

Research on the Construction of University Financial Management Performance Appraisal System Based on Data Mining Technology

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Abstract—In the management system of colleges and universities in China, financial management is a core component. The theoretical research and practical exploration of performance evaluation of financial departments in colleges and universities in China is still in its infancy. The step-by-step operation mode makes the financial managers in colleges and universities lack the awareness of strategic management and can't combine all kinds of related elements well. Based on the data mining technology, this paper introduces the analytic hierarchy process (AHP) into the performance appraisal of financial management in colleges and universities. Combined with some methods of data mining, we can analyze the diagnostic data from the whole or a specific project, and build a financial management performance appraisal model based on these data. It provides an effective basis for colleges and universities to improve financial management effectiveness and risk prevention ability.

Keywords—Data mining, University financial management, Performance appraisal, System construction

I. INTRODUCTION

College budget is an annual expenditure plan formulated by the school according to its own development plan and task requirements, which is an important basis for the normal operation of the school, and also reflects the development scale and scientific research strength of the school. [Maintaining a good financial situation and certain development potential is a necessary condition for the sustained and stable development of colleges and universities. At present, the theoretical research and practical exploration on the performance evaluation of financial departments in colleges and universities are still in the initial stage, lacking the category boundary and framework foundation to guide the implementation, so it is urgent to explore its basic categories in theory and construct its framework system in practice[1]. For a long time, the financial management of colleges and universities in China has always shown a situation of neglecting efficiency and paying more attention to investment. With the increasingly complex financial management environment of colleges and universities, more and more problems have been exposed in the financial management under this situation. Therefore, it is of great theoretical and practical significance to scientifically evaluate the performance of financial security management in colleges and universities, timely and accurately feed back financial information, understand the development potential of colleges and universities, and discover the weaknesses of financial performance management in colleges and universities.

Improving the management level of the public sector and improving the efficiency of the use of financial funds has always been a hot issue for domestic and foreign experts and scholars to study and solve. To solve this problem, scholars in western countries, such as the United States, Britain, Australia and New Zealand, have made many explorations on performance budgeting from the theoretical and practical perspectives. Zhang believes that with the continuous reform of higher education system, the new performance budget model should be used to allocate resources [2]. At the same time, it points out that there are some obstacles in the system, goal consistency and budget evaluation system. Li used AHP method to study the financial management performance of 37 universities in a province [3]; Wang set up the internal performance budget management mode of colleges and universities, set up the index system for the performance evaluation of various departments within the school, expounded the evaluation methods, and established the budget constraint mechanism based on the evaluation results as the basis for the next year's fund allocation [4].

Data mining is an interdisciplinary subject, which is influenced by many disciplines, including database system, statistics, machine learning, visualization and information science, etc. It promotes people's application of data from low-level simple query to mining knowledge from database and providing decision support. The application of data mining in financial management performance appraisal can find hidden problems in finance in time and formulate corresponding financial system and internal control system; Therefore, based on data mining technology, this paper constructs the performance evaluation index system of financial management in colleges and universities, evaluates the performance of financial management through scientific evaluation methods, and improves the efficiency of the use of funds in colleges and universities.

II. DATA MINING PROCESS

A. Data collection stage

Data mining deals with a large amount of data and information, which are usually stored in specific data systems. After determining the processing objects of data mining, it is necessary to collect the internal and external data of related business objects, and select the processing objects suitable for data mining application from these data. Some of the data processing methods are constantly improving and maturing. Using some existing database technologies and some heuristic methods for databases in

some specialties in data mining can extract some characteristic knowledge from the database, including the breakthrough of spatial and geographical boundaries, the improvement of information transmission efficiency, the increase of transmission capacity, the acceleration of capital scheduling, the diversification of potential risks of financial crisis, and the impact of financial control means.

