Study of optimizing the transportation distribution of coal

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ABSTRACT

According to the present situation of the influence on the environment from the transportation system of coal, it’s necessary to study the construction and optimization of the transportation system of coal and design an operating mechanism of green transportation system of coal in order to achieve the transformation from traditional transportation to green transportation. The present paper has supplied an optimized scheme: in order to minimize the pollution and green transportation, the shortest path and the best distribution can be achieved through the method of multimodal transport, considering both road and rail. First of all, considering both road and rail, a network chart of road and rail transportation has been plotted. Based on the algorithm of Warshall-Floyd, the shortest path between supply place and marketing place can be obtained. Secondly, according to table dispatching method, the best distribution scheme can be plotted. Then you can get the minimum freight.

KEYWORDS

Method of multimodal transport; Shortest path; Table dispatching method; War shall-floyd algorithm.

INTRODUCTION

The transportation of coal, as a key link of coal industry, is a bridge and link between the production and consumption of coal. However, coal industry, as one of the largest flow of social material resources, will inevitably have a negative influence on the environment. At the same time, the irrational distribution scheme of coal will cause more serious pollution.

Based on the optimization theory, according to the present situation of the influence on the environment from the transportation system of coal, it’s necessary to study the construction and optimization of the transportation system of coal and design an operating mechanism of green transportation system of coal.

QUESTION ANALYSES

According to the present situation of the influence on the environment from the transportation system of coal, in order to study the construction and optimization of the transportation system of coal and design an operating mechanism of green transportation and achieve the transformation from traditional transportation to green transportation, the present paper covers two questions:

Question 1

Considering the transportation method and route. Therefore the key to the question is how to make sure of the shortest route from the various routes quickly.
and efficiently.

**Question 2**

Obtaining the best distribution scheme, based on the shortest route, under the balance between supply and demand.

**SYMBOL DESCRIPTIONS**

- \( A_i \): the \( i \)-th place of production (\( i=\{1,2,3\} \))
- \( E_j \): the \( j \)-th place of demand (\( j=\{1,2,3,4\} \))
- \( a_i \): the output of the \( i \)-th place
- \( b_j \): the sales volume of the \( j \)-th place
- \( c_{ij} \): freight (the sum of all the sections of freight on the shortest path)
- \( x_{ij} \): the cargo volume from the \( i \)-th place of production to the \( j \)-th place of demand

This paper is supported by the Instructional Project of Science and Technology from Coal Industry Association (MTKJ2013-415) and the Natural Scientific Fund Project in Hebei Province (A2011209019).

\( Z \): cost of transporting coal

\( d_{ij} \): the shortest distance between vertex \( A_i \) to \( E_j \)

\( W_{ij} \): the weight of vertex \( A_i \) to \( E_j \)

**CONSTRUCTIONS OF MODELS AND SOLUTIONS**

Assume that the freight per ton per kilometer is the same with the same mode of transportation. The freight volume will not change in the process of transportation, namely, assume that the goods will not be damaged or lost. There is no time limits of transportation. Assume the production balances with marketing.

**Question 1**

**The construction of model of shortest path**

1. The connected graph of network of coal transportation
2. According to the network of routes, the adjacency matrix of freight per volume between two cities about graph 1 can be obtained.

\[
\begin{array}{cccccccccccccccc}
& 0 & 19 & 19 & 24 & 28 & 30 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
19 & 0 & 24 & 23 & 15 & 20 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
24 & 0 & 29 & 17 & 15 & 27 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
20 & 23 & 29 & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
24 & 25 & 17 & \infty & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
28 & 20 & 15 & \infty & \infty & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
30 & \infty & \infty & \infty & \infty & \infty & 9 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
M &=& \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
19 & 27 & 17 & 13 & 13 & \infty & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
24 & 23 & \infty & 9 & 26 & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
20 & \infty & \infty & \infty & \infty & \infty & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
24 & \infty & \infty & \infty & 23 & 13 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
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19 & 27 & 17 & 13 & 13 & \infty & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
24 & 23 & \infty & 9 & 26 & 0 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
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24 & \infty & \infty & \infty & 23 & 13 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
28 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
30 & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty & \infty \\
\end{array}
\]

The solution of the model of shortest path

Let be \( d_{ij} \) is the shortest distance between vertex \( A_i \) and \( E_j \); and \( W_{ij} \) is the weight of vertex \( A_i \) to \( E_j \)

According to graph theory, the shortest route to each city can be obtained through Warshall-Floyd algorithm.

