Chapter 11
Hybrid Metaheuristics Algorithms for Inventory Management Problems

Ata Allah Taleizadeh
Iran University of Science and Technology, Iran

Leopoldo Eduardo Cárdenas-Barrón
Tecnológico de Monterrey, México

ABSTRACT

The hybrid metaheuristics algorithms (HMHAs) have gained a considerable attention for their capability to solve difficult problems in different fields of science. This chapter introduces some applications of HMHAs in solving inventory theory problems. Three basic inventory problems, joint replenishment EOQ problem, newsboy problem, and stochastic review problem, in certain and uncertain environments such as stochastic, rough, and fuzzy environments with six different applications, are considered. Several HMHAs such as genetic algorithm (GA), simulated annealing (SA), particle swarm optimization (PSO), harmony search (HS), variable neighborhood search (VNS), and bees colony optimization (BCO) methods are used to solve the inventory problems. The proposed metaheuristics algorithms also are combined with fuzzy simulation, rough simulation, Pareto selecting and goal programming approaches. The computational performance of all of them, on solving these three optimization problems, is compared together.

INTRODUCTION

For as long as managers remember, companies have tried to design an effective and efficient business model where the vital goal is to satisfy customer needs better than competitors. Success depends basically on the design of processes that actually create or add value and with this one can be innovative. Companies should have always deliveries of products and services on time, with high quality, and at low cost. Those are some of the main issues that any customer demands.

Inventory is obviously a common issue in any organization. Many retail stores are stocked with a large quantity of goods. Manufacturers are also filled with huge inventory of raw materials,

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work in process and finished goods. According to Muckstadt and Sapra (2010) manufacturers are also stored with inventories of equipment, machines, spare parts, among other things. Inventory theory is one of the fields where operations research has had noteworthy developments. For example, there are several mathematical models for the inventory control in use today in which the main objective is to have a good management of inventories of raw materials, spare parts or finished goods. Some of them are included in the most of commercial software for business solutions. Most of inventory models are developed to answer three primary questions: (1) what goods should be stored? (2) how much should be ordered when an order is placed to the vendor? and (3) when an order should be placed? The answer to these questions basically depends on the objectives of the business or even manager and the strategy used to accomplish the objectives. In actuality to answer these questions, one designs a variety of mathematical models based on a different set of assumptions concerning the way the inventory system being studied operates. Thus, the complexity of the inventory models depends on the assumptions and situation under which manager should decide about the demand, cost structure, and physical characteristic of inventory systems. It is a fact that the objective in most inventory models is to minimize costs. According to our experience, in most cases minimizing costs result in the same inventory policy as that determined by maximizing profits. This is one of the reasons why many researchers use the minimization approach instead of maximizing approach.

Typically, most inventory problems in situations of the real life involve multiple products. However, it is frequently that exist inventory models with a single product because these inventory models are capable to capture the fundamental elements of the problem. Therefore, it is not necessary to include the interaction of different products into the mathematical formulation. Furthermore multiple product inventory models are often too cumbersome to be used in practice when the variety of products is very huge. For this reason, single product inventory models are presented in the literature and are used frequently in practice. However, we will consider multi product inventory models in order to show that these models can be also implemented in practice easily.

This chapter reviews three practical inventory management problems considering certain and uncertain environments. They are: (1) joint replenishment EOQ problem, (2) newsboy problem, and (3) stochastic review problem. For each of them two different applications are provided.

The classical economic order quantity (EOQ) formula is the simplest inventory model for the cycle stock. It is well known that in the EOQ inventory model the demand, ordering and holding costs are deterministic over time. Also, the batch quantity may not be an integer, the whole batch quantity is delivered at the same time and backorders are not permissible. But we will give up all of mentioned assumptions and extend this version in two practical cases.

The newsboy problem is a classical periodic inventory management problem in which uncertainty in demand during a single period is considered. While the probability distribution of demand is known, the actual number of demand will not be known until after that the decision was made. Obviously, until the end of the period one can know the actual demand. In newsboy problem the order should be placed only in the beginning of the cycle. As it happens in the EOQ model also in the newsboy model the ordering and holding costs are deterministic over time. In this chapter we study an extended version of newsboy problem that considers fuzzy and rough environments and two different applications of the mentioned problem are proposed.

The stochastic review problem is one of the inventory management problems studied widely recently. Periodic inventory control problems are mainly developed considering two main assumptions: (1) the continuous review, where

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