B. Data preprocessing stage

The processing object is a large amount of data, which is usually stored in the database system and accumulated for a long time. However, it is often not suitable for knowledge mining directly on these data, which requires data preparation, including data selection, purification, speculation, conversion and data reduction. In the process of data cleaning, it is sometimes necessary to group data to improve the efficiency of data mining and reduce the complexity of the model. Generally, these methods are applied by first establishing a mathematical model or statistical model, and then extracting relevant knowledge according to this model.

C. Data mining

Data mining is the most critical step of knowledge discovery, and it is also the technical difficulty. Most of the researchers who study knowledge discovery are studying data mining technology, and many technologies are used, such as decision tree, classification, clustering, rough set, association rules, neural network, genetic algorithm and so on. Due to the decomposition of paradigm, information is split. Different purposes of data use lead to waste of data; The data structure often changes, which makes the analysis model difficult to take; External associated data should be designed for information integration; This series of problems depends on the integration and transformation of data. The function of data warehouse is to process the original operation data and convert it into comprehensive information, and analyze the information in multiple directions through the provided analysis tools [6].

D. Evaluation and expression of results

To some extent, evaluating and interpreting the model established in the previous stage may have no practical significance or use value, and even more seriously, it cannot accurately reflect the true meaning of the data, which is contrary to the facts. It is precisely because of these problems that we need to evaluate and determine which models are really effective and useful. Discovery of knowledge is for application, and how to make knowledge be applied is also one of the steps of knowledge discovery. There are two ways to apply knowledge: one is to support decision-making only by looking at the relationship or result described by knowledge itself; the other is to apply knowledge to new data, which may lead to new problems, and further optimization of knowledge is needed.

The process of data mining is difficult to succeed at one time, and sometimes it may need to be repeated many times. In every step and stage involved in data mining, once there is a difference with the previously set goals, we should immediately return to the previous steps, re-adjust and execute them. Combined with the above, the data mining process is shown in Figure 1:

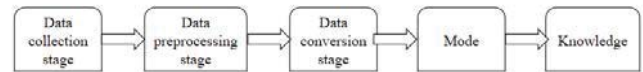


Figure 1 Data mining process

III. PERFORMANCE EVALUATION METHOD OF FINANCIAL MANAGEMENT IN COLLEGES AND UNIVERSITIES

At the level of financial performance evaluation methods in colleges and universities, Yin pointed out that radar chart analysis method can avoid affecting the overall evaluation results of financial performance of colleges and universities because a certain index is too high or too low, and applied this method to the concrete analysis of financial management of a university [7]. Setting the evaluation content scientifically and reasonably is a key link in the process of constructing the financial performance evaluation system in colleges and universities, and the rationality of the evaluation content directly determines the scientificity of the financial performance evaluation system. Evaluating organizational performance from different dimensions makes organizational performance management more comprehensive and effective. The content of evaluation should have scientific stipulation, the concept of each index should be scientific, accurate, representative and the integrity of its system, and the indexes should not be repeated or omitted, and they should be independent. Through comprehensive evaluation, the evaluation results are more scientific and reasonable. The core idea is to decompose the complex problem (target) into several levels and indicators, analyze and judge the relative importance of every two indicators, and get the corresponding judgment matrix, and then calculate the maximum eigenvalue and the corresponding eigenvector of the judgment matrix. Adjust the evaluation index value in time, and improve the work enthusiasm of each department, so as to improve the implementation effect of financial management performance evaluation system.

Performance budget management in colleges and universities is to integrate the concept of performance budget into budget management in colleges and universities. It is a budget management mode that takes the performance of educational products in colleges and universities as the core, controls the implementation of departmental budgets, and measures the benefits of budget implementation with quantifiable indicators. From the current actual situation, colleges and universities still lack special evaluation, supervision and examination in the use efficiency of financial funds, which is not conducive to the effective development of financial management activities to a certain extent [8]. The basic information of performance evaluation includes not only the income, expenditure and surplus information of financial capital flow, the financial information of annual budget implementation, asset management, debt management and cost, but also non-financial information such as service consciousness, business process and team building which are difficult to quantify. It is necessary to select scientific and reasonable evaluation indicators and select indicators close to reality according to the actual financial management of colleges and universities. Only in this way can we make an accurate and objective evaluation of the financial management of colleges and universities. In a word, we should try our best to design a set of index system to meet the information

needs of different people, so that the index has the function of full expansion and decomposition and combination, thus ensuring the authority and accuracy of index evaluation.

