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Solving the Problem of Material Distribution Based on Table Operations Method

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Abstract: *Distribution is the most basic function of logistics system. With the rapid development of the logistics industry, logistics companies to increase rapidly, the logistics companies increasingly competitive, how to strengthen management to reduce the cost of logistics companies has becoming the mainstream topic of concern. Distribution is the displacement of goods involved in a number of supply positions to a number of positions of demand for, it is the key to consider supply and demand balance and transportation cost optimization in the distribution problem. In this paper, to determine the distribution location and their supply, customer point and the premise of each customer point of demand, considering what kind of scheduling program to make the goods according to the specified needs shipping and the lowest freight, to meet the requirements of the table Table Operations Method can be an effective solution to this problem.*

Keywords: *distribution, transportation model, Table Operation Method*

1. Introduction

Table Operation Method, that is, using the list method to solve the problem of linear programming in the transport model of the calculation method, in fact, is a simplex method way, the only different is the completed specific forms. Different from the general linear programming, the production and sales equilibrium problem must have feasible solution, and there must be the optimal solution.

1.1. Basic Steps on the Table Operation Method

(1) Find the initial basis feasible solution, (m + n-1) digital lattice as the basic variable. Generally use the minimum element method, Vogel or northwest corner method;

(2) Find out the test number of non-basic variable;

(3) Determine the base input-variables, min $\{\sigma_{ij} \mid \sigma_{ij}<0\} = \sigma_{lk}$, then X_{lk} for the entry variables;

(4) Determine the base output-variable, find out the closed loop of the base variable;

(5) Adjust the transportation scheme with closed loop method;

(6) Repeat steps (2), (3), (4), and (5) until the optimal solution is obtained.

The process is shown in Figure 1.

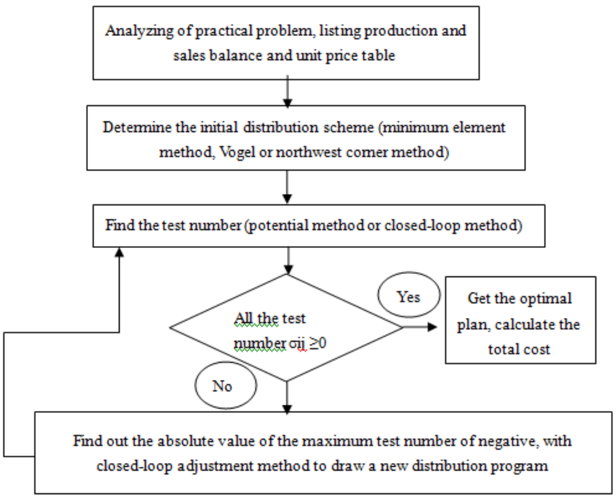

Figure1. *Basic Steps of the Table Operation Method*

2. ESTABLISHMENT OF MATHEMATICAL MODEL OF DISTRIBUTION PLAN

2.1. Firstly, To Determine Decision Variables

Logistics companies often have a number of distribution centers in a region to supply the goods, each logistics center has a certain amount of supply. As for anyone, the distribution of goods customers are often more than one, one to more customers is more common. So the decision-making variables for the distribution problem between the two volumes.

Suppose that m = 3, n = 4 indicates that there are three distribution centers, four demand, assuming the transport from the ith delivery point to the jth customer location of the amount of material for the Xij (i = 1.2.3 j = 1.2.3.4), And then determine the objective function, that is, the lowest cost of delivery. The unit price Cij represents the unit delivery price from the distribution center i to the customer j, the supply ai(15.12.13) of each delivery site Ai, and the demand quantity bj(10.13.12.5) of each customer Bj.

See Table 1 for details.

