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Advantages of Fuzzy Techniques and Applications in Inventory Control

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Abstract:
All industrial and business organizations have some types of planning and controlling for the inventory management system. Currently, inventory is one of the important expensive assets of 80% of business and industrial companies. The most difficult task is maintaining the balance between the inventory investment of a firm and its customer service. This research study proposed a comprehensive review on inventory system with fuzzy environment. Fuzzy set theory is generally considered with imprecision and the uncertain nature of quantitative coefficients.

Keywords: Inventory, Fuzzy, Business, soft computing.

INTRODUCTION

For a smooth running of an organization, a need of raw material is a must which should always be kept in hand. Any physical asset which has some economic value is called inventory. For a smooth running of an organization, the need for raw material is a must that should always be kept in hand. Any physical asset which has some economic value is called inventory. One is inventory is physically present, it must be handled and stored at minimum cost while at the same time, allowing production schedules. Inventory control techniques not only help in minimizing the capital tied up in inventory but also provide the required service level.

In today's business scenario, the highly business asset plays a vital role in manufacturing and warehouses management. A large number of raw material (especially sessional items) is required for starting the production which is based on highly financial structure. The inventory system is an important part of supply chain management system that observes each and every effort in whole production system from initial to final stage. The main work of inventory system is to maintain the complete record of any product. In business industries, manufacturer need to planning to new advanced strategies due to the customer's attraction and retaining is a very challenging task. In inventory models, there are uncertainties in cost coefficients and demand of products. In this research work, the importance of fuzzy in uncertain coefficients to find the optimal results using signed distance method are discussed.

Due to market competition, the replacement policy is much more attractive to the customer these days. Many shopping sites like Flipkart, Amazon, etc. provide the facilities to replace the demise, deteriorating products. Such types of products are packed foods, dry-fruits, pharmaceuticals, clothes, cosmetic items are included in the category which is widely used in every family. Many industrial firms adopt non-instantaneous deteriorating items to enhance their business policy, which is also the most attractive for the customer in a competitive world. The non-instantaneous policy for products attracts the customer's interest and the product can be freshly used for some time and get more benefit. These policies are applied in cosmetics, pharmaceuticals, packet food, eggs, fish, dry fruits products, etc.

The role model for soft computing is the human mind. The main basic ideas for soft computing in its current personification have links to many former influences, among them Zadeh's 1965 paper on fuzzy sets. The presence of neural computing and genetic computing in soft computing originated at an advanced point. First the study of the deterioration with inventory model began with Ghare and Schrader (1963) who established the classical inventory model in which consider the constant rate of decay. A general model having variable deterioration rate discussed by Covert and Philip (1973) and they the Ghare and Schrader model with two-parameter Weibull distribution. An early discussion on an inventory model with two-warehouse is given by Hartely (1976). After that Sarma

(1983) examined a deterministic inventory model in which consider a finite replenishment rate. Pakkala and Achary (1994) presented a new improved two-level storage inventory model for deteriorating that demand is uniform, replenishment rate is finite and shortages are allowed.

LITERATURE REVIEW

Inventory control and management plays a vital role in any business enterprises. The most popular inventory models which is based on demand and supply: Economic Order Quantity (EOQ) and Economic Production Quantity (EPQ) inventory models. The first inventory system established by Harris (1915) was EOQ model. Hadley and Whitin (1963) examined the study related inventory system in which both types of parameters deterministic and probabilistic parameters, varieties of inventory models and the inventory costs, etc. The main factor in inventory management to obtain the optimal profit before minimize the total inventory cost function for any industries. Recently, research work on inventory problems ha received some attention Sharma et al. (2013); (Singh and Malik (2008, 2009, 2010, 2011); Kumar et al. (2016, 2017 & 2019); Malik et al. (2016, 2017, 2019); Malik and Sharma (2011); Vashisth et al. (2015, 2016); Yadav and Malik (2014); Singh et al. (2011, 2014)). These inventory models consider that the input parameters and the output variables are described as crisp environment or having fixed values.

The research work written by Malik et al. (2018) presented a mathematical model with variable cost coefficients and the optimum result. The article of Gupta et al. (2013) investigated a mathematical model to obtain the optimal result for non-instantaneous deteriorating products, also determine the optimal ordering policies. The inventory model has been used for solving in many fields including supply chain management, sustainable development and engineering of many industrial and business companies. Malik et al. (2008) introduced a new preference system for the inventory model which is based on time-dependent demand rate. Malik et al. (2010) presented a comprehensive review of the developments and research work directed on supply chain management in industrial aspects. As the result of new technologies, market dynamics, increased competition day by day in business companies maintaining and controlling the inventory is more difficult and complex. Due to uncertainty, the fuzzy theory is an option for determining the optimum result, comparing it with traditional optimization techniques in a crisp environment for the inventory system.