At present, the management of most colleges and universities put more emphasis on the development of teaching work and the expansion of business. They often don't know enough about the financial management and its performance evaluation in colleges and universities, and think it is not very important, ignoring the problems that are easy to occur in the process of capital exchanges. In this paper, the analytic hierarchy process and fuzzy comprehensive evaluation method are proposed for analysis. The research ideas of this paper are as follows: firstly, the structural model of financial management performance evaluation in colleges and universities is put forward; Secondly, the relative weight of each performance evaluation index is determined by analytic hierarchy process; Then, the evaluation matrix is obtained through expert scoring, and the financial management performance grade of colleges and universities is obtained by combining the index weight and the evaluation matrix, forming the final evaluation conclusion.

IV. CONSTRUCTING THE PERFORMANCE EVALUATION SYSTEM OF FINANCIAL MANAGEMENT IN COLLEGES AND UNIVERSITIES

A. The setting principle of financial management performance appraisal index is applicable to colleges and universities

Up to now, there is not a clear system for setting performance appraisal indicators of financial management in colleges and universities. However, certain methods can still be used, and the principles of setting the financial management performance appraisal index system should follow the principles of applicability, integrity, dynamics and feasibility (Table I).

TABLE I SETTING PRINCIPLES OF FINANCIAL MANAGEMENT PERFORMANCE APPRAISAL INDICATORS

Principles	Describe
Principle of applicability	It must conform to the characteristics of university management, and strive to be simple, applicable and focused, so as to meet the diagnostic requirements of different universities
Principle of wholeness	From the perspective of university management strategy, the system design of financial management performance appraisal index is carried out, and the overall diagnosis and local diagnosis are organically combined
Dynamic principle	In the process of constructing the financial management performance appraisal index system, it is necessary to adjust the financial management performance appraisal index according to the specific region, the situation of colleges and universities and different time spans
Feasibility principle	First, it should be easy to understand and convenient for data collection; Second, the economic cost should not be too high; Third, the scoring of the diagnostic index system and the calculation of each index should be simple and convenient, which is conducive to the actual diagnostic operation

B. Determination of index weight of financial management performance evaluation in colleges and universities

According to the actual situation of financial operation in colleges and universities, we should comprehensively evaluate the evaluation factors involved in the process of

financial management, prioritize, reasonably design the performance evaluation indicators of financial management, and set the indicators reasonably and feasibly. By visiting the relevant experts of management performance, the designed performance evaluation indexes of financial management in colleges and universities are compared in pairs to obtain the judgment matrix. The maximum eigenvalue of the judgment matrix and the corresponding eigenvectors are solved by the square root method, and the consistency test is carried out to determine the weight of all performance evaluation indexes. Combined with the actual situation of the school, the overall performance target of the school is prepared, which is jointly drafted by the school office and the financial budget preparation department, and submitted to the "College Financial and Economic Work Leading Group" for discussion and revision. At the same time, colleges and universities should strengthen the evaluation of financial use, asset regulation, financial management and financial fund use, and strengthen the awareness of regulating funds and regulating the use of funds in various departments on this basis, so as to improve the performance of government funds.

