Sheet 4 (Multi-Echelon Inventory Control)

Exercise 1:

A wholesaler of telecommunication components could surprisingly obtain a new retailer to distribute its digital receivers. The wholesaler uses distribution requirements planning and has already calculated the projected gross requirements for the digital receivers. But this calculation was done without considering the new retailer's demand.

It takes one period for orders to be shipped from the wholesaler to the retailer and the retailer aims at holding safety stocks of 30 units. The wholesaler has a lead time of 3 periods and no safety stock. The tables below show the current gross requirements plan of the new retailer and the obsolete one of the wholesaler. The table also contains orders placed by the retailer with another wholesaler which are scheduled to arrive in periods 3 and 6.

New retailer								
Time period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Projected gross requirements	--	150	120	130	180	160	90	100
Planned order receipts				200			180	
Projected net inventory at the end of period	230							

Wholesaler								
Time period	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Projected gross requirements	--	200	110	120	160	180	80	140
Planned order receipts			200		100			
Projected net inventory at the end of period	280							

a) Update the projected gross requirements of the wholesaler.

b) Compute the projected net inventories at the beginning of each period and determine the corresponding orders that should be placed for the wholesaler.

Exercise 2

Hifi-Expert, a distributor of flat screens, has two local shops (A and B) and a central warehouse. The central warehouse supplies the local shops where the flat screens are available for the end customer. The distributor has forecasted the following demand in the next periods:

Time period	1	2	3	4	5	6	7
Shop A	120	130	160	120	40	70	100
Shop B	50	150	130	110	50	170	140

Shop A has a lead time of two periods, shop B has a lead time of one period and the warehouse has a lead time of two periods. The initial inventories are 250 units at shop A, 300 units at shop B and 450 units at the warehouse. There are also outstanding orders, which the locations plan to receive: shop A 150 units in period 2 and shop B 120 units in period 4, the warehouse 100 units in period 3. In case of inventory rationing use the priority approach (shop B has higher priority).

a) Calculate the requirements planning sheet for the whole supply chain if the distributor wants to use an installation stock policy with the following parameters: S_A= 400, S_B= 300, S_W= 700 and R=1.

b) Calculate the requirements planning sheet for the whole supply chain if the distributor wants to use an echelon stock policy with the following parameters: S_A = 400, S_B = 300, S_W= 1100 and R=1.

c) Determine in-stock probability and (adjusted) fill rate for the results in b).

d) How do the results in b) and c) change if shop A had the higher priority?

Exercise 3:

Consider a two-stage serial inventory system where the retailer is facing a yearly demand of 2500 units. The retailer has the following cost structure: ordering cost of 25€ and holding cost of 2.5€ per unit and year. The central warehouse pays 20€ for each order and has a holding cost of 1.2€ per unit and year.

Determine optimal lot sizes of the retailer and the warehouse for the following three approaches: independent, sequential and simultaneous planning. What are the resulting costs?

Exercise 4

A2 sells mobile phones in two different colors – silver and black. The following demands were observed during the past eight weeks.

Week	1	2	3	4	5	6	7	8
Silver	250	350	400	150	50	200	250	100
Black	200	200	50	210	330	180	80	250

   a) Determine the coefficient of correlation, mean and standard deviation of demand.

For both colors, the unit revenue is 88 € while the unit procurement price is 55 €. Leftover inventory at the end of the season can be sold to the service department as spare parts for 30 €. You are now placing the final order for the last week of this season.

   b) Assume that the respective demands are identically normally distributed with mean and standard deviation computed in a). What is the optimal order quantity for each color? What is the resulting expected profit?

A2 considers the option of a postponement strategy which means that all phones have the same body, but the color plates can be added quickly and locally according to incoming demand. This change would allow to flexibly react to demand and decrease lead time to 1 day, implying that the specific parts can be manufactured to order. Using this method, A2 will take the risk on the total quantity rather than on the quantity of each color. The procurement unit cost for the common components is 50 € and the color plates are purchased for 5 €. At the end of the season, common components can be salvaged at 29 €.

   c) Using postponement strategy, how many common components should A2 procure? What is the expected profit under the postponement strategy? Briefly explain the result and relate your answer to the portfolio effect.