Table1. *Basic information on the distribution of materials table*

Freight (hundred yuan / t)	B1	B2	B3	B4	Supply (t)
A1	2	6	5	3	15
A2	1	3	2	1	12
A3	3	2	7	4	13
Demand (t)	10	13	12	5	40

2.2. The Objective Function: The Minimum Transportation Costs

$\text{Min}=f(x)=2X_{11}+6X_{12+}5X_{13}+3X_{14}+1X_{21}+3X_{22}+2X_{23}+1X_{24}+3X_{31}+2X_{32}+7X_{33}+4X_{34}$

2.3. Constraints: Each distribution point of supply constraints, demand for each customer demand limit, the supply of non-negative restrictions 3 restrictions

(1) The supply limit: $X_{11}+X_{12}+X_{13}+X_{14}=15$

$X_{21}+X_{22}+X_{23}+X_{24}=12$

$X_{31}+X_{32}+X_{33}+X_{34}=13$

(2) The demand limit: $X11 + X21 + X31 = 10$

$X12 + X22 + X32 = 13$

$X13 + X23 + X33 = 12$

$X14 + X24 + X34 = 5$

(3) The non-negative limit of freight: $Xij \geq 0$ (i = 1.2.3 j = 1.2.3.4)

3. SOLUTION OF THE BEST SOLUTION OF MATERIAL DISTRIBUTION

3.1. Determination of the Initial Distribution Plan

First of all, the data listed in Table 2 as a table of operations, according to the minimum element method (that is, from the table in the smallest unit of price in the beginning, if the table has the same minimum element, optional any start until all supply and demand relations in the table completed) to determine the number of supply and demand supplies delivery.

Table2. *Participation table of decision variables*

Freight (hundred yuan / t)	**B1**	**B2**	**B3**	**B4**	**supply (t)**
A1	2 X_{11}	6 X_{12}	5 X_{13}	3 X_{14}	15
A2	1 X_{21}	3 X_{22}	2 X_{23}	1 X_{24}	12
A3	3 X_{31}	2 X_{32}	7 X_{33}	4 X_{34}	13
Demand (t)	10	13	12	5	40

In Table 2, $C_{21} = C_{24} = 1$ is the smallest element, can choose one of the two as a starting element, where C21 as the starting element is selected to determine A2-B1 material distribution routes, and then determine the volume, A2 supply The capacity is 12t, the demand of B1 is 10t, the smaller of A2 and B1 (12t, 10t) is chosen as A2-B1, the transportation volume is 10t, because the supply of A2 is 12t, Part of the supply of B1, the remaining 2t can be transported to the B2, B3, B4, and B1 10t material needs are met, B1 no longer need to A1 or A3 supply, so A1-B1, A3-B1 transport part of the painting "×" means that the part does not take into account the path of material transport. Then consider the same unit price is 1 C24, determine the volume, compare A2 'and B4 (2,5) in the smaller, set the volume of 2, then A2' = 0 that the supply of material A2 has been All transported out, will no longer B2, B3 material distribution, A2-B2, A2-B3 transport part of the painting "×" that does not take into account the part of the path for material transport. And so on, until the supply and demand balance in the table, that supply all the supply out of the demand for the demand for materials to meet the requirements, the results shown in Table 3.

Table3. *Table of initial material distribution plan*

Freight (hundred yuan / t)	B1	B2	B3	B4	supply (t)
A1	2 ×	6	5 12	3 3	15
A2	1 10	3 ×	2 ×	1 2	12
A3	3 ×	2 13	7 ×	4 0	13
Demand (t)	10	13	12	5	40

$X_{13}=12; X_{14}=3; X_{21}=10; X_{24}=2; X_{32}=13; X_{34}=0;$

$f(x)=(5\times12+3\times3+1\times10+1\times2+2\times13+4\times0)\times100=10700$yuan

3.2. Verify that the Initial Distribution Plan is Optimal

The potential method is used to test the optimality. The so-called potential method, the distribution program in each row gives a factor Ui (row potential), each column gives a factor Vj (column potential), for each solution of the base variable Xij, Cij = Vj + Ui This inside the Vj, Ui can be positive and negative can also be zero. The test number σij = Cij- (Vj + Ui) of the non-basic variable Xij, and the specific process for finding the number of tests based on the job potential method on the Table Operation Method is given in Table 4.5.6.

