Sloan School of Management   15.010/ 15.011
Massachusetts Institute of Technology   Economic Analysis for Business Decisions

FINAL EXAMINATION
(Tuesday, December 18, 2001, 9:00 a.m. to noon)

Directions: This is a closed-book exam. <u>Please print your name clearly on each answer book</u>.

Answer all questions as clearly and legibly as possible. The exam has a total of 540 points; the number of points and a suggested amount of time is indicated for each question.

<u>For numerical problems, please draw a box around your answer.</u>

<u>You must turn in this exam along with your answer books before leaving the room</u>.

Signed: _____

Print your name: _____

Answer all of the following nine questions (total of 540 points). On numerical questions, please place a box around your final answer. Please write your name and Sloan section on each book, and number your books. Leave the bottom of the front page blank, for the recording of grades. (Note: all prices are in dollars unless otherwise noted.)

1. **Short Questions** (96 *points, 32 minute*s). Please answer each of the following 4 questions.

   1a) You have a patent on a drug that has been approved for sale in the U.S. The U.S. demand for this product, for which you are the monopoly producer, is

   $$ln\ Q = 3.4 - 1.5 ln\ P + 0.5\ ln\ A$$

   where Q is millions of tablets sold, P is the price per tablet, A is expenditure on advertising, and *ln* denotes a natural logarithm.

   (i) If you are maximizing profits, and if the marginal cost of a tablet is $0.90, what price should you charge?

   (ii) *[Note: Not covered this year.]* If your revenues at this optimal price are $ 225 million, what is the profit-maximizing level of expenditures on advertising?

   1b) *[Note: Not covered this year.]* The demand for personal computer color laser printers in year t is

   $$ln\ Q_t = 0.30 - 0.40\ ln\ P_t + 0.50\ ln\ I_t + 0.20\ ln\ Q_{t-1},$$

   where Q_t is the quantity of color laser printers sold in year t, P_t is the price of printers, I_t is per capita income, and Q_{t-1} is the quantity of printers sold in period t - 1. The term *ln* indicates a natural logarithm. Both P_t and I_t are adjusted for inflation.

   (i) What is the *short-run* price elasticity of printer demand?

   (ii) What is the *long-run* price elasticity of printer demand?

1c) Bart and Milhous are considering skipping school to play video games. They enjoy playing video games more if they are together, and Bart enjoys skipping school more than Milhous, as can be seen from the following payoff matrix (note: payoffs are displayed as (Bart's payoff, Milhous' payoff)).

		Milhous	
		Skip class	Go to class
Bart	Skip class	12 , 8	6 , 10
	Go to class	0 , 0	8 , 12

(i) Does Bart have a dominant strategy? If so, what is it? Does Milhous? If so, what is it?

(ii) Is there a Nash equilibrium in this game? If so, what is it?

1d) The local market for Christmas trees has demand and supply as follows:

$$Q_d = 16{,}000 - 125P \, ,$$
$$Q_s = 4{,}000 + 175P \, ,$$

where Q is number of trees, and the price P is in dollars per tree.

(i) Calculate the equilibrium price and quantity that will prevail under a completely free market.

(ii) Because of complaints from Santa Claus, it becomes illegal to sell Christmas trees for any price higher than $30. What will be the resulting shortage or surplus?

2. *(48 points; 16 minutes)* The Rolling Stones rock band is coming to Boston to perform at CMGI Stadium, and you are in charge of pricing and selling the tickets (assume all seats are the same and you only need to set a single price). Independent of the number of seats sold, you must pay the administration of CMGI Stadium a fixed amount of $ 1,000,000 (to cover security and cleaning costs), which represents the only cost. There are 60,000 seats in CMGI Stadium.

2a) Based on historical data, you estimate the demand for this event to be

$$Q_d = 160 - .8\,P$$

Where Q_d is in thousands of tickets and P is the price per ticket in dollars. What price P should you charge? How many tickets will you sell and what are your profits? (Don't worry if there are empty seats, you can always give those seats away to worthy charities.)

2b) Suppose you have the option of adding some temporary seats on the grass field for $20 a seat (assume these seats have the same view as the other seats and tickets for them would sell for the same price). Would you add any seats? If so, what price would you charge, how many tickets would you sell and what would your profits be?

