# Dimensionality Reduction and Visualization in Public Management Research from the Perspective of Algorithm Recommendation

Jun Yu [1, a], Yichen Liu [2, b]

[1] Economics and Management College, Civil Aviation University of China, Tianjin 300300, China

[2] School of Economics, Henan University of Economics and Law, Zhengzhou 450000, China

[a] yujuncauc6688@163.com, [b] 15039578750@163.com

**Abstract.** With the development of computer technology, algorithm recommendation systems have been widely used in intelligent transportation, urban planning, and other fields. Aiming at the current problems in public management in China, this paper proposes a dimensionality reduction calculation method, and uses the improved particle swarm optimization algorithm to analyze and evaluate the dimensionality reduction process. With the expectation of providing some reference value and ideas for solving practical application problems, a corresponding relationship equation is established with the minimum expected value as the objective function to solve the corresponding optimal solution, the evaluation results of system performance indicators and comprehensive scoring criteria under relevant parameters and constraints are given. The test results show that the visualization effect of the dimensionality reduction visualization model for public management research based on the algorithm recommendation perspective is over 90%.

**Keywords:** Algorithm Recommendation; Public Management; Dimensionality Reduction Visualization; Dimensionality Reduction Analysis.

## 1. Introduction

Currently, algorithm recommendation technology has been widely used in multiple fields, with the main application being to process and analyze specific data [1-2]. Currently, there are many methods for solving certain problems. However, for different types, different periods of time, or different preferences, when the optimal solution is obtained, the algorithm is stereotyped and cannot provide an effective solution as a whole. In addition, for some special situations, recommendation results can be improved by improving the existing data with high similarity and significant features or keyword characteristics to meet user needs and achieve their own value creation goals [3-4].

Many scholars have studied recommendation algorithms. Some scholars believe that the optimization problem of algorithm recommendation systems is mainly through analyzing existing data to obtain the optimal solution. Under traditional technical conditions, due to differences in information asymmetry, user behavior patterns, and perceived preferences between users and computers, the parameters provided by the algorithm differ [5-6]. Other scholars have proposed the basic idea of algorithm recommendation: based on known information and through analysis of data, user groups that may have similar preferences and differences are divided into different categories, and the objects included in the algorithm can be inferred based on factors such as the degree of similarity and behavioral tendencies among users [7-8]. Therefore, this article explores the dimensionality reduction visualization of public management research based on the algorithm recommendation perspective.

In the era of network information, the personalized needs of users have also changed. The algorithm recommendation system provides a new method to solve the above problems. In this paper, the algorithm is dimensionally reduced. Firstly, it introduces the relevant theories used to solve the problem that algorithms cannot support key technologies such as user data mining and data analysis. By comparing the differences and similarities in different applications in different fields, it elaborates the method and specific process of implementing the optimal personalized recommendation based on the improved model.

# 2. Discussion on Dimensionality Reduction and Visualization in Public Management Research from the Perspective of Algorithm Recommendation

## 2.1 Algorithm Recommendation Technology

In the field of public management, algorithm recommendation technology is a new solution aimed at providing personalized and diversified services to users. It optimizes system performance indicators by analyzing, processing, and filtering data stream information. At the same time, it can adjust or expand system functions to meet the needs of applications required under specific goals based on different user needs, and it can also convert computational formulas into statistical methods that are commonly used in computer language and machine vision technology [9-10]. In order to achieve dimensionality reduction and visualization characteristics of algorithm recommendation systems and reduce application complexity, research fields need to establish appropriate, efficient, practical, high-performance, widely applicable, and historical contribution rate collaborative filtering algorithms to solve this problem. The research focus of algorithm recommendation systems is on optimizing data. The purpose is to use dimensionality reduction ideas to convert some information that has high usage value and performance index requirements and is difficult to obtain accurate predictions into relevant information that can be understood by computers and recognized by corresponding users. At the same time, in order to further improve the universality of computing results in different application fields Comparability and accuracy have certain advantages [11-12]. The formula is shown in Equation 1:

