INVENTORY CONTROL OF THE PRODUCTS FOR SPECIAL SALE MODEL

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ABSTRACT

This research is the continuation of the previous research that had been presented in the QIR seminar at Bali and BKSTI seminar held in Medan, Indonesia.The pharmacy distributors (called the PBF) X is one of the pharmacy distributors located in the Semarang city, in the middle of Java Island, Indonesia. In current condition, the PBF X would like to increase their inventory performance by minimizing the inventory total cost and determination of T (the order period) and the order size areperformed by intuition. In the situation when supplier gives the opportunity of the temporarily special sale price, the PBF X also does not have any method how to determine the order size to get this opportunity. 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.When there was no temporarily special sale price, the Calculation used the joint P-(R;T) model for the calculation of both the order interval (T) and the maximum inventory. In the case of temporarily special sale price situation, the calculation uses the temporarily special sale price 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, special sale price, P(R,T) model.*

1. INTRODUCTION

1.1. Special Sale Price Model

This research is the continuation of the previous research with consideration of known price increase. In that case, supplier announces to PBF X that in the near future there will be the known price increase for one or more product. Of course, the PBF X should take this information to take the benefit before the price increase.

The PBF X usually experiencesthe probabilistic demand and until now there is no 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 and overstock that effectdirectlyto the inventory performance. 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. This problem has been solved by the previous research. The PBF X should also consider when the price of the product (in this case medicine) change, either in the known price increase (this problem has also been solved by the previous research) or the temporarily special sale price. 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. 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 a special order when the special sale or the known price increased occur.
2. 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. THEORETICAL BACKGROUND

The temporarily special sale price is the condition when the supplier gives a lower price temporarily. The condition of the special sale price model for one product had been considered by the previous research (a). This paper will consider the situation when there are many products experiencing the temporarily special sale price. Figure 1 shows this situation (b).

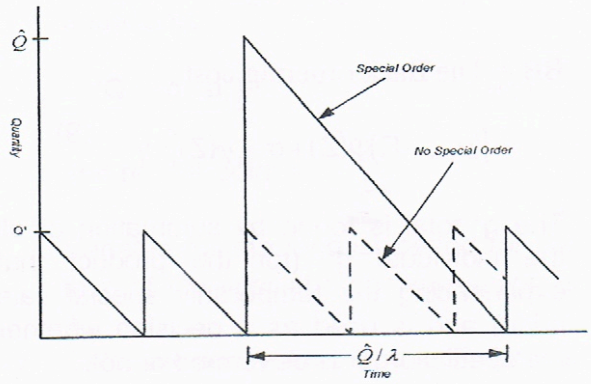

Figure 1. The special sale model

Logically, if there is a temporarily special sale price, the firm should take this opportunity by doing a special order $\hat{Q}$. If TCn is total cost with no special order and TCs is the total cost with special cost, then the the difference is the saving g that the firm can get. The following is the expression of the saving g;

$$g = TC_n - TC_s$$

$$g = \left(d + \frac{2L}{Q^*}\right)\hat{Q} - \frac{(P-d)I\hat{Q}^2}{2\lambda} - dQ^* - \frac{dI(Q^*)^2}{2\lambda} - L \quad (1)$$

where
d = The value of price decreasing.
P = The product price/unit
L=Ordering cost per order.
I=The holding cost fraction.
λ =The annual demand.
Q* = EOQ

The optimal value $\hat{Q}^*$ is found by taking the first derivative of the equation g with respect to $\hat{Q}$ and set the result to zero. It is found that :

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

If the temporarily special sale price given to some of products, than the figure 2 is used for the analysis.

