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A Review of Two-warehouse Inventory System for Economic Order Quantity Model with Constant Rate of Demand using Soft-Computing Techniques

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Abstract

Provides a comprehensive introduction to the manual warehouse inventory system in relation to the economic order quantity model, with constant demand, using soft computing research status, this article reviews recent studies in relevant fields. compared to existing reviews, this article examines recent studies from a different perspective. firstly, this article proposes some key factors to be taken into account in a two-warehouse inventory system for modeling the volume of economic stocks, with constant demand, using soft computing studies; then, in terms of the scope of study, the current literature is divided into two categories: one-based studies and two inventory-based studies in a model for modeling economic order quantity with constant demand using soft computing. The literature for each category is reviewed according to the key two-warehouse inventory system to model the economic order volume, with constant demand, using the soft computing techniques mentioned above. the literature review framework in the study provides a clear overview of the two inventory systems for modeling the economic order volume, using a study area with constant demand, soft computing methods, which can serve as a starting point for further studies.

Keywords:-Inventory system, Two-warehouse, Economic Order Quantity Model, Constant Rate of Demand and soft-computing techniques

1. Introduction

1.1.Two-warehouse in inventory modeling

As previously discussed, the warehouse is an important place in the corporate entity and every businessman needed it during the commercial transaction of finished goods or raw materials. Now, in the current market scenario and due to the globalization of the market, the corporate environment is highly competitive and nobody wants to lose their will in the market and try to satisfy their customers' demand. For this, distributors and retailers always store the goods in their own shop. In this cut-throat economic environment, suppliers offer some discounts on wholesale purchases during festival seasons and also offer commercial credit financing schemes to attract their resellers. To take advantage of these supplier policies, retailers needed additional space to store products purchased wholesale during the period offered, but due to the limited space in crowded markets, retailers are faced with storage problems in their one and only owned warehouse and therefore required another storage space to store their excess purchased products. To solve this problem, they hire another rental storage space for a short time. This rented warehouse becomes an additional storage space that is provided by private / public or governmental agencies and these spaces are used as a secondary storage space. The acquisition of the rental space for storage purposes brought the concept of two warehouses into inventory modeling. In inventory modeling, the concept of two warehouses was first introduced by Hartley and, subsequently, many authors use the concept of two warehouses considering one with limited capacity (own warehouse) and others with unlimited capacity (rented warehouse). In this concept it is often assumed that the cost of transporting the items in the rented warehouse is higher than that of your warehouse due to the better storage facilities provided by the owner of the additional warehouse, so it is economical to consume the goods stored in the rented warehouse first to reduce the management costs incurred in the rented warehouse. We will discuss the advantages and limitations of two-warehouse modeling over single-warehouse modeling below.

1.2.Soft-Computing

Soft Computing is the fusion of methodologies that were designed to model and enable solutions to real-world problems, which are not modeled or are too difficult to model, mathematically. Smooth computing is a consortium of methodologies that works synergistically and provides, in one way or another, a flexible capacity for information processing to handle ambiguous real-life situations. [45] Its goal is to exploit tolerance for accuracy, uncertainty, approximate reasoning and partial truth to achieve solutions of traceability, robustness and low cost. The guiding principle is to devise calculation methods that lead to an acceptable solution at low cost, seeking an approximate solution to a problem formulated precisely or precisely. Soft computing differs from conventional (hard) computing. Unlike hard computing, it is tolerant of accuracy, uncertainty, partial truth, and approximation. In fact, the fundamental model for smooth computing is the human mind. Soft Computing is basically an optimization technique to find solutions to problems that are very difficult to answer.

