



IIT ROORKEE



NPTEL ONLINE  
CERTIFICATION COURSE

# SUPPLY CHAIN ANALYTICS

Multi echelon Inventory Management for four stations  
(Numerical Example continued)

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Data for four echelon inventory system discussed in lecture 20 suggests merger of installation 3 & 4.

After merger new parameters look as follows:

| Installations | Setup Cost( $k_i$ ) | Echelon Holding Cost( $h_i$ ) | $K_i / e_i$ |
|---------------|---------------------|-------------------------------|-------------|
| 1             | Rs 250              | Rs 0.50                       | 500         |
| 2             | Rs 6                | Rs 0.05                       | 120         |
| 3 (+4)        | Rs 140              | Rs 7                          | 20          |
|               |                     |                               |             |

Now,  $k/e$  from top to down is decreasing order. So,  $Q_1 > Q_2 > Q_{3(+4)}$



As a simple understanding of the solution,

$$Q_1 = n_1 Q_2$$

$$Q_2 = n_2 Q_{3(+4)}$$

But for the purpose of logistics convenience,  
We will simplify solutions to

$$Q_1 = 2^{m1} Q_2$$

$$Q_2 = 2^{m2} Q_{3(+4)}$$

Now  $Q_i$  will be only 1,2,4,8,..... times of  $Q_{i+1}$ .

Phase I of the solution process,

$$Q_i = \sqrt{2}dk_i/e_i$$

$$\text{So, } Q_1 = \sqrt{2} \times 4000 \times 250 / 0.50 = 2000$$

$$Q_2 = \sqrt{2} \times 4000 \times 6 / 0.05 = 980$$

$$Q_3 = \sqrt{2} \times 4000 \times 140 / 7 = 400$$



## Phase II

- In second phase of the solution process,  $Q_3$  of phase I will be the starting value.
- We want to develop  $Q_2 = 2^{m_2} Q_3$

We find that

$$2^1 Q_3^* < Q_2 < 2^2 Q_3^*$$

Here,  $Q_3^* = 400$  &  $Q_2 = 980$

Since  $2(400) < 980 < 4(400) = 1600$

We set  $n_2 = 2^1 = 2$  and  $Q_2^* = n_2 Q_3^* = 800$ .

Similarly, we set  $n_1 = 2^1 = 2$  and  $Q_1^* = n_1 Q_2^* = 1600$ ,

Since  $2(800) = 1600 < 2000 < 4(800) = 3200$  and  $2000/1600 < 3200/2000$

Results from applying the solution procedure to the four echelon example,

| Installations<br>i | Phase I        |                | Phase II       |                |                |                |
|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|
|                    | Q <sub>i</sub> | C <sub>i</sub> | Stage I        |                | Stage II       |                |
|                    |                |                | Q <sub>i</sub> | C <sub>i</sub> | Q <sub>i</sub> | C <sub>i</sub> |
| 1                  | 2000           | 1000           | 1600           | 1025           | 1700           | 1013           |
| 2                  | 980            | 49             | 800            | 50             | 850            | 49             |
| 3(+4)              | 400            | 2800           | 400            | 2800           | 425            | 2805           |

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$n_1 = 2$   
 $n_2 = 2$

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$Q_3 = \sqrt{2 \times 4000(k_1/p_1 + k_2/p_2 + k_3/p_3)} / (e_1 p_1 + e_2 p_2 + e_3 p_3)$  where,  $p_1 = n_1 n_2 = 2 \times 2 = 4$ ,  $p_2 = n_2 = 2$ ,  $p_3 = 1$

$Q_3 = \sqrt{2 \times 4000(250/4 + 6/2 + 140/1)} / (0.50 \times 4 + 0.05 \times 2 + 7 \times 1) = 425$



# THANK YOU

