NORTHEASTERN UNIVERSITY

Department of Mechanical and Industrial Engineering

Supply Chain Engineering **Prof. Gupta**

IE 7200 **Spring 2014 (Mondays)**

Homework No. 3
(Solution)

Problem 1.

This is a SS case for multiple products.

Given, P = \$200/order, I = \$5/unit-year, D = 500 units/months = 6000 units/year, A = 1500 units/month = 18000 units/year and W = \$10/unit-year,

$$EMQ_M = \sqrt{\frac{2DP}{(I+W)(1+D/A)}} = 346 \text{ units.}$$

Inventory cost/unit-year

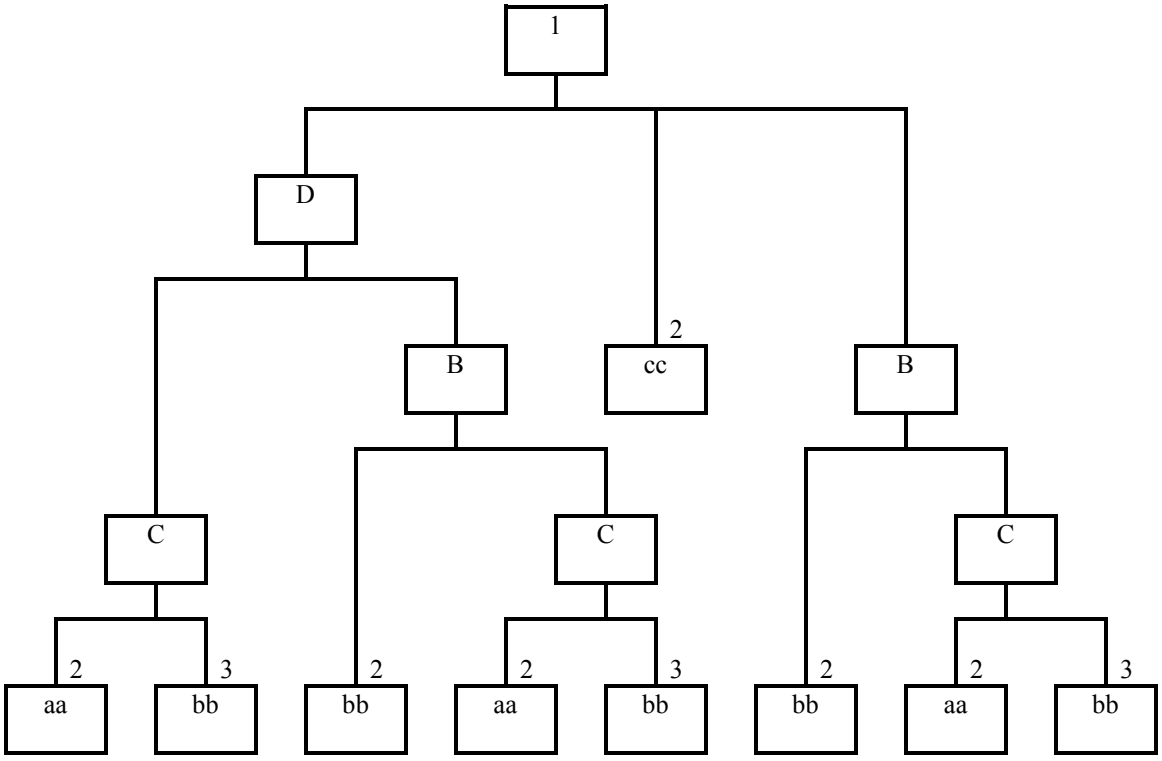
$$= \frac{P}{Q} + \frac{(I+W)(1+D/A)}{2D}Q = \$1.15.$$

