DETERMINATION OF MAXIMUM PROFIT OF A MANUFACTURING COMPANY USING A NEW TRANSPORTATION TECHNIQUE

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ABSTRACT

A newly developed transportation technique is applied here in order to determine the maximum profit of a manufacturing company. At the very beginning of the main operation a table called Total Opportunity Table (TOT) is determined, that makes the total procedure easier. Then the Distribution Indicators (DI) are calculated from the difference of the biggest and the smallest Unit Profit of each row and each column of the TOT. Basic cells are located which are the biggest entries of the TOT along the biggest DIs. Finally, allocations are made in the cells of Transportation Table (TT) corresponding to the basic cells of the TOT. The technique is justified with numerical example for its efficiency.

Key Words: TOT, DI, TT, Unit Profit.

01. INTRODUCTION

Transportation problem is a special class of the linear programming problems, that handles the situation where a particular goods is transported from several sources to several destinations in such a way that the total transportation cost is minimum while satisfying the supply limit and demand requirement. There is an impact of transportation cost on profit. Also the transportation techniques may be applied in production scheduling. The existing transportation algorithms like Vogel's Approximation Method (VAM), North West Corner (NWC) method, Matrix Minima method have been used in scheduling production for long [1, 2, 3, 4]. Now, many research works including Balakrishnan's Modified Vogel's Approximation Method for Unbalance Transportation Problem [5], Amirul et al.'s algorithms [6, 7, 8, 9], Korukoglu et al.'s Improved Vogel's Approximation Method (IVAM) for the Transportation Problem [10], Kasana et al.'s Extremum Difference Method (EDM) for Transportation [11] are playing vital roles in production scheduling. A new technique is introduced here, in order to accelerate the total works of resource allocation in manufacturing company. Before going to the main operation a new Transportation Table (TT) called Total Opportunity Table (TOT) is created and then Extremum Difference Method (EDM) is applied on TOT. Maximization transportation problem can be solved by any one of the methods mentioned earlier. But the presented technique is some extent more capable to solve the profit maximization problems.

2.1 Algorithm for TOT

Step 1 Subtract the smallest entry from each of the elements of every row of the TT and write down them on the right-top position of the corresponding element.

Step 2 Similarly subtract the smallest entry from each of the elements of every column and write down them on the right-bottom position of the corresponding element.

Step 3 Construct the TOT whose entries are the sums of right-top and right-bottom elements of Steps 1 and 2.

2.2 Algorithm for Profit Maximization

Step 1 Fix the row and the column distribution indicators just after and below the supply capacity and demand requirement respectively within first brackets that are the differences of the biggest elements and the smallest elements of each row and column of the TOT.

Step 2 Identify the biggest distribution indicator, if there are two or more than two biggest distribution indicators; choose the biggest indicator along which the greatest unit profit is present. If there is two or more than two greatest unit profit, choose any one of them arbitrarily.

Step 3 Allocate $x_{ij} = \min\ (a_i, b_j)$ on the left-top position of the biggest entry in the (i, j)th cell of the TOT; a_i and b_j are supply capacity and demand requirement of ith tools and jth product respectively.

Step 4 If $a_i < b_j$, leave the ith row and readjust b_j as $b_j^{/} = b_j - a_i$.
If $a_i > b_j$, leave the jth column and readjust a_i as $a_i^{/} = a_i - b_j$.
If $a_i = b_j$, leave either ith row or jth column but not both.

Step 5 Repeat Steps 1 to 4 until the satisfaction of rim requirement.

Step 6 Calculate, $P = \sum_{i=1}^{m} \sum_{j=1}^{n} p_{ij} x_{ij}$, P is the maximum profit; p_{ij} is the profit unit of (i,j)th cell and x_{ij} amount of jth product produced by ith machine.

3.0 NUMERICAL EXAMPLE

Four finished goods G_1, G_2, G_3 and G_4 are produced by three different tools T_1, T_2 and T_3. And their corresponding profit margins are given in the following table. We seek a suitable production schedule so that the capacities and requirements are satisfied and the profit is maximized.

Machines	Products				Capacity
	G_1	G_2	G_3	G_4	a_i
T_1	4	5	6	7	10
T_2	7	5	6	8	13
T_3	8	6	5	5	17
Demand b_j	9	13	8	10	40

Now get the row differences and column differences as:

Machines	Products				Capacity
	G_1	G_2	G_3	G_4	a_i
T_1	4^0_0	5^1_0	6^2_1	7^3_2	10
T_2	7^2_3	5^0_0	6^1_1	8^3_3	13
T_3	8^3_4	6^1_1	5^0_0	5^0_0	17
Demand b_j	9	13	8	10	40

The TOT is

Machines	Products				Capacity
	G_1	G_2	G_3	G_4	
T_1	0	1	3	5	10
T_2	5	0	2	6	13
T_3	7	2	0	0	17
Demand	9	13	8	10	40

Let us now make the distribution by Extremum Difference Method

Machines	Products				Capacity	Row Distribution Indicator			
	G_1	G_2	G_3	G_4					
T_1	0	$^{2}1$	$^{8}3$	5	10	(5)	(4)	(2)	(1)
T_2	5	$^{3}0$	2	$^{10}6$	13	(6)	(6)	(2)	(0)
T_3	$^{9}7$	$^{8}2$	0	0	17	(7)	(2)	(2)	(2)
Demand	9	13	8	10					
Column Distribution Indicator	(7)	(2)	(3)	(6)					
	-	(2)	(3)	(6)					
	-	(2)	(3)	-					
	-	(2)	-	-					

Now we see that the final allocation is

Machines	Products				Capacity
	G_1	G_2	G_3	G_4	
T_1	4	$^{2}5$	$^{8}6$	7	10
T_2	7	$^{3}5$	6	$^{10}8$	13
T_3	$^{9}8$	$^{8}6$	5	5	17
Demand	9	13	8	10	40

Therefore the maximized profit is

$$P = 5\times2 + 6\times8 + 5\times3 + 8\times10 + 8\times9 + 6\times8$$

= 10+ 48 + 15 + 80 + 72 + 48 = 273 units

4.0 COMPARISON OF PROFIT OBTAINED IN DIFFERENT METHODS

Methods	Profit
Presented Method	273
VAM	273
North -West Corner Method	192
Matrix Minima Method	273
Row Minima	255
Column Minima	273

From the above table it is clear that the presented technique and the VAM have given the highest profit for the manufacturing process. VAM always provides better resource allocation decision because of its close dealings with the profit units. In proposed method, a moderate table called TOT has been formed before going to the allocation process. This TOT has played a vital role in order to get the maximum profit. For the other cases, the North-West Corner method has considered only the locations of profit units where as the value of profit units would be the first matter of consideration. For this reason this method has given the worst result. In each case of Matrix Minima, Row Minima and Column Minima Methods, the highest profit units have been considered for allocation of resource. For this reason these methods have given better result than the North-West Corner method. It is checked that the optimal profit is 273 units that is provided by the proposed method.

05. CONCLUSIONS

The presented technique may be an effective tool for the managerial work in arranging the production schedule that can maximize the profit of the manufacturing company. In the illustrative example we see that the profit provided by our technique is directly optimal. So the technique developed here is capable in solving any type of profit maximization problems and it can ensure a solution which takes the value that is very nearer to the optimal solution. Sometimes it provides the optimal profit directly.

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