3.   *(45 points; 15 minutes)* The Museum of Chinese Scholar Rocks has hired you to set its admission prices. There are two types of people who live in the museum's area: Connoisseurs (C's), who love scholar rocks, and Students (S's), who think that rocks are less enchanting.   The demand of each C is estimated as

$$Q_1 = 20 - 2P$$

where Q is number of visits per year and P is in dollars per visit.   The demand of each S is estimated as
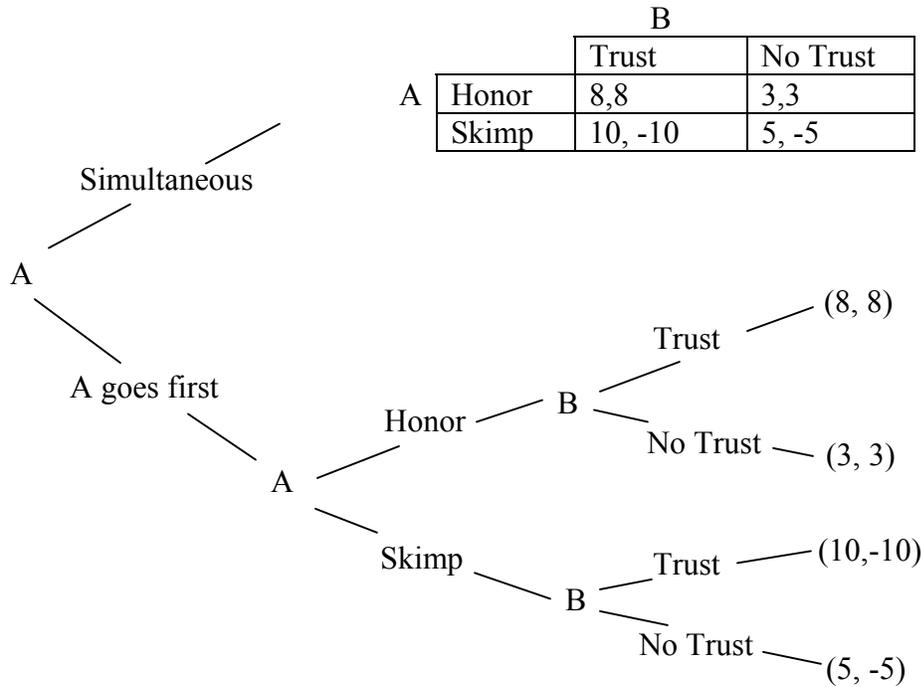
$$Q_2 = 10 - P$$

There are 2,000 C's and 8,000 S's in the local population. Also, the Museum faces a marginal cost of zero per visit, and a fixed overhead cost of $50,000.

3a) Suppose you can identify who is a C and who an S by checking identification. To maximize profits, what daily admission fee should you charge C's, and what daily admission fee should you charge S's? What are profits here?

3b) Again suppose you can identify who is a C and who an S by checking identification. Suppose that you sold annual memberships, as well as charged a daily admission rate. To maximize profits, what membership fee should you charge C's, what membership fee should you charge S's and what daily admission rate should you charge? What are profits here?

3c) Suppose now that you *cannot* identify who is a C and who is an S. Suppose you offer admission by charging one annual membership fee, but with free daily visits. In this case, what is the annual fee that maximizes profits for the Museum? Be sure to indicate which groups (C's, S's or both) choose to become members. What are total profits?

4. *(45 points; 15 minutes)* Augustin Cournot studied the town of Ale, which has two water producers, A and B. The demand for water by Ale residents is given as

$$P = 12 - Q$$

where P is in dollars per pint and Q is in thousands of pints. Water is produced at zero cost. If A and B choose quantities Q_A and Q_B to supply, how much will they supply in equilibrium, and what is the market price?

5. *(30 points; 10 minutes)* Firm A supplies bolts to firm B. The two firms have agreed (informally) on a specific quality level. Firm A can either Honor that agreement or Skimp on quality. Firm B has to decide whether it should inspect all incoming products from A (No Trust) or use them uninspected in its production (Trust). Firm A has the opportunity to move first and commit to Honoring or Skimping on quality.   If A decides not to move first, then both firms will choose simultaneously. The game tree on the following page represents the possible actions and the corresponding payoffs. (Payoffs are in thousands of dollars, and are known to both participants).

B

		Trust	No Trust
A	Honor	8,8	3,3
	Skimp	10, -10	5, -5

Simultaneous

A

A goes first

Honor — B

Trust — (8, 8)

No Trust — (3, 3)

A

Skimp — B

Trust — (10,-10)

No Trust — (5, -5)

Note: payoffs are displayed as

(A payoff, B payoff)

5a) What is the equilibrium of this game? Explain your answer.

5b) Suppose that firm A was required to pay to be able to go first. How much would A be willing to pay to be allowed to go first?

