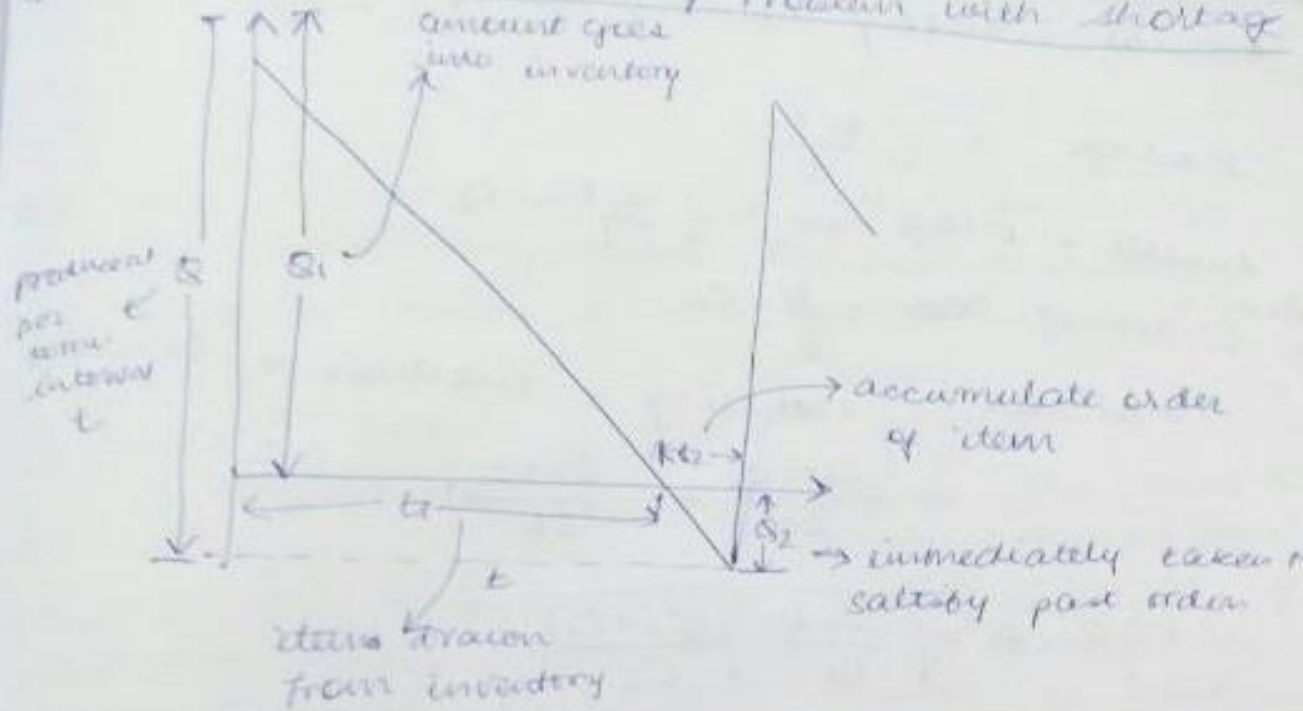
10/4/18 Deterministic Inventory Problem with shortage



If shortage occurs, then this can be classified into the following two categories:

1. As soon as the desired unit of a certain commodity arrives in inventory, the back order are satisfied.
2. ~~As soon as the demo~~
2. shortage are lost sales

These cases deal with those problems of shortage where back order are satisfied. The total time period, t is divided into t_1 and t_2.

Let c_2 be the shortage cost per unit of time per ~~unit~~ unit quantity.

$$t = t_1 + t_2$$

During t_1, the demo are drawn from inventory as needed and during t_2, order of the item are being accumulated but not filled.

Total inventory over the time period $t = \frac{1}{2} Q_1 t_1$

Avg inventory at any time $= \frac{\frac{1}{2} Q_1 t_1}{t}$

Annual inventory holding cost $= \frac{1}{2}\frac{Q_1 t_1}{t} \cdot C_1$

shortage $= \frac{1}{2}\frac{Q_2 t_2}{t}$

Annual shortage cost $= \frac{1}{2}\frac{Q_2 t_2}{t} C_2$

Annual Ordering cost $= \frac{D}{Q} \cdot C_0$

Total cost = Holding + shortage + Ordering

$$= \frac{Q_1 t_1 C_1}{2t} + \frac{Q_2 t_2 C_2}{2t} + \frac{D C_0}{Q}$$

EOQ, $Q^* = \sqrt{\frac{2C_0 D}{C_1}} \cdot \sqrt{\frac{(C_1+C_2)}{C_2}}$

$$Q_1^* = \sqrt{\frac{C_2}{C_1+C_2}} \cdot \sqrt{\frac{2C_0 D}{C_1}}$$

$$Q_2^* = Q^* - Q_1^*$$

$$TC^* = \sqrt{2DC_0C_1}\sqrt{\frac{C_2}{C_1+C_2}}$$

Q. The demand for a certain item is 16 units per period. Unsatisfied demand causes a shortage cost of Rs. 0.75 per unit per short period. The cost of initiating purchasing action is Rs 15 per purchase and the holding cost is 15% of average inventory valuation per period. Item cost is Rs 8 per unit. (Assume that shortages are being back ordered at the above mentioned cost). Find the minimum cost purchase quantity.

A: $C_0 = ₹15$

$D = 16$

$C_1 = \frac{15}{100} \times 8 = ₹0.12$

$C_2 = 0.75$

EOQ : $S^* = \frac{2 \times 15 \times 16}{0.12}$ =

8.2) The dealer supplies you the following info. w.r.t a product. Annual demand

Annual demand — 10,000
Ordering cost — 10/order
order price — 20/unit
Inventory carrying cost = 20% of the value of inventory per year

The dealer is considering the possibility of allowing some back order to occur. He has estimated that annual cost of back ordering will be 25% of the value of inventory

a) What should be the optimum no. of units of the product to be bought in one lot?
b) What quantity of the product would be allowed to be back order, if any?
c) What would be the max. quantity of inventory at any time of the year?
d) Would you recommend to allow backordering? If so, what would be annual cost saving by adopting policy of back ordering?

A: $D = 10,000$

$C_o = 10$

$C_1 = \frac{20}{100} \times 20 = 4$

$C_2 = \frac{25}{100} \times 20 = 5$

(a) Stock out not permitted

$\therefore S^* = \sqrt{\frac{2DC_o}{C_1}}$

$= \sqrt{\frac{2 \times 10,000 \times 10}{4}}$

$= 223.6$ units

Stock out permitted

$S^* = \sqrt{\frac{2 C_o D}{C_1}} \sqrt{\frac{C_1 + C_2}{C_2}}$

$= 300$ units

(b) $Q_2^* = Q_0\left(\frac{C_1}{C_1+C_2}\right)$

$= 133$ units

(c) $Q_1^* = Q_0^* - Q_2^* = 300 - 133 = 167$ units

(d) $TC(223.6) = \sqrt{2DC_0C_1} = 894.43$

$TC(300) = 666.67$ (proposed)