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Minimisation of Transportation Cost in Logistics

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Abstract—*This paper aims at introducing the concept of transportation cost in logistics. Logistics play a key role in trade and, ensures the success of business operations. Methods to minimise the transportation cost is discussed in this paper. However, changing consumer demands, complex business models and growing client demands are just some of the top factors that pose a challenge logistics management.*

Design/Methodology

A possible mathematical model using transportation problem example and optimizing the transportation cost it carried out in TORA application for linear programming.

Introduction

Transportation and logistics problems have been studied for a long time by researchers and practitioners in operational research. In fact, in 1930, a model for the solution of a problem related to the transportation of salt, cement, and other cargo between sources and destinations along the railway network of the Soviet Union. The author studied the transportation problem and described various solution and the now well-known idea that an optimal solution does not have any negative cost cycle in its residual graph. Transportation**, is the crucial link and it acts as the nervous system of an economy.** With the rise of e-commerce industry and online platforms the need for bulk delivery of products, is growing at an exponential rate. There are, however some problems which inhibits the logistics industry from achieving its full potential. The two key areas of logistics industry requires the attention to minimise cost and value added services.

The objective of Transportation problem is to determine the optimum shipping schedule so that it minimises the total shipping from manufacturer to the final consumers through a variety of channels of distribution (wholesalers, retailers, distributors etc.) there is a need to minimize the cost of transportation so as to increase profit.

The following are the main objective of this paper:

1. To develop a mathematical model, which can be implemented in e-commerce sector.
2. To optimize the total costs of transportation with the help of multiple iteration using TORA software.
3. To identify the future scope of this research.

Types of Logistics

There are usually two types of logistics in trade. Forward Logistics and Reverse logistics. Forward Logistics is the flow of products from factory to consumer. The different types of forward supply chain includes hub services, direct order fulfillment, pick-and-pack services, and shipping. Reverse Logistics is the area of return of products from the destination to source. RL has become a matter of concern in the past years. A growing trend in reusable product has created an opportunity to add value through reverse logistics of **returnable** and reusable assets. In this way RL has become a matter of strategic concern and the companies are looking into their decision making process and the supply chains.

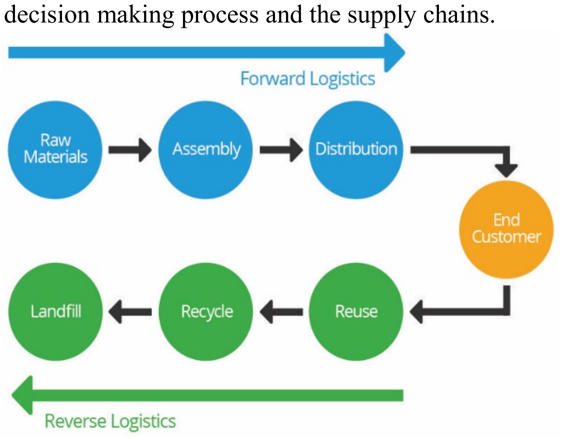


Figure 1: Transportation Problem

The transportation problem is one of the most important and successful applications of quantitative analysis in solving business problems has been in the physical distribution of products, commonly referred to as transportation problems. Basically, the purpose is to minimize the cost of shipping goods from one location to another so that the needs of each arrival area are met and every shipping location operates within its capacity. There are two methods for solving Transportation problem. These are Stepping Stone method and Modified Distribution method. In applying simplex method the initial solution had to be established in the initial simplex tableau. In transportation problem the initial solution can be found by several methods such as North west corner method, minimum cell cost method and Vogel's approximation method.

The following example is used to demonstrate the formulation of the Transportation model.

The linear programming model for this problem is formulated in the equations which are as follows:

To minimize Z $6x_{1A}$ $8x_{1B}$ $10x_{1C}$ $7x_{2A}$ $11x_{2B}$ $11x_{2C}$ $4x_{3A}$ $5x_{3B}$ $12x_{3C}$ subject to:

x_{1A}	x_{1B}	x_{1C}	150
x_{2A}	x_{2B}	x_{2C}	175
x_{3A}	x_{3B}	x_{3C}	275
x_{1A}	x_{2A}	x_{3A}	200
x_{1B}	x_{2B}	x_{3B}	100
x_{1C}	x_{2C}	x_{3C}	300

Northwest Corner Method

The **Northwest corner** Method or it is also called as upper left hand corner is a heuristic that is applied to a special type of Linear Programming problem structure called the Transportation Model, which ensures that there is an initial basic feasible solution. Northwest corner requires more no. of iterations and Vogel's method produces the best initial basic solution.

The following are the NWC steps

Step1: Allocate the maximum amount available to the selected cell and adjust the associated supply and demand quantities by subtracting the allocated quantity.

The problem is to determine how many tons of wheat to transport from each grain elevator to each mill in order to minimize the total cost of transportation. The cost of transporting one ton of wheat from each source to destination differs according to the distance. These costs are shown

Step2: Exit the row or the column when the supply or demand reaches zero and cross it out, to show that you cannot make any more allocations to that row or column. If a row or a column simultaneously reach zero, only cross out one (the row or the column) and leave a zero supply (demand) in the row (column) that is not crossed out.

Step 3: If exactly one row or column is left that is not crossed out, stop. Otherwise, advance to the cell to the right if a column has just been crossed out, or to the cell below if a row was crossed out. Continue with Step 1.

