

January Examination Period 2024

ECN361: Advanced Microeconomics

Duration: 2 hours

**YOU ARE NOT PERMITTED TO READ THE CONTENTS OF THIS QUESTION PAPER
UNTIL INSTRUCTED TO DO SO BY AN INVIGILATOR**

Answer all questions.

Cross out any answers that you do not wish to be marked.

You are permitted to bring 20 x A4 pages of notes into your examination (i.e. 10 double sided pieces of paper). These can be typed or handwritten and can include graphs and images. They can include material from any source. Your notes must be stapled together and include your student ID number and the module code on the first page. You must submit your notes at the end of the examination with your answer booklet.

Calculators are permitted in this examination. Please state on your answer book the name and type of machine used. Complete all rough workings in the answer book and cross through any work that is not to be assessed.

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Question 1**[28 marks]**Give *concise* answers to the following questions.

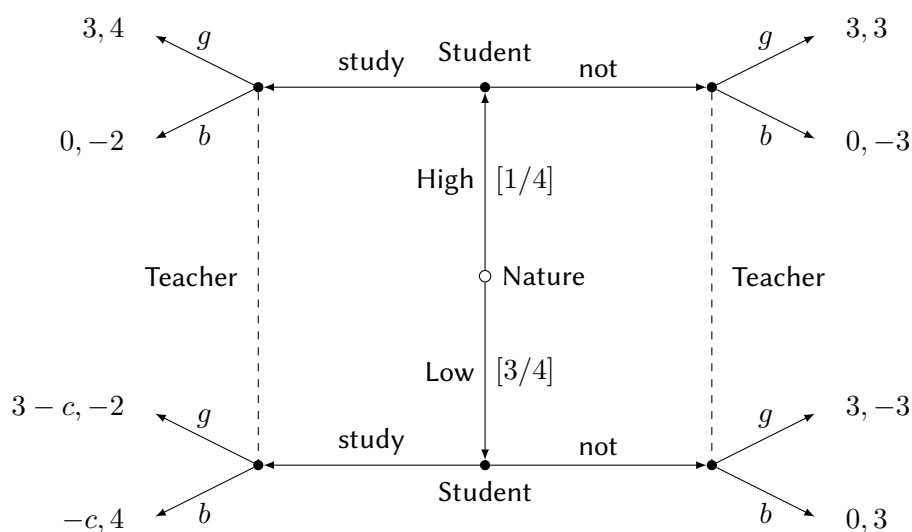
- a) Suppose the following stage game is repeated twice and the final payoff is the sum of the two stage-game payoffs (no discounting).

	L	M	R
T	1,1	5,0	1,0
M	0,5	4,4	0,0
B	0,1	0,0	3,3

- (i) Find a pure-strategy subgame-perfect equilibrium in which (M, M) is played in the first period.
- (ii) Find a pure-strategy Nash equilibrium that is not subgame perfect in which (M, M) is played in the first period. Explain why your strategy profile is not subgame perfect.
- b) The moral hazard problem has an efficient solution if the agent is risk neutral and not protected by limited liability. Explain how this efficient contract works; and why it does not generally work without risk-neutrality or without unlimited liability.

Question 2**[32 marks]**

Consider a signalling game between a student and a teacher. The student's skill type is either high (H) or low (L). After learning his type, the student chooses whether to study or not. Studying entails a cost of $c > 0$ for the low-skilled student and no cost for the high-skilled student. After observing the student's choice (but not his type) the teacher gives him a good (g) or a bad (b) grade. The payoffs are summarised in the game tree below.



- Suppose that the student plays the following strategy: $(\beta_H = 1/2, \beta_L = 1/3)$, where β_H denotes the probability that the student chooses to study if his type is H and β_L for type L . Denote the teacher's belief that the student is of type H after observing that he studied by μ_s and the belief that the student is of type H after observing that he did not study by μ_n . What beliefs are consistent with the student's strategy?
- Can the strategy in (a) form part of a PBE for any value of $c > 0$? Explain.
- Describe **all** pooling equilibria of the game in which both types of student choose not to study.
- Does any of the equilibria you found in (c) satisfy the Intuitive Criterion if $c = 1.5$? Explain.
[If you did not answer (c), for partial points you may consider the following strategy profile (which is NOT a PBE) and explain what the Intuitive Criterion would imply for the beliefs $((H \rightarrow s, L \rightarrow s) \ (s \rightarrow d, n \rightarrow b))$.]
- For which values of c is there a separating equilibrium in which the high type chooses to study and the low type chooses not to study? Describe the Equilibrium profile. Give an interpretation of the condition on c .

Question 3**[40 marks]**

A firm makes a ‘take-it-or-leave-it’ offer to a potential worker. If the worker accepts, he chooses effort level $e \in \{e^L, e^H\}$. His work produces profit $x_i \in \{x_1, x_2\}$. Denote the probability of profit x_i under effort e^k by p_i^k . The probability of the high profit x_2 depending on effort e^k is

$$p_2^k = \begin{cases} \frac{1}{3} & \text{if } e^k = e^L, \\ \frac{2}{3} & \text{if } e^k = e^H. \end{cases}$$

With the remaining probability $1 - p_2^k$ the profit is x_1 .

Profit is verifiable but effort is not. The utility of the firm when she gets profit x and pays wage w to the worker is $x - w$. The utility of the worker when he chooses effort e and receives wage w is $u(w) - c(e)$. Assume $u(w) = \sqrt{w}$, $c(e^L) = 1$, $c(e^H) = 2$, $x_1 = 3$, and $x_2 = 24$. If the worker rejects the contract, he gets utility of $\underline{u} = 0$.

- a) Describe the concepts Moral Hazard and Adverse Selection. What is the key difference between the situations in which one or the other arises? Which type is present in this model?
- b) Determine the optimal contract for the firm if effort is verifiable.

Assume for parts (c)-(f) that effort is not verifiable.

- c) Write down the firm’s optimisation problem assuming that she wants to implement effort e^H . Describe the role of each constraint.
- d) Determine the optimal contract to implement effort e^H by solving the problem in (c).
- e) Which effort level would the firm implement when effort is not verifiable?
- f) Now suppose that there is an additional effort level e^M for which the probability of output x_2 and the cost lie in between the values for the other two effort levels, that is, $p_2^L < p_2^M < p_2^H$ and $c(e^L) < c(e^M) < c(e^H)$. Which of the following statements is true?
 - (i) The principal is always (weakly) better off with the new effort level than without it.
 - (ii) The principal is always (weakly) worse off with the new effort level than without it.
 - (iii) Whether the principal is better or worse cannot be determined unambiguously without knowledge of the values of p_2^M and $c(e^M)$.

Justify your answer (no calculations necessary) and explain the potential advantages and/or disadvantages the introduction of the new effort level creates for the principal.

- g) (How) does your answer to the previous question change if effort was verifiable instead of non-verifiable? Explain.

End of Paper