

# Examination in Microeconomics I, Version A

## Summer Term 2006

### Handling of the exam

- Please check carefully whether your exam sheets are complete and correct, objections after the exam cannot be considered:
  - There are 2 **versions** of this exam, which are denoted by A and C respectively. Please check carefully, whether the version on the question sheet corresponds to the one on the solution sheet.
  - The **question sheet** (including the pages with the general remarks) consists of 9 pages. In addition there is a **solution sheet**, which consists of two pages.
- The use of resources other than a non-programmable calculator and at most one dictionary is not allowed. The use of other resources (e.g. programmable calculators, your own concept paper) leads to the disqualification from the exam.
- You have 90 minutes to solve the exam.
- The **exam** consists of 4 True- / False questions, each consisting of 5 subquestions, and 3 Text Problems again each consisting of 5 subquestions.
- For the **True- / False- questions** you have to decide whether a statement is true or false. For *each* subquestion you have to mark on the solution sheet whether the statement is true (T) or false (F). You will be awarded points according to the following rule: If your answer is correct, you will obtain *3 points* per statement. If your answer is wrong or if both answers are marked, you will obtain *0 points*. If no answer is given, then you will get *1 point*. For the True- / False- questions you can therefore obtain at most obtain 60 points.
- The **Text Problems** have, on the one hand, Multiple-Choice-subquestions (MC) with 5 answers provided for each question, where *exactly one of these answers is correct*. On the other hand, there are numerical subquestions (N), where you have to fill in a number on the solution sheet in encoded form. For each subquestion you get 5 points if answered correctly and 0 otherwise. For the Text Problems you can therefore at most obtain 75 points. Here is an example on how to encode integers in the numerical subquestions: Suppose the solution to the question is **503**. Then this number has to be filled in as follows:

Zahl Frage	100er	10er	1er
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>

Figure 1:

**Important:** Mark the zero in the first column if the solution is a two-digit number. Similarly, mark the zero in the first and in the second column if the solution is a single-digit number.

- You will have passed the exam with certainty, if you obtain at least *100 points*. The final passing threshold may be below but not above 100 points.

Handling of the solution sheet:

- You **only** have to submit the solution sheet at the end of the exam. Answers on concept sheets or on the question sheet will not be considered. We recommend that you fill in the solutions at the **end of the exam** in order to avoid corrections. Please start to fill in your answers **at least 5 minutes before the end of the exam**. The supervisors have orders to collect the solution sheets, even if you have not yet filled in your answers.
- *Please fill in the whole circle, do not mark answers with a cross! Only unambiguously legible solutions can yield points. Please do not use TippiEx to correct your answers!*
- You must sign your solution sheet at the bottom, otherwise your exam is not **valid**.
- If you do not wish that we publish your registration number, your points and your expected mark on our homepage, you have to mark the respective field on the solution sheet. If you mark this field, you have to wait for your grade until it is announced by the "Studienbüro", which may take some time.

Concerning the content of the exam

1. Assume that the "Ceteris-Paribus" condition holds. This means that all variables that are not explicitly changed remain constant. If we ask for example about the repercussions of the change of one variable (e.g.  $p_1$ ), you have to assume that the other variables (e.g.  $p_2$ ) remain constant, unless explicitly stated otherwise.
2. If we say that a variable (e.g.  $p_1$ ) is changed, we mean a marginal change, which is strictly different from zero, unless explicitly stated otherwise.
3. Assume infinitely divisible goods, unless explicitly stated otherwise.
4. Assume strictly positive and finite prices and income.
5. Assume that consumers maximize their utility and firms maximize profit. Utility functions are strictly increasing.
6. Market demand functions are always weakly decreasing, market supply functions are weakly increasing.

*We wish you every success for this exam !*

# 1 True-/False questions

1.1 Consider a household with budget  $Y$  who can consume two goods. Which of the following statements are true?

- a** The proportion of the budget that the household spends on each of the two goods is independent of the price.
- b** The proportion of the budget that the household spends on each of the two goods is independent of  $Y$ .
- c** If the goods are perfect substitutes, then the proportion of the budget that the household spends on each of the two goods is independent of the price.
- d** If the goods are perfect complements ( $U(x_1, x_2) = \min(x_1, x_2)$ ), then the proportion of the budget that the household spends on each of the two goods is strictly increasing in  $Y$ .
- e** If the goods are perfect complements, then the household's total expenditure for each of the two goods exclusively depends on the price of the respective good.

