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Application research of data envelopment analysis and multimedia information fusion algorithm in public performance management

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Abstract
Under the increasingly complex social and economic environment, it is particularly important to conduct scientific performance evaluation and analysis. As an effective means of performance evaluation and management, multimedia data envelopment analysis has been widely used in various industries, and has produced numerous research results. At present, there are relatively few applications of multimedia data envelopment analysis in this area. The research of new multimedia data envelopment analysis model combined with modern data mining technology is scientific and innovative, and can provide certain performance for complex performance evaluation and analysis. In view of this, the paper firstly studies the multimedia data envelopment analysis model by combining fuzzy c-means clustering, principal component analysis and multimedia data envelopment analysis, and establishes the multimedia data envelopment optimization selection model and PCA-DEA. The model is mixed and the solution algorithm is given. Then, using the collected local unit data, the multimedia data envelope index data is constructed, and the established model is used to analyze the multimedia data envelope. The research results show that the established model combines the characteristics of data mining technology and multimedia data envelopment analysis method to meet certain complex performance evaluation and analysis requirements, and can provide certain data support for local public performance management.

Keywords Multimedia data · Data envelopment analysis · Multimedia information · Public performance management research

1 Introduction

In recent years, with the rapid development of multimedia technology, the application of multimedia systems has penetrated into all fields of human life with great penetration, such as

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games, education, archives, books, entertainment, art, stock bonds, financial transactions, architectural design, family, communications and so on. Among them, the most widely used and earliest is video games. Tens of millions of teenagers and even adults are fascinated by them. This shows the power of multimedia. The electronic shopping touch screen in shopping malls and post offices is also an example. Its appearance greatly facilitates people's lives. In recent years, there have been multimedia products for teaching, one-to-one professors, which have benefited many students [9, 18]. Because of this, many visionary enterprises have seen this form, and have used it for enterprise propaganda and even use its interactive ability to join e-commerce, self-service maintenance, Professor use functions, which facilitates customers, improves the corporate image, expands business opportunities, and benefits in both sales and image.

At present, the multimedia service personnel of various units have made many explorations in the management system of multimedia classroom, the application of new technologies and the improvement of work efficiency, and have made some achievements, which has promoted the development of public performance management, but there are still some deficiencies in the refinement of service quality [20]. As one of the core parts of service operation management, the research of service quality has become the focus of people's research. How to adapt to the actual situation of the unit, find out the shortcomings, improve the quality of service, and promote our transformation from the current technical organization to service-oriented organization is an important issue facing our educational technicians. Multimedia classroom service quality management performance index system is usually a complex, multi-dimensional structure systems, its design should be process-based service quality management. The goal is to build a service-oriented organization, so its idea should embody the service concept of customer orientation and performance evaluation. The whole system is based on quality control and process-based, which can be summarized as quality control, performance intervention and process-based.

Data Envelopment Analysis (DEA) is an effective system analysis method developed in recent years. DEA is a new field of interdisciplinary research of operations research, management science and mathematical economics. It is a new system analysis method developed by Charnes and Cooper in 1978 based on the concept of "relative efficiency evaluation". It extends the concept of engineering efficiency under SISO to the relative effectiveness evaluation of MIMO complex systems. Since the first DEA model-C^2R model came out, DEA method has developed rapidly in both theoretical research and practical application. It has become a common and important analytical tool and means in the fields of management science, system engineering, decision analysis and evaluation technology [3, 10, 19]. DEA not only avoids subjective factors, but also reduces errors, because it does not need any weight assumption and explicit function relationship between input and output in advance. Moreover, it greatly enriches the theory and application technology of production function in microeconomics, and extends the main research methods of production function from single parameter method to parametric method and non-parametric method.

In recent years, great progress has been made in the study of cost, benefit and profit and their efficiency by data envelopment analysis. The application of DEA model in cost, benefit and profit analysis is discussed in detail in the literature. A DEA model based on cost-benefit is established, and the minimum cost and maximum benefit are analyzed. In the DEA model in literature, market economy factors are taken into account comprehensively. The input vector of production factors, its price vector, the quantity vector of output products and its price vector

are used to analyze the input-output efficiency, which is effective in evaluating the cost efficiency of enterprises. However, there are some limitations in using this model to evaluate cost efficiency in practice [11, 14, 17]. It is not convenient to analyze cost efficiency. Its objective function is the minimum cost corresponding to an output, and DMU (x, y) is composed of known output vectors and their corresponding unknown input vectors. It is not a sample decision-making unit, which makes this model only an approximate application of DEA method, not a real DEA model, so many properties are not fully applied; this model only considers the minimum cost from output, in fact, it may lead to two different outputs corresponding to the same minimum cost. The same is true for revenue and profits. Combining with the general method of cost efficiency evaluation, this paper improves the shortcomings of the original model and constructs a cost efficiency DEA model. By solving it, the cost efficiency evaluation index can be obtained directly, so that the application of DEA model can be further promoted. The cost-efficiency DEA model discussed and studied in this paper has important economic significance and reference value for optimizing decision-making units, reducing resource input and improving output level.

