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Inventory Control of the Special Sale and Known Price Increased Model

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ABSTRACT

In the recent globalization era, the competition among the companies for the same area of business is more intense, such as the competition in the Pharmacy industries for the pharmacy distributors (called the PBF). The PBF X is one of the pharmacy distributors located in the Semarang city, in the middle of Java Island, Indonesia. Due to of this highly competition, the PBF X would like to increase their inventory performance by minimizing the inventory total cost. In the present situation, the determination of T (the order period) and the order size are performed by intuition. In the situation where the price of medicine changes, the PBF X does not have any method how to determine the order size and T. This situation may create the condition of stock out or overstock and may also increase the expected total cost and automatically reduce the inventory performance. The research focuses on the fast moving medicines that often experience the stock out condition. The Calculation used the joint P-(R;T) model when there is no change in the price of medicine where the model determines both the order interval (T) and the maximum inventory. In the case of price medicine change, the calculation uses either the special sale model or the known price increased model and the results are the number of special order and the total benefit. This total benefit can affect the PBF X in making decision whether to perform special order or not.

Keywords

Inventory control, the special sale model, the known price increased model

1. INTRODUCTION

It is known that inventory has the main role in the manufacturing, where the inventory control usually deals with the determination either the order interval or the order size. The Indonesian pharmacy industry has developed so rapidly by knowing the increasing number of the pharmacy distributors, especially in the Semarang city, in the middle of java, Indonesia. It causes that the retailer is relatively easy to choose which the pharmacy distributors they prefer. It is the reason that the pharmacy distributor (one of them is PBF X distributor) should improve their performance so they can win the competition.

The PBF X is experiencing the probabilistic demand and until now there is a specific method that can be used to determine the order interval and the order size. The PBF X often faces the condition of stockout (usually in the backorder condition) and overstock that effect the inventory performance directly. The number of backorder is usually 20% from the total number of order and it can be minimized by calculating the optimal value of the order interval and the order size and at the same time it will minimize the expected total cost of inventory. The PBF X should also consider when the price of the product (in this case medicine) change, either in the temporarily special sale price or in the known price increase. The special sale price exists when the supplier temporarily give a discount for the product in the regular replenishment. The firm should take this opportunity by ordering the product with a special order. If in the future the price of the product is known increased, the firm should also take this opportunity by ordering the product with a special order. Ordering the item with a special order should consider the benefit for the company it self.

Based on the explanation above, it can be concluded that the problem of the research are :

1. How to determine the order period T and the maximum inventory that could minimize the backorder and the expected total cost
2. How to determine a special order when the special sale or the known price increased occur.
3. How the performance of the current inventory control compared to the result of the research.

The research used the following assumptions:

1. The leadtime is constant.
2. The stockout cost is determined by the backorder cost.
3. Due to the object of the research is the fast moving product, then the expired dated cost can be ignored.

2. MODEL AND RESEARCH

Research will consider the following three situations in the inventory system;

1. The joint P(R;T) model when no Price change
2. The Special sale price model
3. The known price increase model

2.1 The Joint P(R,T) model when no price change

The following is the formula of the total inventory cost K for the P(R,T) model [1];

$$K = \frac{L + (n-1)a}{T} + \sum_{i=1}^{n}\left[IC_i\left(R_i - \mu_i - \frac{\lambda_i T}{2}\right) + (\gamma_i \times E(R_i, T))\right] \qquad (1)$$

Where: L = the ordering cost per order
n = the number of product that will be ordered jointly
a = The additional order cost
T = the order interval
I = the holding cost fraction per year
C_i = the unit cost of item i
λ_i = the expected demand per year for the i^{th} product
R_i = the inventory maximum for the i^{th} product = $(Z \times \sigma_{T+\tau}(i)) + \mu_{T+\tau}(i)$
τ = Lead time
μ_i = The expected lead time demand for the i^{th} product
$\mu_{T+\tau}(i)$ = the expected demand for period $T+\tau$ for the i^{th} product
$(\sigma_{T+\tau}(i))$ = the standard deviation demand for period $T+\tau$ for the i^{th} product

$$= \sqrt{\frac{T+\tau}{52}} \times \sigma$$

σ = the annual standard deviation demand
γ_i = the cost of backordering per unit per year for the i^{th} product
$E(R_i,T)$ = the expected backorder for the i^{th} product

The following table shows the product and the data demand that used for the research.

Table 1. The product used for the research

No.	The products	*Mean*	Standard deviasi	Distribution
1	*Acyclovir* 400 mg	15.692	2.776	Normal
2	*Amoxicilin* kaplet	56.942	3.152	Normal
3	*Ampicilin* 500 mg	46.808	3.705	Normal
4	*Chloramphenicol*	38.173	3.400	Normal
5	*Tetracyclin*	41.365	3.150	Normal

By increasing the value of T in the equation (1) It is found that $T_{optimal}$ = 1.17 weeks. Table 2 shows the graphic of the iteration between T and K. It can be concluded that if the company performing the joint order with T equal to 1.17 weeks, the company will have a minimum total cost.

