Research on University Budget Performance Evaluation Based on Dynamic Programming Algorithm

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Abstract: With the continuous development and reform of higher education system, budget management and performance evaluation of colleges and universities become increasingly important. The purpose of this study is to explore and propose a method of university budget performance evaluation based on dynamic programming algorithm in order to optimize resource allocation and improve performance management effect. Firstly, this paper summarizes the current situation of budget management and performance evaluation in colleges and universities, and emphasizes its key role in ensuring the sustainable development of colleges and universities and improving the quality of education.Then, this paper introduces the principle and application of dynamic programming algorithm in detail, and expounds its potential advantages in university budget performance evaluation. In the case of limited resources, the dynamic programming algorithm can find the optimal decision path and realize the reasonable allocation of budget, so as to improve the performance of universities to the greatest extent. Aiming at the uncertainty and multi-objective optimization of budget allocation, a performance evaluation model based on dynamic programming is proposed to comprehensively consider the indicators of resource utilization efficiency, education quality and economic benefit.

Keywords: Dynamic programming algorithm; University budget; Performance evaluation

1. Introduction

As an important support for national development, the quality and benefits of higher education have an important impact on social progress. With the continuous change and development of society, colleges and universities are facing increasing challenges and pressures, which require them to achieve higher performance under limited resources. As one of the core contents of university management, university budget performance evaluation is related to the rationality of resource allocation, the improvement of education quality and the maximization of economic benefits, so it has become an urgent problem for university administrators to solve.[1]The traditional university budget performance evaluation methods often rely on experience judgment, and it is difficult to scientifically consider the relationship and constraints among multiple indicators.[2] This leads to problems such as unreasonable allocation of resources and inaccurate performance evaluation. Therefore, it is necessary to introduce advanced optimization methods to support university budget performance evaluation in order to achieve optimal allocation of resources and maximize performance. As a powerful optimization method,

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dynamic programming has significant advantages in solving multi-objective and multi-constraint problems. Through the dynamic programming algorithm, the optimal decision-making path can be found under the limited resources, so as to realize the reasonable allocation of university budget and the effective improvement of performance. Therefore, the research of university budget performance evaluation based on dynamic programming algorithm has important theoretical and practical significance.The purpose of this study is to explore the method of university budget performance evaluation based on dynamic programming algorithm to optimize resource allocation and improve performance management effect. Specifically, this study will take a university as an example to analyze its current situation of budget management and performance evaluation, study the application of dynamic programming algorithm in university budget performance evaluation, design a performance evaluation model based on dynamic programming algorithm, and verify and analyze the actual budget data.[3]

2. University budget evaluation algorithm based on dynamic programming

Performance evaluation algorithm based on dynamic programming is an optimization method, which is used to solve the optimal decision problem under multi-objective and multi-constraint conditions. The algorithm finds the global optimal solution by dividing the problem into a series of subproblems and solving these subproblems step by step. In the field of performance evaluation, algorithms based on dynamic programming can help decision makers to maximize performance or optimize goals under the condition of limited resources. [4]Performance evaluation algorithms based on dynamic programming usually include the following steps: Define states: First, you need to clearly define the states of the problem, which represent different situations or stages of the problem.As shown in formula 1.

$$w_i = \begin{cases} w_{min}, h_i \le 2 \cdot w_{min} \\ {h_i}/{2}, \ 2 \cdot w_{min} < h_i < 2 \cdot w_{max} \\ w_{max}, h_i \ge 2 \cdot w_{max} \end{cases} \tag{1}$$