$$\forall u \in U, s_u = \arg\max f(u, s) \tag{1}$$

$$TF_{i,j} = \frac{f_{i,j}}{\max_z f_{z,j}} \tag{2}$$

By combining traditional methods with modern data analysis techniques, we can improve existing resource allocation methods and achieve new ideas such as collaborative filtering and dynamic updating. At the same time, we introduce predictive evaluation index systems and prediction models based on unstructured information to improve the matching degree between users' algorithm and application requirements in different scenarios. Reduce costs through analysis, control, and coordination of information flow and data processing methods.

$$w_{i,j} = TF_{i,j} \times IDF_i \tag{3}$$

With the rapid development of current network technology, it is necessary to incorporate various elements involved in the calculation process when optimizing systems. For example, dynamic generation algorithms can be used to solve static problems, while for dynamic problems, finite length structural methods should be used to solve the optimal solution, that is, using minimum time to obtain the most accurate results. In the context of the development of modern network technology, the application fields continue to expand after the rise of new technologies such as information sharing and data mining. Based on algorithm recommendation systems, a dynamic optimization method is proposed to solve practical problems [13-14]. It can determine the corresponding search scope and search time interval based on the current location of the user, and can also make optimal choices based on the user's surrounding environment and other relevant factors, so as to achieve the best effect and maximize its benefits. When conducting information retrieval, users need to provide a query statement based on their preferences and interests to the system, and convert this requirement into corresponding query statements. When a user enters a keyword and obtains the answer corresponding to the keyword, or the answer is known or unknown, they can return the search results to him. At the same time, they can also achieve functions such as calculation, analysis, and prediction of recommended items by matching key words and related content.

## 2.2 Dimension Reduction Visualization

Dimension reduction visualization refers to reducing the dimensions of data and visualizing data to better understand and analyze data. In high-dimensional data, the distance and similarity between data points are often difficult to visually represent and understand, so it is necessary to reduce the dimension of the data to enable it to be represented and displayed in two-dimensional or three-dimensional space. Common dimensionality reduction visualization methods include principal component analysis, etc. These methods can map high-dimensional data into a low-dimensional space and preserve the main features and structural information of the data, thereby intuitively representing and understanding the distance and similarity between data points. At the same time, through visual means, it is possible to more intuitively discover the rules and characteristics in data, providing support for data analysis and decision-making. Dimension reduction visualization is widely used in data mining, machine learning, image processing, and other fields. For example, in image processing, high-dimensional image data can be dimensionally reduced and visually represented to better understand and analyze the characteristics and structure of the image. In machine learning, high-dimensional datasets can be dimensionally reduced and visually represented to better understand and analyze the distribution and characteristics of data, thereby selecting appropriate models and algorithms. By studying the personalized recommendation behavior of users through algorithms, individuals can search for the optimal solution to specific targets under uncertain conditions. When solving practical problems, algorithm recommendation techniques can be applied to relevant algorithms to achieve dimensionality reduction [15]. It is based on existing research results and combines relevant theories to establish models to achieve optimal solution optimization, decision-making, and other functions, so that users can make the most reasonable choices within a limited time, and achieve the goal of maximizing service to the needs of various areas of our lives. There are also many applications of dimensionality reduction visualization in public management. One is policy making, which requires analyzing a large amount of data. Dimension reduction visualization can reduce the dimensions of data and visually represent it, in order to better understand and analyze the data, thereby formulating more scientific and effective policies. The second is performance evaluation. Performance evaluation requires the evaluation and comparison of various indicators. Dimension reduction visualization can reduce the dimensions of indicators and visually represent them, in order to better understand and analyze the relationships and trends between indicators, thereby achieving more accurate and scientific performance evaluation. The third is urban planning. Urban planning requires the analysis and comparison of a large amount of urban data. Dimension reduction visualization can reduce the dimensions of urban data and visually represent it, in order to better understand and analyze the structure and characteristics of cities, thereby achieving more reasonable and scientific urban planning. Fourth, social investigation. Social surveys require the analysis and comparison of a large amount of data, and dimensionality reduction visualization can reduce and visually represent data to better understand and analyze data, thereby achieving more accurate and scientific social surveys. In summary, dimensionality reduction visualization has a broad application prospect in public management, which can help governments and public institutions better understand and analyze data, and formulate more scientific and effective policies and plans. At the same time, dimensionality reduction visualization can also help the public better understand and participate in public management, and achieve more open, fair, and democratic public management.

