International Journal of Operations Research

International Journal of Operations Research Vol. 18, No. 4, 79-96 (2021)

Optimization of Fuzzy Integrated Inventory Model with Ordering Cost Reduction Dependent on Lead Time

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Received September 2020; Revised March 2021; Accepted December 2021

Abstract: The intellectual and industrial design of a complex inventory system becomes a vital issue for the organization of responsiveness to uncertainties. The parameters involved in inventory model are likely to be varied due to the fluctuating business environment. Therefore, it will be more realistic apply fuzzy model rather than crisp model. This paper derives a single-vendor and a single-buyer integrated inventory model with ordering cost reduction dependent on lead time in a fuzzy environment. In this model, buyer and vendor cost parameters are uncertainties which necessitate the use of trapezoidal fuzzy numbers. The purpose of this model is to determine the minimum integrated total cost and optimal order quantity in the fuzzy scenario. There are two mathematical inventory models proposed in this paper. Initially, a crisp model is developed with fuzzy total inventory cost along with crisp optimal order quantity. Next, the fuzzy model is formulated with fuzzy total inventory cost and fuzzy optimal order quantity. Graded mean integration formula is employed to defuzzify the total inventory cost and the extension of the Lagrangian method is used to determine the optimal order quantity. An algorithm is developed to obtain the optimal order quantity and minimum integrated total cost. The comparison of a fuzzy inventory model with the conventional crisp inventory model is made through numerical examples. This proposed fuzzy model is also compared with some specific cases of the previous models. Finally, the graphical representation is presented to demonstrate the proposed model. The result illustrates that this fuzzy model can be quite useful in determining the optimal order quantity and minimum integrated total cost procedure when the lead time is analysed.

Keyword — Optimal integrated total cost, Optimal order quantity, Graded mean integration representation method, Fuzzy inventory system, Lagrangian method.

1. INTRODUCTION

Many authors handle inventory systems with various lead time cases where the cost components are considered as crisp values which do not represent the actual inventory system completely. In rare cases, the inventory cost components are considered as fuzzy values. In actual life, varying physical or synthetic features may cause an influence on the cost components and exact values of cost features as it becomes a risk to measure the exact amount of holding, order, and setup cost. Thus, in controlling the inventory system, it may allow some flexibility in the cost parameter values in order to treat the ambiguity which always fits the actual situations. Fuzzy set theory meets these prerequisites to some extent. In this paper, fuzziness is introduced by allowing the buyer and vendor ordering cost, inventory holding cost, setup cost and lead time crashing cost. It is suitable for the inventory system to fit the real situation and proves to be profitable.

The integrated inventory management organization is a common exercise in the global markets and provides economic benefits both for the vendor and the buyer. In recent years, most integrated inventory management organizations have focused on the integration between vendor and buyer. Once they form a tactical alliance to minimize their own cost or maximize their own income, trading parties can cooperate and share information to achieve enhanced benefits. Currently, companies can no longer contribute solely as individual entities in the constantly varying business world. Globalization of marketplace and increased competition force organizations to depend on effective supply chains to progress their overall performance. Lead time management is an important issue in manufacture and operation management. In many practical circumstances, lead time can be compacted using crashing cost.

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http://doi.org/10.6886/IJOR.202112_18(4).0001