APPLICATION OF A NEW TRANSPORTATION ALGORITHM ON PROFIT MAXIMIZATION PROBLEM

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Abstract:
A transportation algorithm is developed and applied herein which can efficiently schedule the resources in order to maximize profit of a manufacturing company. Herein, the Distribution Indicators (DI) have been determined from the difference of largest two Unit Profit of each row and column. The locations of the basic cells have been determined as the largest entry of the Transportation Table (TT) along the highest DI. Maximum profit provided by this algorithm is very closer to the optimal profit. In most of the cases it provides the optimal profit directly. The method is illustrated with numerical examples to justify its efficiency.

Keywords: *DI, TT, Unit Profit.*

1.0 INTRODUCTION:

Transportation model plays a vital role to ensure the efficient movement and in-time availability of raw materials and finished goods from sources to destinations while satisfying the supply limit and demand requirement in such a way that the transportation cost is minimum. There is an impact of transportation cost on profit maximization. The existing transportation algorithms, such as, Vogel's Approximation Method (VAM), North West Corner (NWC) method, Matrix Minima method have been used in order to solve transportation problem for long [7, 8, 12, 13, 14]. Now, many researchers are developing new methods for solving transportation problems such as: Korukoglu et al.'s An Improved Vogel's Approximation Method (IVAM) for the Transportation Problem [10], Kasana et al.'s Extremum Difference Method (EDM) for Transportation [9], Balakrishnan's Modified Vogel's Approximation Method for Unbalance Transportation Problem [6], Amirul et al.'s Determination of Basic Feasible Solution of Transportation Problem: A New Approach [4] are appreciated. We may solve the maximization transportation problem by any one of the methods just mentioned. Here we present a new transportation algorithm that can efficiently solve any type of profit maximization problem.

We assume that the readers are well acquainted with transportation problems and resource allocation for profit maximization; we would present our developed algorithm.

2.0 ALGORITHM OF THE PRESENTED METHOD:

Step 1 Place the row and the column distribution indicators just after and below the supply limits and demand requirements respectively within first brackets, which are the difference of the two larger unit profit of each row and column of TT.

Step 2 Identify the highest distribution indicator and choose the greatest unit profit along the highest DI. If there are two or more highest indicators; choose the highest indicator along which the greatest unit profit is present.

Step 3 Allocate x_{ij} = min (a_i, b_j) on the left-top of the greatest unit profit in the (i, j) th cell of the TT where x_{ij} is the amount to be produced by the *i*-th machine of *j*-th product; a_i and b_j are the production capacity and demand requirement of *i*-th machine and *j*-th product respectively.

Step 4 If $a_i < b_j$, leave the *i*-th row and readjust b_j as $b_j' = b_j - a_i$.
If $a_i > b_j$, leave the *j*-th column and readjust a_i as $a_i' = a_i - b_j$.
If $a_i = b_j$, leave either *i*-th row or *j*-th column but not both.

Step 5 Repeat Steps 1 to 4 until the capacity limit and demand requirement are satisfied.

Step 6 Calculate $P = \sum_{i=1}^{m} \sum_{j=1}^{n} p_{ij} x_{ij}$, *P* being the maximum profit, where p_{ij} is the profit unit of *i*-th row and *j*-th column of the TT.

3.0 NUMERICAL ILLUSTRATIONS:

Example 1: Four products P1, P2, P3 and P4 are produced by three machines M1, M2 and M3 and their profit margins are given in the following table. We are required to find a suitable plan of production in machines so that the capacities and requirements are satisfied and the profit is maximized.