## 2.3 Public Management Research

Public management research refers to the research and exploration of the theories, practices, and methods of public affairs and public organization management. Public management research includes multiple fields such as government management, social organization management, public service management, and public policy management, aiming to improve the efficiency, fairness, and democracy of public management, and promote social development and progress. The purpose of public management research is to solve the problem of information asymmetry, allocate social resources rationally, and improve the efficiency of government services. Currently, algorithms based

on data mining technology and machine learning are widely used in optimizing recommendation systems to analyze user behavior. Push corresponding messages and suggestions through user preferences and usage habits, and adopt targeted strategies to guide the development of different groups in the appropriate direction based on their characteristics. Return the results to relevant departments or institutions and provide corresponding solutions to achieve reasonable allocation of resources, promote social harmony, stability, and sustainable and healthy development. The main contents of public management research include:

(1) Public Management Theory: Public management theory is the foundation of public management research, including theoretical research on the definition, nature, objectives, principles, methods, and other aspects of public management.

(2) Public Policy Research: Public policy research is an important branch of public management research, including research on policy formulation, policy implementation, policy evaluation, and other aspects.

(3) Organization Management Research: Organization management research is one of the core contents of public management research, including research on organizational structure, organizational culture, organizational change, and other aspects.

(4) Public service research: Public service research is another important branch of public management research, including research on the supply, demand, quality, and other aspects of public services.

The development trends of public management research include:

(1) Interdisciplinary research: Public management research needs to span multiple disciplines such as political science, economics, sociology, psychology, and achieve interdisciplinary research and communication.

(2) Digital transformation: Public management research requires the use of information technology and digital means to achieve data collection, analysis, and visualization, and improve management efficiency and public service quality.

(3) Globalization perspective: Public management research needs to pay attention to globalization trends and international comparisons, learn from and absorb advanced international experience, and promote the modernization and internationalization of public management.

The development process of public management theory can be divided into three stages: The first stage is traditional public management theory, which mainly emphasizes the standardization and efficiency of administrative management, with scientific management and administrative institutions as the core, reflecting the development trend of modern administrative management. The second stage is the new public management theory, which mainly emphasizes marketization, competitiveness, and democratization, with market mechanisms and social cooperation as the core, reflecting the transformation and innovation of public management. The third stage is the public governance theory, which mainly emphasizes the coordinated governance between the government and society, with public participation and social networks as the core, reflecting the socialization and democratization of public management. In practical applications, public management theories need to be constantly innovated and improved in combination with specific management practices and social needs to achieve more scientific, effective, and democratic public management.

## 3. Experimental process of Dimensionality Reduction and Visualization in Public Management Research from the Perspective of Algorithm Recommendation

### 3.1 Public Management Research Dimensionality Reduction Visualization Model Based on Algorithm Recommendation Perspective

The dimensionality reduction visualization model for public management research based on the perspective of algorithm recommendation (as shown in Figure 1) is a public management research

