Intermediate Microeconomics

Problem Set 9.

Deadline: Friday, April 28th, 1:00pm.

Submission options:

- in person during lectures or TA sessions;
- in Xiaoye Liao's mail box at 19 West 4th, 6th Floor;
- (less recommended) e-mail Xiaoye Liao at xl775@nyu.edu
  - in that case, be sure to use the subject line: "Submission Problem Set 9".

Exercise **1** *Model of an Airlines Market*

American Airlines and United Airlines compete for customers on flights between Chicago and Los Angeles. The total number of passengers flown by these two firms (per quarter), q, is the sum of the number of passengers flown on American, q_A, and those flown on United, q_U. Assume no other companies can enter. The flight Chicago–Los Angeles costs each airline \$147 per passenger. Let p be the price per passenger in dollars. Suppose that the demand function is $q(p) = 339 - p$.

(1) If American were a monopoly, what would its optimal quantity and price be? What would its profit be?

(2) In the duopoly described above, what is the Cournot equilibrium price for this industry? What is each airline's profits?

(3) If American were to move first, and United second, what would be the Stackelberg equilibrium quantities? price? profits?

(3) Consider a situation where American and United would form an alliance, called AUA, which behaves as a monopolist on this market. What would AUA optimal quantity be? What would be the resulting price? What would its profit be? Assuming each Airline gets half of AUA's profits, what would each Airline's profit be? Are these profits greater than their profits in the duopoly (both Cournot and Stackelberg)?

Exercise **2**

Consider the two-player games with the following payoff-matrices (rows and columns describe players' pure strategies).

1. Find all the Nash equilibria of this game (including those in mixed strategies).

	C	D
A	$0, 1$	$1, -1$
B	$3, 1$	$5, 0$

2. Find all the Nash equilibria of this game (including those in mixed strategies).

	L	C	R
U	$2,3$	$3,-1$	$4,1$
M	$-2,4$	$2,2$	$2,1$
D	$3,0$	$4,\frac{1}{2}$	$7,2$

EXERCISE **3**

Alice and Betsy are playing a game in which each can play either of two strategies, leave or stay. If both play the strategy leave, then each gets a payoff of \$300. If both play the strategy stay, then each gets a payoff of \$600. If one plays stay and the other plays leave, then the one who plays stay gets a payoff of \$C and the one who plays leave gets a payoff of \$D. For which values of C and/or D is the outcome (leave, leave) a Nash equilibrium?

EXERCISE **4**

Imagine three little girls sitting in a circle, each wearing either a red hat or a white hat (no girl can see the color of her own hat). Suppose that all the hats are red. When the teacher asks if any student can identify the color of her own hat, the answer is always negative, since nobody can see her own hat. But the teacher reveals that there is at least one red hat in the room, a fact which is known to every child (who can see two red hats in the room). Then the teacher asks if any student can identify the color of her own hat, and no one can. The teacher asks a second time if any student can identify the color of her own hat, and no one can. The teacher asks a third and last time if any student can identify the color of her own hat, and each little girl answers "red."

Describe the reasoning that has led each little girl to the answer.

EXERCISE **5**

Boeing and Airbus are competing to fill an order of jets for Singapore Airlines. Each firm can offer a price of \$10 million per jet or \$5 million per jet. If both firms offer the same price, the airline will split the order between the two firms, 50-50. If one firm offers a higher price than the other, the lower-price competitor wins the entire order. Here is the profit that Boeing and Airbus expect they could earn from this transaction:

	$\$5m$	$\$10m$
$\$5m$	$30,30$	$270,0$
$\$10m$	$0,270$	$50,50$

(1) What is the Nash equilibrium of this game?

(2) Suppose that Boeing and Airbus anticipate that they will be competing for orders like the one from Singapore Airlines every quarter, from now to the foreseeable future. Each quarter, each firm offers a price, and the payoffs are determined according to the table above. The prices offered by each airline are public information. Suppose

that Airbus has made the following public statement:

" To shore up profit margins, in the upcoming quarter, we intend to be statesmanlike in the pricing of our aircraft and will not cut price simply to win an order. However, if the competition takes advantage of our statesmanlike policy, we intend to abandon this policy and will compete all out for orders in every subsequent quarter."

Boeing is considering its pricing strategy for the upcoming quarter (assuming the above statement is a credible commitment from Airbus). What price would you recommend that Boeing charge? Present a formal reasoning.

(Note: to evaluate payoffs, imagine that each quarter Boeing and Airbus receive their payoff right away. That is, if in some quarter, Boeing chooses \$5m and Airbus chooses \$10, Boeing will immediately receive its profit of \$270 in that particular quarter). Furthermore, assume that Boeing and Airbus evaluate future payoffs in the following way: a stream of payoffs of \$1 starting next quarter and received in every quarter thereafter has exactly the same value as a one-time payoff of \$40 received immediately this quarter.

(3) Suppose that aircraft orders are received once a year rather than once a quarter. That is, Boeing and Airbus will compete with each other for an order this year (with payoffs given in the table above), but their next competitive encounter will not occur for another year. In terms of evaluating present and future payoffs, suppose that each firm views a stream of payoffs of \$1 starting next year and received in every year thereafter as equivalent to \$10 received immediately this year. Again assuming that Airbus will follow the policy in its public statement, what price would you recommend that Boeing charge in this year and beyond? Present a formal reasoning.