Intermediate Microeconomics – Spring 2025

Instructor: Yuanning Liang

Problems Set 5

Due Wednesday June 9th

Instructions:

1. You can either write down your answers by hand or type out your solutions. Please submit a digital copy to the TA via email. Most importantly, please remember to indicate your name and student number on your homework.

2. The problem sets should be submitted to the TA before the beginning of the lecture on the due day. Late submissions will NOT be accepted.

3. You are encouraged to discuss with your classmates, but please write down your answers individually. Directly copying others' answers may result in zero points.

Question 1 (Uncertainty and Risk)

Ben is a proud owner of a romantic mansion facing the West lake worth $500,000. The location attractive as it is, however has one drawback. Occasionally in the spring heavy rains raise the water level in the lake, flooding the house. When this happens, the value of the house drops to $50,000. The flood occurs with probability 1/10. Ben finds the situation too stressful and therefore he is going to sell the house in the summer (after the potential flood). His wealth is denoted by c_F if there is flood, and c_{NF} if there is no flood.

a. In the commodity space (c_F, c_{NF}), show the affordable bundle if there is no insurance (the endowment point).

b. Ben can buy insurance that pays $\$x$ dollars when there is a food, paying premium $0.1x$ (he chooses x) – find his budget constraint, and then show on the graph.

c. Suppose Ben's von Neumann Morgenstern utility function is given by

$$U(c_F, c_{NF}) = 0.1\sqrt{c_F} + 0.9\sqrt{c_{NF}}$$

Is Ben risk averse (argue using a graph of his utility function $U(c)$)?

d. What is his MRS at the endowment point (no insurance)?

e. Find the optimal insurance and wealth levels under two contingencies. Does he insure fully?

f. On the graph show how your answer changes if the insurance premium is $0.2x$?

Question 2 (Asymmetric Information)

Clare manages a piano store. Her utility function is given by

$$Utility = w - 100,$$

where w is the total of all monetary payments to her and 100 represents the monetary equivalent of the disutility of exerting effort to run the store. Her next best alternative to managing the store gives her zero utility. The store's revenue depends on random factors, with an equal chance of being $1,000 or $400.

a. If shareholders offered to share half of the store's revenue with her, what would her expected utility be? Would she accept such a contract? What if she were only given a quarter share? What is the lowest share she would accept to manage the firm?

b. What is the most she would pay to buy out the store if shareholders decided to sell it to her?

c. Suppose instead that shareholders decided to offer her a $100 bonus if the store earns $1,000. What fixed salary would she need to be paid in addition to get her to accept the contract?

d. Suppose Clare can still choose to exert effort, as above, but now can also choose not to exert effort, in which case she saves on the disutility cost of effort and the shop's revenue is $400 for certain.

i. If shareholders decide to offer her a revenue-sharing contract as in part (a), what is the lowest share that would induce her to exert effort?
ii. If shareholders could design a contract for her involving a fixed salary plus bonus, what design maximizes their expected profit (revenues minus payments to the manager)?

Question 3 (Game Theory)

Two neighboring homeowners, i =1, 2, simultaneously choose how many hours l_i to spend maintaining a beautiful lawn. The average benefit per hour is

$$10 - l_i + \frac{l_j}{2},$$

and the (opportunity) cost per hour for each is 4. Home-owner i's average benefit is increasing in the hours neighbor j spends on his own lawn because the appearance of one's property depends in part on the beauty of the surrounding neighborhood.

a. Compute the Nash equilibrium.

b. Graph the best-response functions and indicate the Nash equilibrium on the graph.

c. On the graph, show how the equilibrium would change if the intercept of one of the neighbor's average benefit functions fell from 10 to some smaller number.

d. Suppose that player 2's opportunity cost of an hour of landscaping work is still 4. Suppose that player 1's opportunity cost is either 3 or 5 with equal probability and that this cost is player 1's private information.

   i. Solve for the Bayesian–Nash equilibrium.

   ii. Indicate the Bayesian–Nash equilibrium on a best-response function diagram.

   iii. Which type of player 1 would like to send a truthful signal to player 2 if it could? Which type would like to hide his or her private information?