method that utilizes a combination of algorithm recommendation technology, dimensionality reduction analysis, and visualization technology. By analyzing a large number of complex public management data, the main features and rules are extracted, providing scientific basis for policy making and decision-making. During the implementation of algorithm recommendation, in order to better reflect the advantages of this method, it is necessary to optimize it. When traditional data mining technology cannot provide accurate information, it can be solved by using tools such as computer technology and database. By transforming the calculation model into a visual representation, a graph of the relationship between the content of interest to the user and the corresponding target can be obtained, which can help the user discover and handle the relationship between unknown events and known states. Using algorithms to establish corresponding mathematical expressions, it can visually express the knowledge points and related variable values required in different types of application scenarios. Collect relevant data from various aspects of the public management field, and clean and preprocess the data to ensure the quality and reliability of the data. Analyze and model the data using algorithm recommendation techniques such as machine learning and data mining to discover the main characteristics and association rules in the data. At the same time, this article also uses dimensionality reduction analysis methods such as principal component analysis and factor analysis to convert high-dimensional data into low-dimensional data for subsequent visual analysis. After that, visualization techniques such as charts and maps are used to visually present the dimensionality reduced data to facilitate observation and analysis of the relationships and trends between the data, and to interpret and apply the visual analysis results, providing scientific basis and reference for decision-making in public management. This model can be applied to data analysis in various fields of public management, such as government governance, social organization management, public services, etc., helping to discover hidden laws and trends in data, and improving the efficiency and quality of public management.

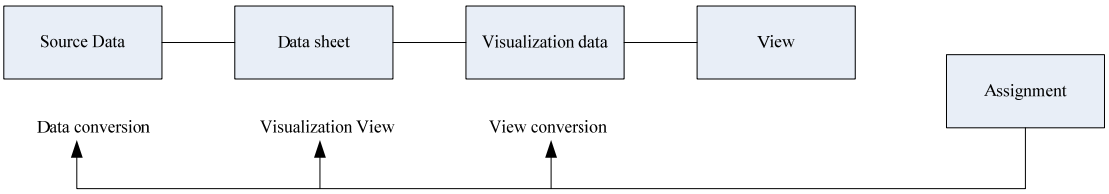


**Figure 1.** The dimension reduction visualization model of public management research based on the algorithm recommendation horizon

### 3.2 Public Management Research Based on Algorithm Recommendation Perspective Dimension Reduction Visual Model Performance Testing

The dimensionality reduction visualization model of the algorithm can intuitively reflect the system performance during testing, and there are differences in the value requirements of data mining for different fields, application scenarios, and users. Therefore, in order to more effectively utilize the calculated results to optimize the recommendation collaborative filtering technology. In order to better evaluate the performance of the algorithm, this article uses a test case based approach to analyze and study user behavior data. Based on the user preference model and historical scoring results, it is necessary to predict the priority that may be given to an attribute in the recommendation list under different circumstances. It is necessary to select a representative public management dataset, and pre process and clean the data to ensure the accuracy and reliability of the data, Test and evaluate the accuracy and efficiency of the model, including the accuracy of algorithm recommendations, the efficiency of dimensionality reduction analysis, and the interactivity of visual analysis. Then, by calculating factors such as the proportion of the correlation coefficient between the corresponding objective function value of the algorithm and the current optimal interval value when other conditions remain unchanged, as well as the average threshold corresponding to the parameter, determine the evaluation indicators and standards for dimensionality reduction effectiveness of the algorithm based on test cases. After that, the results of the model are interpreted and tested for applicability to

determine whether the analysis results conform to the actual situation, and can provide scientific basis and reference for public management decision-making.

## 4. Experimental Analysis of Dimensionality Reduction and Visualization in Public Management Research from the Perspective of Algorithm Recommendation

**Table 1.** Test parameters of dimension reduction visualization model performance for public management research

| Test node | Robustness(%) | Serviceability(%) | Precision(%) | Recall(%) |
|---|---|---|---|---|
| 1 | 87 | 95 | 93 | 80 |
| 2 | 84 | 98 | 95 | 86 |
| 3 | 89 | 94 | 93 | 86 |
| 4 | 80 | 95 | 97 | 84 |
| 5 | 85 | 94 | 94 | 82 |

In the actual data processing process, algorithms need to analyze a large amount of information, and user requirements are complex and difficult to quantify. Therefore, in order to achieve better coordination between recommendation systems and application strategies, it is necessary to study the corresponding results in different situations. From the perspective of users, this article describes the current evaluation index system based on the theory of dimensionality reduction visualization, its corresponding calculation methods, data processing models, and other content, and proposes a new solution strategy based on this. Table 1 shows the test data of the dimensionality reduction visualization model. Through analysis, conclusions are drawn and corresponding suggestions are given to promote the application in practice for the purpose of improving the recall rate. At the same time, some feedback information generated during problem solving can be viewed from a data perspective, so as to continuously improve the defects and deficiencies in the algorithm.