- \( A_1 \) to \( E_1 \): \( A_1 - C_1 - D_1 - E_1 \); \( A_1 \) to \( E_2 \): \( A_1 - C_1 - D_1 - E_2 \);
- \( A_1 \) to \( E_3 \): \( A_1 - C_1 - D_2 - E_3 \); \( A_1 \) to \( E_4 \): \( A_1 - B_3 - D_3 - E_4 \);
- \( A_2 \) to \( E_1 \): \( A_2 - B_2 - C_1 - D_1 - E_1 \); \( A_2 \) to \( E_2 \): \( A_2 - B_2 - D_2 - E_2 \);
- \( A_2 \) to \( E_3 \): \( A_2 - B_2 - D_2 - E_3 \); \( A_2 \) to \( E_4 \): \( A_2 - B_3 - D_3 - E_4 \);
- \( A_3 \) to \( E_1 \): \( A_3 - C_2 - D_2 - E_1 \); \( A_3 \) to \( E_2 \): \( A_3 - B_2 - D_2 - E_2 \);
- \( A_3 \) to \( E_3 \): \( A_3 - B_3 - D_3 - E_3 \); \( A_3 \) to \( E_4 \): \( A_3 - B_3 - D_3 - E_4 \);
**Question 2**

The construction of the model of allocation of transportation

Cities demand coal of 4,200,000 tons, 3,500,000 tons, 5,100,000 tons, 3,800,000 tons respectively every year, which is supplies by coal mines $A_1, A_2, A_3$. The output of $A_1$ is 5,200,000 tons; $A_2$ is 7,000,000 tons; $A_3$ is 4,400,000 tons. Seek the minimal freight.

Let $x_{ij}$ be the quantity of the goods transported from the place of production $A_i$ to the place of marketing $E_j$ ($i=1,2,3,...,m; j=1,2,3,...,n$).

The mathematical model of transportation is:

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

subject to

$$\sum_{j=1}^{n} x_{ij} = a_i, i = 1,2,3,...,m$$

$$\sum_{i=1}^{m} x_{ij} = b_j, j = 1,2,3,...,n$$

where $x_{ij} \geq 0$

Balance between production and marketing:

$$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$$

According to the known information, the mathematical model of this question can be obtained:

$$\min Z = 65x_{11} + 53x_{12} + 57x_{13} + 59x_{14} + 60x_{21} + 42x_{22} + 46x_{23} + 57x_{24} + 65x_{31} + 48x_{32} + 48x_{33} + 50x_{34}$$

$$x_{11} + x_{12} + x_{13} + x_{14} = 520$$

$$x_{21} + x_{22} + x_{23} + x_{24} = 700$$

$$x_{31} + x_{32} + x_{33} + x_{34} = 440$$

$$x_{11} + x_{21} + x_{31} = 420$$

$$x_{12} + x_{22} + x_{32} = 350$$

$$x_{13} + x_{23} + x_{33} = 510$$

$$x_{14} + x_{24} + x_{34} = 380$$

$$x_{ij} \geq 0, i = 1,2,3, j = 1,2,3,4$$

The best distribution scheme can be obtained based the above chart: From the coal mine A, coal of 4.2 million tons is transported through the route $A_1 - E_1$; coal of 1.0 million tons is transported through the route $A_1 - E_4$. From the coal mine B, coal of 3.5 million tons is transported through the route $A_2 - E_2$; coal of 3.5 million tons is transported through the route $A_2 - E_4$. From the coal mine C, coal of 1.6 million tons is transported through the route $A_3 - E_1$; coal of 2.8 million tons is transported through the route $A_3 - E_4$. According to this scheme, the total freight is 856,80 million yuan.

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