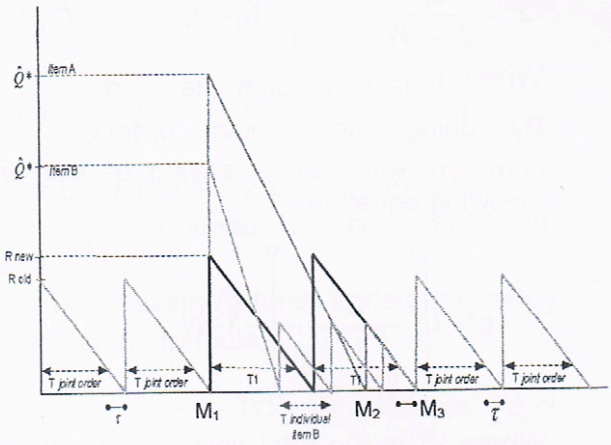

Figure 2. The special sale model for multi products

Prior to M_1, the company use the Joint P(R,T) (the order period is represented by the variable $T_{jointorder}$) 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 temporarily special sale price and the firm should take this opportunity by making an economic special order size $\hat{Q}^*$, represented by the blue line. This special order will finish at time M_2, where $M_1 - M_2 = \hat{Q}^* \lambda^{-1}$. The rest of products that are not experiencing the temporarily special price will be ordered jointly using the joint P(R,T) model (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 calculation for the P(R,T) model was performed at the previous research (c). The maximum new inventory R is greater than the maximum initial inventory R. At time M_2, the product that experiencing the temporarily special price should perform an order sufficiently so the product will finish

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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}).

This is the situation that make a different between this research with the previous one. By considering the inventory position q at M_1, The value of $\hat{Q}^*$ can be calculated by using the following formula:

$$\hat{Q}^* = \frac{d\lambda}{(P-d)I} + \frac{PQ^*}{P-d} - (q-\mu_t) \qquad (3)$$

Where μ_t is the leadtime demand.

By doing the special order $\hat{Q}^*$, the company will have a saving g* with the following equation;

$$g^* = L\left[\left(\frac{Q^{**}}{\sqrt{\frac{P}{P-d}Q^*}}\right)^2 - 1 - W\right] \qquad (4)$$

Where W is the total cost for an order at time M_2.

This research consider when at time M1 supplier announces the temporarily special sale for more than one product (represented by blue and green line) and each product will be treated separately. The calculation W is follow:

The period for the product application for the special order (T_p) and the reorder point for these products can be calculated by the following equations :

$$T_p = \frac{(\hat{Q}^* + q - \mu_t)}{\lambda} \qquad (5)$$

$$\text{Reorder point} = \frac{\lambda\tau}{52} \qquad (6)$$

Defined that T_{pj} is the longest period for the product application of the special order. Each product that experiencing the temporarily special sale price (except for the product with the longest period for the product application)will perform a multi ordering (multiple cycle T_1) that close to T_{pj}. The value of the multiple cycle T_1 will result the following formula:

$$T1 \times \text{rounddown}\left(\frac{T_{pj}}{T_1}\right) \qquad (7)$$

At the end of the multi cycle T_1 (at point M_3) all the products will be ordered jointly. The cost W due to the ordering product(for the product that experiencing the temporarily special sale price) in period T_{pj} is:

Total Cost in the multi cycle T_1 = BP+BS+BB

Where :

BP = The ordering cost
= The frequency of ordering times the cost per order

BS = The holding cost

$$= IC\left(R - \mu_t - \frac{\lambda T}{2}\right) \times \frac{T}{52} \qquad (8)$$

BB = The Back ordering cost

$$= [(\mu_{T+\tau} - R)\Phi(Z) + \sigma_{T+\tau}\varphi(Z)] \times \gamma \qquad (9)$$

The g*-total is found by summation of all the individual g* (for the product that experiencing the temporarily special sale price) and is used as a decision whether the special order is performed or not.

$$g^* \text{ - total} = \sum g^* \text{ (individual)} \qquad (10)$$

The special order will be performed if this value is positive.

3. RESEARCH METHOD

Research used in the research depends on the following conditions faced by the firm:

- there is no price change given by the supplier (a)
- the supplier announces a known price increase for some produts (b)
- the supplier announces a temporarily special sale price for some products

This research considers for the third condition only.

