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Coordination Stock model with Price Discount

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ABSTRACT

This paper proposes coordination stock model with price discount under decentralized and centralized conditions. Under centralized situation coordinated framework cost is made for purchaser - vender with same advantages. A numerical model is inferred by using insightful math and logarithmic procedure to decide the ideal stock approach which limits the complete stock expense. A response methodology for settling the model is created and shown through a mathematical model.

Keywords: Supply Chain, Coordination, Price Discount, EOQ, Stock.

1. INTRODUCTION

Different Organizations go facing phenomenal difficulties in coordinating inventories. Powerless stock organization could result in under-stacking, over-troubling and in addition high stock add up to cost. In this paper, the supplier as well as the retailer embraces the price discount for their customer determined to advance the market rivalry.

Benny Mantin and Lifei Jiang [1] concentrated an essential inventory with quality debasement. Cárdenas-Barrón et al. [2] investigated settling the seller purchaser incorporated stock framework with math mathematical disparity. Chih-Te Yang et al. [3] developed a stock model with brief value rebate when lead time connects to arrange amount. Gusti Fauza et al. [4] set a coordinated single-seller multi-purchaser creation stock approach for food items fusing quality corruption. Mahadi Tajbakhsh et al. [5] fostered a stock model with irregular markdown contributions. Muniappan et al. [6] cultivated an EOQ model with inventory and ware house capacity limitations. Pervin et al. [7] concentrated on two-echelon stock model with stock-subordinate interest and variable holding cost for breaking down things. Ravithammal et al. [8] cultivated stock model for value rebate with lack, putting in a rain check and revamp. Ravithammal et al. [9] created EOQ stock model utilizing arithmetical strategy with stock level requirement. Taleizadeh et al. [10] fostered a monetary request quantity model with incomplete delay purchasing and gradual markdown. Vediappan et al. [11] concentrated on incorporated coordination stock model using Lagrange multiplier technique. Zhan et al. [12] created impetuses through stock control in supply chains.

2. NOTATIONS AND ASSUMPTIONS

The model uses the following notations and assumptions.

2.1 Notations

D Demand rate

H_v Vender's unit holding cost

s_c Vender's unit screening cost

R_1 Purchaser's unit ordering cost

R_2 Vender's unit setup cost

i Inventory carrying charge

p_j Purchase cost per unit where $j = 1, 2, \ldots, n$.

Q_j^* Optimum Order quantity for decentralized model

Q_{j0}^* Optimum Order quantity for centralized model

2.2 Assumptions

- The model accepts consistent interest.
- Coordinated system cost is shaped for system improvement.
- Framework cost is made for purchaser- vender with same advantages.
- Price discount are offered assuming that the buyer requested amount is enormous and the discount plan is given as follows

$$p_j = \begin{cases} p_1, & 0 \le Q_1 \le b_1 \\ p_2, & b_1 \le Q_2 \le b_2 \\ & \vdots \\ p_n, & b_{n-1} \le Q_n \le b_n \end{cases}$$

Here $p_n < p_{n-1} < \ldots < p_1$ and the price of item falls as the ordering quantity is $b_1, b_2 \ldots b_n$.

3. MODEL FORMULATION

Here, centralized and decentralized models are considered. In the two conditions buyer give value rebate to merchant to each extra buy. Under centralized conditions incorporated framework cost is anticipated system development.

Case (i): Price discount Decentralized Model

The total cost for purchaser and seller is communicated as follows i.e., $\mathrm{TC_b} = \frac{\mathrm{DR_1}}{Q_j} + \frac{ip_jQ_j}{2} + \frac{s_cQ_j}{2} + Dp_j$

(1)

Where, $p_j = \begin{Bmatrix} p_1, & 0 \le Q_1 \le b_1 \\ p_2, & b_1 \le Q_2 \le b_2 \\ & \vdots \\ p_n, & b_{n-1} \le Q_n \le b_n \end{Bmatrix}$

and $\mathrm{TC_v} = \frac{\mathrm{DR_2}}{Q_j} + \frac{\mathrm{H_v}Q_j}{2}$

(2)

Equation (1) can be composed as

$\mathrm{TC_b} = Q_j\left[\frac{ip_j}{2} + \frac{s_c}{2}\right] + \frac{1}{Q_j}[\mathrm{DR_1}] + Dp_j$

(3)

Equation (3) It is of the structure, $a_1Q_j + \frac{a_2}{Q_j} + a_3$.

Q_j will be taken as, $\mathrm{Q_j} = \sqrt{\frac{\mathrm{a_2}}{\mathrm{a_1}}}$

$Q_j^* = \sqrt{\frac{2\mathrm{DR_1}}{ip_j + \mathrm{s_c}}}$

(4)

Plan technique for price discount decentralized model

Step 1: Finding optimum order quantity Q_j, j = 1, 2 ... n by utilizing the condition (4).

(i) Computing Q_n. If $Q_n \ge b_{n-1}$ then, optimum order quantity $Q_j = Q_n$.

(ii) If $Q_n < b_{n-1}$, then, find Q_{n-1}. If $Q_{n-1} \ge b_{n-2}$, then, $TC_b(Q_{n-1})$ refer with $TC_b(b_{n-1})$.

(ii) If $Q_n < b_{n-2}$, then, find Q_{n-2}. If $Q_{n-2} \ge b_{n-3}$ then, refer $TC_b(Q_{n-2})$ with $TC_b(b_{n-1})$.