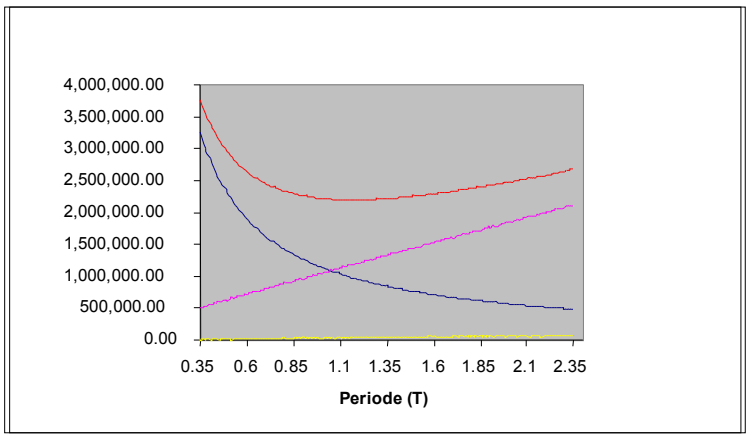

Figure 1. Plotting of the total cost K vs T

2.2 The special sale price model

The special price is the condition when the supplier gives a lower price temporarily. The condition of the special sale price model will consider the special sale priced model for one product only [2]. This situation can be explained in the following figure;

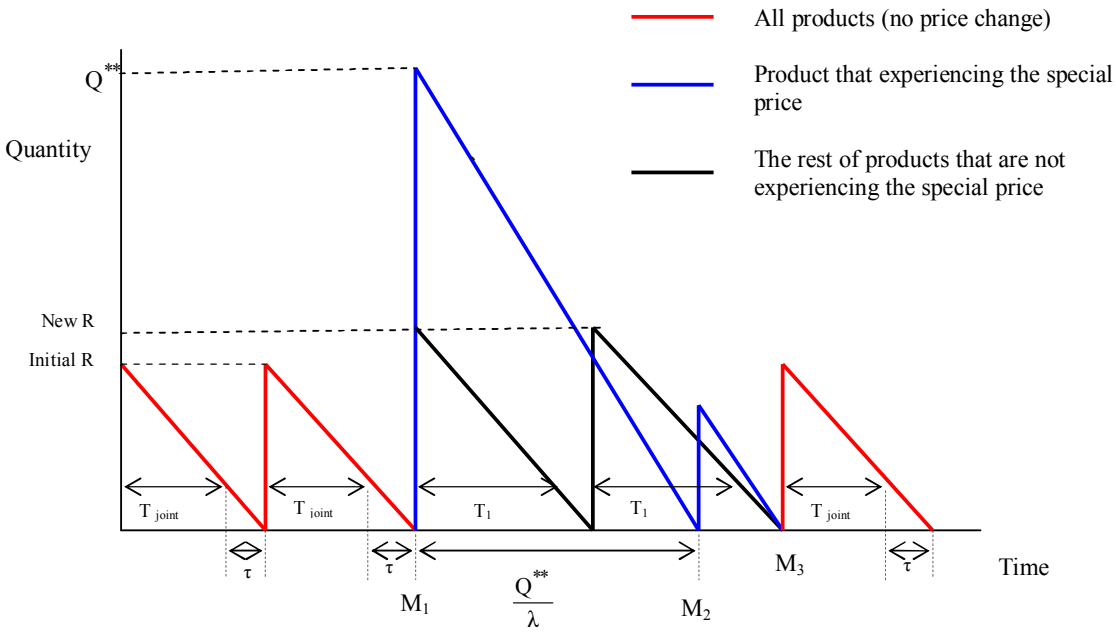

Figure 2. The special sale price for one item only

Prior to M_1, the company use the Joint P(R,T) (the order period is represented by the variable T_{joint}) model and each of the products have their maximum initial inventory R. This situation is represented by the red line. At time M_1, the supplier gives a special sale price temporarily and company should take this opportunity by making an economic special order size Q^{**}, represented by the blue line. This special order will finish at time M_2, where $M_1 - M_2 = Q^{**}/\lambda$. The rest of products that are not experiencing the special price will be ordered jointly using the joint P(R,T) model when no price change (the order period is represented by the variable T_1) and each of these products has their maximum new inventory R. This situation is represented by the black line. The maximum new inventory R is greater than the maximum initial inventory R. At time M_2, the product that experiencing the special price should perform an order sufficiently so the product will finish at time M_3. At M_3 or after M_3 all the products will be ordered jointly and the Joint P(R,T) model will be used as before (again, the order period is represented by the variable T_{joint}). The value of Q^{**} can be calculated by using the following formula [2];

$$Q^{**} = \frac{d\lambda}{(P-d)I} + \frac{PQ^*}{P-d} - (q - \mu_\tau) \quad (2)$$