2 Related work

Data Envelopment Analysis (DEA) is a new efficiency evaluation method based on the concept of relative efficiency, which was first proposed by A. Chames. W. Coop, a famous American operational research scientist. Following the publication of the first DEA Model-C 2R model in 1978, new models and other important theoretical achievements have emerged, and the practical application of the model has become increasingly widespread. The DEA method has become a new research field in operational research. Specifically, DEA uses mathematical programming models to compare the relative efficiency of decision-making units and evaluate them. To some extent, it is an agreement. It can be a school, a hospital, a court, an air base, or a bank or an enterprise. The dominant principle of DMU determination is that each DMU can be regarded as the same entity in terms of its “consumed resources” and “produced products”, that is, each DMU has the same input and output from a certain perspective. Through the comprehensive analysis of input and output data, DEA can get the quantitative index of the comprehensive efficiency of each DMU, and then rank and queue each DMU to determine the effective (i.e. the most efficient) DMU [12, 15, 16]. It also points out the reasons and degree of other DMU’s ineffectiveness and provides management information to the competent departments. It can also judge whether the investment scale of each DMU is appropriate, and give the correct direction and degree of adjustment of the investment scale of each DMU: whether to expand or reduce, how much to change, and so on.

DEA is especially suitable for complex systems with multiple input and multiple output. This is mainly reflected in the following two points [4, 5, 7]: 1) DEA takes the weight of each input and output of the decision-making unit as a variable, and evaluates the decision-making unit from the perspective of the most conducive to the final spring unit, thus avoiding the determination of the weight of each index in the sense of priority. 2) Assuming that each input is associated with one or more outputs, and there is a certain relationship between input and output, the explicit expression of this relationship is not necessary to be determined by using DEA method. The DEA method excludes many subjective factors and is highly objectivity. The key to successful application of DEA is the correct selection of input and output indexes.

In addition to its absolute advantages in dealing with MIMO problems, DEA also has its necessity in evaluating the efficiency of public relations departments. The first successful application of DEA is to evaluate public school projects for mentally handicapped children. In the evaluation, the output includes intangible indicators such as "self-esteem" and the input includes the care of parents and the education level of parents. That is to say, neither indicator can be compared with "market price". It is difficult for electricity to easily determine the appropriate weight.

2.1 Basic models and properties of DEA

In this section, we will introduce several important DEA models. The first DEA model is the C^2R model. In the C^2R model, the DEA effectiveness of DMUs is both for scale effectiveness and technical effectiveness. In practice, this may happen: although a decision-making unit is technically effective (that is, it is located on the front of effective production), it is not necessarily DEA effective, because the decision-making unit is not large-scale effective. Therefore, DEA model -C^2GS^2 is used to evaluate the relative effectiveness of departments. Because of the diversity of production process and economic activities, or the role of decision makers in evaluation activities, based on the above two models, some new DEA models with the same basic functions and forms are derived, such as the additive DEA model for both input and output. Multiplicative DEA model (C-D DEA model) which is more suitable for the effectiveness analysis of incremental production process with marginal output: C^2WH model with conical structure, extensively and profoundly extends the C^2R model [1]. This model can deal with the decision-making unit with more input, evaluation of the output indicators, and the decision-makers can reflect their preferences by selecting the various cones in the model. The C^2W model extends the DEA model in another aspect. It studies the relative efficiency problem with infinite number of decision units. Its significance lies in estimating the unknown effective production frontier through an infinite number of sample observations (i.e. production points corresponding to decision making units (x_j, y_j) and DEA models related to input (output), etc. Here is a brief introduction to these models.

Data envelopment analysis method and fuzzy comprehensive evaluation method are relatively mature and widely used in comprehensive evaluation. Data envelopment analysis (DEA) can give the relative efficiency of the evaluation unit based on objective data and put forward the corresponding improvement direction. Fuzzy comprehensive evaluation can deal with the non-quantitative factors in the evaluation system very well. But because the reliability of data envelopment analysis depends on the accuracy of objective data, and the fuzzy comprehensive evaluation has a high subjective dependence, many scholars put forward some comprehensive evaluation methods which combine DEA and FCA. In fact, these methods are based on the data envelope analysis method of fuzzy mathematics, that is, the introduction of fuzzy mathematics into data envelopment analysis does not make full use of the convenience of fuzzy comprehensive evaluation [6, 13]. Moreover, it is not suitable for DEA with high data accuracy to introduce the fuzzy data which has not been strictly processed into DEA, and it will cause errors. In this paper, a method of fuzzy comprehensive evaluation based on data envelopment analysis (DEA) is proposed. The method uses the evaluation result of DEA as the evaluation index

of fuzzy comprehensive evaluation to make a secondary evaluation. In order to make the fuzzy comprehensive evaluation more objective and convincing, the optimization results of data envelopment analysis (DEA) are used instead of the expert scores in the fuzzy evaluation.

D-FCE method is a multi-level evaluation system as a whole and Fig. 1 is the main thinking process of this method.

