Ec 11 Homework 7
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Winter 2007

CALTECH

1. Find all equilibria of the following games:

(a)

Row \ Column	Left	Right
Up	(7,4)	(11,1)
Down	(4,5)	(9,2)

(b)

Row \ Column	Left	Right
Up	(1,1)	(7,9)
Down	(4,5)	(9,10)

(c)

Row \ Column	Left	Right
Up	(0,6)	(3,0)
Down	(3,0)	(0,3)

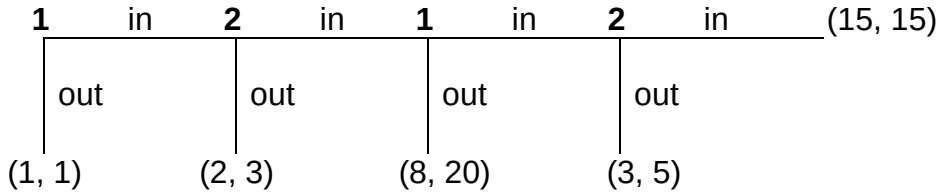
(d)

Row \ Column	Left	Right
Up	(3,1)	(0,9)
Down	(1,2)	(8,8)

(e)

Row \ Column	Left	Right
Up	(1,1)	(3,4)
Down	(4,3)	(2,2)

2. If you multiply a positive constant to a player's payoff, the equilibria of the game do not change. True or false, and why?
3. What payoffs would players receive if they played this two-player sequential game? Payoffs are listed in parentheses, with player 1's payoffs always listed first. (Note that choosing "in" allows the other player to make a decision, while choosing "out" ends the game.)



4. Consider the following game:

		Column	
		L	R
Row	U	1, 3	3, 2
	D	4, 1	2, 4

   a) Find all equilibria of the above game.
   b) What is the subgame perfect equilibrium if you turn this into a sequential game, with Column going first? With Row going first?

In which game does Column get the highest payoff—the simultaneous game, the sequential game when Column goes first, or the sequential game when Column goes second?

5. Draw the (unregulated) market supply and demand for the lawn ornament market. The data on how many of each type of buyer and seller will be provided with the experimental data. Bear in mind that pollution imposed a *0.5 cost on every person in the market, including the buyer and seller. [Hint: There is a subtle point in this question. If a buyer with value 25 buys at a price of 20, the net profit (consumer surplus) from this transaction is 4.5, because the number of lawn ornaments increases and there is added pollution. Thus, a buyer with value 25 is willing to pay at most 24.5 for the ornament. Similarly, a seller who sells increases pollution; thus a seller with cost 23 should not sell at any price less than 23.5.]
6. What is the predicted price and quantity? What was the actual quantity and average price?
7. What is total number of people present? The total pollution cost per unit sold is one-half of this number. Viewing that as a cost (to society), draw the "total social marginal cost" (which is the sum of the marginal private cost (not counting any pollution effects) to individual sellers and the external cost of pollution) on your figure. What is the socially efficient number of transactions? Take care not to double-count the pollution cost (e.g. you already accounted for the cost to a seller of his own pollution).
8. In experiment 4.2, a *6.5 tax was imposed on sellers. How does this affect supply? In a second figure, draw the new supply and demand curves, after the tax.
9. What is the predicted price and quantity? What was the actual quantity and average price in Experiments 4.2?
10. Experiment 4.3 involves two markets, the market for lawn ornaments and the market for pollution permits. How many pollution permits were available? Draw the supply and demand figure for the experiment 4.3 data (do not draw social marginal cost) and add the pollution permit quantity restriction as a vertical line. What is the difference in the buyer's value and seller's cost at that quantity?
11. Why is that difference - the difference between marginal value and marginal cost at the quantity of pollution permits - the value of pollution permits?
12. Pollution permits were given out free to particular buyers and sellers. In a new figure, draw the supply curve for the pollution permit market. What does the demand curve look like? (Hint: you figured out the willingness to pay for pollution permits only for the actual quantity of pollution permits. For other quantities of permits, the logic is the same but the numbers will be different.)

Solutions:

Find all equilibria of the following games:

a

		Column: Left	Column: Right
Row	Up	**(7,4)**	(11,1)
	Down	(4,5)	(9,2)

Row has a dominant strategy of Up, so Column plays Left.

b

		Column: Left	Column: Right
Row	Up	(1,1)	(7,9)
	Down	(4,5)	**(9,10)**

Row has a dominant strategy of Down, so Column plays Right.

c

		Column: Left	Column: Right
Row	Up	(0,6)	(3,0)
	Down	(3,0)	(0,3)

No pure strategy equilibrium. Column plays equal probabilities and Row plays Down twice as often as Up.

d

		Column: Left	Column: Right
Row	Up	(3,1)	(0,9)
	Down	(1,2)	**(8,8)**

Column has a dominant strategy of Right, so Row plays Down.

e

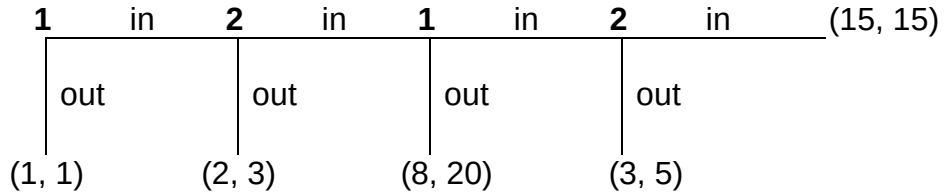
		Column: Left	Column: Right
Row	Up	(1,1)	**(3,4)**
	Down	**(4,3)**	(2,2)

There are two pure strategy equilibria: Row plays Down and Column plays Left, and Row plays Up and Column plays Right. There is also a mixed equilibrium, where Row plays Up 1/4 of the time and Column plays Left 1/4 of the time.

2. If you multiply a positive constant to a player's payoff, the equilibria of the game do not change. True or false, and why?

True, does not change the comparison of payoffs.

3. What payoffs would players receive if they played this two-player sequential game? Payoffs are listed in parentheses, with player 1's payoffs always listed first. (Note that choosing "in" allows the other player to make a decision, while choosing "out" ends the game.)



All players choose "In"

4. Consider the following game:

		Column	
		L	R
Row	U	1, 3	3, 2
	D	4, 1	2, 4

a) Find all equilibria of the above game.

One mixed equilibrium: Row plays U 3/4 of the time and D 1/4 of the time, Column plays L 1/4 of the time and R 3/4 of the time.

b) What is the subgame perfect equilibrium if you turn this into a sequential game, with Column going first? With Row going first?

If Column goes first, the SPE is (R, U). If Row goes first, it is (D, R).

c) In which game does Column get the highest payoff—the simultaneous game, the sequential game when Column goes first, or the sequential game when Column goes second?

When Column moves first, he gets 2. When he moves second, he gets 4. In the simultaneous game, his expected payoff is 5/2. So moving second in the sequential game is best for him.