行政院國家科學委員會專題研究計畫成果報告

緊急供應模式許可下定期盤存制之研究
A Periodic Review Inventory System with Emergency Orders

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一、中文摘要

物料管理一般皆假設一正常供應模式，亦即透過一般運輸方式，獲得供應商的原料。惟實務上物料管理人員遇手中存貨過低時，常使用緊急供應模式，亦即空運或其他較快速運輸，以作迅速之採購。循緊急供應模式下發出之訂單有較短的前置時間，惟卻有較高的訂貨成本。本研究計畫的目的在探討此兩種供應模式並存下之定期盤存制。

本計畫假設物料管理人員，在每一定期盤存時點，必須根據盤存後之存貨量來決定最適採購策略，亦即使用正常供應模式與(或)緊急供應模式。本計畫之研究成果可供國內各企業訂定合適之物料採購計畫，並適度削減存貨，減低營運成本。

關鍵詞：物料管理、定期盤存制、緊急供應模式

Abstract

In this research, we develop a dynamic programming model for a periodic inventory system in which there are two resupply options: namely a regular option and an emergency option. Orders placed through the emergency option have a larger unit item cost but a shorter lead time, compared to orders placed through the regular option. We assume that regular orders are placed at the beginning of order cycles, while emergency orders can be placed upon every periodic review. We devise a simple procedure of computing the optimal policy parameters. Thus, the proposed ordering policy is easy to implement.

Keywords: Periodic Review Inventory System, Regular Supply Mode, Emergency Supply Mode

二、計畫緣由與目的

In a recent article, Chiang and Gutierrez [4] study a periodic inventory system in which emergency orders can be placed upon every periodic review (a period has length of one or few working days), while regular orders are placed every m (an integer greater than one) periods which comprise an *order cycle*. Possible reasons for this (see [4] for more discussion) include avoiding large fixed order costs and achieving economies in the coordination and consolidation of orders for different items, which is particularly true if many items are purchased from the same source. For example, a retailer may order hundreds of items from a distribution center every two weeks (which is then the length of an order cycle). However, [4] considers inventory systems in which the regular and emergency supply lead times differ by more than one period but less than the order-cycle length. In this research, we assume that the emergency supply mode (for which the unit item cost is higher) has a lead time one period shorter than that of the regular supply mode.

Earlier research on periodic systems with two supply modes include that of Barankin [1], Daniel [5], Neuts [7],

Bulinskaya [2], Fukuda [6], Veinott [8], and Wright [10]. They assume that the lead times for regular and emergency replenishment differ by one period. Whittmore and Saunders [9] extend the analysis by allowing the emergency and regular lead times to be of arbitrary lengths. Unfortunately, the form of the optimal policy they derive is extremely complex. They are able to obtain explicit results only for the case in which the two lead times differ by one period. All of these studies assume that both regular and emergency orders can be placed at every periodic review epoch. In this research, we treat the problem in a different setting (where regular orders are placed at the beginning of order cycles) and derive the optimal ordering policy.

We analyze the problem within the framework of a stochastic dynamic program. We assume that emergency orders have a larger unit item cost. It is possible that emergency orders also have a fixed order cost. This research, like [4], treats only a special case, i.e., the cost of placing an emergency order is assumed to be negligible.

三、模型建構

We develop a dynamic programming model for the finite horizon problem in which there is only one state variable (as opposed to two state variables in [4]). We next derive conditions to verify the convergence of the regular and emergency ordering policies as the planning horizon is extended. Hence, the ordering rules to which these policies respectively converge are optimal for the infinite horizon model. Finally, we devise a simple algorithm of computing the optimal policy parameters. See [3] for all details.

四、結果與討論

The most important result of this research is that if two consecutive regular order-up-to levels are equal to each other and greater than (or equal to) all intermediate emergency order-up-to levels, then both the regular and emergency order-up-to levels have converged. These convergence conditions derived are simpler and easier to hold than their counterpart in [4]. In addition, the simple algorithm developed for computing the optimal policy parameters, which involves solving only a one-order-cycle dynamic program, is not available in [4].

五、計畫成果自評

The strength of this research is that the results can be immediately applied in periodic review inventory systems in which an emergency supply mode is used in addition to a regular supply mode. Such inventory systems are found in the import auto industry in Taiwan. The weakness of this research, however, is that the regular and emergency supply lead times are assumed to differ by only one period. Although not so realistic as the one in [4], this assumption may really be true if the supplier's warehouse is not too far away from the buyer.

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