It can be clearly seen from the figure that the whole D-FCE method is divided into two main parts: primary evaluation and secondary evaluation. The primary evaluation of D-FCE method is divided into two parts: data envelopment analysis for quantitative indicators and fuzzy comprehensive processing for non-quantitative indicators. From the first "comprehensive principle" of the construction principle of the comprehensive evaluation index system, we can see that the index system of a complete comprehensive evaluation system can include both digital quantity (quantitative index, such as the number of investment funds) and fuzzy concept quantity (non-quantitative index, such as the quality of product, the quality of system performance, etc.). If the digital quantity is evaluated by fuzzy synthesis, although the result can be obtained, the intermediate fuzzy process will cause loss to the original information. Similarly, the application of fuzzy quantity to data envelopment analysis will result in unpredictable errors or can not apply the fuzzy quantity to the method at all. Therefore, data envelopment analysis (DEA) is used to pre-process digital quantities, while fuzzy quantities are used to synthesize them, which can complement each other's advantages [2]. Secondary evaluation here uses the method of fuzzy synthesis for comprehensive evaluation. The primary evaluation results are taken as the evaluation parameters of the fuzzy evaluation at this level, and then the evaluation results are obtained by fuzzy synthesis. If the initial indicators of the evaluation system are complex, which leads to a large number of primary evaluation indicators classification, then a fuzzy comprehensive evaluation may not be enough to meet the requirements of the system,

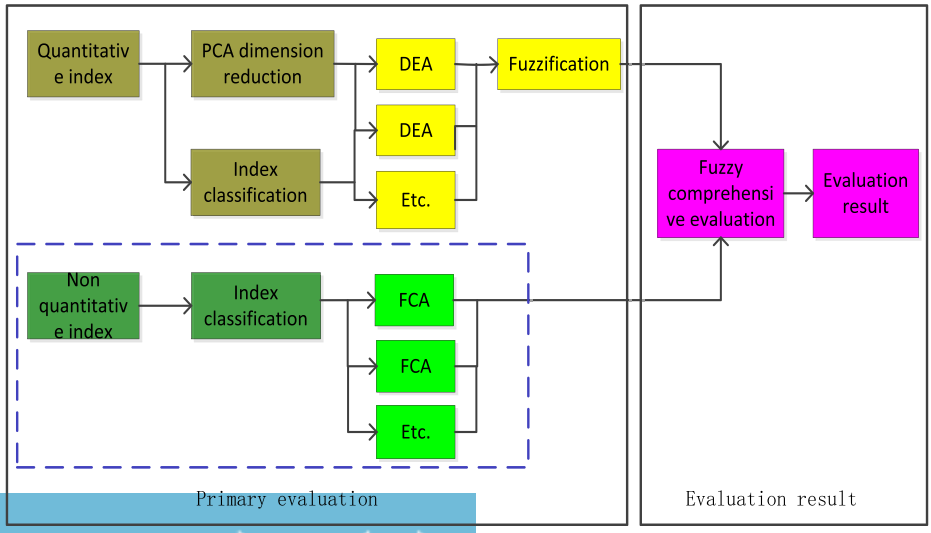

Fig. 1 Evaluation process

it is necessary to carry out three-level or even multi-level evaluation of the system, and evaluation methods can also be flexible choice.

Based on the concept of "relative efficiency", envelope analysis is a systematic analysis method to evaluate the relative effectiveness (DEA effectiveness) or performance of the same type of decision making unit (DMU) according to the objective data of multi-index input and multi-index output. To judge whether DEA is valid or not based on the index data of each evaluation unit is essentially to judge whether the evaluation unit is located on the "production front" of the production possibility set. DEA is based on the concept of relative efficiency, convex analysis and linear programming. It can be used in multi-objective decision-making problems. Its advantage is that it uses objective information of index data to evaluate, eliminating errors caused by human factors. The input and output weight coefficients of decision-making units are variables, which are evaluated from the perspective of the most advantageous decision-making units, thus avoiding determining the weight coefficients of each index in the sense of priority. The evaluation index can include unstructured factors in humanities, society, psychology and other fields. DEA method does not synthesize the index data directly, so it does not need dimensionless data processing and display to establish the functional relationship between input and output before establishing the model. But data envelopment analysis is very sensitive to the accuracy of the data provided, and many indicators of comprehensive evaluation in reality are difficult to express with accurate figures, which limits the further application of data envelopment analysis method.

2.2 C²R model and DEA validity

There are two forms of C²R model. One is the form of fractional programming, the other is linear programming. Fractional programming is based on the ratio definition of engineering efficiency.

Definition $h_j = \frac{u^T y_j}{v^T x_j}$ is the efficiency evaluation index of the j decision making unit DMU_j. To evaluate the efficiency of DMU_0, we can always choose the weight coefficient u and v to maximize h under the condition that the efficiency evaluation index of each DMU does not exceed 1. So there are the following optimization models (C²R model).

$$\begin{aligned} &\max h_0 = \frac{u^T y_0}{v^T x_0} \\ (\bar{P})\ &s.t. h_j = \frac{u^T y_j}{v^T x_j} \le 1, j = 1, 2, ..., n \\ &u \ge 0, v \ge 0 \end{aligned} \tag{1}$$

The linear programming form of C²R model is based on the assumptions of convexity, conicity, inefficiency, minimization and other production axioms. By Charess-Cooper transformation, fractional programming form $(\bar{P})$ of C²R model can be transformed into linear programming form equivalently. In order to facilitate

computation, linear programming is often adopted, and the linear programming form based on the input C^2R model is:

$$(P_1)\begin{array}{l}\max u^T y_0 \\ s.t.\ \ \omega^T x_j - u^T y_j \geq 0, j = 1, 2, ..., n \\ \omega^T x_0 = 1 \\ \omega \geq 0, \mu \geq 0\end{array} \tag{2}$$

