Chapter 106
Metaheuristic Algorithms for Supply Chain Management Problems

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ABSTRACT

Recently, metaheuristic algorithms (MHAs) have gained noteworthy attention for their abilities to solve difficult optimization problems in engineering, business, economics, finance, and other fields. This chapter introduces some applications of MHAs in supply chain management (SCM) problems. For example, consider a multi-product multi-constraint SCM problem in which demands for each product are not deterministic, the lead-time varies linearly with regard to the lot-size and partial backordering of shortages are assumed. Thus, since the main goal is to determine the re-order point, the order quantity and number of shipments under the total cost of the whole chain is minimized. In this chapter, the authors concentrate on MHAs such as harmony search (HS), particle swarm optimization (PSO), genetic algorithm (GA), firefly algorithm (FA), and simulated annealing (SA) for solving the following four supply chain models: single-vendor single-buyer (SBSV), multi-buyers single-vendor (MBSV), multi-buyers multi-vendors (MBMV) and multi-objective multi-buyers multi-vendors (MOMBMV). These models typically are in any supply chain. For illustrative purposes, a numerical example is solved in each model.

INTRODUCTION

Always the companies have tried to design an effective and efficient business model where the main goal is to satisfy client needs better than competitors. Obviously, the success is determined by the design of systems that actually create and/or add value and with this the companies can be innovative. In nowadays companies should have always deliveries of products and services on time, with high quality, and at minimum cost. Those are some of the main issues that any client demands. As mangers attempt to accomplish these matters

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they often find that the enterprise lacks of needed resources and skills. Therefore, the managers are beginning to look more proactively beyond of the companies' walls to contemplate how resources of both suppliers and clients can be used to create and/or add value. Fawcett et al. (2007) mention that the efforts to align goals, share resources and collaborate across company boundaries are the essence and the challenge of the supply chain management.

A typical supply chain has several members and those are involved, directly or indirectly, in satisfying a customer request. The supply chain includes manufacturer, suppliers, transporters, warehouses, retailers, and even costumers themselves. In any organization (i.e. a manufacturer), its supply chain management should involve all functions from receiving until filling a costumer request.

According to Chopra and Meindl (2007) these functions are, but are not limited to, new product development, marketing, operations, distributions, finance and customer services.

This chapter will review four practical SCM problems. All of these problems involve uncertain demands for each product and variable delivery time due to the vendor. Some constraints such as budget, space and service level limitations are considered in the proposed models. These models are varied on the number of buyers, number of vendors and the nature of objective function. The first one considers the simple chain which is the multi-product multi-constraint single-buyer single-vendor (SBSV). The second one deals with the multi-buyers single-vendor chain (MBSV). The third one contains a more complex chain which is comprised of multi-buyers multi-vendors (MBMV). Finally, the fourth model contains the previous one and considers three different objective functions: minimizing the total whole chain cost, minimizing lead-time and maximizing service level (MOMBMV). For most problems of practical dimensions, even though for the simple model SVSB, these models contains a large number of variables, making hard to find the optimal solution.

In the next section we will prepare a brief explanation about what we will discuss in this chapter.

BACKGROUND ON SUPPLY CHAIN

Supply chain management (SCM) has been an important research topic in the field of operations research over last two decades, and it has established into a notion that covers strategic, tactical and operational management issues.

In recent years, the companies realize a more effective and efficient management of inventories across the whole supply chain through a better coordination and more cooperation. In this direction, they are in the joint benefit of all members involved. For this reason, the joint single-buyer single-vendor (SBSV), which the simplest form of SCM problem, has received an extensive attention in the literature. Perhaps, Goyal (1977) was the first researcher in introducing the basic single-buyer single-vendor integrated inventory model. Later, Banerjee (1986) considers that the vendor plays the role of a manufacturer with a finite production rate and uses lot-sizing policy to satisfy buyer's requests as separate batches. Hill (1999) develops a SBSV with an unequal shipment policy and concludes that using shipment sizes which can be increased by a fixed factor in the beginning and then remaining constant after a well-specified number of shipments is an optimal policy for SBSV problem. Hariga and Ben-Daya (1999) develop a SBSV in which reorder point, order quantity, and lead time are the decision variables. Hsiao and Lin (2005) also investigate a SBSV where the vendor holds a monopolistic status and he or she not only owns cost information about the retailer but also has the decision making right of the lead time. For other instances of the SBSV we can refer to Goyal (1988), Goyal and Gupta (1989), and Lu (1995), just to name a few.