14.03 Fall 1999 – Exam Number 3

DO NOT OPEN THIS EXAM UNTIL TIME IS ANNOUNCED!

There are 80 points on this exam and you have 80 minutes to complete it.

There are three parts to the exam. Please use a separate blue book for each part and don't forget to write your name on each blue book

Part I contains six TRUE-FALSE-UNCERTAIN AND WHY questions. You must defend your answers with one or two sentences or graphs. ***Answers without explanations will receive zero credit.*** **(5 points each, 30 points overall*)***

Part II contains two more detailed questions (10 points each, 20 points overall).

Part III contains one five-part question (30 points).

If you have a question about the exam, please come to the front of the room to ask for clarification.

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Part I. 5 points each

True, False, or Uncertain AND WHY. You must explain your answer with one or two sentences and/or graphs. Answers without justification receive zero points.

1. In a non-cooperative game (i.e., the type of we analyzed in class), a dominant strategy is a strategy that is optimal providing that the other player is also playing his or her dominant strategy. [An example would be helpful.]

2. Models of network externalities demonstrate that individuals often make socially inefficient choices about adopting new technologies due to risk aversion. [Explain your answer.]

3. One way that the U.S. government can raise revenue without harming U.S. citizens is by placing a tax on imports, thereby taxing foreigners rather than U.S. consumers. [Your answer must include a diagram.]

4. While international trade is normally welfare improving for technologically advanced countries like the U.S., it can harm less developed countries that don't have a comparative advantage in anything. [Provide a diagram or numerical example]

5. Consider an exchange economy with an initial endowment E. Let S_1 be the set of allocations that are Pareto superior to E. Let S_2 be the set of allocations that are competitive equilibria that can be reached by trading at competitive prices from E. Then, S_2 is a subset of S_1. [Your answer should include a diagram]

6. In the competitive equilibrium of a pure exchange economy with heterogeneous consumers, we would not expect that $MRS_i = MRS_j \; \forall \; i \neq j$ since each person has different preferences. [Provide a diagram that illustrates your answer.]

Part II: 10 points each.

1. A popular children's nursery rhyme reads, "Jack Sprat can eat no fat and his wife can eat no lean." Construct an Edgeworth Box diagram for Mr. and Ms. Sprat with appropriately labeled axes. Draw their indifference curves and show the set of Pareto optimal allocations. Assuming that both Mr. and Ms. Sprat are endowed with positive quantities of both fat and lean, what is the competitive equilibrium allocation? Explain.

2. The supply of rental apartments in Cambridge is given by $Q_s = 0.5P$. The demand for rental apartments is given by $Q_D = 3{,}000 - P$.

   A. (2.5 points) What is the equilibrium price and quantity of rental apartments in Cambridge (P^*, Q^*)?

   B. (2.5 points) In response to high apartment rental prices, the Cambridge City Planning Board implements a rent control policy mandating that the maximum price for a rental apartment in Cambridge is ¾ times P^* from part A. What is the new equilibrium price and quantity for rental apartments in Cambridge (P_R, Q_R)? How many renters are unable to find an apartment (or apartments unable to find a renter)?

   C. (2.5 points) Draw a carefully labeled diagram that shows the impact of the rent control policy on the apartment market. Label each of the relevant regions of the diagram under the new policy in terms of gain or loss of consumer surplus, gain or loss of 'landlord surplus', and any net gains or dead weight losses that may result. Calculate the size of each region (in dollars) and tabulate the results (including who gains and who losses each region).

   D. (2.5 points) Recognizing the difficulties analyzed above, the City Planning Board repeals rent control and instead implements a 'luxury' tax of T on each apartment that a landlord rents. Starting at the market equilibrium price and quantity from Part A., calculate what percentage of the tax T landlords ultimately pay and what percentage renters pay.

Part III: 30 points total, 6 points each sub-question

1. The countries of North and South are in a dispute over fishing rights in George's Bank, a fertile fishing ground off the coast of New England. The source of disagreement is that each boat sent into George's Bank reduces the yield of all of the other boats. And while each country, North and South, has control over the number of boats it sends into George's Bank, it has no control over the number of boats the other country sends.

   Let B_N and B_S equal the number of boats sent by North and South respectively, and let $Y(B_N, B_S) = 360 - (B_N + B_S)$ equal the annual fishing yield (in tons) *per boat* from George's Bank.

   A. What is the welfare maximizing number of boats (total) that should be sent to George's Bank each year? What is the total fishing yield in this case? (Note: assume that we are interested in maximizing the fish yield and that we are not taking the welfare of the fish into account.)

   B. Because there is no fishing treaty, North and South make their fishing decisions non-cooperatively by maximizing their national fishing yields. How many boats will each country send to George's bank (in other words, what is the Nash Equilibrium outcome of this dispute)? Call this quantity of boats B^{NC}, where *NC* stands for non-cooperative. What is the yield for each country in this case? (Hint: note that the game is symmetric because each country faces exactly the same payoffs.)

   C. North and South sign a 3-year treaty that allows each country to send exactly one-half the socially optimal number of boats that you solved for in (A). Call this quantity B^*. The treaty stipulates that if either country violates the agreement, the two countries will return to the situation in part (B). How many boats does each country send in each year of the 3-year treaty? Explain your answer and be sure to note what equilibrium concept are you using.

   D. North and South have negotiated a new fishing treaty identical to the previous treaty except that the new treaty lasts forever *unless* either country violates it. Assume that each country has an identical discount rate of d, where $d = 0$ implies that the country discounts the future completely and $d = 1$ implies that the country does not discount the future at all. Under what values of d will the treaty hold? (Hint: *Before* you solve for d, you must solve for the optimal 'defection' (in terms of boats sent) that a country would make were it to violate the treaty.)

   E. After several years of peaceful cooperation under the treaty, South announces that it has developed a new fishing boat called the "Super Trawler." The Super Trawler is the equivalent of 150 (!) fishing boats but <u>all in one boat</u>. You could even say that the Super Trawler is *exactly like* 150 conventional fishing boats all welded together. Moreover, South explains that all of its conventional fishing boats were destroyed by a mysterious fire during the winter. Hence, South can either use the Super Trawler or it can <u>not</u> fish at all.

Assuming that South used the Super Trawler, what would be North's best response in terms of fishing boats deployed? Observe further that if South does not fish at all, North's best response is to send the social optimum number of boats that you solved for in A (note: this is because North would have the whole fishing ground to itself). With these facts in mind, what is the equilibrium outcome of this game? How does the number of boats sent by each country compare to the previous non-cooperative outcome in Part B? Explain the intuition for your result in terms of the game theory tools used in class.