Table: 3.1

Machines	Products				Capacity of Supply
	P_1	P_2	P_3	P_4	
M_1	4	6	7	5	10
M_2	8	6	3	9	12
M_3	6	4	5	3	18
Demand	9	14	7	10	40

The distribution made by the difference of two larger unit profits is

Table: 3.2

Machines	Products				Supply	Row Distribution Indicator			
	P_1	P_2	P_3	P_4					
M_1	4	$^{3}6$	$^{7}7$	5	10	(1)	(1)	(1)	(2)
M_2	$^{2}8$	6	3	$^{10}9$	12	(1)	(2)	-	-
M_3	$^{7}6$	$^{11}4$	5	3	18	(1)	(1)	(1)	(2)
Demand	9	14	7	10	40				
Column Distribution Indicator	(2)	(0)	(2)	(4)					
	(2)	(0)	(2)	-					
	(2)	(2)	(2)	-					
	(2)	(2)	-	-					

Therefore, the profit is

$$P = 6\times3+7\times7+8\times2+9\times10+6\times7+4\times11$$

Example 2: Four products P1, P2, P3 and P4 are produced in three machines M1, M2 and M3 and their profit margins are given in the following table. We are required to find out optimal schedule of production so that the production capacities and demand requirements are satisfied.

Table: 3.3

Machines	Products				Capacity of Supply
	P_1	P_2	P_3	P_4	
M_1	6	4	1	5	14
M_2	8	9	2	7	18
M_3	4	3	6	2	7
Demand	6	10	15	8	39

The distribution made by the difference of two larger unit profits is

Table: 3.4

Machines	Products				Supply	Row Distribution Indicator			
	P_1	P_2	P_3	P_4					
M_1	6	4	$^{8}1$	$^{6}5$	14	(1)	(1)	(1)	(4)
M_2	$^{6}8$	$^{10}9$	2	$^{2}7$	18	(1)	(1)	(1)	(5)
M_3	4	3	$^{7}6$	2	7	(2)	(2)	-	-
Demand	6	10	15	8	39				
Column Distribution Indicator	(2)	(5)	(4)	(2)					
	(2)	-	(4)	(2)					
	(2)	-	(1)	(2)					
	-	-	(1)	(2)					

Therefore, the profit is

$P = ১ \times ৮ + ৫ \times ৬ + ৮ \times ৬ + ৯ \times ১০ + ৭ \times ২ + ৬ \times ৭$

= 232 units.

4.0 COMPARISON OF PROFIT OBTAINED BY DIFFERENT METHODS:

Table: 4.1

Methods	Profit	
	Example 1	Example 2
Presented Method	259	232
VAM	259	232
North-West Corner Method	183	137
Matrix Minima Method	259	232
Optimal Profit	259	234

We may show the profits obtained in different methods and the optimal profit by the Bar-chart as follows:

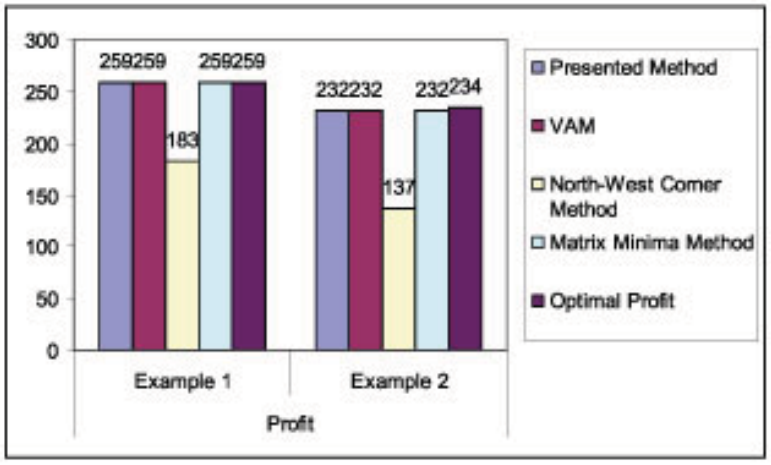

Chart: 4.1: Profits in Different Methods

5.0 CONCLUSION:

The presented method helps the manager to arrange the production schedule which maximizes the profit of the manufacturing company. In the first example we see that the profit provided by our method is directly optimal and in the second example we see that the profit is very closer to the optimal profit. So the method developed here can be used for solving any type of profit maximization problem and it ensures a solution which is very closer to the optimal solution. Sometimes the optimal solution is provided straightforward by the presented method.

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