行政院國家科學委員會補助專題研究計畫成果報告

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※　可控制前置時間的一些隨機性存貨模型之研究　※
※　A Study of Some Stochastic Inventory Models for　※
※　Controllable Lead Time　※
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計畫編號：NSC－89－2213－E－032－013
執行期間：88 **年** 8 **月** 1 **日至** 89 **年** 7 **月** 31 **日**

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行政院國家科學委員會專題研究計畫成果報告
可控制前置時間的一些隨機性存貨模型之研究

A Study of Some Stochastic Inventory Models for Controllable Lead Time

計畫編號：NSC－89－2213－E－032－013

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摘　　要

本研究所探討的隨機性存貨模型涵括連續性和週期性兩種檢查策略。對連續性檢查存貨策略，訂購量、請購點和前置時間為決策變數；而對於週期性檢查存貨策略，則以檢查週期、目標水準和前置時間為決策變數。本研究模型中的目標函數不含有缺貨成本項，代之以服務水準的限制式。在此兩種檢查策略下之部份欠撥與部份不補(即銷售損失)的混合存貨系統，我們首先各別假設其前置時間/保護期間(即檢查週期與前置時間的和)內的需求量服從常態分配；接著，各自放寬常態需求的設定，而僅假設其一級和二級動差存在且已知。對此四種存貨模型，我們各自發展出一套演算法以決定最適的訂購策略。文中亦討論參數變動時對模型及最適解的影響。

關鍵詞：存貨、連續性檢查、週期性檢查、大中取小分配不拘程序

ABSTRACT

The stochastic inventory models analyzed in this study involve two strategies that are continuous review and periodic review. In the continuous review inventory strategy, order quantity, reorder point, and lead time are viewed as decision variables. Contrasting the periodic review inventory strategy, we assume that review period, target level, and lead time are decision variables. Instead of having a stockout cost term in the objective function, a service level constraint is added to each model. For both of these two strategies with a mixture of backorders and lost sales, we first respectively assume that the lead time /protection interval (i.e., review period plus lead time) demand follows a normal distribution, and then relax this assumption by only assuming that the first and second moments of the probability distribution of demand are known. For four models proposed, we respectively develop an algorithm to find the optimal ordering strategy. Furthermore, the sensitivity analysis is also performed.

Keywords：inventory, continuous review, periodic review, minimax distribution free procedure

SOURCE AND PURPOSE

In most of the early literature dealing with inventory problems, in both deterministic and probabilistic models, lead time is viewed as a prescribed constant or a stochastic variable, which therefore, is not subject to control (see, e.g., Naddor [8] and Silver and Peterson [11]). In 1983, Monden [5] studied Toyota production system, and pointed out that shortening lead time is a crux of elevating productivity. The successful Japanese experiences of using Just-In-Time (JIT) production show that the advantages and benefits associated with efforts to control the lead time can be clearly perceived.

Recently, several inventory models have been developed to consider lead time as a decision variable. Liao and Shyu [4] first presented a continuous review inventory model in which the order quantity was predetermined and lead time was a unique decision variable. Later, Ben-Daya and Raouf [1] extended Liao and Shyu's [4] model by allowed both the lead time and order quantity as decision varibles. Ouyang *et al.* [9] allowed both the lead time and order quantity as decision variables and considered a stockout case. In a recent research article, Ouyang and Wu [10] utilized the minimax decision criterion to solve the distribution free model. However, in the models previously mentioned [1,9,10], reorder point was not taken into account, and merely focused on the relationship between lead time and order quantity. In other words, they neglected the possible impact of reorder point on the economic ordering strategy. Such phenomenon is usually not perfect in the real inventory situation. In a recent research article, Moon and Choi [7] revised Ouyanget al.'s [9] model by considering the reorder point to be another decision variable. We note that the stockout cost in their paper is an exact value. However, in many practices, it is difficult to determine an exact value for the stockout cost, hence, we here replace the stockout cost term in the objective function by a service level constraint.

The objective of this paper is to extend Ouyang and Wu's [10] continuous review models to accommodate a more realistic situation. That is, our goal is to establish a (Q, r, L) inventory model with a service level constraint. From the numerical example provided, we can show that our new model is better than that of Ouyang and Wu [10]. On the other hand, we also propose a new (T, R, L) inventory model for periodic review. For both of these models, we first assume that the lead time/protection interval demand follows a normal distribution, and then try to find the optimal ordering policy. We next relax this assumption and merely assume that the first and second moments of the probability distribution of lead time/protection interval demand are known and finite, and then solve this inventory model by using the minimax distribution free approach. An illustrative numerical example is provided in each case.

RESULT AND DISCUSSION

In this study, we presented a mixture inventory model with backorders and lost sales, where the stockout cost term in the objective function is replaced by a service level constraint. First, we extended Ouyang and Wu's [8] continuous review model by simultaneously optimizing order quantity, reorder point, and lead time. Next, we developed a periodic review inventory model in which review period, target inventory level, and lead time are treated as decision variables. For these two models, we assumed that the lead time/protection interval demand follows a normal distribution, and found the optimal solution. Then, we relaxed this assumption and applied the minimax decision criterion to solve the distribution free case.

In future research on this problem, it would be of interesting to consider an inventory model involving the problem of net present value. Another possible extension of this work may be conducted by considering the backorder rate as a decision variable.

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 accepted by Yugoslav Journal of Operations Research.

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