Frankfurt School of Finance & Management
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Examination in the Bachelor of Science
Course title: Markets, Incentives and Ethical Management
Part: Markets and Incentives
Semester: 2
Lecturers: Dr. Homayoon Moradi, Prof. Dr. Markus Reisinger, Dr. Roee Sarel
Group: 172
Examination date: 23th March 2019

Aids: pocket calculator Casio FX-82 solar,
German-English Dictionary, English-English Dictionary

Please enter your student ID (matriculation number) and your group!

Student ID	Group

Please note:

The exam consists of 4 questions of which you will have to answer **all** questions. You have **90** minutes to complete the examination. The maximum of points to be reached is **90**. Please use the enclosed answer sheet to answer your questions and add your student ID on its cover.

We wish you all the best for your examination!

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Question	1	2	3	4	**Total**
Possible points:	23	22	13	32	**90**
Points achieved:					

Signature of corrector

Question 1 – Game Theory (23 points)

Consider a situation with two symmetric firms. Each firm can invest in advertising to increase the demand of its product. The advertising levels are denoted by a_1 and a_2 for firm 1 and firm 2, respectively. Each firm has costs of investing in advertising, which are $(a_i)^2$, with $i=1,2$. The price in the market is equal to 1, while the demand of firm 1 is

$$1 + a_1 + a_1 a_2.$$

Similarly, the demand of firm 2 is

$$1 + a_2 + a_2 a_1.$$

Suppose first that the two firms choose their advertising levels simultaneously.

(a) Set up the profit function of firm 1 and determine the best-response function. (3 points)

(b) Draw the best-response function in a diagram. Is the best-response function increasing or decreasing? Explain your result. (4 points)

(c) Solve for the advertising levels in the Nash equilibrium. (2 points).

Suppose now that the two firms play the advertising game sequentially, that is, firm 1 sets its advertising level before firm 2 (i.e., firm 1 is a first mover and firm 2 is a second mover).

(d) Determine the subgame perfect equilibrium advertising levels of this sequential game. (4 points)

(e) Is the equilibrium advertising level of **firm 1** (i.e., the first mover) higher or lower than in the simultaneous game? Explain your result. (3 points)

(f) Is the equilibrium advertising level of **firm 2** (i.e., the second mover) higher or lower than in the simultaneous game. Explain your result (3 points).

Consider now situations in general, that is, no longer related to the advertising game.

(g) State and explain a situation in which a player can benefit from committing to a particular action. What is the reason for the benefit through commitment? (4 points)

Question 2 – Oligopoly (22 points)

(a) Explain verbally why price competition between firms selling homogeneous products and having constant marginal costs (and no fixed costs) lead to an equilibrium in which prices are equal to marginal costs and firms make no profits. (4 points)

(b) What is the effect of an increase in the number of firms in the situation described in (a) that is, there are additional firms in the market with the same cost function as the firms already in the market. (2 points)

(c) State and briefly explain two strategic variables that can be important for competing firms **apart from prices and quantities**. Provide an industry example where the strategic variable is important. (6 points)

Consider a market with two symmetric firms, firm 1 and firm 2. The two firms compete in prices. The demand functions of the two firms are

$$D_1 = 2 - 4p_1 + 2p_2 \quad \text{and} \quad D_2 = 2 - 4p_2 + 2p_1.$$

The costs of both firms are equal to zero.

(d) Do the two firms sell substitutes or complements? Briefly explain your result. (2 points)

(e) Are the products of the two firms differentiated or not? Briefly explain your result. (2 points)

(f) Solve the game for the Nash equilibrium prices? (4 points)

(g) Are the equilibrium prices above marginal costs? Briefly explain your result. (2 points)

Question 3 – Tacit Collusion (13 points)

Consider the situation in which two firms compete in an infinitely repeated game. They want to sustain the collusive outcome (i.e., each firm obtains half of the monopoly profit) via grim-trigger strategies.

(a) Explain what a grim-trigger strategy is. Explicitly distinguish between the different payoffs that a firm can get when colluding and when not colluding. (6 points)

(b) Explain briefly why the firms can sustain collusion with the grim-trigger strategy only in case the future is sufficiently valuable for each firm (4 points)

Suppose now that 2 additional firms compete in the market, that is, there are now 4 firms instead of only 2.

(c) Is collusion now easier or harder to sustain? Explain your result. (3 points)

Question 4 – Asymmetric Information (32 points)

(a) State an economic situation with hidden information. Explain why hidden information can lead to adverse selection? What is the consequence for market efficiency? (4 points)

(b) Explain for the situation you described in (a) how signaling can improve the market outcome and why it allows the "good type" to distinguish from the "bad type". (4 points)

Consider the following situation of hidden action: A principal needs to hire an agent to perform a particular task. If the agent is successful with the task, the revenue for the principal is 500. Instead, if the agent is not successful with the task, the revenue to the principal is only 100.
The agent has two effort levels, e_1 with costs of 5 for the agent and e_2 with costs of 10 for the agent. The effect of the effort choice on the likelihood of the revenue is given by the following table:

Effort	prob(Revenue=500)	Prob(Revenue=100)
e_1	1/4	3/4
e_2	3/4	1/4

The principal is risk neutral and cares only about the expected revenue minus the expected wage payment to the agent. By contrast, the agent is risk averse, and her utility function is

$$\sqrt{w} - e,$$

where w is the wage she obtains from the principal and e is the effort level, which is either e_1 or e_2. The reservation utility of the agent equals 0.

Consider first the case in which the principal can observe the effort level of the agent (symmetric information).

(c) What is the optimal wage level that the principal pays in case he wants to implement the **high** effort level e_2? What is the expected profit of the principal? (3 points)

(d) Determine the optimal wage level and the expected profit of the principal in case he wants to implement the **low** effort level e_1? Does the principal optimally implement effort level e_1 or e_2 with symmetric information? (3 points)

(e) Explain briefly why the principal optimally pays a flat wage to the agent (i.e., a wage that is not conditional on the revenue) in case the effort level is observable. (2 points)

Suppose now that the principal cannot observe the effort level of the agent (asymmetric information).

(f) Describe the fundamental trade-off of the principal-agent relationship in case of asymmetric information. (4 points)

(g) Formally state the two constraints that the optimal contract must fulfill with asymmetric information if the principal wants to implement the high effort level $e_{2.}$ (4 points)

(h) Determine the optimal wage levels that the principal pays the agent. (4 points)

(i) What is the associated profit of the principal at the optimal contract? (2 points)

(j) Is it optimal for principal to implement the high effort level e_2 instead of the low effort level e_1? (2 points)