In the era of rapid economic development, any organization needs to learn how to use information if it is to succeed. For colleges and universities, a large part of the decision-making basis for their development comes from the performance appraisal information of financial management. It should be adopted reasonably within the scope of financial resources, and the budget amount of each department in the school should be determined and reported to the school budget audit institution, that is, the budget committee composed of school leaders should review it. In order to effectively improve the level and quality of financial management, the relevant personnel should attach great importance to the design of performance evaluation indicators in learning and growth. Quantitative or qualitative indicators can be established from the aspects of on-the-job education and training, the proportion of talent structure, professional quality and the job satisfaction of financial management personnel. After drawing the strategic road map, it should clearly reflect the causal relationship between the four levels of evaluation indicators and the strategic objectives, and clearly reflect the path for the financial departments of colleges and universities to achieve the strategic objectives. In this paper, financial index diagnosis and early warning model diagnosis are combined for analysis (Figure 2).

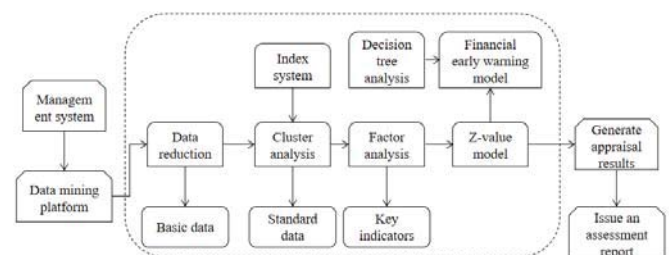


Figure 2 Process model of data mining in financial management performance appraisal

Transforming all driving factors into an evaluation index system. Looking for the corresponding logical relationship between seemingly chaotic indicators, building a performance evaluation analysis framework, and building a complete performance evaluation index system. However,

the attribute with more values may not be the optimal attribute, while the attribute with less values may become the optimal attribute because it provides more information. Using a series of specific algorithms of data mining to extract the index by factor analysis and calculate the overall financial situation of colleges and universities; Then, factor analysis method is used to decompose some related indicators to find out the reasons that lead to the fluctuation of the financial situation of colleges and universities. Because it does not reflect the growth trend of capacity, it needs dynamic indicators to supplement it. The trend of evaluation should be fully considered, the influence of accidental factors should be eliminated, and it should be revised constantly according to the principle of dynamic improvement, so as to reflect the performance level and comprehensive management level of colleges and universities scientifically and accurately.

C. Establish judgment matrix

In Table II, b_{ij} reflects the relative importance of B_i to B_j for A_h . The determination of the index score is subjective. In order to reduce the influence of subjective factors and quantify the judgment, this paper uses 1~9 as the scale. On the basis of consulting relevant experts and financial department workers in colleges and universities, the factors at the criterion level and the index level are compared in pairs and assigned values, and the judgment matrix is shown in Table III and Table IV below.

TABLE II JUDGMENT MATRIX TABLE

A_h	B_1	B_2	...	B_i	...	B_n
B_1	b_{11}	b_{12}	...	b_{1i}	...	b_{1n}
B_2	b_{21}	b_{22}	...	b_{2i}	...	b_{2n}
...
B_i	b_{i1}	b_{i2}	...	b_{ij}	...	b_{in}
...
B_n	b_{n1}	b_{n2}	...	b_{nj}	...	b_{nn}

TABLE III CRITERION LAYER JUDGMENT MATRIX

	B_1	B_2	B_3
B_1	1	1/3	1/3
B_2	3	1	1/3
B_3	3	3	1

TABLE IV JUDGMENT MATRIX OF RESOURCE ALLOCATION PERFORMANCE INDEX LAYER

	C_1	C_2	C_3
C_1	1	2	3
C_2	1/3	1	3
C_3	1/2	1/3	1

D. Calculate the index weight

For calculating the eigenvector and the maximum eigenvalue of the judgment matrix, the formula can be

solved

$$BW = \lambda_{\max} W \quad (1)$$

Get the sort value. Where is the largest feature root of matrix B and W is the ordering vector. The geometric mean value of each row element of the judgment matrix B is calculated respectively, and the row vector is normalized [9]:

$$\bar{W}_i = \sqrt[n]{\prod_{j=1}^n b_{ij}}, (i=1,2,\dots,n) \quad (2)$$

$$W_i = \frac{\bar{W}}{\sum_{j=1}^n \bar{W}_j} \quad (3)$$

W_i refers to the weight coefficient value of each index.