Among $\omega = tv$, $\mu = tu$, $t = 1/v^T x_0$

The dual programming model is:

$$(D_1)\begin{array}{l}\min \theta = V_{D1} \\ s.t. \sum_{j=t}^{n} \lambda_j x_j \leq \theta x_0 \\ \sum_{j=1}^{n} \lambda_j x_j \geq y_0 \\ \lambda_j \geq 0 \\ j = 1, 2, ..., n\end{array} \tag{3}$$

By introducing new variables $s^- \geq 0$, $s^+ \geq 0$, we can express (D_1) as follows:

$$\begin{array}{l}\min \theta = V_{D1} \\ s.t. \sum_{j=t}^{n} \lambda_j x_j + s^- = \theta x_0 \\ \sum_{j=1}^{n} \lambda_j y_j - s^+ = y_0 \\ \lambda_i \geq 0, s^- \geq 0, s^+ \geq 0 \\ j = 1, 2, ..., n\end{array} \tag{4}$$

In the C^2R model, DEA effective decision-making units must be both technology effective and scale effective. The C^2R model is called DEA model which satisfies the invariance of scale returns. The basic idea of DEA method is to seek a linear combination of DMU_j (j = l, 2, n), and to find the minimum input while maintaining at least the output of DMU_0 unchanged, and to compare it with the input of DMU_0. Obviously, there is $\theta^* \leq 1$, if $\theta^* > 1$, the input of the new combination DMU can be smaller. Therefore, the original DMU is not effective. Therefore, the DEA effectiveness is a relative validity in a sense, relative to a set of actual observations.

DEA can also be regarded as a nonparametric estimation method of production frontier. It uses a set of actual input and output observations (i.e. input and output values of DMUs) to construct the external boundaries of all possible combinations of input and output (called "envelope boundary surface") by establishing a certain form of linear programming model (DEA model). The constraints in the model make all the input and output observation points fall within the envelope. Only the production points corresponding to DEA efficient (or weak DEA efficient) decision making units are located on the envelope. The λ_j in the model connects the production points of each effective unit to form an effective envelope (i.e. piecewise linear estimation of the production front). Therefore, DMU located on the previous frontier is considered to be DEA effective, while DMU far from the frontier is non-DEA effective. UUU in C^2R model (P_1) represents a radial optimization quantity or "distance" from DMU to effective frontier or envelope.

The input-based C^2R model studies the input validity of DMU_0, i.e. the output is constant and the input is minimum. The output validity of DMU_0 is studied when the input is unchanged and the output is maximum and the output-based model C^2R is obtained.

$$\begin{aligned} &\max\ \alpha \\ &s.t.\ \sum_{j=t}^{n} \lambda_j x_j \le x_0 \\ &(D_1)\ \sum_{j=1}^{n} \lambda_j y_j \ge \alpha y_0 \\ &\lambda_i \ge 0 \\ &j = 1, 2, ..., n \end{aligned} \tag{5}$$

In the C^2R model, the DEA validity of decision units obtained by solving programming (D_1) and $\left(D_1^{'}\right)$ is equivalent.

3 Construction of performance management index system for multimedia information services

3.1 Interpretation of public performance management framework

Public performance management is a management system rather than a method. It studies how to manage and evaluate the executive ability and results of public organizations, that is, public performance pays attention to both process and results. Public performance management is not only the management of the performance behavior process of public organizations, but also the management of performance results.

(1) Dimensions of Public Performance Management

Performance management is first and foremost a process. From the perspective of management process, performance management is a management process consisting of a series of performance management behaviors and management steps. Therefore, performance management is not only a concept, but also a process, a process in change and improvement. Armstrong defines performance management as a process of strategy and information integration, which enables an organization to achieve sustained success by improving the efficiency of its members and teams [8]. The National Performance Management Group of the United States considers performance management to be "a management process that uses performance information to assist in setting performance goals, allocating resources and prioritizing to inform managers to maintain or change the established goal plan, and report on success in meeting the goals".

In the concept of public performance management, it involves four steps: putting forward performance objectives and directions, guiding the implementation of performance planning, performance evaluation and supervision, performance return and improvement. According to the four steps of public performance management, we can summarize the four dimensions of public performance management content, namely planning, implementation, evaluation and improvement. Each link is interrelated to form an organic chain to improve the performance of the organization. From another point of view, the object of public performance management is

different from that of micro-enterprise organization, which has diversified characteristics. According to the order from macro to micro, the object of public performance management includes three dimensions: overall performance management, Department (organization) performance management and project performance management.

(2) Index System of Public Performance Management

The framework of public performance management includes many links and sides, which can be measured by indicators of different dimensions. As shown in Fig. 2, these indicators include:

1) Input indicators. It is mainly measured by the amount of resources invested, which includes monetary quantitative indicators (such as the amount of funds invested in the project) and non-monetary quantitative indicators (such as the amount of labour invested in the operation of the project). These indicators can be reflected not only in budget and final accounts indicators, but also in expenditure and cost data.
2) Process indicators. The transformation of government input resources into output requires a process that can be expressed by workload.
3) Output indicators. The quantity of products or the degree of service.
4) Benefit indicators. These indicators mainly reflect the various impacts of government behaviour on society and economy, and are reflected in social and economic benefits.