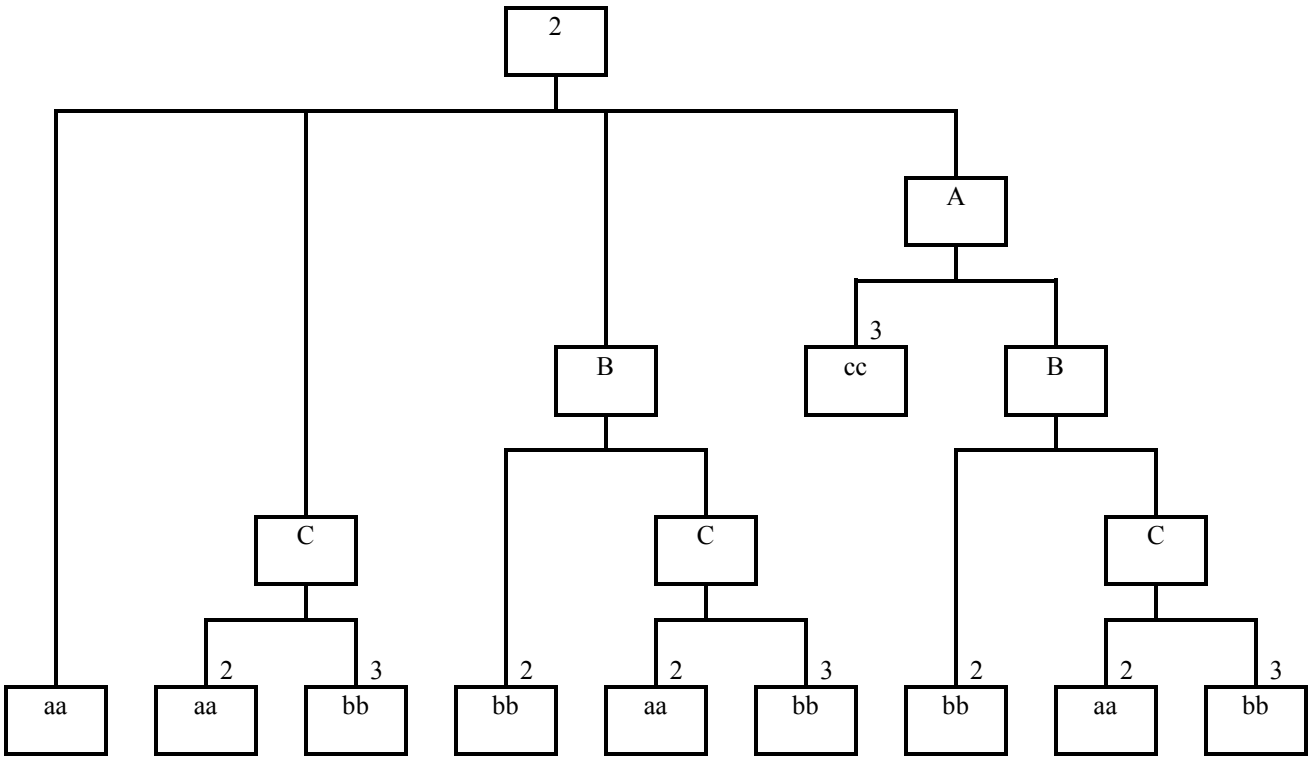
Problem 2.

This is an interesting problem because what this means is that safety stock has to be carried over and above the previous model. The value of this is 500 * 0.2 = 100 units. The *EMQ* remains the same but the inventory cost is increased by (I+W)*100/D = 1500/6000 = \$0.25. Hence the inventory cost/unit-year = 1.15 + 0.25 = \$1.40.

Problem 3.

The two product-structure trees using low-level coding are given below:





Problem 4.

