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A study on transportation problems using operational research

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Abstract
The main aim of the paper is to find the idle time for the jobs and how we can reduce the processing time using operation research. The transportation problem is the special type of linear programming problem where the objective is to minimize the cost of distributing a product from one to another. By replacing the simplex method we use the transportation problem which is to used to determine the minimise cost to transport the product in the destination. The total supply is equal to the total demand is called balanced problem.

Keywords: transportation, VAM, NWC, LCM, maximum, minimum

1. Introduction

1.1. Operation research (OR)?

Operations research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations. In operations research, problems are broken down into basic components and then solved in defined steps by mathematical analysis.

1.2 Transportation Problem

Transportation Problem in Operational Research. The transportation problem in operational research is concerned with finding the minimum cost of transporting a single commodity from a given number of sources (e.g. factories) to a given number of destinations (e.g. warehouses).

1.3 Types of transportation problem?

There are two types of Transportation Problem.

1. Balanced Transportation Problem
2. Unbalanced Transportation Problem.

2. Transportation Method

The transportation method consists of the following three steps.

1. Obtaining an initial solution, that is to say making an initial assignment in such a way that a basic feasible solution is obtained.
2. Ascertaining whether it is optimal or not, by determining opportunity costs associated with the empty cells, and if the solution is not optimal.
3. Revising the solution until an optimal solution is obtained.

The first step in using the transportation method is to obtain a feasible solution, namely, the one that satisfies the rim requirements (i.e. the requirements of demand and supply). The initial feasible solution can be obtained by several methods.

1. North – west Corner Method
2. Least Cost Method (LCM)
3. Vogel's Approximation Method (VAM)

3. Applications of Transportation Problem

- Minimize shipping costs
- Determine low cost location
- Find minimum cost production schedule
- Military distribution system

4. Problems

1. Obtain the minimum transportation cost to the following transportation problem using VAM method.

Table 1

	0.5hp	1.0hp	1.5hp	2.0hp	Supply
Crompton	11	13	17	14	250
Koel	16	18	14	10	300
Besten	21	24	13	10	400
Demand	200	225	275	250	

Solution

Since $\sum a_i$ =950=$\sum b_i$ Total Demand=Total supply
Hence the given problem is transportation problem is balanced.

Table 2

200	50		
11	13	17	14
	175	125	
16	18	14	10
		150	250
21	24	13	10

No. of. Occupied cells = m +n-1

$$= 3 + 4 - 1$$
$$= 6$$

Initial basic feasible solution,

$= (200 * 11) + (50 * 13) + (175 * 18) + (125 * 14) + (150 * 13) + (250 * 10) = Rs. 12,200$

Modi Method

Table 3

110	130	170	140
160	180	140	100
210	240	130	100

Occupied cells: $c_{ij} = u_i + v_j$ $u_1 = 0$
$c_{11} = 0 + v_1$ $c_{12} = 0 + v_2$ $c_{22} = u_2 + 130$ $c_{23} = u_2 + v_3$
$v_1 = 110$ $v_3 = 130$ $u_2 = 50$ $v_3 = 50$
$c_{33} = u_3 + v_3$ $c_{34} = u_3 + v_4$
$u_3 = 80$ $v_4 = 20$

Unoccupied cells
$d_{ij} = c_{ij} - (u_i + v_j)$
$d_{13} = c_{13} - (u_1 + v_3) = 170 - (0 + 80) = 170 - 80 = 90$
$d_{14} = c_{14} - (u_1 + v_4) = 170 - (0 + 20) = 170 - 20 = 150$
$d_{21} = c_{21} - (u_2 + v_1) = 160 - (50 + 110) = 160 - 160 = 0$
$d_{24} = c_{24} - (u_2 + v_4) = 100 - (50 + 20) = 100 - 70 = 30$
$d_{31} = c_{31} - (u_3 + v_1) = 210 - (80 + 110) = 210 - 19 = 20$
$d_{32} = c_{32} - (u_3 + v_2) = 240 - (80 + 130) = 240 - 21 = 30$
All d_{ij} >=0 the solution under the test is optimal.

Optimal solution
$= (200 * 11) + (50 * 13) + (175 * 18) + (125 * 14) + (150 * 13) + (250 * 10) = Rs. 12{,}200$
The minimum transportation cost is Rs.12, 200.

2. Obtain the minimum transportation cost to the following transportation problem using VAM method.

Table 4

	0.5hp	1.0hp	1.5hp	2.0hp	supply
Crompton	21	16	25	13	11
Koel	17	18	14	23	13
Besten	32	27	18	41	19
Demand	6	10	12	15	

Solution

Since $\sum a_i$ =43=$\sum b_i$Total Demand=Total supply
Hence the given problem is transportation problem is balanced.

Table 5

			11
21	16	25	13
6	3		4
17	18	14	23
	7	12	
32	27	18	41

No. of. occupied cells $= m + n - 1$
$= 3 + 4 - 1$
$= 6$

Initial basic feasible solution,
$= (11 * 13) + (6 * 17) + (3 * 18) + (4 * 23) + (7 * 27)\ (12 * 18) = Rs. 796$

Modi Method

Table 6

			11
21	16	25	13
6	3		4
17	18	14	23
	7	12	
32	27	18	41

Occupied cells:
$$c_{ij} = (u_i + v_j)\ u_1 = 0$$
$c_{14} = (u_1 + v_4) = 0 + 13$ $v_4 = 13$
$c_{21} = (u_2 + v_1) = 17 - 10$ $v_1 = 7$
$c_{22} = (u_2 + v_2) = 18 - 10$ $v_2 = 8$
$c_{24} = (u_2 + v_4) = 23 - 13$ $u_2 = 13$
$c_{32} = (u_3 + v_2) = 27 - 8$ $u_3 = 19$
$c_{33} = (u_3 + v_3) = 19 - 18$ $v_3 = 1$

Unoccupied cells:
$d_{ij} = c_{ij} - (u_i + v_j)$
$d_{11} = c_{11} - (u_1 + v_1) = 21 - (0 + 7) = 21 - 7 = 14$
$d_{12} = c_{12} - (u_1 + v_2) = 16 - (0 + 8) = 16 - 8 = 8$
$d_{13} = c_{13} - (u_1 + v_3) = 25 - (0 + 1) = 25 - 1 = 24$
$d_{23} = c_{23} - (u_2 + v_3) = 14 - (10 + 1) = 14 - 11 = 3$
$d_{31} = c_{31} - (u_3 + v_1) = 32 - (19 + 7) = 32 - 26 = 6$
$d_{34} = c_{34} - (u_3 + v_4) = 41 - (19 + 13) = 41 - 32 = 9$

All d_{ij} >=0 the solution under the test is optimal.

Optimal solution
$= (11 * 13) + (6 * 17) + (3 * 18) + (4 * 23) + (7 * 27) + (12 * 18) = Rs. 796$

The minimum transportation cost is Rs.796.

5. Conclusion

This paper is based on operation research. From the problems we can find the idle time for the jobs and how we can reduce the processing time. In addition to that, using the priority transportation rule we can make the best decision rule. By using the transportation method we can also to determine the transportation by which the transport products from one place to another be processed to attain the optimal solution.

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