Least Cost Method

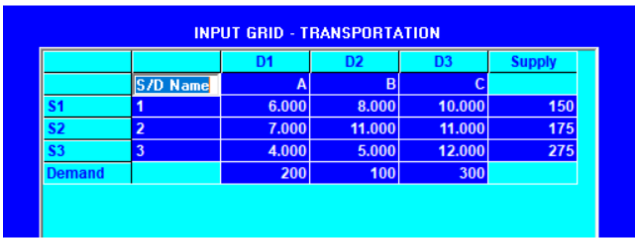
The **Least Cost Method** is one more method used to obtain the initial feasible solution for the transportation problem. Here, the allocation begins with the cell which has the minimum cost. The lower cost cell is chosen over the higher cost cell and the objective is to have the least cost of transportation. This Method is considered to produce more optimal results than the North-west Corner because it considers the shipping cost while making the allocation, whereas the North-West corner method only considers the availability and supply requirement and allocation begin with the extreme left corner, irrespective of the shipping cost.

Vogel's Approximation Method

The **Vogel's Approximation Method** or **VAM** is an iterative procedure calculated to find out the initial feasible solution of the transportation problem. Like Least cost Method, in VAM also the shipping cost is taken into consideration, but in a relative sense. VAM is an improved version of the least-cost method that generally, but not always, produces better starting solutions. VAM is based on the concept of minimizing opportunity costs. The opportunity cost for a given supply row or demand column is defined as the difference between the lowest cost and the next lowest cost alternative. This method is preferred over the methods discussed above because it generally yields, an optimum, or close to optimum, solutions. If we use the initial solution obtained by this method and proceed to solve for the optimise solution, the amount of time required to reach the optimum solution is greatly reduced.

Methodology

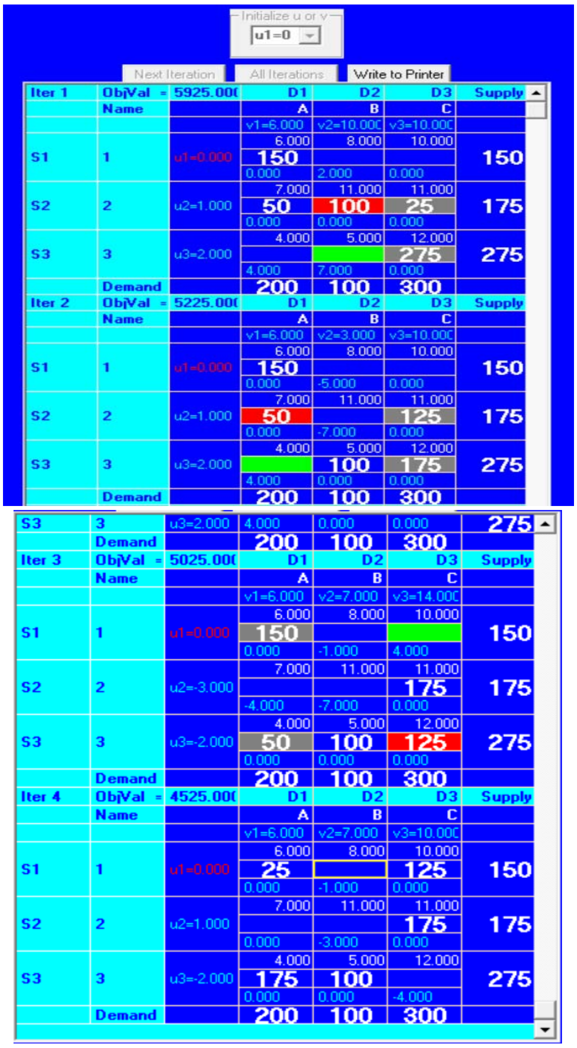
To solve the transportation problem, we use TORA application. TORA application is widely used in industries to solve linear programming problem (here we have a transportation problem). The focus of transportation problem is to find minimum transportation cost of an item. Such problems are solved by the use of specific transportation algorithm. Considering the above problem of wheat grain the below table shows the cost of transporting one ton of wheat from source to destination using TORA. Comparison is made between three methods so as to get minimum cost. Using NWC method we get the optimum cost after 4 iteration and using Vogel's approximation we get the optimum cost after two iteration.


INPUT GRID - TRANSPORTATION

		D1	D2	D3	Supply
	S/D Name	A	B	C	
S1	1	6.000	8.000	10.000	150
S2	2	7.000	11.000	11.000	175
S3	3	4.000	5.000	12.000	275
Demand		200	100	300	

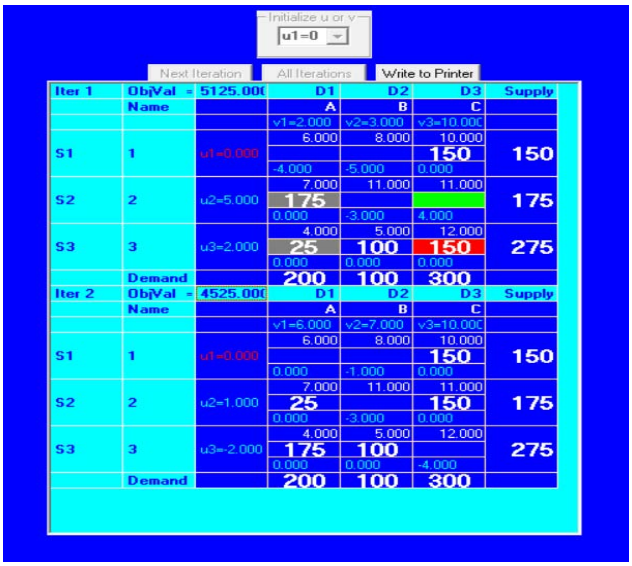
North West Corner

Iteration 1 and 2



Iteration 3 and 4

Vogel approximation Method



Conclusion

Using Vogel approximation for optimization is used to do the mathematical calculations. All mathematical modeling and calculation are performed in the TORA application, and final results are shown in the paper. There is approximately 4% decrease in total cost because of the two iterations performed.

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