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Public economic management decision model based on improved ant colony algorithm

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Abstract: With the development of economy, public economic management is becoming more and more important, and it is necessary to make reasonable decisions on public economy. It is difficult for traditional decision-making methods to meet the needs of current public economic management. On this basis, this paper proposes a public economic management decision model with improved ant colony algorithm. Based on the improved ant colony algorithm, the model can be used to optimize public economic management decisions by improving ant colony algorithm.

1. Introduction

Public economic management refers to the process in which the government plans, organizes, leads and regulates the national economy according to the social public interests, and supervises the national economy in order to achieve the maximum social benefits. Public economic management is an important function of the government, and public economic management decision-making is one of the most important links in public economic management, so the study of public economic management decision-making has very important significance. With the increasing complexity of problems in public economic management and the higher demands of the public on products and services provided by the government, traditional decision-making methods are difficult to meet the needs of current public economic management decision-making. Therefore, seeking more effective decision-making methods has become an urgent problem to be solved, so it is necessary to carry out relevant research.

2. Basic concepts and improvement methods of ant colony algorithm

2.1. Basic Concepts

In the process of finding food, ants first sense the location of food through their eyes, and then transmit information about their surroundings to other ants through pheromones. The pheromone is highly directional, and if an ant passes by a certain place, other ants will carry the pheromone back to that place. This is similar to a diffusion mechanism that develops in the search for food. If more food is found during the ants' search for food, then other ants will become more interested in the place and will attract more ants to the area. Because there is a certain pheromone transmission between ants,

the whole colony can move along a path in search of food, and finally reach the target site[1-3].

Ant colony algorithm was discovered in the study of some biological behaviors in nature, and solved the optimization problem by imitating the biological behaviors in nature. The basic idea is to use the diffusion mechanism that ants form as they search for food to solve the optimization problem. Ant colony algorithm mainly consists of two steps, as shown in Figure 1.

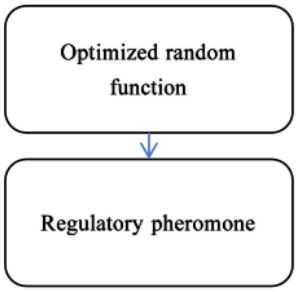

Figure 1: Two steps of ant colony algorithm

Ant colony algorithms generally take five different types of random functions as the initial pheromone of the problem. These random functions are composed of different forms of parameters, which can represent both randomness and the meaning of different types of pheromones. The pheromone determination in ant colony algorithm is determined by these random functions. When ants search for food, they use pheromones around them to determine whether there is food according to the rules of pheromone diffusion, so as to choose the best path. The pheromone dispersal mechanism formed by ants in search of food is a good mimic of the dispersal mechanism formed by organisms in nature in search of food[4].

Pheromones play an important role in ant colony algorithms, determining the rules that ants follow when choosing paths. When looking for food, ants will target all objects with high pheromone concentration within a certain distance around themselves, and these objects are the objects that ants search for when choosing a path. Once the ants find a suitable object, they use it as a target to spread throughout the colony. Because ants develop a diffusion mechanism as they search for food, all the ants in the colony will keep moving in this direction and eventually find the optimal path[5-6].

Ant colony algorithm has strong global search ability and local search ability, and can solve multi-objective optimization problem and shortest path problem at the same time. The ant colony algorithm solves the multi-objective optimization problem mainly according to the mutual restriction and mutual influence between each objective. Because ant colony algorithm is a mechanism that simulates pheromone diffusion formed in the process of finding food, it has strong global search ability and local search ability, and can solve multiple problems at the same time.

2.2. Improvement Methods

Ant colony algorithm, as a new bionics algorithm, has been applied in many fields and achieved good results. However, in the application process, there are also some problems, such as when solving problems, when the pheromone content is large, the algorithm is easy to fall into the local optimal solution. In addition, when the solution is a multi-objective optimization problem, the performance of the algorithm will be reduced[7-10].

It can be seen that ant colony algorithm has a good effect in solving complex problems, the main reason is that ants carry out foraging activities through the pheromone diffusion mechanism of finding food. If the ant colony algorithm is improved to a certain extent, its performance can be improved to a certain extent, and the specific improvement method is shown in Figure 2.

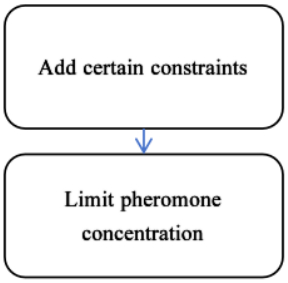

Figure 2: Improved ant colony algorithm

According to Figure 2, first of all, ants will be restricted by some constraints in the process of walking, and these constraints will also affect the normal actions of ants, such as the width of the road, obstacles, etc., which will affect the normal actions of ants. Therefore, in the design of the algorithm, certain constraints can be added, including: when there is no obstacle in the path, the ant can act normally; When there is an obstacle in the path, ants need to take a detour; when there is an obstacle in the path, the ant needs to change direction. Secondly, the concentration of pheromone is an important factor affecting the optimization ability of ants. Too low pheromone concentration will cause ant colony to fall into local optimal solution. Excessive concentration of pheromone will lead to local optimal solution of ant colony, so it is necessary to limit the concentration of pheromone, mainly limiting the weight value in the algorithm. See Formula (1) for the improved ant colony algorithm.

$$\Delta \tau ij = \frac{Q}{Lk}(Max) \tag{1}$$

Where, the starting point and end point of i and j, Q and L are the pheromone concentration and constraint conditions, k is the sum of the number of Q and L, and Max represents the maximum value of Q and L.