1.2 Consider a firm that produces an output with a strictly increasing production function using two inputs. The firm operates in competitive markets. Assume that in the relevant time horizon the first input is fixed at the level  $\bar{x}_1 > 0$ . Which of the following statements is true?

- a** If the average productivity curve of input 2 ( $AP_2$ ) intersects the marginal productivity curve of input 2 ( $MP_2$ ) at the level  $x_2 > 0$ , then it must do so at the minimum of the average productivity curve.
- b** The marginal productivity curve of input 2 ( $MP_2$ ) intersects the average productivity curve of input 2 at least once.
- c** If the average cost curve has a minimum and is differentiable, then the marginal cost curve intersects the average cost curve at this minimum.
- d** If the market price of the produced output drops below the minimum of the average costs, then the firm shuts down production.
- e** The marginal costs are the higher, the higher the level of  $\bar{x}_1$ .

1.3 Aluminium is obtained via an energy intensive process ("smelting") from aluminium oxide. The most important input factors apart from capital and labor (which we neglect here), are aluminium oxide and electricity. A higher level of energy allows more efficient smelting. Thus in order to produce a certain level of output one has to use less aluminium oxide the more electricity is used in production. A producer of aluminium can use the following four input combinations of aluminium (A) and electricity (E), in order to produce  $q=100$  units of aluminium (= output): 1.  $(A,E)=(1,12)$ , 2.  $(A,E)=(2,7)$ , 3.  $(A,E)=(4,6)$ , 4.  $(A,E)=(8,1)$ . Any linear combination of those four production processes also yields 100 units of output (that is for example  $\frac{1}{2}(1, 12) + \frac{1}{2}(4, 6) = (2.5, 9)$ ). Furthermore the firm may increase or reduce production to  $q = a \cdot 100$  units of output by using  $(aA, aE)$  units of input ( $a \geq 0$ ), where  $(A, E)$  are any input quantities required for producing 100 units of output. The price of electricity is  $p_E = 20$  per unit. Which of the following statements are true?

- a** The isoquant for  $q = 100$  is strictly convex.
- b** The isoquant for  $q = 50$  is weakly convex.
- c** If the firm produces  $q = 50$  and the price of aluminium oxide is  $p_A = 22$  per unit, then the firm uses the 4th production process.
- d** If the firm produces  $q = 250$  and the price of aluminium oxide increases from  $p_A = 15$  to  $p_A = 19$ , then the firm reduces the amount of aluminium oxide and switches from the 4th production process to the 2nd process.
- e** If the input prices  $p_A$  and  $p_E$  cannot be influenced by the firm, then the firm has constant average costs.

1.4. Julia's preferences for the consumption of goods ( $C$ ) and leisure ( $F$ ) are given by the utility function  $U(C, F) = F^{1/3}C^{1/3}$ . The price of consumption ( $C$ ) is  $p$ , the price of leisure is given by the wage rate  $w$ , which she may obtain by working. Julia has a monthly total time budget of  $T=450$  hours at her disposal, which she may freely allocate to leisure and work. The government imposes an income tax of  $e = 25$  percent on each Euro earned. Which of the following statements are true?

- a** Julia's expenditure on consumption  $pC$  does not depend on the price  $p$  of consumption.
- b** The price elasticity of Julia's demand for consumption is independent of  $p$ .
- c** If the government increases the income tax to  $e = 30$ , then Julia will strictly decrease her labor supply.

- d** If the government increases the income tax to  $e = 30$ , then Julia will not change her consumption  $C$ .
- e** If Julia (deviating from the above assumption of a free choice of working time) only has the choice to work either 100 or 150 or 200 hours per month, then she will work 150 hours.

## 2 Text Problems

**2.1** A firm produces an output with the short run cost function

$$C(q) = \begin{cases} \frac{1}{8}q^2 + 50 & \text{if } q > 0 \\ 32 & \text{if } q = 0 \end{cases}$$

The market price for the output is given as  $p > 0$ .

**2.1.1 (MC)** Determine the firm's short run profit function for prices  $p \in (4, 5)$  (the profit function gives the firm's maximum profit as a function of  $p$ ). Exactly one of the following answers is correct.

- a** In the given range, the profit function is linear in  $p$  (i.e. it has the form  $ap + b$ , with  $a \neq 0$ ).
- b** In the given range, the profit function is first (i.e. for small  $p$ ) strictly decreasing and then strictly increasing in  $p$ .
- c** In the given range, the profits are first strictly negative and then strictly positive.
- d** In the given range, the profit function is a quadratic function of  $p$  (i.e. it has the form  $ap^2 + bp + c$ , with  $a \neq 0$ ).
- e** None of the above answers is correct.