Table4. *Potential method for the first time to determine the tests number σij initial table*

	B1	B2	B3	B4	Ui
A1			5	3	0
A2	1			1	-2
A3		2		4	1
Vj	3	1	5	3	

Table5. *Determination of non-base variable test number bypotential method table*

	B1	B2	B3	B4	Ui
A1	3	1	5	3	0
A2	1	-1	3	1	-2
A3	4	2	6	4	1
Vj	3	1	5	3	

Table6. *Determines the test number for variables by potential method*

	B1	B2	B3	B4
A1	-1	5	0	0
A2	0	4	-1	0
A3	-1	0	1	0

In the table, the test numbers σ_{11}, σ_{23}, and σ_{31} are negative numbers, indicating that the optimal solution is not obtained and the distribution plan is adjusted

3.3. Adjust the Initial Distribution Plan

The adjustment procedure of distribution plan:

(1) Determine the base In-ariables Choose the smallest number of non-base variables (spaces), that $\min\{\sigma ij \mid \sigma ij <0\}= \sigma_{lk}$, then X_{lk} for the base input-variables (the purpose of the freight as much as possible to reduce);

(2) Determine the base Out-variable. In the closed loop of X_{lk}, the minimum traffic of the even point is the adjustment amountθ, the corresponding θvariable is the base Output-variable;

(3) Adjust the delivery volume. In the closed loop of X_{lk}, the variable corresponding to the odd point is added with the adjustment amount θ, the variable corresponding to the even point is subtracted from the adjustment amount θ, and the remaining variables are not changed, and a new set of feasible solutions are obtained. And then re-test the test number of non-base variables at this time.

This is the basis of the variable into the principle of the minimum tests numbers corresponding to the non-base variables, because it is σ11 = σ23 = σ31, optional three, where the choice of A_2-B_3 as a variable into the base variables for the closed line corresponds to (12, 3, 2) of the even-numbered points is selected as the input-variables. The detailed adjustment process is shown in Table 7.8.9.

Table7. *Non-Base Variable Closed-Loop*

	B1	B2	B3	B4
A1			12-2	3+2
A2	10		+2	2-2
A3		13		0

Table8. *New Distribution Plan after One Adjustment*

	B1	B2	B3	B4
A1			10	5
A2	10		2	0
A3		13		0

The distribution cost at this time: (5×10 + 5×3 + 1×10 + 2×2 + 2×13 + 4×0) ×100 = 10500 yuan

Table9. *The Secend Time Determination of Test number Σij by Potential Method Able*

	B1	B2	B3	B4
A1	-2	5	0	0
A2	0	5	0	1
A3	-2	0	1	0

At this point the test numbers in the table is still negative, indicating that did not reach the optimal.

Table10. *New Distribution Plan after Secondary Adjustment*

	B1	B2	B3	B4
A1	10		0	5
A2			12	
A3		13		0

Total delivery cost: (2×10 + 5×0 +3×5 + 2×12 + 2×13 + 4×0) ×100 = 85000 yuan

3.4. Determine the Optimal Distribution Plan

Table11.*Test Numbers of Decision Variables for the Optimal Distribution Plan*

	B1	B2	B3	B4
A1	0	5	0	0
A2	2	5	0	1
A3	0	0	1	0

At this point the test numbers are positive, that has been the optimal solution, but because σ31 = 0, there are infinitely many optimal solutions. The final material distribution program for the X11 = 10t, X14 = 5, X23 = 12t, X32 = 13t, logistics center 1 to 1 customer distribution of 10 tons of cargo to 4 customers with 5 tons of cargo; logistics company 2 to 3 customers 12 tons goods. The logistics center 3 distributes 13 tons of goods to 2 customers. At this point the logistics company's total cost of distribution of the smallest, the total distribution cost of 85,000 yuan.

4. Conclusion

From the results, it can be seen that the total cost of the optimal solution is reduced by 2200 yuan, Through the establishment of logistics distribution model, using the table operations method to solve the minimum distribution cost, to solve the distribution center to reduce distribution costs, enhance the logistics company's market competitiveness. The whole process of thinking is not only applicable to the case of the minimum of the total freight, but also for the same time or at least the shortest journey. Although the table operations method to solve the problem of material distribution is an effective way, but there are still many problems to be solved, such as how to get the best program to avoid the adjustment of many cases, etc., these are worth Continue to explore the issue.

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