Where;
d = The value of the reducing price
P = The original price per unit
q = The inventory position when the special order is performed
λ = the expected demand per year
Q^* = The economic order quantity (EOQ)
μ_τ = The expected lead time demand

By doing the special order, the company will have a saving g* with the following equation;

$$g^* = L\left[\left(\frac{Q^{**}}{\sqrt{\frac{P}{P-d}}Q^*}\right)^2 - 1 - W\right] \quad (3)$$

Where W is the total cost for an order at time M_2.
The company has an experience that one of the products (*chlorampenicol*) has the special sale price for 4.6%. If the company use this model by performing an economic special order size Q^{**}, the company should have the saving for Rp 980,255.966 but they loss this opportunity.

2.3 Known Priced Increase Model

The steps of the known priced increased model has the same step as those in the special sale model. Figure 2 shows the situation for the known price increase. The difference is only in the formula of the economic special order size Q^{**} and the formula for the saving g^*. This value Q^{**} can be calculated by using the following formula [2];

$$Q^{**} = \frac{k\lambda}{PI} + \frac{(P+k)Q_a^*}{P} - (q - \mu_\tau) \quad (4)$$

where :

$$Q_a^* = \sqrt{\frac{2L\lambda}{(P+k)I}} = Q^* \sqrt{\frac{P}{P+k}} \quad (5)$$

= the economic order size after the price increase.

Q^* = the economic order quantity before the price increase
k = the number of priced increase
At M_3 or after M_3, all the products will be ordered jointly and the Joint P(R,T) model will be used as before (again, the order period is represented by the variable T_{joint} using the new price for this product).

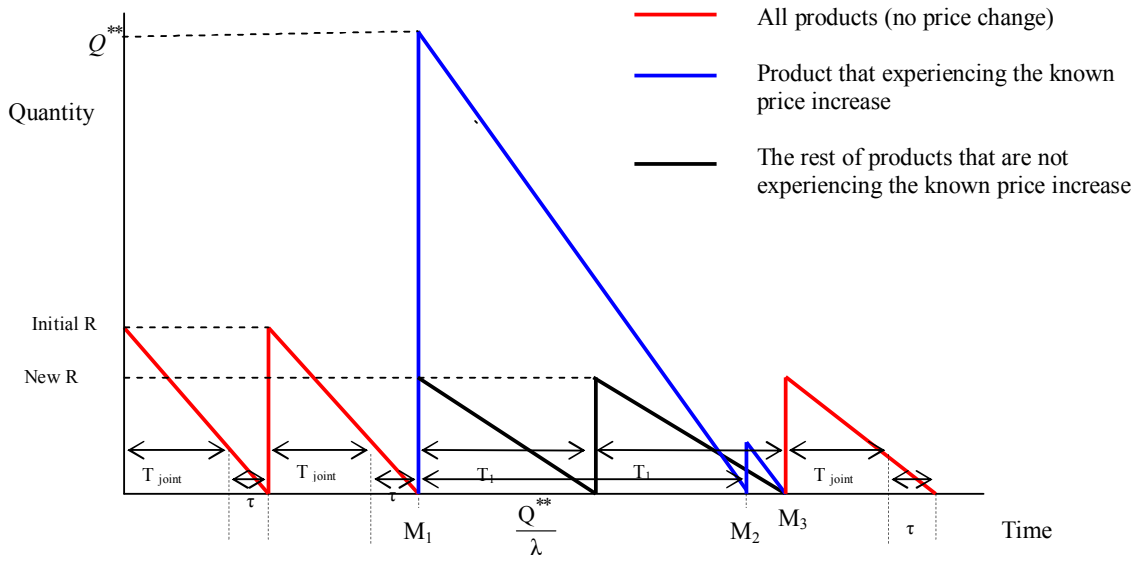

Figure 2. The Known Price Increase Model

By doing the special order, the company will have a saving g* with the following equation;

$$g^* = L\left[\frac{P}{P+k}\left(\frac{Q^{**}}{Q_a^*}\right)^2 - 1\right] = C\left[\left(\frac{Q^{**}}{Q^*}\right)^2 - 1\right] \quad (6)$$

The company has an experience that one of the products (*acyclovir*) has the known price increase for 7.56%. If the company also use this model by performing an economic special order size Q^{**} (using the equation 4.), the company should have the saving g^* for Rp 1,366,019.720, but they loss this opportunity.

4. CONCLUSION

The present condition of the company inventory system does not have a specific method that can be used in their daily inventory system activities. The company work for their inventory system intuitively. If the company facing whether the special sale price or the known price increase, they make an order intuitively. The company usually works with individual T and R. It is recommended that company uses the result of this research.

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