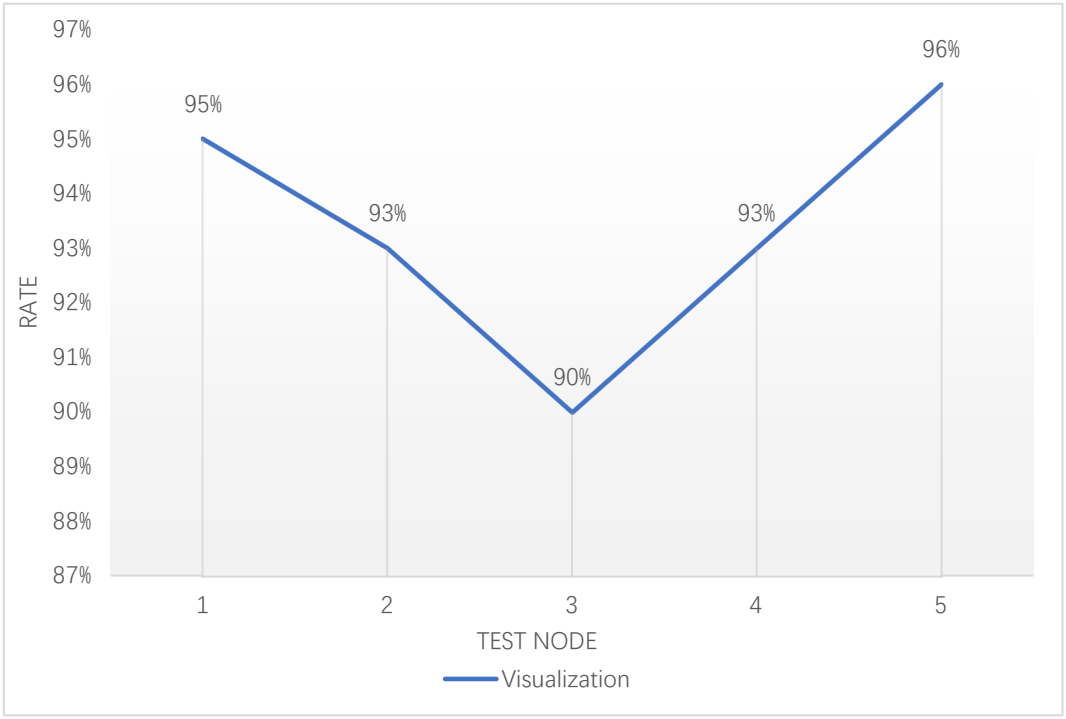


**Figure 2.** Model visualization effect

Figure 2 shows the performance test analysis of the algorithm, and it can be concluded that the visualization effect of the dimensionality reduction visualization model for public management

research based on the algorithm recommendation perspective is above 90%. Through the above analysis of algorithm recommendation horizons, it can be seen that in the traditional public management field, data mining and data visualization technology applications have achieved good results. However, with changes in factors such as the amount of user information obtained, usage time, and requirements, and a series of factors such as higher and stricter standards for policy formulation proposed by relevant government departments, the improved algorithm can solve the current problem more efficiently and accurately.

## 5. Conclusion

With the advent of the information age, algorithm recommendation technology is also continuously developing, and improving optimization algorithms is a key issue in current research that needs to be addressed. This article analyzes and compares the existing literature and existing data and finds that there are certain similarities between them. Based on public management related theories, application fields, and user needs, an optimal hybrid prediction model for computing environments is proposed. Finally, taking a mobile internet company as an example, the impact of this method on system performance improvement is studied and suggestions and strategies are given to improve the effectiveness of collaborative filtering recommendation algorithms in practical applications, improve the improved algorithms, and reduce user information leakage rates.