(iii) If $Q_{n-2} < b_{n-2}$, then, find Q_{n-3} . If $Q_{n-3} \ge b_{n-4}$, then, refer with, $TC_b(b_{n-3})$, $TC_b(b_{n-2})$ and $TC_b(b_{n-1})$.

(iv) Continuing in this manner, until $Q_{n-j} \ge b_{n-(j+1)}$, $0 \le j \le n-1$ and refer $TC_b(b_{n-j-2})$ …, …, $TC_b(b_{n-1})$.

Step 2: Finding TC_b and $TC_v(Q_j)$ utilizing the conditions (1) and (2).

Case (ii): Price discount Centralized Model

The integrated system cost is communicated as follows

$\mathrm{TC_s} = \mathrm{TC_b} + \mathrm{TC_v}$

$= \frac{\mathrm{DR_1}}{Q_{\mathrm{j0}}} + \frac{i\mathrm{p_j}Q_{\mathrm{j0}}}{2} + \frac{\mathrm{s_c}Q_{\mathrm{j0}}}{2} + Dp_j + \frac{\mathrm{DR_2}}{Q_{\mathrm{j0}}} + \frac{\mathrm{H_v}Q_{\mathrm{j0}}}{2}$

(5)

Where, $p_j = \begin{Bmatrix} p_1, & 0 \le Q_1 \le b_1 \\ p_2, & b_1 \le Q_2 \le b_2 \\ & \vdots \\ p_n, & b_{n-1} \le Q_n \le b_n \end{Bmatrix}$

Equation (5) can be composed as

$\mathrm{TC_s} = Q_{\mathrm{j0}}\left[\frac{ip_j}{2} + \frac{\mathrm{s_c}}{2} + \frac{\mathrm{H_v}}{2}\right] + \frac{1}{Q_{\mathrm{j0}}}[\mathrm{DR_1} + \mathrm{DR_2}] + Dp_j$

(6)

Equation (6) It is of the structure, $a_1Q_j + \frac{a_2}{Q_j} + a_3$.

Q_{j0} will be taken as, $Q_{\mathrm{j0}} = \sqrt{\frac{\mathrm{a_2}}{\mathrm{a_1}}}$

$Q_{j0}^* = \sqrt{\frac{2\mathrm{D(R_1+R_2)}}{(ip_j + \mathrm{s_c} + \mathrm{H_v})}}$

(7)

Plan technique for price discount centralized model

Step 1: Finding optimum order quantity Q_{j0}, j = 1, 2 ... n by utilizing the condition (7).

(i) Computing Q_n. If $Q_n \ge b_{n-1}$ then, optimum order quantity $Q_{j0} = Q_n$.

(ii) If $Q_n < b_{n-1}$, then, find Q_{n-1}. If $Q_{n-1} \ge b_{n-2}$, then, $TC_s(Q_{n-1})$ refer with $TC_s(b_{n-1})$.

(iii) If $Q_n < b_{n-2}$, then, find Q_{n-2} . If $Q_{n-2} \ge b_{n-3}$ then, refer $TC_s(Q_{n-2})$ with $TC_s(b_{n-1})$.

(iv) If $Q_{n-2} < b_{n-2}$, then, determining Q_{n-3}. If $Q_{n-3} \ge b_{n-4}$, then, refer with, $TC_s(b_{n-3})$, $TC_s(b_{n-2})$ and $TC_s(b_{n-1})$.

(v) Continuing in this manner, until $Q_{n-j} \ge b_{n-(j+1)}$, $0 \le j \le n-1$ and refer with $TC_s(b_{n-j-2})$ ……, $TC_s(b_{n-1})$.

Step 2: Determining $TC_s(Q_{j0})$ by utilizing the condition (5).

4. NUMERICAL EXAMPLES

In this section numerical example is presented to illustrate the developed model.

Example 1

Let D = 1000 units per year, R_1 = 200, R_2 = 400, H_v= 2, i = 25%, $s_c = 5$. The discount schedule is given as follows

Range of quantity	Purchase cost per unit in Rs.
$0 \le Q_1 \le 100$	10
$101 \le Q_2 \le 200$	8.50
$201 \le Q_3$	6.50

The optimal solution is
$Q_j = 332, \mathrm{TC_b} = 7704.16, \mathrm{TC_v} = 1536.34,$ $Q_{\mathrm{j0}} = 462, \mathrm{TC_s} = 9098.08$

Example 2

Let D = 2000 units per year, R_1= 100, R_2 = 200, H_v = 3, i = 15%, $s_c = 2$. The discount schedule is given as follows

Range of quantity	Purchase cost per unit in Rs.
$0 \le Q_1 \le 150$	20
$151 \le Q_2 \le 300$	19
$301 \le Q_3$	18

The optimal solution is
$Q_j = 291, \mathrm{TC_b} = 37371.13, \mathrm{TC_v} = 1808.726,$ $Q_{\mathrm{j0}} = 395, \mathrm{TC_s} = 39039.69$

5. CONCLUSION

In this paper coordination stock model with price discount under decentralized and incorporated conditions is discussed. Under centralized situation coordinated composed system cost is made for system improvement and ideal characteristics are found by using insightful calculation and mathematical procedure. A numerical model is given to show the speculation. For the further investigates, the model can be connected in credit period, one time discount, multi-echelon supply chains, temporary discount, exchange credit approach, etc.

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