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Discussion of Optimize Method of Fire Alarm Dispatching Based on Operation Research Principle

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Abstract

In recent years, fires in China are gradually developing to large, complex, cross-regional and other directions. The probability of multiple simultaneous major fire accidents is rising. How to optimize fire vehicles becomes the key point of fire prevention at the present stage. This paper discusses a optimize method of Fire alarm vehicles dispatching based on the transportation model and assignment problem, sets a mathematical model of this problem, which solution is given by LINDO/LINGO software. It verifies the feasibility and efficiency of this optimal method through a real example.

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Keywords: transportation model, assignment problem, fire alarm dispatching, linear program;

1. Introduction

In recent years, fires in China are gradually developing to large, complex, cross-regional and other directions. Due to the large scale, the harmfulness of fire, the personnel needs, it is difficult to control fire timely and effectively by relying on limited fire fighting forces. Instead, it often affects fire fighting and rescue work and cause s great damage. So, in the cases of many places occur great fire accident simultaneously, it is a problem badly in need of solution that how should fire command center set up an optimal distribution of equipment for each fire station to muster enough forces at first time and douse the fire.

As an important branch of operations research, transport problem combines with the actual needs. Transport model is used to solve the delivery plan of a single origin of goods from several producing areas to several destinations. Transportation problem is a typical linear programming problem. As a specific form of the 0-1 integer programming, Assignment problem is very important. The common application of Assignment problem is to distribute road for vehicle whose goal is consume the minimum total resources. At the same time, many transportation problems can evolve into the assignment problem to solve.

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2. The analyses of transport model and assignment model

2.1. The mathematical model of the transportation problem

Transportation problem is a special kind of linear programming problem. It is used to solve the delivery plan of a single origin of goods from several producing areas to several destinations [1].

Put the transport costs of goods is proportional to the transportation quantity. And x_{ij} express the transportation quantity from origins to place of sales. On the premise of balance of production, we need solve the linear programming problem below to get the minimum total freight.

$$\min Z = \sum_{i=1}^m \cdot \sum_{j=1}^n c_{ij} x_{ij} \tag{1}$$

$$s. t \begin{cases} \sum_{j=1}^n x_{ij} = a_i, i = 1, 2, \dots, m \\ \sum_{i=1}^m x_{ij} = b_j, j = 1, 2, \dots, n \\ x_{ij} \geq 0, j = 1, 2, \dots, n \end{cases} \tag{2}$$

In the formula, the a_i, b_j, c_{ij} express supply, quantity demanded and unit price separately.

On the problem of dispatching fire service vehicles, supposing the amount of available forces are equal to the amount of vehicles for fire need, the optimal method of Fire alarm vehicles dispatching can be built in the basis of mathematical model of transportation problem.

2.2. The mathematical model of assignment problem

The assignment problem is n units to undertake m tasks. Due to the different specialty, each unit accomplish different mission, its efficiency is different. Therefore, it is necessary to assign the task scientifically, ensuring consume the least resources to complete m tasks [2]. The assignment problem is also a 0-1 integer programming model, the variable x_{ij} only values 0 or 1. Then x_{ij} called the 0-1 variables, or binary variable. And x_{ij} generally can be expressed as:

$$x_{ij} = \begin{cases} 1. & \text{表示指派第 } i \text{ 个人完成第 } j \text{ 项工作。} \\ 0. & \text{表示不指派第 } i \text{ 个人去完成第 } j \text{ 项工作。} \end{cases}$$

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