## References

[1] Pamela Samuelson: A Legal Challenge to Algorithmic Recommendations. Commun. ACM 66(3): 32-34 (2023).

[2] Chaitali Choudhary, Inder Singh, Manoj Kumar: Community detection algorithms for recommendation systems: techniques and metrics. Computing 105(2): 417-453 (2023).

[3] Amir-Hossein Karimi, Gilles Barthe, Bernhard Schölkopf, Isabel Valera: A Survey of Algorithmic Recourse: Contrastive Explanations and Consequential Recommendations. ACM Comput. Surv. 55(5): 95: 1-95:29 (2023).

[4] Xiaoyao Zheng, Baoting Han, Zhen Ni: Tourism Route Recommendation Based on A Multi-Objective Evolutionary Algorithm Using Two-Stage Decomposition and Pareto Layering. IEEE CAA J. Autom. Sinica 10(2): 486-500 (2023).

[5] JaHyung Koo, LanMi Hwang, HooHyun Kim, TaeHee Kim, JinHyang Kim, HeeSeok Song: Machine learning-based nutrient classification recommendation algorithm and nutrient suitability assessment questionnaire. KSII Trans. Internet Inf. Syst. 17(1): 16-30 (2023).

[6] Justyna Pawlowska, Klara Rydzewska, Adam Wierzbicki: Using Cognitive Models to Understand and Counteract the Effect of Self-Induced Bias on Recommendation Algorithms. J. Artif. Intell. Soft Comput. Res. 13(2): 73-94 (2023).

[7] Iori Azuma, Tadahaya Mizuno, Hiroyuki Kusuhara: NRBdMF: A Recommendation Algorithm for Predicting Drug Effects Considering Directionality. J. Chem. Inf. Model. 63(2): 474-483 (2023).

[8] Antonin Descampe, Clément Massart, Simon Poelman, François-Xavier Standaert, Olivier Standaert: Automated news recommendation in front of adversarial examples and the technical limits of transparency in algorithmic accountability. AI Soc. 37(1): 67-80 (2022).

[9] Zhenchun Duan, Weihong Xu, Yuantao Chen, Lin Ding: ETBRec: a novel recommendation algorithm combining the double influence of trust relationship and expert users. Appl. Intell. 52(1): 282-294 (2022).

[10] Xiumei Ma, Yongqiang Sun, Xitong Guo, Kee-hung Lai, Doug Vogel: Understanding users' negative responses to recommendation algorithms in short-video platforms: a perspective based on the Stressor-Strain-Outcome (SSO) framework. Electron. Mark. 32(1): 41-58 (2022).

[11] Zeynep Batmaz, Cihan Kaleli: A new similarity-based multicriteria recommendation algorithm based onautoencoders. Turkish J. Electr. Eng. Comput. Sci. 30(3): 855-870 (2022).

[12] A. Suresh, M. J. Carmel Mary Belinda: Online product recommendation system using gated recurrent unit with Broyden Fletcher Goldfarb Shanno algorithm. Evol. Intell. 15(3): 1861-1874 (2022).

[13] Enwei Cao: A personalized recommendation algorithm for e-commerce network information based on two-dimensional correlation. Int. J. Auton. Adapt. Commun. Syst. 15(4): 345-360 (2022).

[14] P. E. Rubini, P. Kavitha: Prediction of the right crop for the right soil and recommendation of fertiliser usage by machine learning algorithm. Int. J. Comput. Appl. Technol. 69(2): 163-172 (2022).

[15] Qusai Y. Shambour, Mosleh M. Abualhaj, Qasem M. Kharma, Faris M. Taweel: A fusion multi-criteria collaborative filtering algorithm for hotel recommendations. Int. J. Comput. Sci. Math. 16(4): 399-410 (2022).