



Main Examination Period 2023

ECN211

Microeconomics II

Duration: 2 hours

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Answer each of the FOUR questions

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Examiners: Paweł Dziewulski

Question 1

Consider an economy with two goods $s = 1, 2$ and two consumers $i = A, B$ with identical preferences. Whenever an individual consumes x_1 units of good 1 and x_2 units of good 2, their utility is given by

$$u(x_1, x_2) = \frac{1}{2} \ln x_1 + \frac{1}{2} \ln x_2.$$

- (i) Calculate the marginal rate of substitution for those preferences at any consumption profile (x_1, x_2) . What is the marginal rate of substitution when $x_1 = x_2$?

[4 marks]

Suppose that consumer A is endowed with 2 units of good 1, but has no endowment of good 2. Consumer B has no endowment of good 1, but owns 4 units of good 2. In the remainder of this question, let p denote the price of good 1 and let the price of good 2 be normalised to 1.

- (ii) Show that, given price p , the demand of A for good 1 and 2 are given by $x_1^A = 1$, $x_2^A = p$, respectively. Similarly, show that the demand of B is given by $x_1^B = 2/p$ and $x_2^B = 2$.

[6 marks]

- (iii) Show that $p = 2$ is the competitive equilibrium price.

[4 marks]

- (iv) Plot the above economy and equilibrium in an Edgeworth box. Make sure to include the endowments, equilibrium prices, allocations, and sketch some indifference curves for each agent. In addition, include the 45° line for each consumer.

[5 marks]

Suppose we interpret the economy above as follows. There are two states of the world $s = 1, 2$, each equally likely. Let goods 1 and 2 correspond to the consumption of each agent in the respective state.

- (v) The government finds it imperative that (in this economy) each consumer should be fully insured in equilibrium. That is, agent A should have the same level of consumption in state 1 and 2, and the same should apply to consumer B . Is it possible to reach this objective by making appropriate transfers of the initial endowment between the two consumers? Precisely motivate your answer.

[6 marks]

Question 2

A profit-maximising firm has to decide how much pollution to emit. Its profit depends on the level of emission h and the amount of money w_f , and is given by

$$\pi(h) = w_f + \theta h - \frac{1}{2}h^2,$$

where θ is a positive parameter. The pollution affects a consumer living nearby. The consumer's payoff depends on the level of emissions h and the amount of money w_c she has. Her preferences are

$$\phi(h) = w_c - \frac{1}{2}h^2.$$

- (i) What is the profit-maximising level of pollution for the firm (as a function of θ)?

[6 marks]

- (ii) What is the Pareto optimal level of pollution? How does it depend on the parameter θ ? How does the optimal level of pollution relate to the one selected by the firm?

[7 marks]

- (iii) Obtain an expression for the optimal Pigouvian tax as a function of θ . From the welfare perspective, would the economy be better off if the government introduced the optimal level of quota on pollution? Precisely motivate your answer.

[6 marks]

Suppose the government does not know the actual value of θ , but they know that it may obtain the value $\theta_L = 2$ or $\theta_H = 4$ with equal probability.

- (iv) The government needs to decide whether to implement Pigouvian taxation or quota before the uncertainty regarding θ is resolved. Assuming that the government is interested in minimising the expected dead weight loss, which policy would be better? *[Hint: By symmetry, it suffices to compare the dead weight loss induced by each policy, conditional on $\theta = \theta_L = 2$.]*

[6 marks]

Question 3

- (i) What is the *certainty equivalent* of a lottery? How can it be used to determine whether or not someone should participate in one?

[4 marks]

Agents A and B are risk averse expected utility maximisers, each deriving utility $u(w) = \ln w$ from their final wealth w . There is a lottery that would leave A with final wealth of either 5 or 20, each equally likely; another lottery that would leave B with final wealth of either 4 or 25, again, each equally likely.

- (ii) Assuming that both agents have the same level of initial wealth, explain why they would either both accept or decline their separate gambles.

[6 marks]

In the remainder of the question, assume that each agent has the initial wealth equal to 12.

- (iii) If the two lotteries are independent, would you advise them to each participate in their lottery and share the costs and proceeds equally? Precisely motivate your answer.

[5 marks]

- (iv) Suppose that the two lotteries are perfectly negatively correlated. That is, one lottery yields high prize if, and only if, the other one yields the low one. Would you advise them to each participate in their lottery (again, sharing the costs and proceeds equally)? Does your answer change if the utility of the agents was not given by $u(w) = \ln w$?

[5 marks]

- (v) Finally, suppose that the two lotteries are independent with probability p , and perfectly negatively correlated with the remaining probability. For what value of p would you advise them to each participate in their lottery (again, sharing the costs and proceeds equally)?

[5 marks]

Question 4

A risk-neutral principal (P) must delegate one task to a risk-neutral agent (A). The agent can exert two levels of effort: $e = 0$ and $e = 1$. There are two possible outcomes (revenue levels) for the principal: $\pi = 0$ and $\pi = 8$. The principal can offer a contract (w_L, w_H) , where w_L denotes a monetary transfer from the principal to the agent if the principal's outcome is equal to 0, and w_H is a monetary transfer from the principal to the agent whenever $\pi = 8$. The principal maximises the expected profit equal to the difference between the expected revenue $\mathbb{E}\pi$ and the expected wage bill $\mathbb{E}w$.

The agent's utility is given by $\mathbb{E}w - \psi(e)$, where $\psi(e)$ is the disutility from effort e . Assume throughout that $\psi(0) = 0$ and $\psi(1) = 3$. Whenever the agent exerts effort $e = 0$, the probability of high revenue $\pi = 8$ is equal to $1/3$. If $e = 1$, the probability of the same event is $2/3$. If the agent does not accept the contract, they receive the utility of 0 from their outside option.

- (i) First, suppose that the principal can perfectly observe the effort level of the agent. What would be the optimal contract if they wanted to induce no effort, i.e., $e = 0$? What would be the optimal contract if they wanted to induce high effort, i.e., $e = 1$?

[7 marks]

In the remainder of the question assume that the principal is unable to observe the effort of the agent.

- (ii) What would be the optimal contract if the principal wanted to induce no effort, i.e., $e = 0$?

[5 marks]

- (iii) What would be the optimal contract if the principal wanted to induce high effort, i.e., $e = 1$? (You may assume that negative transfers are possible.)

[7 marks]

- (iv) From the point of view of the principal, what is the optimal level of effort when actions of the agent are not observable? Precisely motivate your answer.

[6 marks]

End of Paper