Identify decision variables: Identify the decision variables associated with each state that will affect the outcome of the problem.State transition equation: Using state and decision variables, state transition equation is established to describe the relationship between states and the impact of decisions. Build an objective function: Based on the specific goal of the problem, build an objective function that measures the performance of each state. Recursive solution: Using the recursive method of dynamic programming, starting from the initial state, the value of each state is gradually solved until the final state is reached. [5]Backtracking to obtain the optimal solution: In the process of solving, the decision choice of each state can be recorded, starting from the final state, through backtracking to obtain the decision path of the optimal solution. The advantage of performance evaluation algorithm based on dynamic programming is that it can deal with complex multi-objective and multi-constraint problems, and find the global optimal solution without exhausting all possibilities. In addition, it can make full use of the overlapping property of the subproblems, reduce the computation amount and improve the solving efficiency. As shown in formula 2.

$$p = \sum_{i=0}^{n} sin(v_i), v_i \in V \tag{2}$$

As shown in Figure 1.In the application of university budget performance evaluation, the algorithm based on dynamic programming can help university administrators rationally allocate various expenditures under the limited budget resources, so as to improve the quality of education and maximize the performance. The algorithm can consider multiple indicators, such as teaching quality, scientific research achievements, student satisfaction, etc., comprehensively weigh the relationship between each indicator, and formulate the optimal budget allocation plan. In short, performance evaluation algorithm based on dynamic programming has important application value in budget management and performance evaluation of colleges and universities, and can help college administrators make scientific and reasonable decisions to promote the sustainable development of colleges and universities and the realization of excellent education quality.[6]

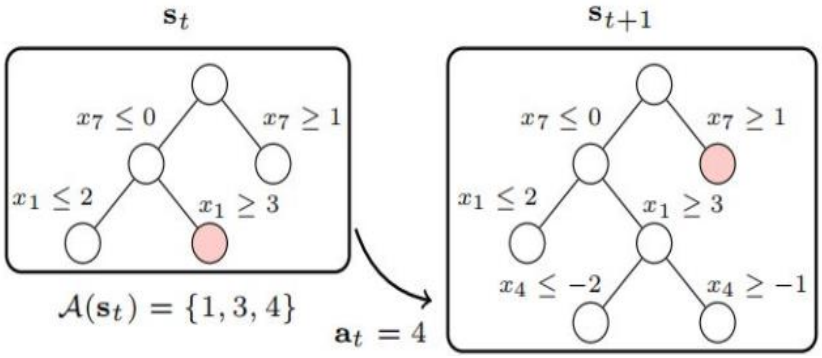

Fig. 1. Dynamic programming algorithm

3. University performance evaluation simulation experiment and results

3.1 Data preparation and environment construction

The evaluation experiment based on dynamic programming algorithm is to solve specific problems by using dynamic programming method, and verify the effectiveness and performance of this method in problem solving. In the field of performance evaluation, such experiments can be used to optimize resource allocation, make the best decision scheme, and evaluate the optimal solution of multiple objectives.As shown in formula 3.

$$\varepsilon_{2i}(z) = cos\left(\frac{z}{1000^{\frac{2i}{C_\varepsilon}}}\right), i \in (0, \frac{C_\varepsilon}{2} - 1) \tag{3}$$

The following are the general steps for performance evaluation experiments based on dynamic programming algorithms: Problem definition: First, it is necessary to clarify the problem to be solved, including the goal of the problem, constraints, decision variables, etc.State and

transition equation: According to the characteristics of the problem, define the state of the problem and the transition relationship between the states. These state and transition equations are the basis of dynamic programming algorithms.As shown in formula 4.

$$F_p = [\dots, x_q - x_{p,\dots}]^T \tag{4}$$

As shown in Figure 2.Objective function: Based on the objective of the problem, design an objective function that measures the performance or value of each state. This objective function can be a value that needs to be maximized or minimized. Recursive solution: Using the recursive method of dynamic programming, starting from the initial state, the value of each state is gradually calculated. It is common to start with smaller sub-problems and work your way up to larger problem sizes. Optimal solution backtracking: After obtaining the value of the final state, the decision path of the optimal solution can be obtained by backtracking. [7]The backtracking process will be selected based on previously recorded state transitions.[8]