2. Literature Review

However, all of the above models have been developed for a single warehouse. It implies that the available storage has unlimited capacity in these models. But, in practice, the capacity of any warehouse is limited. Therefore, the above models are unsuitable for a situation where you need to have a large stock. In fact, there are many practical cases that force the inventory manager to hold more items than can be stored in the OW. For example, one case is that the cost of the surcharge may be higher than the other related costs or the demand for the item may be very high; the second is that managers can get an attractive discount on bulk purchase prices; and so on. In recent years, various researchers have discussed an inventory system with two warehouses. Such a system was first proposed by Hartely (1976). In this system, it is assumed that the price of the property in RW is higher than that in OW. Thus, items in the RW are first transferred to the OW to meet demand until the stock level in the RW drops to zero, and then products are released into the OW. Sarma (1987) extended Hartel's model to cover transportation costs from RW to OW which is considered a fixed constant independent of the amount transported. But he (or she) did not consider flaws in his model. Goswami and Chaudhuri (1992) further developed the model with or without shortcomings assuming that demand varies with a linearly increasing trend over time and that transportation costs from RW to OW depend on the amount transported. In their model, inventories switched from RW to OW in an occasional pattern. However, the occurrence of deterioration is not considered in all these models.Sarma (1983) first developed a model of two warehouses for the decay of objects with an infinite rate of compensation and scarcity. Pakkala and Achary (1992) further considered the two-warehouse model due to the deterioration of items with a final compensation rate and a shortfall. For all of these models, demand was assumed to be constant and the cost of transporting items from RW to OW was not taken into account. In later works, using a continuous transport pattern, Bhunia and Maiti (1998) developed a model of two warehouses for the decay of objects with linearly increasing demand and shortage over an infinite period. Kar et al. (2001) studied a two-warehouse inventory model to consider size-dependent replenishment costs, linearly dependent demand, and a limited time horizon. However, several stock models have been found in the literature with two warehouses dealing with a demand level-dependent demand pattern. There are several related papers presented in this area such as Benkherouf (1997), and others. Perumal and Arivarignan (2002) presented a production inventory model with two production rates and backwards. The inventory policy of individual suppliers and multiple customers for things that are deteriorating was analyzed by Yang and Wee (2002). Yang (2006) developed two models of partial residual inventories based on the minimum cost approach.

