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Coordination stock model with stock level and space included constraints for deteriorating products

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ABSTRACT

In this paper two section coordination procedures like with and without coordination are analyze for deteriorating items. For coordination procedure, buyer screened or organized the hurt things and has no inadequacies and seller gives quantity discount to the buyer for obvious orders. For non coordination, procedure buyer has inadequacy and screened or organized the hurt things. Furthermore, Structure cost is sorted out for seller - purchaser with same advantages and it satisfies the stock level and space included limit. The model is addressed systematically to get the best arrangement and illustrated with the help of mathematical models.

Keywords: Inventory, EOQ, Constraints, Coordination.

1. INTRODUCTION

One of the main parts of the Operations Research is inventory control system which is essential in business and Industries. Among these the going to pieces things stock has procured huge highlight to some degree as of late. In the genuine circumstance, decay of products is a typical cycle. We can't be disregarded harm, rot, waste or decay of things like food things, vegetables, organic products, drugs and so on. The significant issue for any cutting edge association is the control and upkeep of inventories of deteriorating things.

Amir Nasiri pour et al. [1] concentrated on ideal selling cost, renewal part size and number of shipments for two-echelon store network model with decaying things. Hollah and Fergany [3] dissected occasional audit stock model for Gumbel breaking down things when request follows Pareto appropriation. Li et al. [5] made organizing provider retailer and transporter with cost rebate strategy. Muniappan et al. [8] broke down an incorporated financial request amount model including stock level and product house limit requirement. Ravithammal et al. [9] concentrated on monetary request amount stock model utilizing logarithmic strategy with stock level limitation. Ravithammal et al. [10] fostered an ideal evaluating stock model for decaying things with positive outstanding capacity of cost markdown pace of interest. Sunil Tiwari et al. [11] read joint valuing and stock model for decaying things with termination dates and fractional multiplying under two-level incomplete exchange credits inventory network. Vediappan et al. [12] examined incorporated coordination model for buyer - dealer utilizing Lagrange multiplier procedure. Hemamalini et al. [2] read EOQ stock model for buyer dealer with screening, organized cost and controllable lead time. Mari Selvi et al. [6] mulled over merchant buyer joined stock model for controllable lead time with screening and organized cost. Muniappan et al. [7] researched production model for going to pieces things including to some degree collected inadequacies. Khanna et al. [4] read imperative creation showing for blemished things with deficient examination process, change, and arrangements return under two-level exchange credit.

2. NOTATIONS AND ASSUMPTIONS

The model uses the following notations and assumptions.

2.1 Notations

d Demand rate

r_1 Ordering cost for Buyer / order

r_2 Ordering cost for Seller / order

h_1 Buyer's unit holding cost /unit

h_2 Seller's unit holding cost / unit

b Shortage Cost

V Seller unit Variable cost for Ordering handling and receiving

p Purchase cost for per order

k Orders of multiples for buyer

$d(k)$ Discount factor

F Fixed transportations cost / order

u Percentage of defecting items

v Percentage of scrap items

d_c Disposed cost

S_c Seller's unit screening cost / unit

n Seller's multiples of order for without coordination

m Seller's multiples of order for coordination

k Buyer's multiples of order for coordination

Q Economic Order Quantity

Q_1 Back order level

X Maximum inventory level

Y Total available storage space for buyer

F_s Space occupied per product

2.2 Assumptions 30

- The model recognizes predictable interest.
- For non coordination procedure, buyer having shortage. In coordination procedure, seller gives quantity discount to the buyer for prominent orders.
- Additionally, for coordination procedure buyer screened or disposed the hurt things and have no shortages and for non coordination procedure seller screened or disposed the hurt things.
- Structure cost is sorted out for seller - buyer with same benefits and it satisfies the stock level and space involved restriction. Mathematically, the prerequisite will be made as $\frac{Q}{2} \le X$ and $F_s Q \le Y$.

3. MODEL FORMULATION

In this section, both Non- coordination and Coordination models are figured.

Case - I: Structure cost without coordination

The total cost for buyer and Seller is contains as following cost

TC_b = Ordering cost + Holding cost + Shortage cost

i.e., $TC_b = \frac{r_1 d}{Q} + \frac{h_1 Q_1^2}{2Q} + \frac{b(Q-Q_1)^2}{2Q}$

TC_v = Setup cost + Holding cost + Disposed cost + Screening cost + Transportation cost

i.e., $TC_v = \frac{r_2 d}{nQ} + \frac{nh_2 Q}{2} + \frac{nuvd_c Q}{2} + \frac{S_c Q}{2} + F + VQ$

Now, the Structure cost is written as

$TC_s = TC_b + TC_v$

Subject to the constraints, $\frac{Q}{2} \le X$ and $F_s Q \le Y$

$$TC_s = TC_b + TC_v + \lambda\left(\frac{Q}{2} - X\right) + \gamma\,(F_s Q - Y)$$

$$TC_s = \frac{r_1 d}{Q} + \frac{h_1 Q_1^2}{2Q} + \frac{b(Q-Q_1)^2}{2Q} + \frac{r_2 d}{nQ} + \frac{nh_2 Q}{2} + \frac{nuvd_c Q}{2} + \frac{S_c Q}{2} + F + VQ + \lambda\left(\frac{Q}{2} - X\right) + \gamma\,(F_s Q - Y)$$

$$TC_s = \left(\frac{h_1+b}{2Q}\right)Q_1^2 - bQ_1 + \frac{bQ}{2} + \left(\frac{nh_2+nuvd_c+S_c+2V+\lambda+2\gamma F_s}{2}\right)Q + \frac{1}{Q}\left(r_1 d + \frac{r_2 d}{n}\right) + F - \lambda X - \gamma Y$$