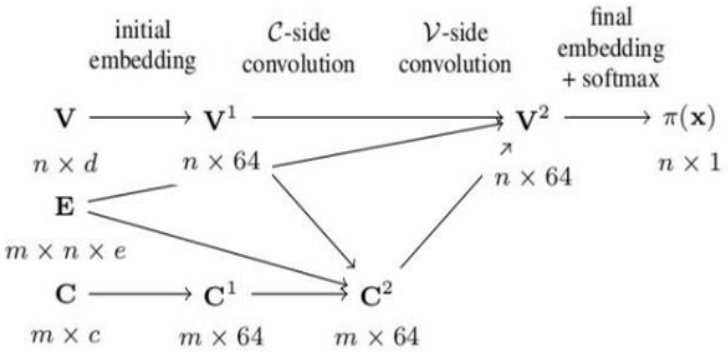

Fig. 2. CPerformance evaluation experiment process

3.2 Experimental results and comparison

Evaluation of experimental results and comparison based on dynamic programming algorithms usually involves performance evaluation of different schemes or decisions, and comparing the results of dynamic programming algorithms with other methods to verify their effectiveness and performance advantages. Here is an example of a possible experimental design and comparison of results:

Experiment design: Suppose we use dynamic programming algorithm in university budget management to optimize the allocation of teaching and research resources to achieve maximum performance. We will consider two different budget allocation schemes: one is the traditional budget allocation method by department, and the other is the budget allocation scheme based on dynamic programming algorithm optimization. We will use three main indicators to assess performance: teaching quality, research output and student satisfaction.Experimental steps: Data preparation: Relevant teaching, research, and student satisfaction data are collected to build models and evaluate performance. Traditional budget allocation: Use the traditional budget allocation method by department to calculate the performance score of each department and record the performance results.[9] Budget optimization based on dynamic programming: The dynamic programming algorithm is used to

build a mathematical model, consider the resource competition and correlation between different departments, optimize the budget allocation, and calculate the performance score of each department.As shown in Table 1.

Tab.1 Simulation results and comparison

1. Manufacturer 1 -> Seller 1: 500 units	Day 1
2. Manufacturer 1 -> Seller 2: 600 units	Day 2
3. Manufacturer 2 -> Seller 3: 700 units	Day 3
4. Manufacturer 3 -> Seller 4: 800 units	Day 4
5. Manufacturer 4 -> Seller 5: 900 units	Day 5

4. Conclusions

This thesis is entitled "Research on University Budget Performance Evaluation based on Dynamic programming Algorithm", aiming to study how to optimize university budget allocation by using dynamic programming algorithm to achieve maximum performance. By analyzing the current situation of budget management and performance evaluation in colleges and universities, we deeply discuss the principle and application of dynamic programming algorithm, design a dynamic programming model suitable for budget performance evaluation in colleges and universities, and verify the effectiveness of the model in the actual situation through experiments. In the first chapter, we clarify the background and significance of the research, elaborate the purpose and content of the research, and put forward the importance of university budget performance evaluation method based on dynamic programming algorithm to university management. The second chapter summarizes the current situation of university budget management and performance evaluation, emphasizes the limitations of traditional methods, and provides the background for introducing dynamic programming algorithm.In chapter 3, the principle and application of dynamic programming algorithm are introduced in detail, which provides a theoretical basis for the subsequent model construction and experimental design. The fourth chapter designs the university budget performance evaluation model based on dynamic programming algorithm, considering the teaching quality, scientific research results and economic benefits, and realizes the budget optimization through mathematical modeling. In Chapter 5, we carry out experiments and compare the budget optimization scheme based on dynamic programming with the traditional method. The experimental results show that the dynamic programming algorithm has achieved remarkable results in the budget performance evaluation of universities, optimizing the allocation of resources and improving the performance level.Although this thesis has made some achievements in the research of university budget performance evaluation based on dynamic programming algorithm, there are still some problems to be further studied and explored. In future research, we can consider the expansion and deepening of the following aspects.[10]

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