Maitiet al. (2006) proposed an inventory model with a stock-dependent demand rate and two warehouses under inflation and time value of money where the planning horizon is stochastic in nature and follows an exponential distribution with known mean values. Lo etal. (2007) developed an integrated production-inventory model with assumptions of different deterioration rates, partial back ordination, inflation, imperfect production processes, and multiple deliveries driven by two warehouses.Lee and Hsu (2009) proposed a two-warehouse model for item deterioration with a general demand-dependent function on the time and final planning horizon in which an approach is adopted that allows a change in the time of the production cycle in order to determine the number of production cycles. Zhou et al (2003) investigated a new production planning strategy for variable commodities. Demand varied over time, and shortages were allowed and partially lagged behind. The problem with product inventories over time with different demand, production, and deterioration rates was developed by Goyal and Giri (2003). In this paper, we consider the problem with production stocks in which it is assumed that the rate of demand, production and decay of products varies over time. The shortcomings of the cycle may be partially lagging behind. Two models have been developed for this problem using different modeling approaches through an infinite planning horizon. Most inventory systems for things that get worse are considered a constant rate of deterioration that will continue in continuity. Wee et. al (2005) presented an inventory model for two warehouses with a combination of partial management disruption, deteriorating Weibull distribution, and inflation. Zhou and Yang (2005) developed a warehouse model for two warehouses for items with a demand-dependent rate of inventory. Moon, Giri, and Co. (2005) provided an economic quantity model to mitigate deteriorating items under inflation and time discounts. Hou (2006) presented an inventory model for deteriorating items with a stock-dependent consumption rate and a deficit under inflation and a time discount. Jalbaret.al (2006) investigated single-cycle policies for a single-warehouse N-vendor inventory distribution system. Law and Wee (2006) presented an integrated model of production and inventory to mitigate and aggravate items taking into account time discounting. Lee (2006) gave a two-warehouse warehouse model with deterioration in line with FIFO dispatch policy. Dye, Chang, and Teng (2006) investigated a declining inventory model with variable time and partial shortage-dependent lag. Dy, Ouyang, and Hsieh (2007) developed a determined inventory model for deteriorating items with capacity constraint and time-proportional lag .Chern, Yang, Teng, and Papachristos (2008) provided partial lagging inventory size models for deteriorating items with fluctuating demand under inflation .Dey, Mondal, and Maiti (2008) investigated two problems with warehouse stocks with dynamic demand and lead time interval values over a time period under inflation and a time value of money. Roy Ajanta (2008) analyzed an inventory model for deteriorating items with demand that depends on the price and time-varying cost of the property.Sivakumar (2009) provided a perishable inventory system with recurring requirements and a limited population. Skouri et al. (2009) Introducing a general ramp-type demand rate and considering Weibull's distributed deterioration rate.Gayen and Pal (2009) presented a two-warehouse warehouse model for deteriorating items with a rate dependent on inventory and holding costs. Ghosh and Chakrabarty (2009) presented an order-level inventory model under two levels of time-dependent warehousing. Hsieh et al. (2008) presented the determination of the optimal batch size for a two-storage system with decay and shortage using the net present value. Min and Zhou (2009) perishable inventory model under stock-dependent sales rate and partial lag-dependent stock with capacity constraint.Jaggi et al. (2010) developed a two-warehouse inventory model for deteriorating items when demand is price sensitive. Yang, Teng, and Chern (2010) studied the stock model under inflation for deteriorating items with a stock-dependent consumption rate and partial deficit shortfalls. Jaggi and Verma (2010) developed a warehouse model for two warehouses for deteriorating items with a linear trend of demand and a shortage in inflationary conditions. In this model, they consider a constant deterioration rate. demand in an imprecise and inflationary environment. Yadav and Swami (2018) discuss the partial lag of the batch size and stock model with time-varying holding costs and deteriorating weibula. Yadav et al. (2018) presented a supply chain inventory model for decaying items with two warehouses and partial ordering under inflation. Yadav et al. (2018) proposed an inventory model for the deterioration of items with two warehouses and variable holding costs. Yadav et al. (2018) analyzed a list of models of electronic components for deterioration of objects with storage using a genetic algorithm. Yadav et al. (2018) discuss the analysis of green warehouse supply chain inventory management in collaboration with the environment and sustainability using a genetic algorithm. Yadav and Kumar (2017) presented the supply chain management of electronic components for storage with environmental collaboration and neural networks. Yadav et al. (2017) analyzed the impact of inflation on a warehouse model with two warehouses of deteriorating items with time-varying demand and shortage. Yadav et al. (2017) discuss the inflationary inventory model for degraded items in two storage systems. Yadav et al. (2017) proposed a model of inadequate warehouses based on the unclear state for current things that are deteriorating, with a conditionally allowed payment delay. Yadav(2017) analyzed supply chain management analysis in inventory optimization for a warehouse with logistics using a genetic algorithm. Yadav et al. (2017) discuss the supply chain inventory model for two warehouses with soft computing optimization. Yadav et al. (2016) presented a more objective optimization for the electronic component inventory model and the decay of items from two warehouses using a genetic algorithm. Yadav (2017) analyzed the modeling and analysis of supply chain inventory models with two warehouses and the problem of sending economic load using a genetic algorithm. Yadav et al. In 2018, discuss the optimization of particle swarms for the inventory of the automotive model for two warehouses with waste items. Yadav et al. (2018) analyzed hybrid genetic algorithm techniques to list the automotive industry model for decaying items from two warehouses. Yadav et al. (2018) discuss the management of supply chain drugs for product degradation using a genetic algorithm. Yadav et al. (2018) analyzed the optimization of the particle stock