3.2 Analysis of government financial information demand under the framework of public performance management

Bouckaert and Peters argue that performance measurement is a weak link in many public sector reforms. However, performance measurement goes beyond the scope of public sector reform and needs to rely on Micro-government accounting and reporting system to obtain data support. The index system of public performance management can be divided into monetary and non-monetary quantitative indicators. These two kinds of indicators are indispensable in

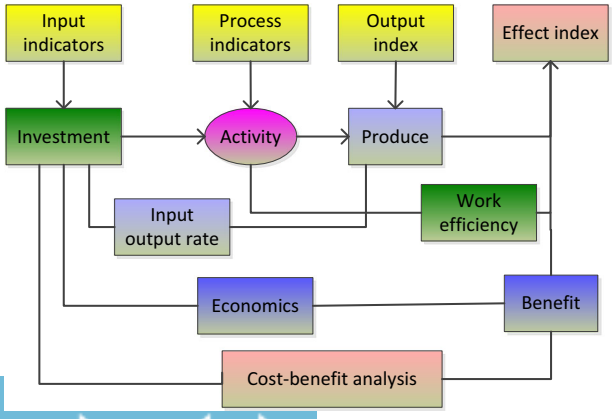

Fig. 2 Index system of public performance management

the process of public performance management. Currency Quantitative Index (MI) refers to an index that can be measured directly or indirectly by money. For example, government budgetary revenue, expenditure and government debt. Non-monetary quantitative indicators (NMI) refer to indicators that cannot be measured in money. For example, the number of employees, the built-up housing area and so on. Limited to the existing government accounting framework, the government financial report is more monetary quantitative indicators.

The implementation of the four dimensions of public performance management content needs quantitative data and indicators to varying degrees, especially the demand for quantitative data in public performance evaluation is the most direct. If combined with the three dimensions of public performance management objects, government financial performance evaluation can also be carried out at three levels: government overall performance evaluation, government departments (units) performance evaluation and government project performance evaluation. As mentioned above, input indicators, process indicators, output indicators and effect indicators are the basic indicators system of public performance management. These indicators will be used in the overall performance evaluation of the government. Among them, government input indicators and process indicators obviously need the data support of budget reports and financial statements; department or unit performance evaluation mainly includes government administration, resource management and other evaluation projects; specific resource consumption and resource use efficiency quantitative indicators need to obtain data from department-based financial statements and cost statements. Because of the public welfare of government service projects and construction projects, the performance evaluation of government projects often focuses on their social and economic effects, so more non-financial indicators and information are needed. The main way to obtain such information is the special audit reports of audit institutions at all levels. In addition to project cost information, it is difficult to obtain sufficient information directly from financial indicators.

3.3 Analysis on information supply of government financial performance

On the theoretical level, government financial information has the attribute of public goods. The demand for government financial information exists objectively, but the supply of government financial information will be restricted by many factors. The most important constraints come from the constraints of economic costs and political costs. Providing government financial information, especially financial performance information, not only requires high economic costs, but also restricts the degree of freedom of government action and decision-making, resulting in political costs due to the disclosure of external information. Therefore, the voluntary supply of government financial performance information may be inadequate, so it is necessary to study and construct a standardized system of government financial performance information disclosure. Government financial information can be summarized as government budget management performance information, government departments or units'financial performance information, government service performance and project performance information, and government financial performance management information. These financial performance information match with different modules of government accounting and government financial statistics, and form the basis of the government financial performance reporting system. As shown in Fig. 3.

From a practical point of view, the budget and final accounts at the government level can provide almost all the information about the use of public service plans and the financial resources that have been used. However, budgets and statements do not provide information

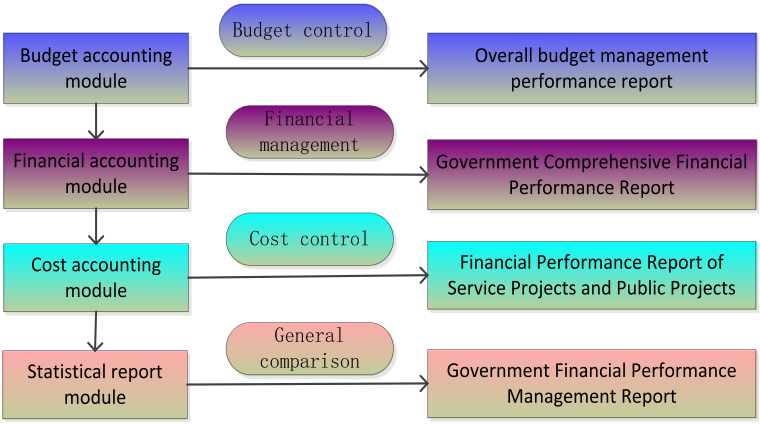

Fig. 3 The overall framework of government financial performance reporting system

on the efficiency and effectiveness of public services and public projects. Because budgetary accounting under cash system has no cost accounting, especially the lack of public goods cost accounting. The absence of cost data can not establish the link between cost and output, nor the link between cost and effect. The efficiency and effect of government providing public goods or public services can not be measured. Therefore, the current budget reporting system is not conducive to the evaluation and supervision of the efficiency of government activities, and it is difficult to complete the important task of serving the public performance management. It is an inevitable trend to construct the government financial performance reporting system.

