

Econ 160: Midterm Exam
Winter Quarter, 2002

DIRECTIONS (Read Carefully!!):

- This exam includes 4 questions. Please answer each question in a separate blue book. I have tried to order the questions according to their difficulty. It is strongly recommended to read the whole exam before you attempt to solve it.
- Please hand in your answers in a comprehensible format; illegible answers may lose valuable points! Also any answer that is not supported by calculations or justifications (when relevant) will receive reduced credit!
- Starting time: 1:15 PM Ending time: 3:05 PM

GOOD LUCK!!

Question 1: Basic Concepts (15 points)

For each of the following statements, provide a proof if it is true or a counter-example if it is not (3 points each):

- (a) If G is a normal form game with more than one Nash equilibrium then more than one equilibrium must be Pareto Optimal.
- (b) In a normal form game, every strategy of each player is either strictly dominated or it is a dominant strategy.

Define, using as best you can the notation introduced in class, and briefly explain the following terms (3 points each):

- (c) Dominant strategy
- (d) Dominated strategy
- (e) Best response

Question 2: Technology Adoption (25 points)

During the adoption of a new technology a CEO (player 1) can design a new task for a division manager. The new task can either be a high level (H) or low level (L). The manager simultaneously chooses to invest in good training (G) or bad training (B). The payoffs from this interaction is given by the following bi-matrix:

| | | | |
|----------|---|----------|------|
| | | Player 2 | |
| | | G | B |
| player 1 | H | 5,4 | -5,2 |
| | L | 2,-2 | 0,0 |

- (a) Present the game in extensive form (a game tree). How many proper subgames does it have?
- (b) Solve for all the Nash Equilibria and subgame perfect equilibria.

Now assume that before the game is played the CEO can choose not to adopt this new technology, in which case the payoffs are (1, 1), or to adopt it and then the game above is played.

- (c) Present the *entire* game in extensive form. How many proper subgames does it have?
- (d) Solve for all the *pure strategy* Nash Equilibria and subgame perfect equilibria (SPE).
- (e) Are there SPE that have a mixed strategy in equilibrium?

Question 3: Debt and Repayment (30 points)

A project costing \$100 yields a gross return of \$110. A lender (player 1) is approached by a debtor (player 2) requesting a standard loan contract to complete the project. If the lender chooses *not to offer* a loan, then both parties earn nothing. If the lender chooses to *offer* a loan of \$100, the debtor can realize the projects gains, and is obliged by contract to repay \$105. For simplicity, assume that money is continuous, and that the lender can choose to return any amount of money $x \leq 110$. Also, ignore the time value of money.

Assume first that no legal system is in place that can cause the lender to repay, so that default on the loan (less than full repayment) carries no repercussions for the debtor.

- (a) Model this as an extensive form game tree as best as you can.
- (b) Find a Subgame Perfect Equilibrium (SPE) of this game. Is it unique?

Now assume that there is a legal system in place that allows the lender to *voluntarily* choose whether to sue or not to sue when the debtor defaults and repays an amount $x < 105$. Furthermore, assume that it is *costless* to use the legal system (it is supplied by the state), and if the lender sues a debtor that defaulted, the lender will get the \$105 repaid in full. After paying the lender, the borrower will pay a fine of \$5 to the court above and beyond the repayment.

- (c) Model this as an extensive form game tree as best as you can.
- (d) Find a Subgame Perfect Equilibrium (SPE) of this game. Is it unique?
- (e) Are there NE that are not SPE? Explain.

Now assume that using the legal system is *costly*: if the lender sues, he pays lawyers a *legal fee* of \$105 (this is the lawyers price which is unrelated to the contract above). The rest proceeds the same as before (if the lender sues a debtor that defaulted, the lender will get repaid in full; after paying the lender, the borrower will pay a fine of \$5 above and beyond the repayment.)

- (f) Model this as an extensive form game tree as best as you can.
- (g) Find a Subgame Perfect Equilibrium (SPE) of this game. Is it unique?
- (h) Are there NE that are not SPE? Explain.

Now assume that a law change is proposed: upon default, if a debtor is sued he has to first repay the lender \$105, and then pay the legal fees of \$105 above and beyond repayment of the loan, and no extra fine is imposed.

- (i) Should the lender be willing to pay for this law change? If so, how much?
- (j) If you were the “social planner”, would you implemented the suggested law?

Question 4: Entry Deterrence (30 points)

Consider the Cournot duopoly game we did in class with demand $p = 100 - (q_1 + q_2)$, and variable costs $c_i(q_i) = 0$ for $i \in \{1, 2\}$. The twist is that there is now a fixed cost of production $k > 0$ that is the same for both firms. Assume first that both firms choose their quantities simultaneously.

- (a) Model this as a normal form game.
- (b) Write down the firm's best response function for $k = 1000$ and solve for pure strategy Nash equilibrium. Is it unique?

Now assume that firm 1 is a "Stackelberg leader" in the sense that it moves first and chooses q_1 , and then after observing q_1 firm 2 chooses q_2 . Also assume that if firm 2 cannot make strictly positive profits then it will not produce at all.

- (c) Model this as an extensive form game tree as best as you can.
- (d) Find a Subgame Perfect Equilibrium (SPE) of this game for $k = 25$. Is it unique?
- (e) How does your answer in (e) change for $k = 225$?