are used to make the data collection of social governance capacity more timely and accurate, which can be used to locate individuals and specific blocks, so as to provide data basis for the construction of risk monitoring model and realize the accurate monitoring of event risk sources.

Second, the risk prediction module is established. How to make precise, accurate, and scientific prediction of major public health emergencies is an important support for epidemic prevention and control [20]. The transmission model of infectious diseases is established, according to the factors such as infection cases, infection rate, infection area, and regional traffic network, with the help of intelligent models and information technology such as transmission dynamics model, dynamic infection model, and regression model. It can not only analyze and display the heat distribution of the incidence of public health emergencies and the risks of close contacts but also predict and evaluate the source, speed, route, and risk of virus transmission, so as to predict the risk status and trend of social governance of public health emergencies.

Third, a collaborative governance model is established. The social governance of public health emergencies is mainly reflected in the prevention and control of risk events, which requires the cooperation of Party committees, governments, society, markets, the public, and other subjects to overcome difficulties. Through the in-depth sharing, correlation analysis, and efficient utilization of public health emergency data and information, the overall coordination across departments, fields, regions, and industries is strengthened and the coordination and linkage ability and emergency management level between government levels, between departments, and between government and society is improved.

Fourth, a government communication module is established. To enhance new coronavirus pneumonia, we need to monitor, analyze, evaluate, and alert popular information such as social networking, portal websites, and search engines. Novel coronavirus pneumonia prevention and control process steps are collected and summarized, and the public's preferences and cognition for public safety incidents are accurately grasped [21]. With the help of industry risk monitoring and intelligent analysis, the characteristics and trends of public opinion of emergencies are comprehensively grasped, communication strategies are improved, communication effects are improved, public recognition of government credibility and execution is enhanced, and publicity, emergency education, and communication mechanism are improved.

Based on the aforementioned analysis, the method design of improving the social governance ability of Public Health Emergencies Based on artificial intelligence is completed.

3 Experimental study

To verify the application performance of the proposed social governance method based on artificial intelligence in public health emergencies, MATLAB is used for the simulation experiment [22].

3.1 Experimental preparation

To verify the clustering effect of multisource heterogeneous data, the 3source data set is used for the simulation experiment. The 3source data set is composed of news data, including 6 types of sample data of 416 news texts. The data source of 3source data set is composed of three different news channels. Three clustering indexes are used as the evaluation criteria in the experiment: clustering accuracy, regularization mutual index, and adjusted rand index (ARI) index. The accuracy of clustering is the ratio of the correct sample to the total sample number of cluster, and the calculation formula is shown in formula (7):

$$c = \frac{\sum y(B_1, B_0)}{N}. \tag{7}$$

In formula (7), c represents the clustering precision; N represents the total number of data samples; $\sum y(B_1, B_0)$ represents the number of correct tags after clustering; B_1 represents the real tag set; and B_0 represents the cluster tag set. The normalized mutual index represents the similarity between clustering partition and real partition. The calculation formula is shown in formula (8):

$$I = \frac{M(B_1, B_0)}{\max[g(B_1), g(B_0)]}. \tag{8}$$

In formula (8), I is the regularized mutual index; $M\ (B_{1,}B_0)$ represents the mutual information of two tags; and $g(B_1)$ and $g(B_0)$ represent the entropy of two label sets. The ARI index indicates the degree of consistency between the clustering results and the real situation. The calculation formula is shown in formula (9):

$$\begin{cases} \text{ARI} = \dfrac{D - E(D)}{\max(D) - E(D)}, \\ D = \dfrac{s_1 + s_2}{s}. \end{cases} \tag{9}$$

In formula (9), D is the Rand index; $E(D)$ is the expected value; S_1 is the number of two samples of the same kind gathered in the same class; S_2 is the number of two samples of different classes gathered in the different class; and s is the number of all sample pairs.

3.2 Effect evaluation of information data clustering

To analyze the clustering effect of the design method in this article, a comparative experiment was carried out with the existing methods. The three existing methods are based on different clustering algorithms. The traditional method based on feature series algorithm is set as control group 1, the traditional method based on collaborative regularization clustering algorithm is set as control group 2, the traditional method based on multitask spectral clustering algorithm is set as control group 3, and the method in this article is the experimental group. The test results of clustering accuracy are shown in Figure 3, the test results of regularized mutual index are presented in Table 1, and the test results of ARI index are presented in Table 2.