E. Consistency check

Calculate the maximum feature root. The calculation method is: multiply the discriminant matrix B by the maximum feature root W , and calculate the average value of the ratio with the corresponding elements.

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^n \frac{(BW)_i}{W_i}, (i=1,2,\dots,n) \quad (4)$$

If the judgment matrix has satisfactory consistency, λ_{\max} is slightly larger than the matrix order n , and other characteristic roots are close to zero.

Calculate the consistency ratio.

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (5)$$

$$CR = \frac{CI}{RI} \quad (6)$$

In formula (6), RI is a random index, which is the average value calculated according to the consistency of the random occurrence discrimination matrix under the condition of random sampling. The random index values of the matrix are 0.55, 0.79 and 1.02 respectively.

If the consistency index is less than $CR < 0.2$, the judgment matrix has satisfactory consistency; If $CR > 0.2$, the judgment matrix is inconsistent, and the judgment value should be adjusted to pass the one-time test. Combined with the above formula, the maximum characteristic root and consistency ratio of each judgment matrix are obtained as shown in Table V:

TABLE V MAXIMUM FEATURE ROOT AND CONSISTENCY TEST RESULTS

	A	B_1	B_2	B_3
λ_{\max}	3.0721	5.8732	5.2146	4.521
CI	0.0356	0.0654	0.0264	0.08221
CR	0.0276	0.0453	0.01345	0.06347

V. PERFORMANCE EVALUATION OF FINANCIAL MANAGEMENT IN COLLEGES AND UNIVERSITIES

Make full use of the role of performance appraisal, guide the financial management of colleges and universities to build in a more reasonable and perfect direction, and pay attention to it ideologically. All secondary units and departments should strictly control budget expenditures in the process of budget implementation, and must not overspend, and conduct performance self-evaluation at the end of each quarter. In the middle of the year, performance budget management departments should conduct mid-term performance evaluation for all or part of secondary units or departments. Determine financial management objectives

and strategies. Because colleges and universities are non-profit units, when constructing the financial performance evaluation system, we should focus mainly on social benefits. The higher authorities require the financial departments of colleges and universities to allocate financial resources scientifically and reasonably and use them according to regulations, do a good job in raising and dispatching funds, and complete various financial tasks with good quality and quantity.

The performance evaluation team of financial management consists of nine members, including academic experts in related research fields and personnel with rich financial management experience. Based on their own professional and financial management experience, and combined with the current situation of financial management in colleges and universities, each participant made judgments on 11 evaluation indicators under five dimensions in the financial management performance evaluation system of the university. The evaluation grades include four grades: excellent, good, qualified and unqualified. The statistics are shown in Table VI.

TABLE VI EVALUATION STATISTICS OF FINANCIAL MANAGEMENT PERFORMANCE OF COLLEGES AND UNIVERSITIES BY EVALUATORS

Criterion layer	Index layer	Excellent	Good	Qualified	Unqualified
Stakeholder satisfaction	The benefits of schools to society	3	7	0	0
	Staff satisfaction	5	3	1	0
	Student satisfaction	2	8	1	0
Organizational strategy	Asset-liability ratio	3	6	2	1
	Rate of return on school investment	5	4	3	0
Organizational process	Completion degree of budget expenditure	2	2	1	0
	Efficiency of fund utilization	1	5	1	0
Organizational ability	Teachers' quality level	5	3	2	0
	Graduate employment rate	3	7	3	0
	Conversion rate of scientific research achievements	6	7	1	1
	Compliance degree of decision-making on major issues	8	3	1	0