The steps of the temporarily special sale priced model for n type items ($n \geq 1$) are following:

i. Calculate the EOQ (Q*) for each n type of items experiencing the

temporarily special sale price by using the following formula:

$$EOQ = Q^* = \sqrt{\frac{2L\lambda}{PI}} \qquad (11)$$

ii. Calculate the size special order $(\hat{Q}^*)$ for the items experiecing the temporarily special sale price by considering the current level inventory q and the leadtime demand (formula 3).

iii. Calculate the period of the special order application (T_p) and reorder point for the item experiecing the special sale price using the following both equations:

$$T_p = \frac{(\hat{Q}^* + q - \mu_r)}{\lambda} \qquad (12)$$

and reoder point = $\frac{\lambda}{52}$

Variable for the longest period for the item of the special order application is T_{pj}

iv. Calculate the values T and R for the items that do not experiencing the special sale price. This new joint order value T is symbolized by T_1 determined by P-(R;T) joint order model.

v. Calculate the multi cycle of T_1 close to the value of T_{pj} and the order size of items covering the demand of multiple cycle of T_1 for the items experiencing special sale price when inventory reach the reorder point.

For the items with the longest period T_{pj}, the calculation uses the following formula: the multiple cycle T_1 closed to T_{pj} value is equal to equation (7).

The order size that can fulfill the demand for T_1 is determined by the following formula :

$$(T_1 - T_{Pj} + \tau) x \frac{\lambda}{52}$$

The other items with special sale price but lower in the special order period (T_{pj}) will be ordered individually, first using the individual T model until it is close to the multiple cycle T_1. Additional order is performed to fulfill the multiple cycle T_1 demand. This steps is performed first by calculating the order frequency using the following formula :

$$\left(\left(\text{Multiple cycle of T1 - } T_{pj}\right) \text{/T\_individual}\right)$$

The order size for fulfilling the T_1 demand is determined by using the following expression:

$$(\text{Multiple cycle of T1} - T_{pj} - (F \times \text{T\_individual}) + \tau) \times \frac{\lambda}{52}$$

After the multiple cycles T_1, the joint order is again performed for the whole item types.

The total saving (g-total) is determined by the following formula :

$$\text{g-total} = \sum_{i=1}^{n} g^* - TC\_\text{for}\_\text{multiple}\_\text{cycle}$$

$$\sum_{i=1}^{n} g^* - \sum_{i=1}^{n} (BP_i + BS_i + BB_i) \qquad (14)$$

Where :

$$g^* = L\left[\left(\frac{\hat{Q}^*}{\sqrt{\frac{P}{P-d}Q^*}}\right)^2 - 1\right] \qquad (15)$$

4. RESULT AND DISCUSSION

Table 1 shows the order interval T and the maximum inventory R for the products considered in this research. The calculation uses the steps as derived in previous research:

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Tabel 1. Products considered for the research

No.	the Item	T (days)	R (box)
1	*Acyclovir*	7	27
2	*Amoxicilin*		83
3	*Ampicilin*		71
4	*Chlorampenicol*		58
5	*Tetracyclin*		63
6	*Cefadroxil*	9	36
7	*Cefixime*		57
8	*Ciprofloxacin*		37
9	*Clindamycin*		36
10	*Cotrimoxazole*		32
11	*Lincomycin*		55
12	*Thiampenicol Dexicol*		61

According to the history, In 2008, the firm has the opportunity for the temporarily special sale price for product Chlorampenicol and Tetractclin. The product price was decreased by 4.60% and 3.53%, respectively. At that time, the firm did not have any specific method used to take the advantage for this situation. After the calculation using this method, it is expected that the firm may get the saving for Rp 2.608.927, but they lost this opportunity.

5. CONCLUSION

Sometimes the supplier of this PBX gives a temporarily special sale price for some products. it is suggested that the PBF X uses the method as derived in section 2. The special order is performed if it is found by the calculation that there is a saving or g- total is positive.

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