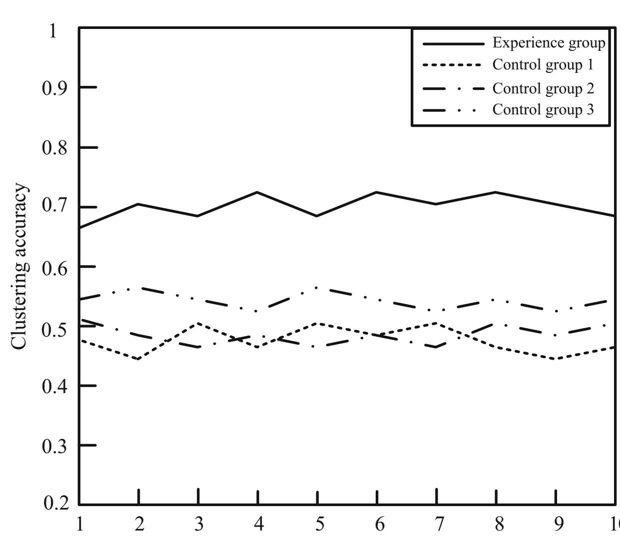

Figure 3: Clustering accuracy test results.

Table 1: Regularized mutual index test results

Test serial number	Experience group	Control group 1	Control group 2	Control group 3
1	0.826	0.382	0.268	0.352
2	0.857	0.386	0.279	0.329
3	0.823	0.395	0.294	0.306
4	0.845	0.382	0.283	0.347
5	0.812	0.376	0.271	0.358
6	0.793	0.395	0.292	0.362
7	0.786	0.372	0.266	0.412
8	0.815	0.426	0.281	0.384
9	0.824	0.417	0.275	0.375
10	0.838	0.403	0.283	0.365

Table 2: ARI index test results

Test serial number	Experience group	Control group 1	Control group 2	Control group 3
1	0.678	0.246	0.124	0.228
2	0.674	0.243	0.126	0.234
3	0.682	0.247	0.128	0.229
4	0.675	0.251	0.119	0.226
5	0.683	0.253	0.123	0.231
6	0.692	0.256	0.154	0.232
7	0.688	0.248	0.146	0.226
8	0.682	0.256	0.148	0.234
9	0.694	0.257	0.152	0.228
10	0.687	0.249	0.125	0.225

It can be seen from the clustering accuracy test results shown in Figure 3 that the design method in this article has certain advantages in clustering accuracy, and the clustering ability is more than 0.68. The main reason is that this algorithm uses the firefly optimization algorithm to collect the social governance ability information data of public health emergencies, establish a unified format, and save it. Then, the relevance of clustering data is mined by using artificial intelligence technology, and a learning model is established based on it to improve the clustering accuracy. Finally, the clustering accuracy of the test results is higher than that of the control group.

According to the test results presented in Table 1, the regularization mutual index of the design method is 0.822, which is 0.429, 0.543, and 0.463 higher than the traditional method. It shows that the design method has better clustering similarity.

According to the test results presented in Table 2, the ARI index of the design method is 0.684, which is 0.433, 0.549, and 0.455 higher than the traditional method. It shows that the clustering results of the design method are in good agreement with the real situation. Based on the comparison results of the three test indexes, the design method is superior to the traditional method in clustering precision, regularization mutual index, and ARI index. It shows that it can improve the performance of data fusion clustering and promote the learning efficiency of data fusion of social governance.

4 Conclusion

Relying on digital technologies such as Internet of things, big data, cloud computing, and artificial intelligence, the digital government can improve knowledge management ability and social collaborative governance ability, and realize effective response to public health emergencies. In the future development, the digital government should focus on improving the technical capabilities of data mining and data analysis, establishing the management concept of digital "serving the people," and further breaking the internal organizational inertia that hinders social coordination. Therefore, this article studies the social governance method of Public Health Emergencies Based on artificial intelligence. The experimental results show that the clustering ability of this method is more than 0.68, and the cross regularization index is 0.822, which is higher than that of the comparison method. It can be seen that this method improves the clustering performance of social governance ability data and provides fusion data support for improving social governance ability. However, the research method of this article is to establish the correlation based on the corresponding relationship of social governance ability data. The follow-up research should fully consider the lack of the corresponding relationship, so as to further improve the applicability of this method.

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Conflict of Interest: The authors state no conflict of interest.

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