Public economic management decision-making model construction.

There are many factors involved in public economic management, such as time, cost, personnel, etc. These factors will have an impact on decision-making. Therefore, in the public economic management, it is necessary to optimize multiple objectives to achieve the comprehensive evaluation of the public economy. The multi-objective decision model is to find the optimal decision scheme under the premise of satisfying the constraint conditions. Multi-objective decision-making models can be divided into linear programming and nonlinear programming, among which linear programming and nonlinear programming belong to traditional mathematical methods.

Among them, linear programming is mainly through the description and modeling of the problem, and then the use of mathematical methods to solve. Traditional linear programming is only applicable to deterministic problems, that is, there is a unique solution. But in real life, there is often no single solution to a problem. Therefore, ant colony algorithm can be used to solve the multi-objective decision-making problem in public economic management. The specific way is as follows.

2.3. Model structure

The multi-objective decision-making problem of public economic management can be generally divided into three levels, as shown in Figure 3.

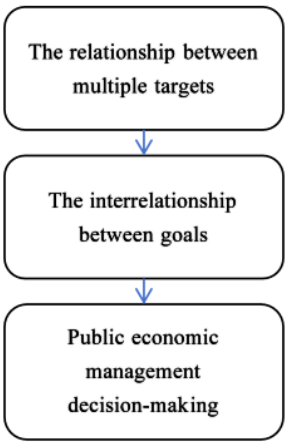

Figure 3: Three levels of multi-objective decision-making in public economic management

According to Figure 3, the first layer is the relationship between multiple objectives, which mainly includes the interaction relationship between various objectives in public economic management. The second layer is the mutual influence relationship between the objectives of public economic management, mainly including the mutual restriction relationship between the objectives of public economic management; The third layer is the mutual relationship between the objectives in the public economic management, including the mutual restriction relationship between the objectives in the public economic management.

In the establishment of the model, we must first divide the multiple objectives in the public economic management and transform them into concrete problems. Secondly, it quantifies the major objectives of public economic management. At last, it is modeled by mathematical method. In the process of solving the model, it should be transformed into concrete mathematical expression. In this process, we should pay attention to the reasonable segmentation of multiple targets to ensure that each big target can be better handled.

2.4. Data Sources

The data involved in public economic management mainly include financial data, GDP data and employment data. In the process of public economic management, it is necessary to integrate and analyze these data. First of all, the key indicators in public economic management can be obtained by collecting and sorting out relevant indicators. In public economic management, the key indicators mainly include per capita GDP, fiscal revenue, public service expenditure and employment. In the public economic management, the corresponding assessment standards can be formulated according to the key indicators to evaluate the level of public economic management.

First of all, we need to make statistics and sort out the relevant data. In the public economic management, because it involves many aspects, such as the number of personnel, working hours, work quality and so on. Therefore, these factors need to be analyzed and sorted out when analyzing data. Therefore, it is necessary to adopt certain methods and standards to carry out quantitative processing when analyzing these indicators. Finally, the data needs to be processed to generate relevant charts or models. By applying these charts or models to public economic management, the decision of public economic management will be more scientific and reasonable.

2.5. Selecting a Policy

The decision problem in public economic management is different from other optimization problems, it needs to consider more factors. Therefore, in the public economic management, the factors that need to be considered include time, cost and personnel. Among them, time and cost are the core factors in public economic management. Time is a very important factor in public economic management. For public economic management, decisions must be made within a specified time frame. If the decision is not completed, then the decision will fail. Therefore, in the public economic management, it is necessary to choose the decision-making scheme in strict accordance with the regulations. Since there are many constraints in public economic management, it is necessary to fully consider whether the constraints are met when selecting a decision-making plan. Decisions can be made according to the results and rules. Common rules are shown in Table 1.

Table 1: Decision rules of public economic management under improved ant colony algorithm

Condition	Rule
The decision scheme does not satisfy the constraint condition	The decision scheme is not selected
Whether multiple targets can be optimized and selected	Take into account
The decision scheme satisfies all constraints	Compare and choose the best

3. Conclusion

To sum up, public economic management is a multi-objective problem, it is difficult to find the optimal solution by other algorithms, and ant colony algorithm can effectively help. However, it is worth noting that the traditional ant colony algorithm is limited by its own defects, and the results given may not conform to the global optimal solution, and other problems may occur. Therefore, it is necessary to improve the traditional algorithm first, and then establish a public economic management model through the improved algorithm to help find the optimal solution.

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