For optimality $\frac{\partial TC_s}{\partial Q_1} = 0$ and $\frac{\partial^2 TC_s}{\partial Q_1^2} > 0$ and $\frac{\partial TC_s}{\partial Q} = 0$ and $\frac{\partial^2 TC_s}{\partial Q^2} > 0$ we get,

$Q_1^* = \frac{bQ}{h_1+b}$ and

$$Q^* = \sqrt{\frac{2(h_1+b)\left[r_1 d + \frac{r_2 d}{n}\right]}{bh_1 + (h_1+b)[nh_2 + nuvd_c + S_c + 2V + \lambda + 2\gamma F_s]}}$$

Where

$$\lambda = \frac{(h_1+b)\left[r_1 d + \frac{r_2 d}{n}\right] - 2X^2[bh_1 + (h_1+b)[nh_2+nuvd_c+S_c+2V+2\gamma F_s]]}{2X^2(h_1+b)}$$

$$\gamma = \frac{2F_s^2(h_1+b)\left[r_1 d + \frac{r_2 d}{n}\right] - Y^2[bh_1 + (h_1+b)[nh_2+nuvd_c+S_c+2V+\lambda]]}{2Y^2(h_1+b)F_s}$$

Case -II: Structure cost with coordination

The total cost for buyer and Seller is contains as following cost

TC_b = Ordering cost + Holding cost + Screening cost + Disposed cost

i.e., $TC_b = \frac{r_1 d}{Q} + \frac{h_1 Q}{2} + \frac{S_c Q}{2} + \frac{uvd_c Q}{2}$

TC_v = Setup cost + Holding cost + Transportation cost + Discount factor

i.e., $TC_v = \frac{r_2 d}{mkQ} + \frac{mkh_2 Q}{2} + F + VQ + dpd(k)$

Now, the Structure cost is written as

$TC_s = TC_b + TC_v$

Subject to the constraints, $\frac{Q}{2} \le X$ and $F_s Q \le Y$

$$TC_s = TC_b + TC_v + \lambda\left(\frac{Q}{2} - X\right) + \gamma\,(F_s Q - Y)$$

$$TC_s = \frac{r_1 d}{Q} + \frac{h_1 Q}{2} + \frac{S_c Q}{2} + \frac{uvd_c Q}{2} + \frac{r_2 d}{mkQ} + \frac{mkh_2 Q}{2} + F + VQ + dpd(k) + \lambda\left(\frac{Q}{2} - X\right) + \gamma\,(F_s Q - Y)$$

For optimality $\frac{\partial TC_s}{\partial Q} = 0$ and $\frac{\partial^2 TC_s}{\partial Q^2} > 0$ we get,

$$Q^* = \sqrt{\frac{2\left[r_1 d + \frac{r_2 d}{mk}\right]}{h_1 + S_c + uvd_c + mkh_2 + 2V + \lambda + 2\gamma F_s}}$$

Where

$$\lambda = \frac{\left[r_1 d + \frac{r_2 d}{mk}\right] - 2X^2[h_1+S_c+uvd_c+mkh_2+2V+2\gamma F_s]}{2X^2}$$

$$\gamma = \frac{2F_s^2\left[r_1 d + \frac{r_2 d}{mk}\right] - Y^2[h_1+S_c+uvd_c+mkh_2+2V+\lambda]}{2Y^2 F_s}$$

4. NUMERICAL EXAMPLES

Example 1: Let $r_1 = 100$, $r_2 = 400$, D = 1500, h_1 = 0.02, h_2 = 0.03, S_c = 0.1, b = 0.25, d_c = 0.2, u = 0.2, v = 0.1, F = 0.2, p = 0.3, n = 1, m =2, k= 2, d(k) = 40%, F_s = 2,V=0.2, γ = 0.3, X = 800, Y = 4000.

The optimal solutions are

Non coordination: $Q^* = 1381.50$, $Q_1^* = 1279.17$, $TC_s = 659.24$ satisfies the constraints $\frac{Q^*}{2} \le 800$ *and* $F_s Q^* \le 4000$

Coordination: $Q^* = 1395.32$, $kQ^* = 2790.64$, $TC_s = 591.55$ satisfies the constraints $\frac{Q}{2} \le 800$ *and* $F_s Q \le 4000$

Example 2: Let $r_1 = 600$, $r_2 = 800$, D = 2000, h_1 = 0.03, h_2

= 0.04, S_c = 0.3, b = 0.25, $d_c = 0.05$, u = 0.7, v = 0.5, F = 0.2, p = 0.3, n = 2, m =3, k= 3, d(k) = 25%, $F_s = 2$,V=2, $\gamma = 0.3$, X = 1000, Y = 4000.

The optimal solutions are

Non coordination: $Q^* = 1000$, $Q_1^* = 892.86$, $TC_s = 4441.99$ satisfies the constraints $\frac{Q^*}{2} \leq 1000 \; and \; F_s Q^* \leq 4000$.

Coordination: $Q^* = 1141.5$, $kQ^* = 3424.5$, $TC_s = 4219.91$ satisfies the constraints $\frac{Q^*}{2} \leq 1000 \; and \; F_s Q^* \leq 4000$.

5. CONCLUSION

In this paper, seller – buyer stock model is created under two section coordination procedures. Buyer has inadequacy in non coordination procedure and has no inadequacy in coordination procedure. Likewise, for coordination procedure seller gives quantity discount to the buyer for mass orders. Structure cost is conveyed for both the procedure for the same benefits of buyer and seller. To compare with non coordination procedure, coordination procedure demonstrates more advantages. It is then outlined with the help of numerical models. The targets of this paper can likewise be reached out to different settings including various attributes of interest, temporary discount, one time discount and so forth.,

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