Economics 431
Fall 2003
First Midterm Exam
October 6, 2003

Print your name here _____

Your UM ID number[1] _____

Instructions:

- Do not open the exam until you are told to do so.
- *Once the exam begins*, check that you have all the pages. There should be 12 pages including this one.
- This is a closed book, closed notes exam.
- You have 1 hour and 20 minutes minutes to take the exam.
- Answer the questions in the space provided. To get credit on word questions, you should provide a brief explanation of your answer. Please write concisely and to the point. Feel free to use diagrams, but label them properly. If your answer involves doing math, show all work (this way you will get partial credit in case your ideas are correct but your math is not).
- If you run out of space on a particular question, you may use the back side of the same page. Clearly indicate on the front of the page that your answer is on the back; and on the back, give the number of question you are answering.

Good Luck!

[1] The underlined 8 digits on the face of your M-Card

Part I True or false (credit given for explanation and/or explicit calculation)

1) (7 points) Consider an industry that consists of a large number of identical firms. In the long run competitive equilibrium, a firm's marginal cost must equal its average cost.

2) (5 points) Third degree price discrimination can lower monopolist's profits compared to uniform pricing, because the overall surplus from trade may decrease.

3) (8 points) Suppose that an industry has $CR_4 = 100$. Then its Herfindahl index H cannot be less than 2500.

Part II Problems (show all work)

4) (20 points) Suppose that initially the industry with many identical firms is in the long-run equilibrium. Each firm has a cost function $C_0(q) = 1 + q^2$. Discovery of a new production technique lowers the variable cost, and this makes each firm's total cost function $C_1(q) = 1 + \frac{1}{4}q^2$.

a) **(10 points)** Calculate the initial long-run equilibrium price (p_0) and the new long-run equilibrium price (p_1).

b) **(10 points)** Suppose that market demand is linear and given by $p = 4 - 0.1 \cdot Q$, where p is the market price and Q is the total quantity demanded. Calculate the number of firms in the industry before and after the change in technology. (Hint: what is the quantity produced by each firm in the long-run equilibrium?)

5) (15 points) A profit-maximizing electric utility (truthfully!) reported a profit of \$9 million. It charges a uniform price of \$0.14 per kilowatt. Assume that demand for electricity is *linear* with intercept $A = \$0.23$ per kilowatt

a) **(5 points)** Calculate the electric utility's marginal cost.

b) **(5 points)** Calculate the quantity (in kilowatts) sold on the market

c) **(5 points)** Calculate the elasticity of demand for electricity at monopoly price

6) (10 points) A software company sells a proprietary statistical package and charges a uniform price of $200. At this price, there are no students among the buyers of the software, although some students are willing to pay above the software's marginal cost.

a) **(6 points)** Will the company sell more copies of software if it can charge students and other users different prices? Is third degree price discrimination in this case more efficient or less efficient than uniform pricing? Explain.

b) **(4 points)** The elasticity of demand for software among non-students is $-4/3$, and the price that the software company chooses to charge student users is $100. Calculate the elasticity of demand for this software among students.

7) (30 points) Big C cable is a monopoly that can offer cable packages with different number of channels at different monthly fees. The marginal cost of providing an additional TV channel is $c = 0$. Let p be the customer's willingness to pay (in cents per month) for an additional TV channel when he already has q channels. There are two types of customers: high types whose demand for channels is given by

$$p = 120 - q$$

and low types whose demand for channels is given by

$$p = 60 - q$$

a) **(8 points)** Suppose all the high type customers live in Yuppieville and all the low type customers live in Sticksfield. What number of channels and at what monthly fee will Big C offer in each of these two areas?

b) **(8 points)** Alternatively, assume that high types and low types live in the same area, and Big C cannot tell its customers apart. Now it has to design a Basic package with 60 channels targeted at low types and a Premium package with 120 channels targeted at high types. If Big C wants to sell to both types, what is the profit-maximizing price for the Basic and Premium packages?

c) **(8 points)** If 20% of Big C's customers are high types and 80% are low types, will Big C benefit from including just 40 (instead of 60) channels in its Basic Package? (Credit given for explicit calculation of new prices for Basic and Premium packages)

d) **(6 points)** Rate the packages in a), b) and c) in terms of their economic efficiency. Explain.

8) (20 points) An ice cream maker has to decides what types of ice cream to sell and at what prices. The customers who buy ice cream have different tastes x for fat content, with x ranging from $\frac{1}{4}$ to $\frac{5}{4}$. For each x, there is an equal number of customers with taste x. If x is the customer's most preferred fat content, and the ice cream has fat content z, then customer x is willing to pay

$$2 - 0.8\,|x - z|$$

for this ice cream. The marginal cost of producing an ice cream with any fat content is $c = 0.4$. Assume that the manufacturer always serves the whole market.

a) **(6 points)** If the manufacturer is free to offer any two types of ice cream, what will be their optimal "locations" in terms of fat content and what will be the profit maximizing prices?

b) **(6 points)** Suppose that due to a fashion for low fat foods, customer tastes ("addresses") unexpectedly shift from the interval $\left[\frac{1}{4}, \frac{5}{4}\right]$ to the interval $[0, 1]$. For these new tastes, determine the profit-maximizing prices for the product line that you found in part a). Continue to assume that the manufacturer serves all the market.

c) **(8 points)** If it costs $F = 5$ per product (this fixed cost is measured in flow terms, same as profit) to adapt the product to the change in tastes (i.e. to re-locate each of the two products to its new optimal fat content), will the manufacturer choose to adapt or stay with his old product line? In doing profit calculations, assume that the total number of customers is 100.

Derivatives of some functions

$$\begin{aligned} \frac{d}{dx}\left(x^2\right) &= 2x \\ \frac{d}{dx}\left(\frac{1}{x}\right) &= -\frac{1}{x^2} \end{aligned}$$

Marginal revenue for a monopolist

$$\frac{d}{dq}\left(p(q)\cdot q\right) \equiv MR\left(q\right) = p(q)\cdot\left(1-\frac{1}{\eta\left(p\right)}\right),$$

where $p(q)$ is the market price when quantity sold is q and

$$\eta\left(p\right) = \left|\frac{dQ_D}{dp}\cdot\frac{p}{Q_D}\right|$$

is the positive of the elasticity of demand.

Profit maximization problem for the monopolist facing linear demand

$$p = A - BQ$$

and constant marginal cost c:

$$\pi = pQ - cQ = \left(p-c\right)Q = \left(A-c-BQ\right)Q$$

Condition for profit maximization

$$MR = A - 2BQ_M = c = MC$$

Monopoly quantity and monopoly price

$$Q_M = \frac{A-c}{2B};\; p_M = \frac{A+c}{2}.$$