Fuzzy theory is one of the most prominent techniques to obtain the optimality of the function with uncertainty constraints. Inventory cost coefficients like holding cost, deterioration cost, ordering cost is very difficult for determining their accurate value in decision making. However, these cost coefficients can be fixed or uncertain. Demand and cost coefficient uncertainty is very common in inventory management system such as in the field of mathematics, engineering, science, statistics and economics. Zadeh (1965) in the first effort to discuss the new set theory named fuzzy set theory which is based on the uncertain nature of coefficients and functions. Due to the uncertainty of cost coefficients and their objective function, sometimes obtaining the optimal result is not possible due to the fluctuation of their values of constraints. Therefore to obtain the optimal result of the function use the fuzzy constraints.

A fuzzy based approach was developed by Guiffrida (2010) to inventory system with EOQ models and Economic Production Quantity (EPQ) models, Single period models, multi-items models, and multi-period inventory models, developed in a general sense. Bellman and Zadeh (1970) also carried out research work on how to integrate the fuzzy parameters and goals which constituted the decision making that approximated the fuzzy sense for maximization decision is obtained from various knowledge areas. Kao and Hsu (2002) explored the fuzzy mathematical model in which asset trapezoidal fuzzy numbers and fuzzy demand rate. Chang et al. (2006) discussed the optimum cost function with fuzzy lead and fuzzy demand, and also used centroid method to obtain the optimum order quantity. Many researchers were interested in working with fuzzy set theory with inventory cost coefficients like demand, objective function and deterioration by Mizumoto and Tanaka (1981); Zimmermann (1985); Chang et al. (2004); Vujosevic and Petrovic (1996); Chen (1985); Halim et al. (2010); Yao and Lee (1999); Guiffrida and Negi (1998); Yung et al. (2007); Jaggi et al. (2013); Lin et al. (2017); Garg (2017); Dubois and Prade (1980); Yong et al. (2010); De (2021), etc., have been developed the various model with fuzzy environment over the last few decades.

Among these uncertainties, the fuzzy Model for uncertain quantity is especially used. The advantages of the fuzzy model include its ability to handle easily and provide a better result in comparison to a crisp model for the benefit of industrial problems. Yao and Chiang (2003) investigated the fuzzy inventory model for optimal ordering quantity and optimal result. They used the two method for solving the model: signed distance and centroid method. Chou (2009) developed a Kuhn-Tucker condition based fuzzy economic order quantity model with trapezoidal fuzzy number based constraints using function principal and Graded mean integration. Dutta et al. (2007) examined an inventory system with mixed environment including fuzzy random variable for buyer demand and determine the optimal solution with ranking method of fuzzy numbers.

Keeping in mind that fuzzy environment could be a flexible way of representing the cost coefficients, Malik and Singh (2011 & 2013); Malik et al. (2012) developed the

mathematical models with fuzzy and crisp environment considered the fuzzy constraints. Singh et al. (2014) explored the comprehensive survey on soft computing, which is the most attractive field for a researcher. Daniel et al. (2016) introduced and studied the fuzzy theory and its properties to generalize the decision-making policies for the dynamic models. Shekarian et al. (2017) employed the fuzzy theory to inventory system with systematic sample of large data is assumed for modelling and analyzing.

Priyan and Manivannan (2017) quantify the modeling and analysis of supply chain model for obtaining the optimal inventory policies in a uncertainty environment. Sarkar and Mahapatra (2017) concluded that the fuzzy demand and lead time based inventory models. They assumed the logarithmic investment function and used computational algorithms to obtain the expected total cost and optimal cycle length. Malik et al. (2018) presented a numerical and experimental analysis of inventory systems with time-varying demand. A recent addition to the inventory model with Pareto distribution based demand by Hollah and Fergany (2019), they introduced the stochastic deterioration rate for products. Malik and Garg (2021) evaluated the fuzzy inventory model to determine the optimum objective inventory cost function. Therefore the soft computing (fuzzy, Machine learning etc.) is likely to play a very significant role in medical, science, management, technology and engineering etc.

CONCLUSION

It can be concluded that the research works in literature prove that the application of fuzzy techniques for business scenario is entirely dependent on the inventory control and management. This article deals with a fuzzy-based inventory system where the fuzzy approach is applied to obtain the optimal inventory policies. A relative research study that assumed our examined policy with the most relevant inventory policies from the literary work which we adopt in our inventory system is shown. A future work will be further incorporate in the present work by introducing big data, machine learning, Blockchain techniques based.

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