6. *(90 points; 30 minutes)* Smallville's Tennis Club is a monopolist of tennis court access and sells lifetime memberships, giving members permanent access to its courts without any additional fees. Racquets R' Us is a monopolist of tennis racquets; and racquets last a lifetime. The Tennis Club has zero marginal costs associated with providing memberships, and a fixed overhead cost of $ 500. Racquets 'R Us has total costs of $TC(q) = 100 + q^2/2$ of producing q racquets. To play tennis in Smallville, one needs both a membership and a tennis racquet (and one is useless without the other). Residents' demand to play tennis (i.e. for *both* membership and a racquet) is described by the relationship

$$P = 180 - Q$$

where Q represents the number of residents buying both a membership and a racquet, and P is the combined price (membership and racquet), in dollars.

6a) Suppose that the Tennis Club has committed to the price $30 for memberships. What quantity of racquets should Racquets R' Us sell in order to maximize profits? What price will they sell for? What is the profit to Racquets R' Us? What is the profit to the Tennis Club?

6b) What price should the Tennis Club charge to maximize profits, given that they commit to a price prior to Racquets R' Us? (Note: the Tennis Club decision must take into account that Racquet's R' Us maximizes profit after knowing the Tennis Club's chosen price.) What is the profit for the Tennis Club? What is the profit to Racquets R' Us?

6c) Suppose now instead that the Tennis Club and Racquets R' Us sign a contract to sell (only) the *bundle* of membership together with a racquet. What price will they charge for the bundle in order to maximize their joint profit? What is their joint profit?

6d) Suppose instead that the Tennis Club opens its own racquet store (with identical costs as Racquets R' Us) and sells (only) the bundle of a lifetime membership together with a racquet. What do you think would happen to Racquets R' Us sales in Smallville? (Briefly explain your answer, no calculations required.)

7. *(60 points; 20 minutes)* Footspring is a producer of handheld pc's. Footspring has an upstream division that produces the operating system for such devices. Footspring has a downstream division that assembles handheld pc's. The demand curve for Footspring's handheld pc's is given as

$$Q = 300 - P$$

where Q is the quantity of handhelds it will sell when it sets its price equal to P. All prices are in dollars, while quantities are in thousand units. Each handheld costs $100 to produce, excluding the cost of the operating system. It does not cost anything for Footspring to make an extra copy of the operating system.

7a) Assume that the downstream division's manager maximizes divisional profits in a transfer price system. Show that Net Marginal Revenue of the downstream division is $NMR = 200 - 2Q$.

7b) How should top management optimally set the transfer price that the downstream division has to pay the software division for each copy of the O/S it sells (i.e. for each handheld with that O/S it sells). How many handhelds will the downstream division produce? What are Footspring profits?

7c) Assume that due to anti-trust actions, Footspring must be split into a software division, which retains the name Footspring, and an independent handheld producer, called Toehold. How much will Footspring charge Toehold for each O/S copy now?

7d) How do the joint profits of Toehold and Footspring compare to Footspring's profit before the spin-off? Explain (give a reason) for the difference you see.

8. *(54 points; 18 minutes)* Morning commuting in the city of Cartown is becoming a problem. Every morning 25,000 people from uptown must go downtown to work. There are two commuting options: subway (s) and car (c). Assume that the subway has unlimited capacity, that each car accommodates 1 person, and that benefits and costs are in dollars. The benefit of traveling by subway is $b_s = 40$ and the cost is $c_s = 20$, so that someone that takes the subway gets a net benefit of $\pi_s = b_s - c_s = 20$. The benefit of driving the car is $b_c = 50$. The cost, however, depends on traffic and is equal to $c_c = 10 + N_c$, where N_c is the number of thousands of people driving their cars.

8a) Find the number of people that take the subway (N_s) and the number of people that drive their cars (N_c) to work.

8b) Suppose that the total welfare of the 25,000 commuters is the sum of their net benefits. Find the optimal allocation of commuters between cars and subway that maximizes total welfare. Why doesn't the answer to **8a)** maximize total welfare?

8c) How should the government implement your solution to **8b)** in practice? Name a method and provide numbers that give rise to your solution.

9. True, False, Uncertain (72 *points, 24 minutes*). Decide whether each of the following three statements is true, false or uncertain. Most of the credit will be given for the explanation, and be sure to define relevant terms.

9a) The Winner's Curse occurs because people shade their bids in descending price, private value auctions.

9b) In the pricing of a new product, positive network externalities would suggest raising prices initially, since the earliest users will end up getting the highest value for the product.

9c) Volbo is making the Eyehumvee, an automobile with an enhanced visual display that will allow drivers to see hazards earlier than just with their eyes. Certainly the number of accidents per driver for the Eyehumvee will be lower than for other vehicles.