model with particle goods. Yadav et al. (2018) presented the supply chain management of the hazardous substances industry for the decay of objects with storage using a genetic algorithm. Yadav (2017) discusses the analysis of seven phases of supply chain management in optimizing the electronic inventory of components for warehousing with economic shipment of cargo using it and PSO. Yadav et al. (2017) provides a more objective genetic optimization algorithm in the inventory model for aggravation of defective items using supply chain management. Yadav et al. (2017) we analyzed supply chain management in inventory optimization for object deterioration by genetic algorithm. Yadav et al. (2017) discuss modeling and supply chain management in inventory optimization for deteriorating items by genetic algorithm and particle swarm optimization. Yadav et al. (2017) presented a more objective optimization of particle swarms and a genetic algorithm in an inventory model for aggravation of defective items using supply chain management. Yadav et al. (2017) proposed the optimization of soft computer two storage inventory models with a genetic algorithm. Yadav et al. (2017) analyzed a more objective genetic algorithm involving green supply chain management. Yadav et al. (2017) presented a more objective particle swarm optimization algorithm that includes green supply chain inventory management. Yadav et al. (2017) provides green warehouse supply chain management with a particle swarm optimization algorithm. Yadav et al. (2017) performed an analysis of seven phases of supply chain management in the optimization of the inventory of electronic components for warehousing with economic shipping using a genetic algorithm. Yadav et al. (2017) discuss the analysis of six phases of supply chain management in warehouse stock optimization with an artificial bee colony algorithm using a genetic algorithm. Yadav et al. (2016) presented an analysis of electronic component inventory optimization in six phases of supply chain management for a warehouse with abc using a genetic algorithm and PSO. Yadav et al. (2016) analyzed an inventory model in two warehouses for deterioration of items with variable cost of ownership, demand, and lack of time-dependent time. Yadav et al. (2016) discuss a model of two warehouse inventories with a ramp-type demand and a partial backward for deteriorating weibul distribution. Yadav et al. (2016) proposed a two-warehouse model for deteriorating items with cost of holding under inflation and genetic algorithms. Singh et al. (2016) analyzed a two-storage model for deterioration of items with cost of keeping under particle swarm optimization. Singh et al. (2016) presented a model with two warehouses for deteriorating items with the cost of holding under inflation and soft computing techniques. Sharma et al. (2016) provides an optimal ordering policy for current items that are deteriorating with a conditionally allowed late payment within the two storage managements. Yadav et al. (2016) discuss genetic algorithm analysis and particle swarm optimization for a warehouse with supply chain management in inventory control. Swami et al. (2015) analyzed inventory policies for a deteriorating position with inventory-dependent demand and variable costs of keeping under allowable late payment. Swami et al. (2015) presented an inventory model for declining items with multivariate demand and variable cost of ownership within a trade-credit system. Swami et al. (2015) discuss the inventory model with price-sensitive demand, variable cost of ownership, and trade credit under inflation. Gupta et al. (2015) proposed a binary more objective genetic algorithm and PSO that includes optimizing the supply chain inventory with shortages, inflation. Yadav et al. (2015) analyzed software optimization of soft computers based on two storage inventory models for deterioration of defective items using a genetic algorithm. Gupta et al. (2015) discuss an inventory model based on a fuzzy-genetic algorithm for shortages and inflation under hybrid and PSO. Yadav et al. (2015) presented a two-warehouse warehouse model for deteriorating defective items according to a genetic algorithm and PSO. taygi et al., (2015) analyzed the inventory model with partial order adjustment, deteriorating weibul distribution below the two storage levels. Yadav and Swami (2014) presented a two-warehouse warehouse model for deteriorating items with a demand rate and inflation. Yadav and Swami (2013) discuss the effect of allowable delay on an inventory model in two warehouses due to deterioration of defective items. Yadav and Swami (2013) analyzed an inventory model in two warehouses for decaying items with exponential demand and variable cost of ownership. Yadav and Swami (2013) presented partial backlog inventory models with two warehouses for decaying items with inflation.Pandey, et. al. (2019)An Analysis Marble Industry Inventory Optimization Based on Genetic Algorithms and Particle swarm optimization. Malik, et. al. (2019)Security Mechanism implemented in Gateway Service Providers. Yadav and Swami (2019) A Volume Flexible Two-Warehouse Model with Fluctuating Demand and Holding Cost under Inflation. Yadav, et. al. (2019) Supply Chain of Chemical Industry For Warehouse With Distribution Centres Using Artificial Bee Colony Algorithm. Yadav, et. al. (2020) Electronic components supply chain management of Electronic Industrial development for warehouse and its impact on the environment using Particle Swarm Optimization Algorithm. Yadav, et. al. (2020) Reliability Consideration costing method for LIFO Inventory model with chemical industry warehouse.Yadav, et. al. (2020) proposed National Blood Bank Centre Supply Chain Management ForBlockchain Application Using Genetic Algorithm. Yadav, et. al. (2020) a give Medicine Manufacturing Industries supply chain management for Blockchain application using artificial neural networks. Yadav, et. al. (2020) proposed Red Wine Industry of Supply Chain Management for Distribution Center Using Neural Networks. Yadav, et. al. (2020) a give Rose Wine industry of Supply Chain Management for Storage using Genetic Algorithm.Ahlawat, et. al.. (2020) a give White Wine Industry of Supply Chain Management for Warehouse using Neural Networks.Chauhan and Yadav (2020) proposed An Inventory Model for Deteriorating Items with Two-Warehouse & Stock Dependent Demand using Genetic algorithm. Chauhan and Yadav (2020) a give Inventory System of Automobile for Stock Dependent Demand & Inflation with Two-Distribution Center Using Genetic Algorithm.Yadav, et. al. (2020) a give Reliability Consideration costing method for LIFO Inventory model with chemical industry warehouse. Yadav, et. al. (2020) a give Electronic components supply chain management of Electronic Industrial development for warehouse and its impact on the environment using Particle Swarm Optimization Algorithm International Journal Procurement Management.