4 Experiment and discussion of model application

4.1 Model application

Taking the performance evaluation of a functional department of a government agency as an example, they can be regarded as the same function and the same type of unit. According to DEA algorithm, performance evaluation indicators should include input indicators and output indicators. In the actual investigation, more than 100 indicators have been drawn up according to the Circular of the Ministry of Public Security on the Issue and Issuance of Measures for Grading Public Security Police Stations. If all of them are used up, on the one hand, in the mathematical model, it is difficult to process such large data, on the other hand, it is quite difficult in practice. Because in practice, we must follow the principle of "simple and easy to use, scientific and reasonable", so we must carry out the synthesis and selection of indicators. In the process of selecting indicators, this paper Yunchuan expert survey method and 360-degree assessment method, preliminary selection of the following indicators.

The input indicators for performance evaluation of this functional department refer to the occupancy or use cost of the resources such as people, money and goods belonging to the department. Including the number of police officers X_1, the quality of police officers X_2, number of police equipment X_3, the number of official vehicles X_4, the number of communications equipment X_5, jurisdiction X_6, and the use of funds X_7. Output indicators refer to the achievements and efficiency of public security management, industry management, population

management, fire control management, public security office police command management, team education and management and team building. Including immigrant registration rate Y_1, key population supervision and control rate Y_2, strike handling number Y_3, industry consolidation rate Y_4, fire number Y_5, burglary and poisoning cases Y_6, prostitution and prostitution, public gambling number Y_7, civil air defense, material defense, planning and prevention implementation Y_8, complaint number Y_9, mass satisfaction rate Y_{10}, etc.

According to the requirements of DEA algorithm and the actual situation, the following explanation is made:

(1) Input indicators of employee quality are obtained by multiplying the number of employees and the corresponding educational level by a certain score.
(2) The number of official vehicles X4 is divided into police cars and motorcycles. Some experts are interviewed and different scores are added up.
(3) Output indicators, the number of fires Y5, the number of complaints Y9, the level of violation of discipline, the number of Y12 are actually a negation of police performance. If we consider the results, the smaller the better, and generally speaking, DEA algorithm requires data to be non-negative, so when dealing with the data of these indicators, take the reciprocal.
(4) The opinions of experts and relevant leaders are also taken into account when converting grades and times of violations into numerical values.
(5) Mass Satisfaction Rate Y10 is a questionnaire survey method, which is used to survey the areas under the jurisdiction of each police station and the competent departments respectively. According to the study of people's psychological characteristics and thinking rules, we use 9-level satisfaction rate level to express people's judgment results. It is a middle level between very satisfied, relatively satisfied, general, unsatisfactory, extremely unsatisfactory and each of them. These nine levels are expressed by numbers between 1_9.

In the light of the above description, the relevant input and output indicators are listed in Tables 1 and 2 and Figs. 4 and 5.

Table 1 Input index value

Department	X1	X2	X3	X4	X5	X6	X7
DMU1	13	17.6	23	9	21	28.5	16
DMU2	15	18.5	27	10	26	31.9	17
DMU3	13	14.8	24	12	23	43.2	15
DMU4	19	23	36	13	41	30	21
DMU5	11	16.3	17	8	19	42	13
DMU6	12	15.2	24	9	26	44	13
DMU7	14	13.7	26	13	31	29.7	15
DMU8	10	13.5	17	8	16	39.6	11
DMU9	13	15.8	26	14	25	41	14
DMU10	18	24.4	31	17	37	21	23
DMU11	19	23.7	34	14	39	47	24
DMU12	10	9.9	15	13	11	32	12
DMU13	7	7	9	3	7	25	6
DMU14	16	21	33	15	35	44.7	15
DMU15	15	21.4	30	12	31	47.8	17

Table 2 Output index value

Department	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
DMU1	0.82	0.87	78	0.75	1/4	13	10	1	1/8	8	18	1/5
DMU2	0.76	0.86	86	0.69	1/2	21	12	0.75	1/6	6	5.6	1/4
DMU3	0.85	0.75	47	0.79	1/6	19	9	7	1/7	6	6	1/4
DMU4	0.92	0.78	76	0.66	1/4	27	8	0.89	1/5	7	22.6	1/6
DMU5	0.78	0.79	57	0.59	1/1	9	7	0.79	1/7	5	17.9	1/2
DMU6	0.61	0.82	85	0.67	1/2	15	9	0.6	1/5	9	13.6	1/4
DMU7	0.67	0.62	74	0.72	100	14	10	0.69	1/9	6	7.6	1/2
DMU8	0.75	0.92	53	0.85	1/7	10	12	0.85	1/6	9	14	1/3
DMU9	0.85	0.72	68	0.76	1/3	17	17	0.68	1/8	6	10	1/2
DMU10	0.87	0.76	90	0.83	1/6	18	8	0.92	1/10	8	27	1/1
DMU11	0.86	0.64	79	0.63	1/2	21	6	0.88	1/6	7	9	1/2
DMU12	0.92	0.89	70	0.59	1/5	13	12	0.56	1/3	5	11	1/1
DMU13	0.64	0.79	46	0.79	1/4	8	5	0.73	1/4	9	3	1/4
DMU14	0.62	0.52	72	0.73	1/7	11	11	0.84	1/7	8	7.6	1/4
DMU15	0.75	0.69	75	0.68	1/8	9	9	0.69	1/6	6	6	1/4

According to the previous DEA algorithm introduction, this paper initially draws up 7 input indicators and 12 output indicators, then the decision-making unit should be no less than 38, but in practice only 15 decision-making units can be assessed. Therefore, it is necessary to reduce the dimension of the above 19 indicators. In this paper, the principal component analysis method is applied to the DEA algorithm in order to meet the requirements of the DEA algorithm.

