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A triangular fuzzy demand stochastic process model for IoT

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Abstract

In terms of randomness and fuzziness of the inventory control and decision-making process that affect the two-echelon supply chain of textile, this paper proposes to construct a triangular fuzzy demand stochastic process model of textile two-echelon supply chain combined costs. To begin with, the researcher will study the textile two-echelon supply chain to produce the optimal model of combined costs. And then, this paper will try to prove the efficiency of the model.

Keywords: Subsidy; Game algorithm; Textile; Supply chain; Decision-making analysis

1. Introduction

Many factors, including globalization of market, information technology, advertisement, as well as the market competition, supplier and dealer, will directly and indirectly affect the price of products. Thus, the inventory system parameter of textile two-echelon supply chain changes with the passing of time, while the inventory extension under changing environment involves the complex problem of modeling. The supply chain is a commercial distribution activity based on network, embracing material purchase, raw material – finished product conversion and customer delivery in sequence (Bjørner & Jensen, 2002; Bly & Oldfield, 1986).

Generally speaking, the supply chain of an enterprise consists of several different phases: such as supplier, manufacturer, distributor and salesman. According to different distribution demands, products will be saved in different places. Therefore, the time of shipment, cargo size, etc. are decided by administrator through network, and the decision-making process have two main structures: integrated or dispersed (Li, 2000). For the former, the whole supply chain system is controlled by administrator and the purpose is maximize the benefits and minimize the costs. While for the latter, it has several different goals, which might be conflict, and during the decision-making process, in order to optimize the whole supply chain, all parts need to cooperate with each other.

To date, nearly all studies concentrate in the research of the adjustment mechanism for the cooperation and coordination and optimal schedule of joint channel among manufacturer and buyer under a certain condition. For example, manufacture-adversary system, including the purchase of raw materials, which is called as integrated procurement production (IPP) in the document (Min, Zou, Sun, Zhang, & Tan, 2012). It pointed out a supply chain optimal model that takes the delivery time of the raw material as the variate in decision-making process. Another document (Beach, Murray, Piggott, & Wohlgenant, 2002) developed a vendor managed inventory (VMI) system, in

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which the inventory is diminishing out of the conversion into finished products. These documents just deal with the problems in supply chain by supposing a certain condition. But in reality, demands are mostly random, or it is coexisted with fuzziness.

Therefore, under the real market, it's obviously inappropriate to take the fixed demands, and the using of probability theory needs a huge amount of historical data record. But actually, this part of historical record might simply cannot be used, especially in new supply chain. Fuzzy set theory, thanks to its slackness and flexibility in complete information, is a efficient way to solve this kind of problem. It also provides a algorithm framework dealing with uncertain dynamical system or data. In recent years, the application of fuzzy set theory in the inventory management of supply chain has gained extensive attention and study of experts in this area (Costafont, Jimenezmartin, & Vilaplana, 2016).

To take the document (Hirose, 1999) as an example, it studied the possibility of suppliers utilizing fuzzy supply chain system by designing fuzzy hierarchy analysis or fuzzy performance assessment. In the document (Alomar, 2013), the researcher designed fuzzy demands and shipment cost supply chain network to construct fuzzy mathematical programming argument. The document (Liberalizing, 2014) put forward a dual target supply chain model, considering under the circumstance of fuzzy ordering amount, the very first goal was to minimize the total cost of supply chain, and then to decline the bullwhip effect; The document (Ou & University, 2016) created a supply chain management solution for dairy industry, in which fuzzy quality management was executed to maximize the satisfaction degree of customers; And another document (Xu & Jiang, 2014) involved the selection of several purchasing suppliers, and applied fuzzy demands rate in retailers (Ashokkumar, Arunkumr, & Don, 2018; Hussein et al., 2018; Khanna et al., 2018; Wei, Meng, & Arunkumar, 2018).

In practice, the key parameters of supply chain system in commercial activity are not accurate, or it might be a random process (Elhoseny et al., 2018; Faeq Hussein et al., 2018; Sarvaghad-Moghaddam et al., 2018). Fussy random variate is a kind of hybrid uncertain model, having fuzziness and randomness, and is a relatively efficient tool in inventory modeling (Abdulhay, Elamaran, Arunkumar, & Venkatraman, 2018; Tharwat, Elhoseny, Hassanien, Gabel, & Arunkumar, 2018; Vardhana, Arunkumar, Abdulhay, & Ramirez-Gonzalez, 2018). For instance, a document extended constant inventory system by trying to take demand rate as a constant variate in a fuzzy random process; Another document studied the defective percentage of constant inventory system under fuzzy and random circumstance, and applied fuzzy random process in updating concept and constructed the needed cost function (Enas Abdulhay, Arunkumar, Narasimhan, Vellaiappan, & Venkatraman, 2018; Vardhana, Arunkumar, & Abdulhay, 2018); Also, a document tried to produce a cost-inventory model to transfer risk by machine under fuzzy and random environment, and the shift time if the variate of fuzzy and random process. Another document wanted to create a integrated supply chain system where demands rate depends on fuzzy and random process under the multi-goal frame.

On the basis of the above-mentioned documents, this paper will give priority to the integrated IPP inventory system model with single manufacturer and single buyer. And in the real supply chain system, this kind of textile two-echelon supply chain is the most common. So this kind of model study of the fuzzy and random process is more close to the reality and has higher real application value.

2. Modeling of textile two-echelon supply chain

2.1. Description of the problem

In this paper, the research constructed a two-echelon integrated procurement production of inventory system with a single manufacturer and a single buyer. The whole model frame of supply chain is shown in Fig. 1.

The mostly common supply chain include the manufacturer purchases raw materials, and turns it into finished products, and provide buyers with satisfactory products. However, there is no supply inventory administration (SCIM) model under fuzzy and random environment.

In general, the proportion of raw material and finished product are defined as transformation factors, and in many industries, like steel, food processing, etc., these factors are less than 1. In Fig. 1, the materials that didn't converted into finished products was stored as waste. Due to the limitation of inventory, the waste will be shifted instantly, and at present, many solutions will not optimize SCIM, especially when the installation cost of the manufacturer is higher than that of the ordering cost of buyer. Under this circumstance, the amount of raw materials predicted by model is usually times of that buyer's order. Compared with dispersed structure, separately integrating the manufacturing and ordering, as well as the purchasing of raw

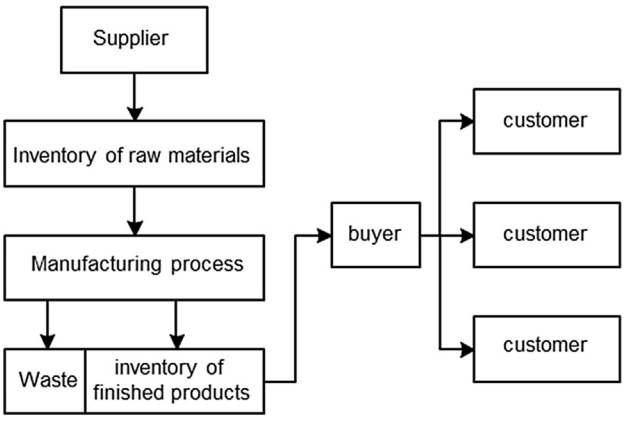

Fig. 1. Model of two-echelon supply chain.