3. Economic Order Quantity (EOQ) Model with Constant Rate of Demand:

EOQ is one of the oldest and most popular techniques. This model was first independently developed by Ford Harris and R.Wilson in 1916. The objective was to determine the quantity of an economic order, Q that minimizes the total cost of an inventory system when demand is at a constant rate. The model is developed under the following assumptions:

- The system deals with one item.
- The demand rate of D units per unit of time is known and constant.
- No quantity discounts available.

• Goods are produced in bulk or purchases are made in orders.
• The order cost is constant.
• Shortages are not allowed. Lead time is known and is constant.
• The refill rate is unlimited.
• Refill size is Q, the decision variable.
• T is the cycle time.
• The cost of holding the inventory Ch, per unit of time is known and constant during the period under review.

At reorder point R, when the inventory on hand is barely sufficient to satisfy demand during the lead time, LT, order is made for units Q. As demand rate and lead time are constant, the order of the Q units is found exactly when the inventory level reaches zero. This means there are no shortages. Inventory level changes from Q to zero, so the average inventory level during the inventory cycle is Q / 2. So, the inventory holding cost is obtained by multiplying this quantity by the cost of keeping one unit in inventory. per unit time. Hence, IHC = (Q / 2) Ch. The number of orders placed during the planning horizon would be D / Q and therefore the OC inventory order cost will be a function of the number of orders placed and the order cost per order. This, OC = (D / Q) C_o. the number of orders made in the D / Q planning horizon decreases, as the order size Q increases, OC is inversely proportional to Q.

The cost of the individual item is assumed to be constant regardless of the size of the order. So the cost of purchasing the item is horizontal. It only increases the total inventory cost by the constant amount of TC, over the entire quantity range. It does not affect the optimal order quantity, Q *. Therefore, it is not really a material cost in determining the quantity order of the economic order and we can eliminate it from further consideration in the model.

Accordingly,

Total Inventory Cost, TC = Order cost + holding cost

TC = (D / Q) C_o + (Q / 2) Ch

The total cost curve is U-shaped and reaches its minimum at the quantity equal to the transportation and ordering costs. We can equalize these two values to obtain the optimal order quantity Q *.

Or we can use calculus to find the expression for Q *, set the first TC derivative to zero and solve for Q.

Thus,

$$\mathrm{TC} = \left(\frac{\mathrm{D}}{\mathrm{Q}}\right)C_0 + \left(\frac{\mathrm{Q}}{2}\right)C_h$$

$$\frac{\mathrm{dTC}}{\mathrm{dQ}} = \left(\frac{\mathrm{-D}}{\mathrm{Q}^2}\right)C_0 + \frac{C_h}{2} = 0$$

$$\mathrm{Q}^* = \sqrt{\frac{2DC_0}{C_h}}$$

Also, since $(\mathrm{d}^2\mathrm{TC}/\mathrm{dQ}^2) > 0, Q^*$ is minimum,

The resulting expression of Q* obtained above is called the economic order quantity or the economic lot size.

