A LITERATURE REVIEW ON MODELS OF INVENTORY MANAGEMENT UNDER UNCERTAINTY

Abstract

Inventories are raw materials, work-in-process goods and completely finished goods that are considered to be the portion of business's assets that are ready or will be ready for sale. Formulating a suitable inventory model is one of the major concerns for an industry.

The earliest scientific inventory management researches date back to the second decade of the past century, but the interest in this scientific area is still great. Again considering the reliability of any process is an important feature in the research activities. Values of some factors are very hard to define or almost unreal. In such cases, fuzzy models of inventory management take an important place. This paper analyzes possible parameters of existing models of inventory control. An attempt is made to provide an up-to-date review of existing literature, concentrating on descriptions of the characteristics and types of inventory control models that have been developed.

Introduction

The problem of inventory control is one of the most important in organizational management. As a rule, there is no standard solution – the conditions at each company or firm are unique and include many different features and limitations. An occurring task of the mathematical models development and determining the optimal inventory control strategy is related with this problem. Features of inventory management models are that the resulting optimal solutions can be implemented in a fast changing situation where, for example, the conditions are changed daily. There is a need for new and effective methods for modelling systems associated with inventory management, in the face of uncertainty. Uncertainty exists regarding the control object, as the process of obtaining the necessary information about the object is not always possible. The solution of such complex tasks requires the use of systems analysis, development of a systematic approach to the problem of management in general. Inventory models are distinguished by the assumptions made about the key variables: demand, the cost structure, physical characteristics of the system.

These assumptions may not suit to the real environment. There is a great deal of uncertainty and variability.

Inventory management

Stocks (reserves) are created to carry out the normal activities of the company. Proper and timely determination of the optimal inventory control strategy allows freeing a significant amount of assets, frozen in the form of stocks, which ultimately increases the efficiency of resource use. Even though there are literally millions of different types of products manufactured in our society, there are only two fundamental decisions that one has to make when controlling inventory:

1. How large should an inventory replenishment order be?
2. When should an inventory replenishment order be placed?

Economic order quantity models

For the fixed order size inventory models, the economic order quantity (EOQ) model is most well-known. The basic EOQ model is a formula for determining the optimal order size that minimizes the sum of carrying costs and ordering costs. The model is derived under a set of restrictive assumptions, as follows:

- Demand is known with certainty and is constant over time.
- No shortages are allowed.
- Lead time of orders is constant.
- The order quantity is received all at once.

Economic production quantity models

Economic Production Quantity model (EPQ) determines the quantity a company or retailer should order to minimize the total inventory costs by balancing the inventory holding cost and average fixed ordering cost. The EPQ model was developed by E.W. Taft in 1918 (Taft, 1918). This method is an extension of the EOQ model. The classical economic production quantity model (EPQ) has been widely used. Numerous research efforts have been undertaken to extend the basic EPQ model by releasing various assumptions or adding new so that the model conforms more closely to real-world situations. Recently, re-work activities have attracted considerable attention because of the reduction of the natural resources and the rise in the cost of raw material.

Joint economic lot sizing models

Inventory models that address issues of inventory coordination between a buyer and a seller have been extensively studied in the literature. This class of inventory models is commonly referred to as joint economic lot sizing (JELS) models. The objective of these models is the development of a jointly coordinated buyer-seller inventory strategy that is more beneficial to each member's individual non-coordinated inventory strategy. One of the first attempts was made by Lam and Wong (1996), extending the existing model of Dolan. They applied fuzzy mathematical programming to solve the joint economic lot size problem with multiple price breaks. Single and multiple incremental price discounts are modelled as fuzzy numbers.

Single-period models

The newsvendor model is a single-period, probabilistic inventory model, which objective is to determine the order quantity that minimizes expected underage costs (costs due to shortage) and overage costs (costs due to holding inventory). First single-period inventory models were designed by D. Petrovic (1996), who has formulated a conception of second level fuzzy set, methods of s-fuzzification and arithmetic defuzzification. Ishii and Konno (1998) introduced fuzziness of shortage cost explicitly into the classical newsboy problem. They investigated the so-called fuzzy newsboy problem where its shortage cost is vague and given by an L shape fuzzy number. Then, the total expected profit function was considered to be a fuzzy number.

Multi-period models

The main difference between the single-period model and the multi-period model is that the multi-period model may involve stock leftovers from previous periods, which makes the optimal choice of order quantities more complicated. In real-world applications, inventory and production decisions are interdependent and temporal in nature. Fuzzy logic has been useful in formulating multi-period lot sizing models.

Conclusion

In the past years, the efficiency of inventory management has become an area of major concern in business. New inventory models for managing the

inventory levels are now available. This paper has presented a literature survey of models of inventory control under uncertainty. Most of the analytical models addressed only one type of uncertainty and assumed a simple structure of the production process. The most common dimensions to be considered as fuzzy variables are demand, the cost of acquisition.

Each model, based on some assumptions, has its benefits and disadvantages, but still, many authors continue to design inventory control models using such approach as fuzzy logic.