Examination: 20302 **ST 2013**

Name: _____

Matriculation no. _____

Faculty: _____

Exam: **Supply Chain Coordination**

Examiner: **Prof. Dr. Karl Inderfurth**

Grade: _____

Signature: _____

Permitted aids: Non-programmable pocket calculator, in accordance with the regulations of the faculty's examination office; English (or English to X / X to English where X is any other language) dictionary (book, not electronic) without any handwritten entries.

Instructions:

- For calculations and answers please use this examination booklet. In case the provided space is not sufficient, use page 2 of the booklet and clearly indicate the respective assignment number.
- The examination comprises four assignments with each assignment accounting for 30 points. **Assignment 1 is mandatory**. Additionally, two out of assignments 2-4 are to be solved. In case all these assignments are solved, assignment 4 will be ignored. The maximum number of points is 90.
- Please answer in English (students from German speaking study programs are allowed to answer in German) and do not use pencils for your entries.

Only for the examiner!

Assignment	1	2	3	4	Total
Points					

Calculations:

Assignment 1 (mandatory): True or false? **(30 points)**

For a correct answer you are awarded 2 points. False or no answers yield 0 points.

	true	**false**
Monetary transfers in coordinated supply chains move always in upstream direction of the supply chain.	☐	☐
In the Aspirin supply chain, the Push/Pull boundary is located between the procurement and the manufacturing cycle.	☐	☐
The empirically observed tendency towards the bullwhip effect is larger at the distributor's stage than at the retailer's stage in a supply chain.	☐	☐
The bullwhip effect increases with the lead time in random demand supply chains.	☐	☐
The order-up-to-level in supply chains with stationary and independent demand and full information does not vary across periods.	☐	☐
Under action field [1] (retail pricing) the buyer's locally optimal retail price p_B decreases with the supplier's wholesale price p_S.	☐	☐
Under action field [1] (retail pricing) an arbitrary profit split between the actors is not possible when applying a volume-based quantity discount contract.	☐	☐
Strategic interaction in supply chains cannot achieve coordination.	☐	☐
The buyer in a supply chain under action field [2] (lot sizing) accepts an order-based quantity discount contract as long as the resulting profit is larger than the supplier's profit.	☐	☐
A two-part tariff can be used to achieve coordination in action field [2] (lot sizing).	☐	☐
Under action field [3] (ordering and safety stock planning) the buyer's locally optimal order quantity under a simple wholesale price contract is never smaller than the supply chain optimal order quantity.	☐	☐
The information needs for implementing a revenue sharing contract in action field [3] (ordering and safety stock planning) are the same as for implementing a buyback contract.	☐	☐
The critical ratio which determines the globally optimal order quantity in action field [3] (ordering and safety stock planning) does not depend on the salvage value.	☐	☐
In supply chains with asymmetric information and profit maximizing actors coordination cannot be achieved through contracts.	☐	☐
Cheap talk is a method to truthfully share information in supply chains under asymmetric information.	☐	☐

Assignment 2 **(30 points)**

Describe the phenomenon of the "Bullwhip effect" in supply chains. Name and explain four reasons for the occurrence of the bullwhip effect when assuming rational behavior of all actors in the supply chain. For each driver, describe countermeasures to avoid the bullwhip effect. Furthermore, how can the bullwhip effect be caused by irrational behavior of the actors?

Assignment 3 **(30 points)**

Assume a two-stage supply chain according to action field [1] under strategic interaction with a buyer B and a supplier S. The supplier produces a product at per unit production cost $c_S = 12$ and sells it at a unit wholesale price p_S to the buyer. The buyer processes the product at a unit cost of $c_B = 2$ and finally sells R units to the end customer at a retail price p_B per unit. The price-dependent total demand is given by the following function: $R = 120 - 2 \cdot p_B$.

(a) What wholesale price would the supplier chose in order to maximize her own profit (without coordination)? How much profit is gained by the buyer, the supplier, and the supply chain, respectively?
Hint: Calculate the retail p_B^+ the buyer would chose as a reaction to the wholesale price p_S^{++} set by the supplier.

(b) By how much (in %) does the supply chain profit from (a) (without coordination) deviate from the optimal supply chain profit (with coordination)?

(c) Assume the supplier offers a volume-based quantity discount contract to the buyer in order to achieve coordination. Derive the discount function $p_S(R)$ that the supplier would offer in order to receive 60% of the total supply chain profit.

Hint: Use the contract construction scheme: $P_B^T\left(R, p_S(R)\right) = \gamma \cdot P(R)$

Assignment 4 **(30 points)**

Analyze the buyback contract for order quantity and safety stock planning in a two-stage supply chain with stochastic demand (action field [3]).
Use the common supply chain notation with c_S, c_B, p_S, p_B, O_B, R and the functions $\varphi(\cdot)$, $P_S(\cdot)$, $P_B(\cdot)$ and $P(\cdot)$.

(a) Specify the transfer function $T(O_B, p_S, p_R, R)$.

(b) What values do the contract parameters p_S and p_R have to take in order to coordinate the supply chain?

Hint: Use the contract construction scheme: $P_B^T(O_B, p_S, p_R) \overset{!}{=} \gamma \cdot P(O_B)$

(c) What information is needed in order to implement the contract? Furthermore, explain which supply chain party has an incentive the offer the contract and why!