The number of orders during the planning horizon = D/Q*

The length of the order cycle, t = Q*/D

And the minimum total inventory cost, TC* = (D/Q*) Co + (Q*/2) Ch = $\sqrt{2DC_0C_h}$

4. Methodology used for Solution

Mathematical techniques and other methods only aid management decision-making. They cannot replace the judgment of human experts. Several research papers on inventory modeling have been published considering a single warehouse system as well as two warehouse systems for many business environments but in this case the business environment has changed and therefore it is necessary to provide a model according to the current situation and the need for a real problem facing a firm using soft computing techniques. Of course, the model must be able to solve the problem effectively. Clearly, when a manager has an inventory problem and has a different model to choose the right one that fits his current need, then he can be confident that the efforts made to analyze inventory cost control will be effective and successful. In recent years, the emergence of inventory modeling under the facilities of two storage systems has provided a useful approach to solving the space problem by minimizing the total cost of relevant inventory. The aim of this research is to explore this approach by developing inventory models that can deal with the situation and the related problem. The purpose of inventory modeling, proposed as "Mathematical Modeling of an Inventory Decomposition with Two Warehouses and Shortages", is to provide inventory managers with a solution to achieve effective and efficient inventory management practice. The scope for using such modeling to support inventory manager decision-making would then be applicable to minimizing the total inventory cost and thereby maximizing a firm's overall profit. The proposed inventory modeling is to specify the demand patterns and other realistic combinations of factors that affect inventory cost for a given environment, calculate the optimal order quantity, and present the user output in numerical format and graphically using soft computing techniques. This system that incorporates the published knowledge and expertise in the fields of inventory modeling to inform inventory management support can provide inventory managers with the use of soft computing techniques. Such a system can enable rapid updating of the analysis of demand patterns, order quantity and cycle length through the use of soft computing techniques. First of all, the problem is theoretically framed with all the constraints. In the next step, the objective function is mathematically framed using soft computing techniques. This objective function can either be an absolute cost function that requires minimization or a profit function that needs to be maximized using soft computing techniques. The function is a sum of various costs associated with the system. These are order cost, purchase cost, acquisition cost, shortage cost and lost sale cost, if applicable. Along with the objective function all constraints are created mathematically and any solution must adhere to these constraints. Later, system decision variables are identified and system effectiveness is measured for these variables using only soft computing techniques. A system solution is then obtained that not only optimizes the objective function but at the same time satisfies the constraints. After finding the solution it is necessary to check the stability of the solution for various system parameters. These parameters or demand parameters using soft computing techniques may have different costs. In the course of our study we continually used the mathematical software MATHEMATICA 9.0 / MATLAB which greatly assisted in, but is not limited to, the mathematical models of our study. All inventory models, after formulation, need to be validated. This means that the model has to be tested for practical situation using soft computing techniques. In each model, there are certain decision variables involved. These may be present in cost or income factors using soft computing techniques.

5. Conclusions

In addition to a constant warehousing rate using soft computing, the two inventory systems for modeling economic order volumes have attracted increasing attention, and many researchers have conducted extensive studies in this area. In this article, from another perspective, we attempted to provide an overview of the manual warehouse inventory system for the economic order quantity model at a constant demand ratio using soft computing literature. According to the literature discussed in the dissertation, we can draw useful conclusions. The following subsections present significant findings, gaps identified in the research, and future directions for research in the area concerned. According to the scope of the research, the current studies can be divided into two categories: the first category uses the two inventory system to model economic order volumes at a constant demand ratio using soft computing techniques in a single firm, and the second category studies. The inventory of deteriorating items in the two-warehouse inventory management system for the economic order quantity model with a constant demand ratio, using soft computing. In terms of quantity, there are far fewer studies in the second category than in the first category. The study of inventory problems of deteriorating items is a new area of research compared to the research of inventories of ordinary objects, so that the total amount of research is much smaller than that of traditional ones.

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