行政院國家科學委員會專題研究計劃成果報告

可控制前置時間下含有瑕疵品的混合存貨模型

Mixture Inventory Model Involving Variable Lead Time with Defective Units

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e-mail：liangyuh@mail.tku.edu.tw

執行單位：淡江大學管理科學研究所

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摘　　要

本研究的主要目的是考慮在可控制的前置時間下，缺貨數量允許部份欠撥與部份不補(銷售損失)的混合存貨模型，其中前置時間內的需求量假設服從常態分配並且前置時間與訂購量均為決策變數。另外，我們亦考慮在到達的訂購量中含有某些數量的瑕疵品，並且假設該瑕疵品的個數為一二項隨機變數。本研究針對此兩項特性(可控制的前置時間及訂購量中含有瑕疵品)建立存貨數學模型並求其最適解，且探討參數的敏感度分析。

關鍵詞：瑕疵品，存貨，前置時間，趕工成本，欠撥，銷售損失

ABSTARCT

The purpose of this research is to consider a mixture inventory model with backorders and lost sales, in which the lead time is controllable and the demand during lead time follows a normal distribution, and both lead time and the order quantity as the decision variables. In addition, we also consider that an arrival order may contain some defective units, and assume that the defective units in an arrival order to be a binomial random variable. Our goal is to focus on these two properties (the controllable lead time and the order lot contains defective units) and develop the mathematical inventory model, and then to obtain the optimal solution. Furthermore, the effects of parameters are also included.

Keywords: defective units, inventory, lead time, crashing cost, backorder, lost sales

SOURCE AND PURPOSE

In most of the literature dealing with inventory problems, either in deterministic or probabilistic model, lead time is viewed as a prescribed constant or a stochastic variable, which therefore, is not subject to control (see, for example, Naddor[5] and Silver and Peterson[11]). In fact, lead time usually consists of the following components: order preparation, order transit, supplier lead time, delivery time, and setup time (Tersine[12]). In many practical situations, lead time can be reduced at an added crashing cost; in other words, it is controllable. By shortening the lead time, we can lower the safety stock, reduce the loss caused by stockout, improve the service level to the customer, and increase the competitive ability in business.

Liao and Shyu[3] first presented a probabilistic model in which the order quantity is predetermined and lead time is a unique decision variable. Later, Ben-Daya and Raouf[1] extended the Liao and Shyu's model by considering both lead time and the order quantity as decision variables. In their studies(Liao and Shyu[3], Ben-Daya and Raouf[1]), they assume that the probability of allowable stockout during lead time is vary small, and hence the shortages are neglected. Recently, Ouyang et al.[6] have extended the Ben-Daya and Raouf's model by adding the stockout cost.

The above body of literature does not describe the possible relationship between the order lot and quality. As a result of imperfect production of the supplier, and/or damage in transit, it is often that in an arrival order lot may contain some defective units. Silver[10] introduced an inventory model dealing with defective units. Kalro and Gohil[2] extended Silver's model to the case where demand during the stockout period is either completely or partially backordered. Porteus[8] and Rosenblatt and Lee[9] have studied the effect of defective units on economic manufacturing quantities. Most studies mentioned above, demands during the lead time are constant and deterministic. Later, Moinzadeh and Lee[4] have studied the effect of defective units on the operating characteristic of a discontinuous review inventory system with Poisson demand and constant lead time. Recently, Paknejad et al.[7] presented a quality-adjusted lot-sizing model with stochastic demand and constant lead time and studied the advantages of lower setup costs in such case. In this research, we consider a mixture of backorders and lost sales inventory model in which the shortages are allowed. Inventory is continuously reviewed, and order of size Q are made whenever the inventory level (based on the number of nondefective items) falls to the reorder point r. Besides, we assume that an arrival order may contain some defective units, and the number of defective units in an arrival order of size Q is a random variable

with binomial probability distribution. We also assume that the purchaser inspects the entire items and the defective units in each lot will be returned to the vendor at the time of delivery of the next lot. Therefore, the model will have an extra cost in the inspection of each lot and an extra cost for holding the defective units in stock until the time they are returned to the supplier.

The purpose of this research is to developed an algorithm procedure to find the optimal order quantity and optimal lead time when the distribution of the lead time demand is normal. Furthermore, the effects of parameters are performed.

RESULT AND DISSCUSSION

This research aims at developing the mathematical inventory model where lead time is controllable and the order lot contains defective units. Its optimal solution is then obtained. To help managers understand the effects of optimal solution on changes in the values of the different parameters associated with the inventory system, sensitivity analysis is also performed in the paper. This research develops a more realistic inventory model which can enhance the efficiency of an inventory manager in decision making.

SELF-EVALUATION

This research corresponds to the original plan and has attained its aim. Hence, the paper is of great academic value and suitable for publication in academic journals. It is now being revised by Computers & Industrial Engineering.

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