Econ 160: Game theory and Economic Applications
Winter 2005
Problem Set 5 - Due 2/17/2005

Question 1: Regulating Medications

Consider a firm (player 1) that produces a unique kind of drug that is used by a consumer (player 2). This drug is regulated by the government so that the price of the drug is $p = 6$. This price is fixed, but the quality of the drug depends on the manufacturing procedure. The "good" (G) manufacturing procedure costs 4 to the firm, and yields a value of 7 to the consumer. The "bad" (B) manufacturing procedure costs 0 to the firm, and yields a value of 4 to the consumer. The consumer can choose whether to buy or not at the price p, and this decision must be made before the actual manufacturing procedure is revealed. However, after consumption, the true quality is revealed to the consumer. The choice of manufacturing procedure, and the cost of production, is made before the firm knows whether the consumer will buy or not.

2 (a) Is this a game of perfect or imperfect information? Explain using clear definitions.

4 (b) Draw the game tree and the matrix of this game.

4 (c) Find all the Nash equilibria of this game.

4 (d) Now assume that the game described above is repeated twice. (The consumer learns the quality of the product in each period only if he consumes.) Assume that each player tries to maximize the (non-discounted) sum of his stage payoffs. Find *all* the subgame-perfect equilibria of this game.

10 (e) Now assume that the game as repeated infinitely many times. Assume that each player tries to maximize the discounted sum of his or her stage payoffs, where the discount rate is $\delta \in (0, 1)$. What is the range of discount factors for which the good manufacturing procedure will be used as part of a SPE?

6 (f) Consumer advocates are pushing for a lower price of the drug, say 5. The firm wants to approach the Federal trade Commission and argue that if the regulated price is decreased to 5 then this may have dire consequences for both consumers and the firm. Can you make a formal argument using the parameters above to support the firm? What about the consumers?

Question 2: Bargaining with an Impatient Opponent

Consider a 3-period sequential (alternating) bargaining model as the one we did in class where two players have to split a pie worth 1 (starting with player 1 making the offer). Now our players have different discount factors, δ_1 and δ_2 .

1. Compute the outcome of the unique SPE.

2. Show that when $\delta_1 = \delta_2$ then player 1 has an advantage.

3. What conditions on δ_1 and δ_2 give player 2 an advantage? Why?

Question 3: The Persistence of Inequality

A brilliant engineer (player 1) and a Venture Capitalist (player 2) have gains from trade: The first owns cash necessary for developing ideas but has no intellectual skills, while the second has the intellectual skills with no cash to develop them. If they agree to cooperate, a successful project would be launched that yields a total **net** profit (or surplus) of 90.

To try and reach a resolution on how to split the surplus, they will meet every day in an alternative offer game, where first the engineer makes an offer $x \in [0, 100]$ of what he will keep, and the VC either accepts his share of $100 - x$ and the game ends, or he does not and they leave the table, only to return the next day with reversed roles, and so on.

There are two twists, however. First, if after three days they fail to reach an agreement then the project will be useless and both get nothing out of it (that is the day in which their competitor will have patented an alternative product). Second, each party i needs to pay its lawyer p_i per round in order to be illegible to make an offer. If a party does not have the cash to pay its lawyer, it cannot make an offer and by default the right to make an offer switches to the other side immediately. The VC has a cheap lawyer (he gets quantity discounts) so that $p_2 = 20$ while the engineer's lawyer charges $p_1 = 30$. Finally, both the VC and the engineer have savings equal to 60 from which they can pay their lawyers before an agreement is reached.

1. Defining payoffs as the total surplus a player gets *net of initial savings*, write down as best you can the extensive form of this game

2. What is the unique subgame perfect equilibrium?

3. Now assume that there is inequality in that the VC has savings of 60, but the engineer only has 30. What is the unique subgame perfect equilibrium?

4. If, given the wealth in part 3 (60 and 30) the engineer had access to a cheap lawyer like the VC's lawyer, would the outcome in part 3 change? Why?