**2.1.2 (N)** Assume that the market price is  $p = 7$ . Calculate the price elasticity of the firm's supply and state it rounded to integer numbers.

**2.1.3 (N)** Determine the minimum of average costs and state it rounded to integer numbers.

**2.1.4 (N)** Which is the smallest market price, for which the firm still optimally produces in the short run (and under which it shuts down production in the short run)? Please state the value rounded to integer numbers.

2.1.5 (N) If the market price drops from  $p = 6$  to  $p = 0$ , by how much does the firm's profit decrease? Please state the value rounded to integer numbers.

**2.2** The demand for German cars in the compact mid-range sector has two components: domestic demand and foreign demand. Letting  $p$  be the price of such cars (in 1 000 Euros), then domestic demand is given by  $Q^I = 20 - \frac{1}{2}p$  and foreign demand by  $Q^A = 30 - p$  (in 100 000 units, respectively), or by 0 if those values are negative. The supply is given by  $S(p) = 2p - 20$  for  $p > 10$ .

2.2.1 (MC) Exactly one of the following answers is correct.

Over the whole range of prices between  $p = 10$  and  $p = 40$ , the elasticity of supply  $S(p)$  is

- a strictly increasing in price
- b strictly decreasing in price
- c first strictly increasing in price and then strictly decreasing
- d first strictly decreasing in price and then strictly increasing
- e None of the above four answers is correct.

2.2.2 (MC) Consider the absolute value of the elasticity of total demand  $D(p)$  (as a reminder: the elasticity of demand is negative by definition). Exactly one of the following answers is correct.

Over the whole range of prices between  $p = 10$  and  $p = 40$ , this absolute value is

- a strictly increasing in price
- b strictly decreasing in price
- c first strictly increasing in price and then strictly decreasing
- d first strictly decreasing in price and then strictly increasing
- e None of the above four answers is correct.

2.2.3 (N) Determine the market equilibrium and state the equilibrium price rounded to integer numbers.

2.2.4 (N) Due to a crisis in the German automobile sector, the supply curve changes to  $\hat{S}(p) = \frac{1}{4}p - 5$ . Calculate the new equilibrium price and state it rounded to integer numbers.

2.2.5 (N) In order to support the automobile industry, the government cuts child benefits and subsidizes each German car sold in Germany by a subsidy of 4, which is paid to the buyers. Calculate the equilibrium number of cars sold ( $Q^I + Q^A$ ) after the introduction of the subsidy and state it rounded to integer numbers. (Use the supply function from 2.2.4).

**2.3** Consumer Ule has the utility function  $u(x_1, x_2) = x_2 + 10 \ln(x_1 + 1)$ .

2.3.1 (MC) Exactly one of the following answers is correct.

- a Ule does not always prefer more of good 1.
- b If Ule's budget  $Y$  increases, then he will consume strictly more of good 1.
- c The utility function  $u_{new}(x_1, x_2) = 1 - (x_2 + 10 \ln(x_1 + 1))$  represents Ule's preferences.
- d Positive monotonic transformations of  $u(x_1, x_2)$  do not affect Ule's marginal utility with respect to good 2.
- e Positive monotonic transformations of  $u(x_1, x_2)$  do not affect Ule's marginal rate of substitution between good 1 and good 2.

2.3.2 (MC) The prices are given by  $p_1 = 5$  and  $p_2 = 1$  and the budget is  $Y = 125$ . Exactly one of the following answers is correct.

- a Ule is able to afford bundle  $(x_1, x_2) = (23, 15)$ .
- b Ule prefers bundle  $(x_1, x_2) = (23, 15)$  to each bundle in his budget set.
- c Ule prefers at least two bundles in his budget set to bundle  $(x_1, x_2) = (23, 15)$ .
- d Ule prefers exactly one bundle from his budget set to bundle  $(x_1, x_2) = (23, 15)$ .
- e None of the answers (a) - (d) is correct.



2.3.3 (N) Prices and the budget are as in 2.3.2. Calculate the slope of good 2's Engel curve for these parameters and state it rounded to integer numbers.

2.3.4 (N) Prices and the budget are as in 2.3.2. Determine the optimal demand for **good 2** for these parameters and state it rounded to integer numbers.

2.3.5 (N) The price of good 1 now increases to  $p_1^{new} = 11$ . Income  $Y$  and price  $p_2$  are as in 2.3.2. Determine the optimal demand for **good 2** for these parameters and state it rounded to integer numbers.