Examination: 20302 **WT 2013/2014**

Name: _____

Matriculation no. _____

Faculty: _____

Exam: **Supply Chain Coordination**

Examiner: **Jun.-Prof. Dr. Guido Voigt**

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. **Three out of those four assignments** are to be solved. In case all four assignments are solved, the last one 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 **(30 points)**

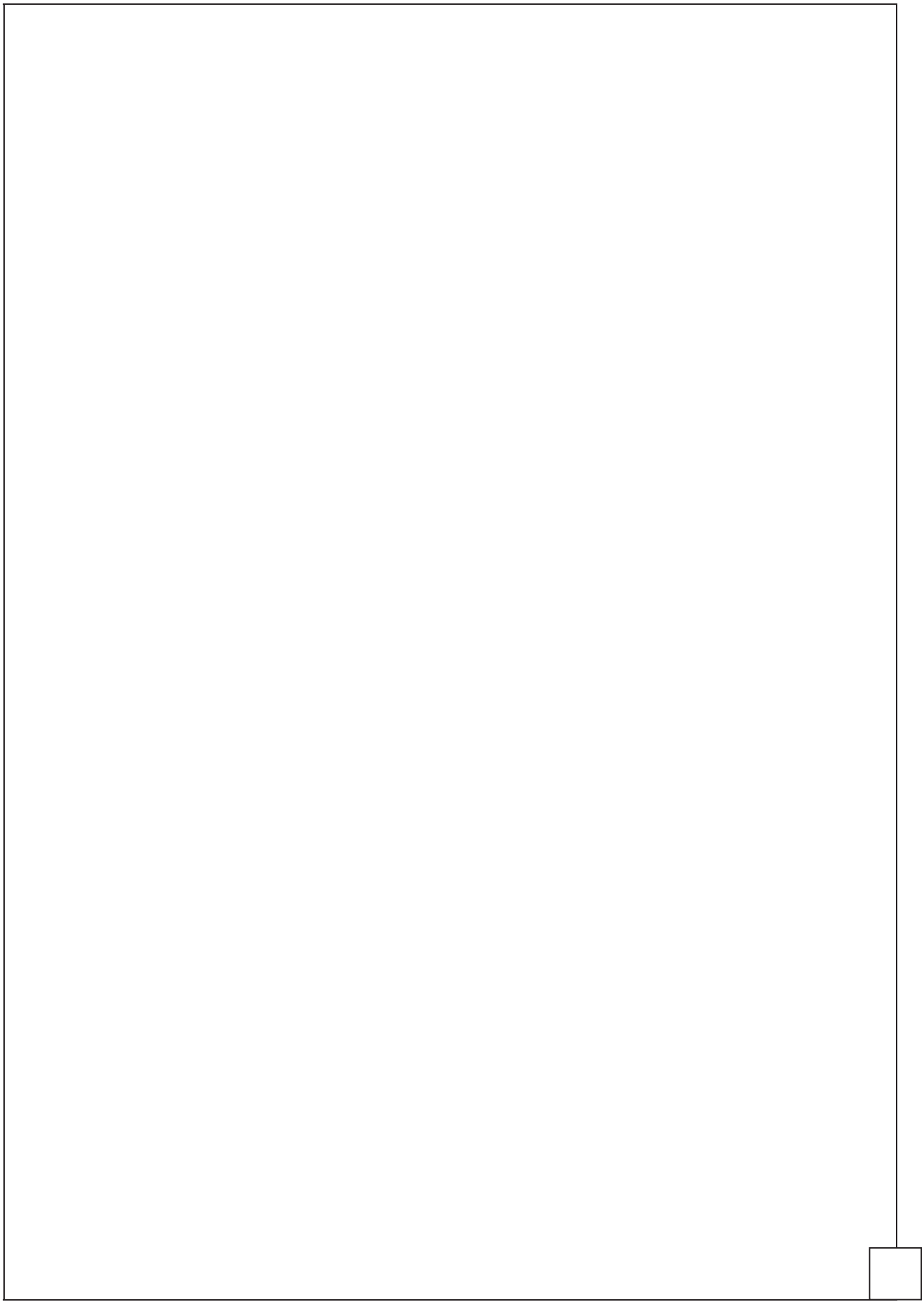
(a) Describe the phenomenon of the "Bullwhip Effect" in supply chains. Also, name and explain 3 methods to analyze it! (*10 points*)

(b) Furthermore, 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! (*20 points*)

Assignment 2 **(30 points)**

Analyze a screening contract for just-in-time lot-sizing in a two-member supply chain (action field [2]) with constant deterministic demand rate $R = 1$ and fixed costs of $f_S = 200$ for supplier *S*. Buyer *B* does not face fixed costs but bears a holding cost h_B per unit. His holding cost is not exactly known to *S*. Supplier *S* assumes that h_B is either equal to 1 or equal to 4, with 50% probability for both cases.

(a) Describe one set of possible contract parameters $\left\{\left(Q^{low}, N^{low}\right);\left(Q^{high}, N^{high}\right)\right\}$ of a screening contract menu which can coordinate the supply chain and guarantees that *B*'s participation constraints are met if it is compared to a just-in-time contract with *Q* =1. Also, show that this contract meets the incentive compatibility constraints that guarantee correct screening of *B*'s cost position. (*20 points*)



(b) What are the expected costs for the supplier, if the contract menu from (a) is exercised? Furthermore, what are the costs the buyer faces in each holding cost scenario? (*6 points*)

(c) Assume a supply chain where demand information is only available to the buyer while all other information is common knowledge. Explain verbally how this demand information can be used privately by the buyer when the supplier has to make a capacity decision before the buyer decides on an order! (*4 points*)

Assignment 3 **(30 points)**

Analyze the buyback contract for order quantity and safety stock planning in a two-member 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 $T\left(O_B, p_S, p_R, R\right)$ as well as the supplier's profit function. (*6 points*)

(b) Derive the buyback price as a function of the wholesale price $p_R(p_S)$ which co-ordinates the supply chain. Use the contract construction scheme:
$P_B^T\left(O_B, p_S, p_R\right) \overset{!}{=} \gamma \cdot P(O_B)$. (*20 points*)

(c) What is the minimum wholesale price the supplier has to set in order to receive at least 40% of the total supply chain profit? (*4 points*)

Assignment 4 **(30 points)**

Assume a two-stage supply chain according to action field [1] with a buyer *B* and a supplier *S*. Supplier *S* produces a good at unit cost $c_S = 8$ and sells it to buyer *B* at unit wholesale price $p_S = 16$. Buyer *B* incurs processing costs of $c_B = 2$ per unit. Demand *R* depends on the unit retail price p_B and is given by the following demand function: $R = 120 - 2 \cdot p_B$.

(a) How much and at what price does *B* sell if he wants to maximize his own profit (without coordination)? Also, provide the profit function of buyer *B*. (*6 points*)

(b) How much and at what price does *B* sell if he wants to maximize overall supply chain profit (optimal coordination)? (*4 points*)

(c) How large is the coordination deficit in this case? (*5 points*)

(d) 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 70% of the total supply chain profit. Use the contract construction scheme: $P_B^T\left(R, p_S(R)\right) \overset{!}{=} \gamma \cdot P(R)$. (*15 points*)