14.20: Industrial Organization
Spring, 2001

Problem Set 1
Due Wednesday, February 21
LATE PROBLEM SETS WILL NOT BE ACCEPTED

1. The following problem asks you to develop some back-of-the-envelope calculations to evaluate Microsoft's behavior in the market for operating systems (OS) for personal computers (PCs). Let the market demand for "mainstream personal computers" (mPCs) be given by the constant elasticity of demand curve:

$$P = \alpha Q^{-1/\varepsilon}.$$

Suppose mPCs can be constructed according to the cost function:

$$C(q) = k + cq,$$

where q is the quantity of mPCs produced, k is a fixed cost to be an mPC manufacturer, and c is the constant marginal cost of building an mPC. Assume all mPCs must ship with an operating system.

   a. Suppose that Microsoft incurred a fixed cost, F, to develop the Windows OS software, but incurs no marginal cost to install Windows on another mPC. If Microsoft were a monopolist in the mPC manufacturing market, what price would it charge, as a function of the parameters in the model?
   b. For concreteness, assume the following values of the parameters in the model. The absolute demand elasticity for computers (ε) is 2, the marginal manufacturing cost (c) is \$950, the scale factor in demand (α) is 10,600. What will be Microsoft's price and quantity in the mPC market?
   c. Suppose instead that Microsoft is a monopolist in the OS market, but does not directly produce mPCs. It rather licenses mPC manufacturers to install Windows on their PCs at a price of r per machine. Let there be M symmetric PC manufacturers, each with the cost curve:

$$C(q) = k + (c + r)q$$

   If these manufacturers compete in a one-shot quantity-setting (Cournot) game, what will be the equilibrium price and quantity of mPCs in the market, as a function of the parameters of the model?

d. Suppose the license fee for Windows (r) is \$57, and there are 10 symmetric mPC manufacturers. What is the Cournot equilibrium price and quantiy of mainstream mPCs in (c)? What are Microsoft's revenues?

e. For what value of k is 10 firms the long-run equilibrium number of mPC manufacturers in (d)?

f. If Microsoft wanted to set the license fee for Windows so that the equilibrium price of PCs in the 10-firm Cournot equilibrium were equal to the price fo mPCs you found in (b), what license fee should it charge? By how much would this increase Microsoft's profits, relative to its profits in (d)?

g. Suppose that the fixed costs to develop a new OS that would be roughly equivalent to Windows 2000 were \$300 million. If potential entrants expect to compete against Microsoft in prices (Bertrand), would you expect to see entry into the OS market under the conditions in (d)? Why or why not?

2. There are two firms that produce "all-natural & organic" children's vitamins: HealthyKids and GreenLife. Each firm has a single production plant for these vitamins. The production costs of these plants are given by:

$$C_H(q_H) = 10 + 4q_H \qquad \text{and} \qquad C_G(q_G) = 5 + .25(q_G)^2,$$

where H denotes HealthyKids and G denotes GreenLife, costs are in thousands and quantities are in thousands of bottles. Demand for these vitamins is given by:

$$P(Q) = 10 - .25Q, \text{ where } Q = q_H + q_G.$$

a. If HealthyKids and GreenLife compete in a static Cournot quantity game, what would you expect the equilibrium price and quantity of these vitamins to be? What are each firm's quantities and profits? What is consumer surplus in this equilibrium?

b. The Federal Trade Commission authorizes a merger between these two firms on the premise that traditional vitamins are a close substitute for the "all natural & organic" vitamins produced by the firms. Assume the resulting firm, GreenKids, continues to operate both plants. What should the new production level be if GreenKids wants to maximize profits? What is production at each plant, and the firm's total profits? What is consumer surplus in this equilibrium?

c. GreenKids has asked you to consult on a proposal to shut down one of its plants. If GreenKids were to shut down one plant, which one should it be? Describe your recommendation to GreenKids and its impact on profits and consumer surplus.

3. Matt Richtel in the *New York Times Magazine*, Sunday, December 19, 1999, p. 34 (available in E52-262), provides a rough breakdown of the cost of a "typical" toy shipment for eToys during the holiday season. The estimates apparently are formed by taking various categories of current expenditures by the firm and dividing the total expenditures by the number of "unit toy" shipments the firm makes to get a "per-unit" cost. A "unit toy" shipment for this purpose is a $68.97 shipment. Assume the time frame corresponding the following questions is the 1999 holiday season (about 3-4 months).

   a. What are the likely variable costs of producing this unit toy shipment? Explain your reasoning in including these costs in the variable cost category. Note: if you believe a given category mixes variable, fixed, and/or sunk costs, state so and explain your reasoning.

   b. Which costs are likely to be fixed costs of producing toy shipments? Explain your reasoning in including these costs in the fixed cost category?

   c. Which costs are sunk costs? Explain your reasoning in including these in the sunk cost category.

   d. Which of these current cost estimates are likely to understate or overstate current economic costs, and why? (Hint: think of capital-like costs, how these are likely to be accounted for, and what if any distortion this creates).

   e. What information would you need to get a rough calculation of economic profits for eToys? Be brief but specific.

4. **GE Case write up.** Please take 1-2 pages to write up your answers to the following questions, based on the Harvard Business School Case 9-380-128, *General Electric vs. Westinghouse in Large Turbine Generators*. The case is available at Graphic Arts in E52-basement. Bring your case and a duplicate copy of your answers to class on Feb. 26 to use in the class discussion of the case.

   a. What is the competitive situation in the large turbine generator market as the case opens in 1963? Briefly discuss with reference to the main competitors in the market, their relative positions, their recent history, and the likely nature of competition in the near term.

   b. What can GE do, if anything, if it wants to lead prices upward in this market? What factors would be likely to limit or increase its probable success in such an endeavor?