It is supposed to construct the performance evaluation index system of financial security management in colleges and universities from four aspects: overall imbalance ability, solvency, operational performance ability and financial development potential, so as to reflect the overall financial risk situation of colleges and universities and provide reference for colleges and universities to prevent financial risks. According to the actual situation, there is still a certain gap between the current scientific research strength of schools and other universities. Therefore, universities should increase investment in scientific research funds in the future development and improve their ability to obtain vertical and horizontal scientific research funds. Put forward specific solutions to the problems, and provide guarantee for improving the efficiency of capital use. At the same time, according to the performance evaluation results of secondary units or departments, a reward and punishment mechanism can be established to enhance the enthusiasm of departments to actively improve the efficiency of capital use, which can be implemented in action, give full play to the role of the performance evaluation of financial management in colleges and universities as the basis for the development decision-making of colleges and universities, and improve the development level and development level of colleges and universities.

VI. SUGGESTIONS ON THE CONSTRUCTION OF FINANCIAL PERFORMANCE EVALUATION SYSTEM IN COLLEGES AND UNIVERSITIES

A. It is necessary to further improve the understanding of the importance of financial management performance evaluation system

Thought is the forerunner of action. We should start from the leadership of colleges and universities, give attention to the teachers and students, strengthen the understanding of the importance of performance evaluation of financial management in colleges and universities, and face up to the important role of performance evaluation system of financial management. In the future development, we should constantly improve the financial management rules and regulations of colleges and universities, so that financial management has rules to follow, and maintain the financial order of colleges and universities by establishing and perfecting the performance evaluation system; Strictly control the use of financial resources. At the same time, the grass-roots faculty and staff are bound to pay attention to the realization of the performance goals of their departments, which can enable the grass-roots faculty and staff to participate in the department management, enhance the democratic degree of performance management, and help improve the level of teaching and scientific research in schools.

B. It is necessary to further rationally set the performance evaluation indicators of financial management

Perfecting the financial budget management of college. Perfect internal financial management mechanism is the fundamental guarantee for schools to introduce performance budget management. We should pay attention to increasing revenue and saving expenditure, make full and rational use of resources, optimize the structure of capital expenditure, reduce the dependence on government financial funds, make full use of social resources and adopt multi-channel ways to raise funds, enhance the ability of self-raising funds, and relieve the pressure of funds. The results of performance evaluation of financial management will be transformed into real development and innovation, so as to improve the level of financial management and realize the sustainable and healthy development of colleges and universities.

C. Establish a smooth information transmission and communication system

The process of performance budget management in colleges and universities includes not only the information transmission between superior leaders and subordinate departments, but also the process of information communication between secondary colleges and administrative departments. We must pay close attention to the implementation of many systems, so as to achieve the goal of information management. It is necessary to start from the understanding and pay attention to the assessment and evaluation of financial management; It is necessary to improve the financial management and performance evaluation system from the mechanism; It is necessary to select scientific evaluation indicators from the indicators. Finally, on the basis of ensuring the investment of teaching and scientific research funds, it is necessary to attract high-level talents through the talent introduction policy, and strive to improve the teaching level and scientific research ability. With the help of the university's scientific research platform and discipline advantages, we can speed up scientific and technological innovation and transformation of scientific research achievements, and improve the comprehensive development strength of the university.

VII. CONCLUSION

With the further improvement of the society's requirements for the quality of education, the requirements and expectations for the self-development of colleges and universities are gradually raised. To achieve the high-quality

development of colleges and universities, it is inseparable from the smooth development of financial management and its performance evaluation. In the application of evaluation index system, this paper evaluates its financial management performance based on data mining technology. The relative weight of each performance evaluation index can be determined by analytic hierarchy process, and the relative importance of each index can be compared horizontally; At the same time, the performance budget management of budget expenditure management of various departments in colleges and universities needs to be further refined, so as to establish and improve the internal reward and punishment mechanism. Therefore, colleges and universities should pay attention to this in the process of development, intensify the exploration of financial performance evaluation system, and maximize the value and function of performance evaluation.

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