End Item 1, Level 0

Lead Time = 1 Lot Size = 119 Lot Sizing Rule = EOQ		Period 1	2	3	4	5	6
Projected Requirement		40	20	10	60	10	30
Scheduled Receipts					119		
On Hand at end of Period	80	40	20	10	69	59	29
Planned Order Release				119			

End Item 2, Level 0

Lead Time = 1 Lot Size = 4 weeks Lot Sizing Rule = POQ		Period 1	2	3	4	5	6
Projected Requirement		20	10	30	50	70	40
Scheduled Receipts				180			
On Hand at end of Period	40	20	10	160	110	40	0
Planned Order Release			180				

Subassembly A, Level 1

Lead Time = 1		Period					
Lot Sizing Rule = PPB		1	2	3	4	5	6
Projected Requirement		0	180	0	0	0	0
Scheduled Receipts			150				
On Hand at end of Period	30	30	0	0	0	0	0
Planned Order Release		150					

Subassembly D, Level 1

Lead Time = 1		Period					
Lot Sizing Rule = LFL		1	2	3	4	5	6
Projected Requirement		0	0	119	0	0	0
Scheduled Receipts				19			
On Hand at end of Period	100	100	100	0	0	0	0
Planned Order Release			19				

Subassembly B, Level 2

Lead Time = 1		Period					
Lot Sizing Rule = LFL		1	2	3	4	5	6
Projected Requirement		150	199	119	10	0	0
Scheduled Receipts			249	119	10		
On Hand at end of Period	100	-50	0	0	0	0	0
Planned Order Release		249	119	10			

Note: In period 1, a negative inventory situation arises. If this happens, an order is placed immediately to correct this situation. An order of 50+199=249 units was needed.

Item cc, Level 2

Lead Time = 1		Period					
Lot Sizing Rule = LFL		1	2	3	4	5	6
Projected Requirement		450	0	238	0	0	0
Scheduled Receipts				188			
On Hand at end of Period	500	50	50	0	0	0	0
Planned Order Release			188				

Subassembly C, Level 3

Lead Time = 1		Period					
Lot Sizing Rule = LFL		1	2	3	4	5	6
Projected Requirement		249	318	10	0	0	10
Scheduled Receipts			467	10			10
On Hand at end of Period	100	-149	0	0	0	0	0
Planned Order Release		467	10			10	

Item aa, Level 4

Lead Time = 1 Lot Sizing Rule = LFL		Period 1	2	3	4	5	6
Projected Requirement		934	200	0	0	40	0
Scheduled Receipts			934			40	
On Hand at end of Period	200	-734	0	0	0	0	0
Planned Order Release		934			40		

Item bb, Level 4

Lead Time = 1 Lot Sizing Rule = LFL		Period 1	2	3	4	5	6
Projected Requirement		1899	268	20	0	30	0
Scheduled Receipts			1867	20		30	
On Hand at end of Period	300	-1599	0	0	0	0	0
Planned Order Release		1867	20		30		

Calculation of lot sizes:

The lot sizes for Item 1, Item 2 and Subassembly A were calculated as follows.

Item 1, EOQ.

$$\text{Average demand} = \frac{40+20+10+60+10+30}{6} = 28.33$$

$$\text{EOQ} = \sqrt{\frac{2(\$25)(28.33)}{\$0.10}} \approx 119.$$

Item 2, POQ.

$$\text{Average demand} = \frac{20+10+30+50+70+40}{6} = 36.67$$

$$\text{EOQ} = \sqrt{\frac{2(\$25)(36.67)}{\$0.10}} \approx 135.$$

Convert EOQ into periods by dividing by average demand.

$$N = \frac{135}{36.67} \approx 4 \text{ (rounded)}.$$

Subassembly A, PPB.

Order Arrives in Period #	Tentative Lot Size	Extra Inventory	No. of Periods held	Extra Carrying Cost	Cumulative Extra Carrying Cost	Is This > Setup Cost ?
2	150	0	0	0	0	No
	150	0	1	0	0	No
	150	0	2	0	0	No
	150	0	3	0	0	No
	150*	0	4	0	0	No

*Since this covers the entire planning horizon of six periods, we choose 150 as the lot size to be arrived in period 2, even though the cumulative extra carrying cost is not greater than the setup cost !