# University of Notre Dame
# Department of Finance
# Economics of the Firm
# Fall 2011

**Problem Set #3**

1) Consider the following version of the prisoners dilemma game (Player one's payoffs are in bold):

| | | Player Two | |
|---|---|---|---|
| | | Cooperate | Cheat |
| Player One | Cooperate | **$10** $10 | **$0** $12 |
| | Cheat | **$12** $0 | **$5** $5 |

   a) What is each player's dominant strategy? Explain the Nash equilibrium of the game.
   b) Suppose that this game were played three times in a row. Is it possible for the cooperative equilibrium to occur? Explain.

2) You and your sister have just inherited $3M that needs to be split between the two of you. You get to make an initial offer, your sister then gets to respond by either accepting your initial offer or making a counter offer. Finally, you can respond by either accepting your sister's offer or making a final offer Assume that each period, $1M is removed from the total (each round of negotiation costs $1M in lawyer's fees). Further, assume that both you and your sister value future payments just as much as current payments (i.e. no discounting future payments). Calculate the Nash equilibrium for this game.

3) Consider a variation of the previous problem: Same rules as in (3), However, this time, you learn something about your sister: You discover that your sister has always hated you. All she cares about with regards to splitting the $3M is that she gets more than you do (i.e. an allocation of $500,000 for you and $1M for her is preferred by her to an allocation of $1.5M apiece!). Calculate the new Nash equilibrium of the game. (Note: Your incentives are the same as in (4), you want to get as much as possible.) Again, assume that you are making the first offer.

4) Consider the game of chicken. Two players drive their cars down the center of the road directly at each other. Each player chooses SWERVE or STAY. Staying wins you the admiration of your peers (a big payoff) only if the other player swerves. Swerving loses face if the other player stays. However, clearly, the worst output is for both players to stay! Specifically, consider the following payouts.
(Player one's payoffs are in bold):

| | | Player Two | |
|---|---|---|---|
| | | Stay | Swerve |
| Player One | Stay | **-6** -6 | **2** -2 |
| | Swerve | **-2** 2 | **1** 1 |

a) Does either player have a dominant strategy? Explain.
b) Suppose that Player B has adopted the strategy of Staying 1/5 of the time and swerving 4/5 of the time. Show that Player A is indifferent between swerving and staying.
c) If both player A and Player B use this probability mix, what is the chance that they crash?

5) Suppose that the (inverse) market demand for fax paper is given by

$$P = 400 - 2Q$$

Where Q is total industry output. There are two firms that produce fax paper. Each firm has a constant marginal cost of production equal to $40 and they are competing in quantities. That is, they each choose production levels simultaneously.

a) Suppose that Firm 2 chooses a production level equal to 40. Complete the following chart:

| Firm 1 Output | Firm 2 Output | Total Output | Price | Total Revenue | Marginal Revenue |
|---|---|---|---|---|---|
| 1 | 40 | | | | |
| 2 | 40 | | | | |
| 3 | 40 | | | | |
| 4 | 40 | | | | |

b) Calculate firm 1's best response to firm 2's choice of output equal to 40 (this will be easier in excel).
c) How would your answer to (b) change if firm 2's production increased to 80? Explain.

d) Show that each firm setting a production level equal to 60 is a Nash equilibrium (i.e. neither firm has an incentive to change).

6) Price competition is a very severe form of competition. In fact, with competition in prices, it only takes two firms in the marketplace to drive price down to marginal cost and profits to zero.

    a) How do capacity constraints influence the equilibrium in Bertrand competition?
    b) How does product variety influence the equilibrium in Bertrand competition?