Chapter 5
Simulation Tool for Transportation Problem: TRANSSIM

Pratiksha Saxena
Gautam Buddha University, India

Abhinav Choudhary
Gautam Buddha University, India

Sanchit Kumar
Gautam Buddha University, India

Satyavan Singh
Gautam Buddha University, India

ABSTRACT

This chapter introduces simulation tool TRANSSIM (Transportation model Simulation) to simulate transportation models. TRANSSIM is a tool which simulates and compares the results of different transportation models. A combination of programming languages is used to design this tool and is based on analytical approach to guide optimization strategy. In TRANSSIM, inputs are provided in terms of resources available, requirement and cost associated. Output performance measurements are calculated in terms of product allocation and associated total cost.

INTRODUCTION

Transportation models are very important for optimization of transport route and total cost associated with it. Transportation problem is referred to as allocation of routes for distribution of certain product from several sources to numerous destinations at minimum cost. It refers to allocation of transportation amount of single product from a set of sources to a set of destinations with the objective of minimization of transportation cost. Transportation model is one of the most important and successful application of quantitative analysis for solving business problems in the physical distribution of products. A key problem is how to allocate scarce resources among various activities or projects.

Transportation model is one of the most important and successful applications in the optimization and is a special class of the linear programming (LP) in the operation research. The optimization processes in mathematics, computer science and economics are solving effectively by choosing the best element from set of available alternatives elements. The main objective of transportation problem solution methods

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is to minimize the cost or the time of transportation. Most of the currently used methods for solving transportation problems are trying to reach the optimal solution, whereby, most of these methods are considered complex and very expansive in term of the execution time.

The transportation problem is concerned with finding the minimum cost of transporting a single commodity from a given number of sources to a given number of destinations. These types of problems can be solved by general network methods but here we use a specific transportation algorithm. The subject area of transportation model control is of major consideration because of its practical and economical importance. These models are important for improvement of services and cost reduction in logistics and supply chain management. Due to randomly changing demand, effective management in different types of environments, a lot of efforts are needed to improve existing transportation models. The objective is to determine how much should be shipped from each source to each destination so as to minimize the total transportation cost. The data of the model include;

1. The level of supply at each source and the amount of demand at each destination.
2. The unit transportation cost of the commodity from each source to each destination.
3. Since there is only one commodity, a destination can receive its demand from more than one source.
4. A transportation model is one in which the total supply and total demand are equal.

A transportation problem can be described mathematically as; For m sources $S_1, S_2, \ldots, S_m$, which provide supply with $a_i \ (i = 1, 2, 3, \ldots, m)$ units of supply respectively and transported among n destinations $D_1, D_2, \ldots, D_n$ with $c_{ij}$ units of demand respectively. If $c_{ij}$ is considered as the cost of shipping one unit of the product from source $i$ to destination $j$ for each route and $x_{ij}$ is number of units transported per route from source $i$ to destination $j$, the problem of transportation can be defined as determination of transportation schedule to minimize the total transportation cost while satisfying the supply and demand conditions. Mathematically, transportation model can be described as:

Minimize (total cost) $Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$

Subject to $\sum_{j=1}^{n} x_{ij} = a_i, \ i = 1, 2, \ldots, m$ (Supply constraints)

$\sum_{i=1}^{m} x_{ij} = b_j, \ j = 1, 2, \ldots, n$ (Demand constraints)

$x_{ij} \geq 0 \ \text{for every} \ i \ \text{and} \ j.$

The basic transportation network problem was firstly formulated by Hitchcock (1941). Linear transportation models were discussed by Ahuja et. al. (1993). An Ant colony algorithm is presented to solve the minimum cost network flow problem with concave cost functions by Marta S. R. M. et. al. (2011). A review paper is presented for national and international freight transportation models by De Jong G. et. al. (2004). A hybrid search algorithm based on genetic algorithm and ant colony optimization for concave cost transportation problem is determined by Altiparmak F. and Karaoglan I. (2007). A simulation tool is proposed for inventory models by Pratiksha Saxena and Tulsi Kushwaha (2014). An improved Heuristic algorithm is presented for the problem of inventory transportation integrated optimization by