Among them, the population management index is weighted by Y_1 and Y_2, the service index is weighted by Y_9 and Y_{10}, the law enforcement index is weighted by Y_3 and Y_4, the safety and prevention index is weighted by Y_5, Y_6, Y_7 and Y_8, and the reward and punishment index is weighted by Y_{11} and Y_{12}. The validity of DMUi is now sought. Considering the dual problem (D) of linear programming (P), it is easier to make in-depth analysis both theoretically and economically. Therefore, this paper uses the dual problem (D) to solve its validity. In this

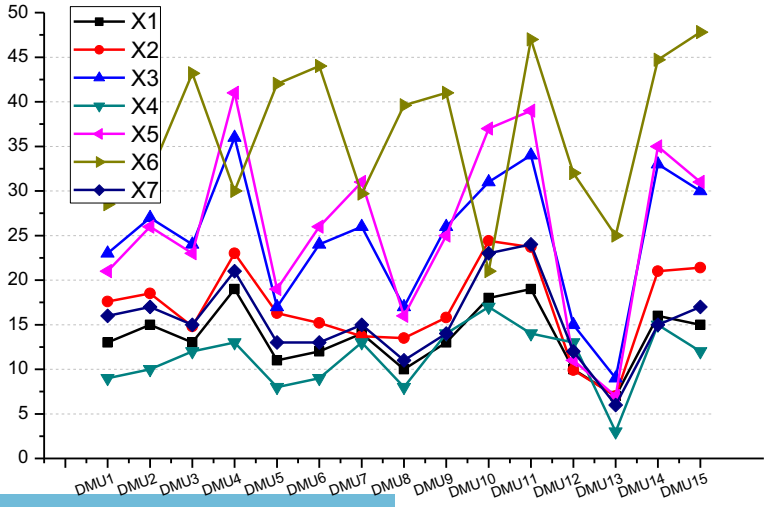

Fig. 4 Input index value

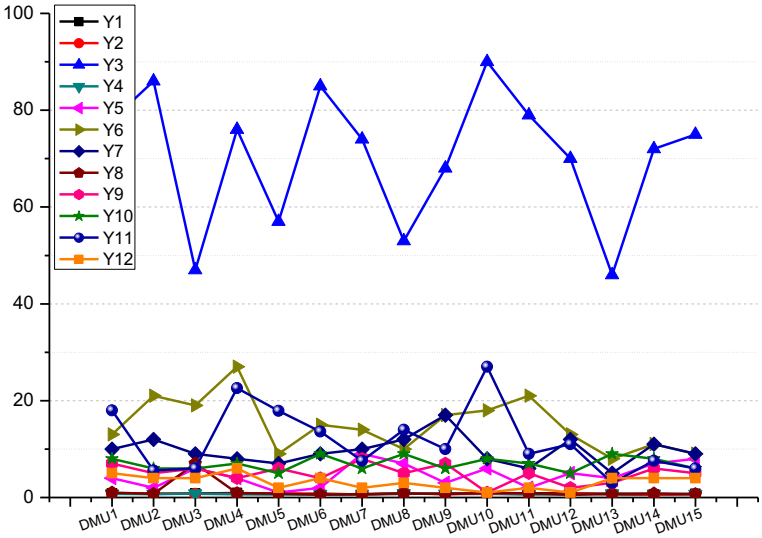

Fig. 5 Output index value

paper, we use Mathematic 4 software to solve the problem and get the results as shown in Table 3.

4.2 Model discussion

(1) From the above table, we can see that only DMU_{10}, DMU_{12} and DMU_{13} have the optimal value of 1, so they are DEA effective (C^2R), that is, compared with the whole 15 units (departments), their three work has reached the optimal. For the other 12 decision-making units, their comprehensive performance can be ranked by the value of θ.

(2) If DMU_j is non-DEA-efficient (C^2R), then consider how to achieve DEA-efficient (C^2R). The above problems can be solved by using the projection of decision making units on the relative effective surface of DEA.

