

行政院國家科學委員會專題研究計畫 成果報告

供應鏈中退化性產品在不同信用交易法則下的最佳訂購策略之研究 研究成果報告(精簡版)

計畫類別：個別型
計畫編號：NSC 95-2221-E-263-002-
執行期間：95年08月01日至96年07月31日
執行單位：致理技術學院企業管理系(科)

計畫主持人：廖瑞容

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處理方式：本計畫涉及專利或其他智慧財產權，1年後可公開查詢

中華民國 96年08月16日

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供應鏈中退化性產品在不同信用交易下的最佳訂購策略之研究

An EOQ model for deterioration Items under different trade credit policy in a supply chain system

計畫編號：NSC95-2221-E-263-002

執行期間：95年8月01日至96年7月31日

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1. Scope and Purposes

Usually, in the classical inventory economic order quantity (EOQ) model, it is assumed that payments will be made to the wholesaler for goods immediately after receiving the consignments. However, in practice, the wholesaler may offer retailers a specific delay period for payments after the items are delivered. In day-to-day dealings, it is observed that the wholesaler offer different trade credit policies to the retailers. One such trade credit policy is “ α/M net T ” which means that a $\alpha\%$ discount on sale price is granted if payments are made within M days and the full sale price is due within $T(>M)$ days from the date of invoice if the discount is not taken. Therefore, it makes economic sense

for the retailer to delay the settlement of the replenishment account up to the last moment of the permissible period allowed by the supplier. Based upon the above arguments, the permissible delay in payments provides two advantages to the retailer: (1) the retailer will have more money to run in that period and (2) allowing a delay in payment to the retailer is a form of price discount and increase sales. In this paper, an attempt has been made to explore the lot size determination problem under a trade-credit policy of type “ α/M net T ”.

2. Literature Review

The effect of a permissible delay in payments on the optimal inventory system has

received the attention from many researchers. Goyal [7] derived an EOQ model under the conditions of permissible delay in payments. Thereafter, some research articles related to Goyal such as Chand and Ward [2] analyzed Goyal's problem under assumptions of the classical economic order quantity model. Aggarwal and Jaggi [1] considered an EOQ model with an exponential deterioration rate under the condition of permissible delay in payments. Chu et al. [5] examined the economic ordering policy of deteriorating items in Aggarwal and Jaggi's model. Jamal et al. [9] further generalized Aggarwal and Jaggi's model to allow for shortages. Shah [10] extended an EOQ model in which delays in payment were permissible and items in inventory deteriorated at a constant rate over time. Chang et al. [3] considered the inventory model for deteriorating items with linear trend demand under the condition that permissible delay in payments. Chen and Chung [4] analyzed buyer's economic order model under trade credit. Davis and Gaither [6] developed an EOQ model for firms offering a one-time opportunity to delay payments for the order of a commodity. Shah [9] developed a

probabilistic time-scheduling model for an exponentially decaying inventory when payment delays were permissible. Hwang and Shinn [7] developed a retailer's pricing and lot-sizing policy for exponentially deteriorating products under the condition of permissible delay in payments. Sarker et al. [8] developed an optimal payment time under permissible delay for payment for products with deterioration.

3. Notations and Assumptions

Notation

- D = the demand rate per year.
- h = the unit holding cost per year excluding interest charges.
- p = the selling price per unit.
- c = the unit purchasing cost, with $c < p$.
- I_c = the interest charged per \$ in stocks per year by the supplier or a bank.
- I_d = the interest earned per \$ per year.
- S = the ordering cost per order.
- Q = the order quantity.
- r = the cash discount rate, $0 < r < 1$.
- θ = the inventory deterioration rate (constant rate of deterioration).
- M_1 = the period of cash discount.

M_2 = the period of permissible delay in setting account, with $M_2 > M_1$.

T = the ordering time interval.

$I(t)$ = the level of inventory at time,

$0 \leq t \leq T$.

$Z(T)$ = the total relevant cost per year.

Assumption

- (1) The demand for the item is constant with time.
- (2) Shortages are not allowed.
- (3) Replenishment is instantaneous.
- (4) The distribution of time to deterioration of the items follows exponential distribution with parameter θ , where $\theta \geq 0$.
- (5) During the time the account is not settled, generated sales revenue is deposited in an interest bearing account. At the end of this period (i.e. M_1 or M_2), the customer pays the supplier the total amount in the interest bearing account, and then starts paying off the amount owed to the supplier whenever the customer has money obtained from sales.
- (6) Time horizon is infinite.

4. Conclusions

The main purpose of this paper is threefold: First, we show that the total variable cost per unit time is convex by a rigorous proof. Second, with convexity, the optimal solution procedures to find the optimal ordering policy and bounds for the optimal ordering time are provided. Third, sensitivity analysis is performed to study the effects of changing parameters values on the optimal solution, and we obtain a lot of managerial insights.

5. Self-Evaluation

This research corresponds to the original plan and has attained its aim. Hence, the study is of great academic value and suitable for publication in academic journals.

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