Chapter 17
A Nelder and Mead Methodology for Solving Small Fixed-Charge Transportation Problems

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ABSTRACT

The term 'supply chain management' has become common in the business world, which can be understood from the positive results of research in the area, particularly in supply chain optimization. Transportation is a frontier in achieving the objectives of the supply chain. Thrust is also given to optimization problems in transportation. The fixed-charge transportation problem is an extension of the transportation problem that includes a fixed cost, along with a variable cost that is proportional to the amount shipped. This article approaches the problem with another meta-heuristics known as the Nelder and Mead methodology to save the computational time with little iteration and obtain better results with the help of a program in C++.
INTRODUCTION

The series of companies (actors) that interact for the production and delivery of goods and service is called a supply chain. The actors are connected through the flow of products, the flow of information, and the flow of money. A definition is given by Simchi-Levi, Kaminsky, and Simchi Levi (2000) for supply chain; they state that supply chains are flexible, dynamic, and complex networks of organizations. The reason for the existence of supply chains is that there are very few companies that can produce end products for end customers from raw materials on their own, without the assistance of other organizations. The company that produces the raw material is often not the same company that sells the end products to the end customers. In order to provide end products to the end customers, a network of actors is involved in activities (such as purchasing, transforming, and distribution) to produce products and/or services. All of these actors add value to the end product (Lummus, 1999). These companies that interact to produce end products, and to contribute to the value of end products, are called supply chain companies. Supply chain management covers all material management activities including inventory receipts, shipments, moves, and counts within a client and its organizations and to suppliers and customers. From this description, the image of a supply chain in general is obtained.

In the automotive world many lessons were understood from the Japanese approaches. The just-in-time (JIT) revolution pointed out that purchasing is a key issue, which involves far more than simply negotiating deals with and managing supply from direct suppliers. Ford, GM, and other western car manufacturers saw many differences in the approach adopted by their counterparts in Japan. The differences were the approaches like the idea of ‘partnership sourcing’, where the car manufacturers and suppliers worked together to attack quality and cost issues, and then shared the benefits. This was in marked contrast to the established western approach where cost reductions were negotiated (or, more accurately, imposed) and the suppliers then worked alone to try to retain some measure of profit from the deal. The lesson from the Japanese companies was that if the suppliers have problems, then it is not only they who suffer.

The other key point that purchasing professionals learned from Japan was that their success was dependent not only on dealings with their direct suppliers, but with the companies further down the procurement cycle who supplied the suppliers. The companies supplying the direct suppliers with components did not have the same purchasing power in the raw materials market as the direct suppliers themselves. This led to the direct suppliers assisting their suppliers in dealings with providers of, for example, metals, plastics, and electronic components.

This evolved into the various forms of suppliers called Tier 1, Tier 2, and Tier 3 suppliers, as shown in Figure 1. So the Japanese concept finally made it very clear that the manufacturers must manage and think of every link in a chain. The managers always wish to optimize the resources as the primary objective. Optimization problems are ubiquitous in the mathematical modeling of real-world systems and cover a very broad range of applications. So the proposed optimization model in this work proves to be of practical significance and may play a key role in the real-life business needs of decision making of the managers.

Optimization modeling requires appropriate time. The general procedure that can be used in the process cycle of modeling is to: (1) describe the problem, (2) prescribe a solution, and (3) control the problem by assessing/updating the optimal solution continuously, while changing the parameters and structure of the problem. Clearly, there are always feedback loops among these general steps. The diagrammatic representation of the process cycle in optimization is depicted in Figure 2.
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