Table 3 Comprehensive performance of decision units

Ranking	Department	θ	S−			S+				
4	DMU1	0.978	0	0	1.63	0	0.04	0.005	0	0.033
5	DMU2	0.928	0	0	0.957	0	0.03	0.003	0	0.067
12	DMU3	0.665	0	0	0.09	0	0.05	0.013	0	0.04
7	DMU4	0.897	0.037	0	0	0	0.013	0.016	0	0.059
6	DMU5	0.923	0	0	0.385	0.293	0.078	0.04	0	0
11	DMU6	0.688	0.021	0	0	0.158	0.023	0	0	0.003
8	DMU7	0.849	0.068	0	0	0.17	0.039	0	0.0384	0
9	DMU8	0.9	0.007	1.578	0	0	0.024	0.004	0	0
10	DMU9	0.798	0.054	1.273	0	0	0.036	0.004	0	0
1	DMU10	1	0.001	0	0	0	0	0	0.003	0
15	DMU11	0.556	0	0	1.475	0.057	0.014	0	0	0.009
1	DMU12	1	0	0	0	0	0	0	0	0
1	DMU13	1	0	0	0	0	0	0	0	0
13	DMU14	0.63	0.075	0	0	0.23	0.032	0	0	0.008
14	DMU15	0.583	0	0	0.9	0.064	0.04	0	0	0.036

Let DMU_{j0} correspond to (X_0, Y_0), and the corresponding optimal solution is λ^*, S^{+*}, S^{-*}, θ^*. Let's construct a transformation.

$$\begin{cases} x_0^{'} = \theta^* x_0 - S^{-*} \\ y_0^{'} = y_0 + S^{+*} \end{cases}$$

Then $\left(X_0^{'}, Y_0^{'}\right)$ is the projection of (X_0, Y_0) on the relative effective surface of DEA, which is DEA effective (C^2R) compared with the original decision unit DMU_j. Accordingly, the inputs and outputs of the above 12 non-DEA-effective decision-making units can take certain measures to achieve DEA-effective (C^2R).

(3) For DMUl0, DMUl2, DMUl3, which are DEA effective decision-making units, we should also compare DEA effectiveness with benchmark. According to the survey, the input and output data of benchmarking are shown in Fig. 6.

Then, DEA analysis is carried out by principal component analysis, dimensionality reduction and benchmarking. Finally, a planning model is established. The results are shown in Table 4.

That is to say, DMU_{10} is DEA effective, but relative to benchmarking, it becomes non-DEA effective. DMU_{12} and DMU_{13} are both DEA effective and benchmarking effective. They are typical high-performance organizations.

(4) From the previous analysis, we know that DEA algorithm has no relation to the preferences of leaders or decision-makers, and does not set corresponding weights. It has complete objectivity and transparency, so it has incomparable advantages compared with other methods.

(5) For DMU_j of DEA effective (C^2R), there is no sorting between them, which is a defect of C^2R model of DEA, but it can be further analyzed by combining other methods such as analytic hierarchy process (AHP) and fuzzy comprehensive evaluation.

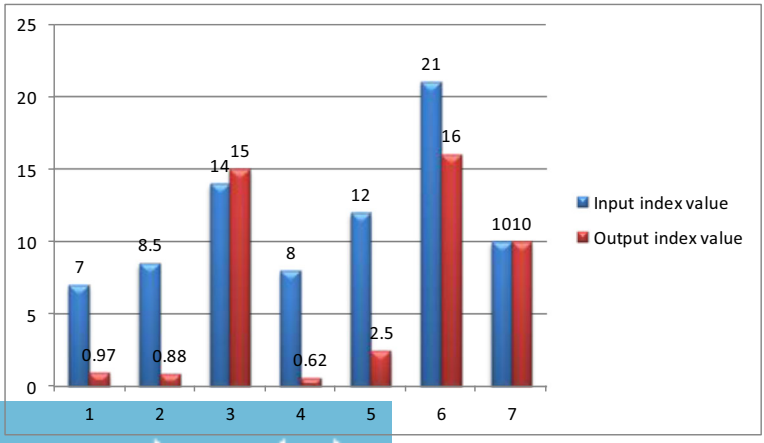

Fig. 6 Input and output index value of benchmarking

Table 4 DEA effectiveness based on benchmarking management

Department	θ	S−	S+
Benchmarking	1	(0,0,0)	(0,0,0,0,0)
DMU10	0.863	(0,0,0.59)	(0,0,0.048,0.005)
DMU12	1	(0,0,0)	(0,0,0,0)
DMU13	1	(0,0,0)	(0,0,0,0)

5 Conclusion

In the increasingly complex social and economic environment, it is particularly important to conduct scientific performance evaluation and analysis. Multimedia Data Envelopment Analysis (MDEA), as an effective means of performance evaluation and management, has been widely used in various industries, and has produced many research results. Many units have experienced many years of rapid development and are in the transitional period of development. Scientific performance evaluation and analysis can provide effective help for long-term development. At present, the application research of multimedia data envelopment analysis in this field is relatively few. The research of new multimedia data envelopment analysis model combined with modern data mining technology is scientific and innovative, and can provide some basic support for complex performance evaluation and analysis. In view of this, this paper firstly combines the fuzzy c-means clustering, principal component analysis and multimedia data envelopment analysis to study the multimedia data envelopment analysis model, establishes the optimization selection model of multimedia data envelopment set and PCA-DEA hybrid model, and gives the solution algorithm. Then, the index data of multimedia data envelopment collection is constructed by using part of the collected local unit data, and the model is applied to multimedia data envelopment analysis. The results show that the model combines the characteristics of data mining technology and multimedia data envelopment analysis method, can meet certain complex performance evaluation and analysis needs, and can provide certain data support for local public performance management.

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