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ORIGINAL ARTICLE

INVENTORY MODEL FOR DETERIORATING ITEM WITH LINEAR PRICE DEPENDENT DEMAND

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1. Abstract:

In this paper an inventory model is developed in crisp environment. This model is nonmanufacturing inventory model. Demand is taken as price dependent. Deterioration rate is considered to be constant. Model is developed for without shortage case. Profit and optimum order quantity is obtained for deterministic inventory parameters. Model is illustrated with numerical values of parameters and sensitivity analysis is provided.

2. Keywords:

Inventory model; Price dependent demand; Deterioration

3. INTRODUCTION:

In Inventory Control System, demand and Deterioration plays important role. Most of the classical inventory models assumed the utility of the inventory remains constantduring their storage period. But in a real life, deterioration does occur in storage. The problemof deteriorating inventory has received considerable attention in recent years. Deterioration isdefined as change, damage, decay, spoilage, evaporation, obsolescence pilferage, and loss ofutility or loss of marginal value of a commodity that results in decreasing usefulness from theoriginal one. Most product such as medicine, blood, fish alcohol, gasoline, vegetables andradioactive chemicals have finite shelf life and start to deteriorate once they are replenished. So An important problem confronting a supply manager in any modern organization is the control and maintenance of inventories of deteriorating items Ongoing deterioration inventory has been studies by several authors in recent decades. price is most important factor invariation of demand. Begum et. al [5] developed an instantaneous replenishmentpolicy for deteriorating items with price-dependent demand. Bhuniaet. al [3]developed an inventory model for decaying items by using selling price along withfrequency of advertisement and linearly time dependent demand with shortages. In this paper profit maximization EOQ model is developed in crisp environment in which selling price is of item is fixed and known. Deterioration rate is constant. In this paper optimal value of quantity of item to be ordered is determined along with time point when inventory is to be replenished.

4: ASSUMPTIONS :

- The scheduling period is constant
- No lead-time.
- Replenishment rate is infinite.
- Demand rate is price dependent.
- Shortages are not allowed

5.NOTATIONS:

- Q(t) : Inventory level at time t
- T : Time period of cycle
- Ch : holding cost per unit
- Cd : Deterioration cost per unit
- P : Selling Price of item
- C :purchasing cost per item.
- R : Demand rate per item; [R=a-bp]
- PF : Net Profit
- θ: Deterioration rate

6.MATHEMATICAL ANALYSIS :

Q(t) is the inventory level at time t of the item, then the differential equation describing the state of inventory is given by

$$\frac{dQ(t)}{dt} + \theta * Q(t) = -(a - b * p), o \leq t \leq T$$

$$\frac{d}{dt} e^{-\theta t} * Q(t) = -(a - b * p)e^{-\theta t}, o \leq t \leq T$$

$$Q(t) = -\frac{(a - b * p)}{\theta} + ce^{-\theta t}, o \leq t \leq T$$

solving the above differential equation using boundary condition Q(t)=Q at t=o, we get ,

$$c = \frac{(a - b * p)}{\theta} + Q$$

$$Q(t) = -\frac{(a - b * p)}{\theta} + \left(\frac{(a - b * p)}{\theta} + Q\right) e^{-\theta t}, o \leq t \leq T$$

and using boundary condition Q(t)=0 at t=T in above equation we get

$$T = \frac{\log \left[1 + \frac{Q\theta}{(a - b * p)}\right]}{\theta}$$

$$\int_0^T Q(t) = -\frac{T*(a-b*p)}{\theta} + \frac{\left(\frac{(a-b*p)}{\theta} + Q\right)(1-e^{-\theta T})}{\theta}$$

$$PF = (c-p)*Q - (Ch + \theta * Cd) * \int_0^T Q(t)$$

$$PF = (c-p)*Q - (Ch + \theta * Cd) * \left(-\frac{T*(a-b*p)}{\theta} + \frac{\left(\frac{(a-b*p)}{\theta} + Q\right)(1-e^{-\theta T})}{\theta} \right)$$

Hence the problem is

Max $PF = (c-p)*Q - (Ch + \theta * Cd) * \left(-\frac{T*(a-b*p)}{\theta} + \frac{\left(\frac{(a-b*p)}{\theta} + Q\right)(1-e^{-\theta T})}{\theta} \right)$

Subject to

$$T = \frac{\log\left[1 + \frac{Q\theta}{(a-b*p)}\right]}{\theta}$$

7.SENSITIVITY ANALYSIS:

Table 1.Effect of sellingprice ‘p’

a	b	c	p	theta	ch	cd	PF	Q	T
100	0.5	10	3	0.05	2.2	2	1169.527	353.5897	3.301595
100	0.5	10	4	0.05	2.2	2	840.9367	294	2.795239
100	0.5	10	5	0.05	2.2	2	571.7189	237.8049	2.301387
100	0.5	10	6	0.05	2.2	2	358.3215	184.7619	1.819436

Table 2.Effect of ‘a’

a	b	c	p	theta	ch	cd	PF	Q	T
100	0.5	10	6	0.05	2.2	2	358.3215	184.7619	1.819436
110	0.5	10	6	0.05	2.2	2	395.2618	203.8095	1.819436
150	0.5	10	6	0.05	2.2	2	543.0233	280	1.819436
200	0.5	10	6	0.05	2.2	2	727.7251	375.2381	1.819436
250	0.5	10	6	0.05	2.2	2	912.4269	470.4762	1.819436

Table 3.Effect of ‘b’

a	b	c	p	theta	ch	cd	PF	Q	T
100	0.5	10	6	0.05	2.2	2	358.3215	184.7619	1.819436

100	0.7	10	6	0.05	2.2	2	353.8886	182.4762	1.819436
100	0.9	10	6	0.05	2.2	2	349.4558	180.1905	1.819436
100	1.1	10	6	0.05	2.2	2	345.023	177.9048	1.819436
100	1.3	10	6	0.05	2.2	2	340.5901	175.619	1.819436

CONCLUSION :

1. From table 1 we can see that as selling price increases profit as well as planning horizon are also decreases.
2. From table 2 we can see that as value of ‘a’ increases profit increases but planning horizon remains same.
3. From table 3 we can see that as value of ‘b’ increases profit decreases but planning horizon remains same

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