LECTURE NOTES ON MICROECONOMICS

ANALYZING MARKETS WITH BASIC CALCULUS

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Part 3: Firms and competition

Chapter 11: Profit maximization and supply

Problems

(11.1) [Profit maximization] Indicate whether each statement is true or false. Explain your reasoning.

a. "No matter what the price, a firm that wants to maximize profit should always set output to operate at the efficient scale—that is, at the lowest point on its average cost curve."
b. "Maximizing profit means maximizing the difference between revenues and costs. So a firm that wants to maximize profit should choose an output level where price is as high above marginal cost as possible."
c. "In the short run, a firm's shutdown price is always be less than its breakeven price."
d. "A firm making losses should shut down immediately."

(11.2) [Long-run cost and supply] Suppose Acme Manufacturing has the following long-run cost curve:

$$TC(q) = 0.02\ q^3 - 0.8\ q^2 + 12\ q$$

a. Find a formula for Acme's marginal cost function MC(q).
b. Find a formula for Acme's average cost function AC(q).
c. Compute Acme's efficient scale of operation q_{ES}. [Hint: The efficient scale is the value of q that minimizes the function AC(q). Find the minimum by setting the slope (derivative) of AC(q) equal to zero.]
d. Also compute minimum average cost $AC(q_{ES})$.
e. What is *Acme's* own supply curve? Give an equation describing the relationship between price and the quantity Acme will supply. [Hint: What happens if the price is greater than minimum average cost? What happens if the price is less than minimum average cost?]
f. Assume that Acme's industry enjoys free entry and exit of firms, that all firms have the same total cost function as Acme, and that each firm's cost is unaffected by the number of firms or the level of output in the industry as a whole. What is the long-run *industry* supply curve? Give an equation.

(11.3) [Long-run cost and supply] Suppose General Manufacturing has the following long-run cost curve:

$$TC(q) = 0.0025\ q^3 - 0.5\ q^2 + 35\ q$$

a. Find a formula for General's marginal cost function MC(q).
b. Find a formula for General's average cost function AC(q).
c. Compute General's efficient scale of operation q_{ES}. [Hint: The efficient scale is the value of q that minimizes the function AC(q). Find the minimum by setting the slope (derivative) of AC(q) equal to zero.]
d. Also compute minimum average cost $AC(q_{ES})$.
e. What is *General's* own supply curve? Give an equation describing the relationship between price and the quantity General will supply. [Hint: What happens if the price is greater than minimum average cost? What happens if the price is less than minimum average cost?]
f. Assume that General's industry enjoys free entry and exit of firms, that all firms have the same total cost function as General, and that each firm's cost is unaffected by the number of firms or the level of output in the industry as a whole. What is the long-run *industry* supply curve? Give an equation.

(11.4) [Short-run cost and firm supply] United Manufacturing has, in the short run, daily fixed costs of $200 and daily variable costs given by the function:

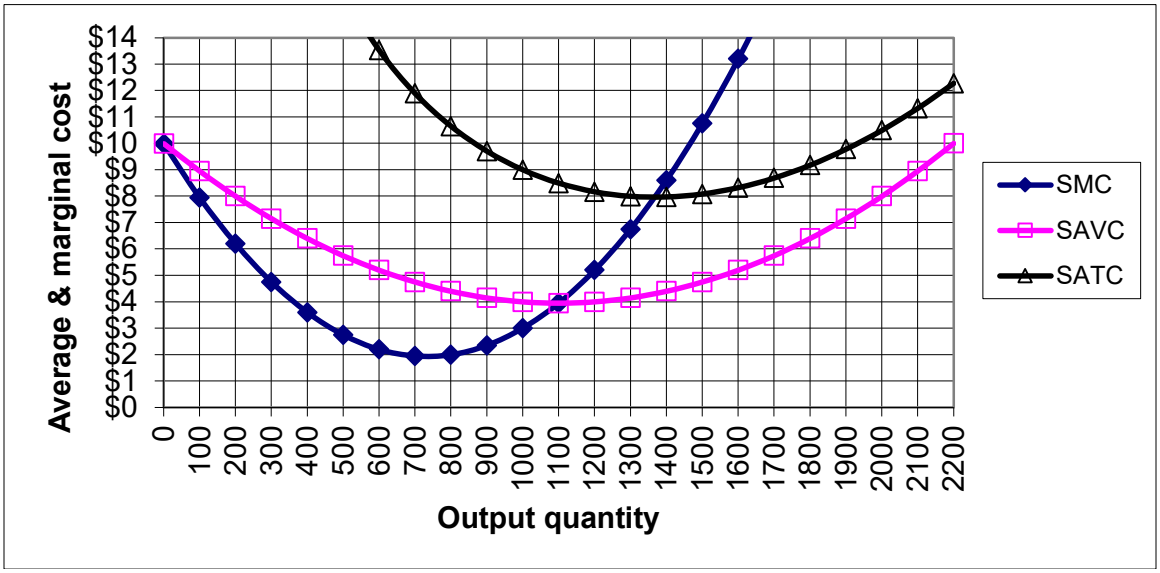
$$SVC(q) = \frac{q^3}{3000} - \frac{q^2}{20} + 5.099q\ .$$

a. Find an expression for United's short-run average variable cost function SAVC(q).
b. Find an expression for United's short-run average fixed cost function SAFC(q).
c. Find an expression for United's short-run average total cost function SATC(q).
d. Find an expression for United's short-run marginal cost function SMC(q).
e. Compute the minimum price at which United would continue to operate in the short run. That is, compute the so-called shutdown price. [Hint: The shutdown price is the minimum of SAVC(q). It is also the value of SAVC(q) when it equals SMC(q). Here the shutdown price is not an integer—sorry!]
f. Compute the profits (or losses) that United would make operating at the shutdown price. [Hint: No algebra or even arithmetic is required if you remember that, at the shutdown price, there is a special relationship between variable costs and revenues.]

Suppose you are the president of United and the going price for United's product is $5.

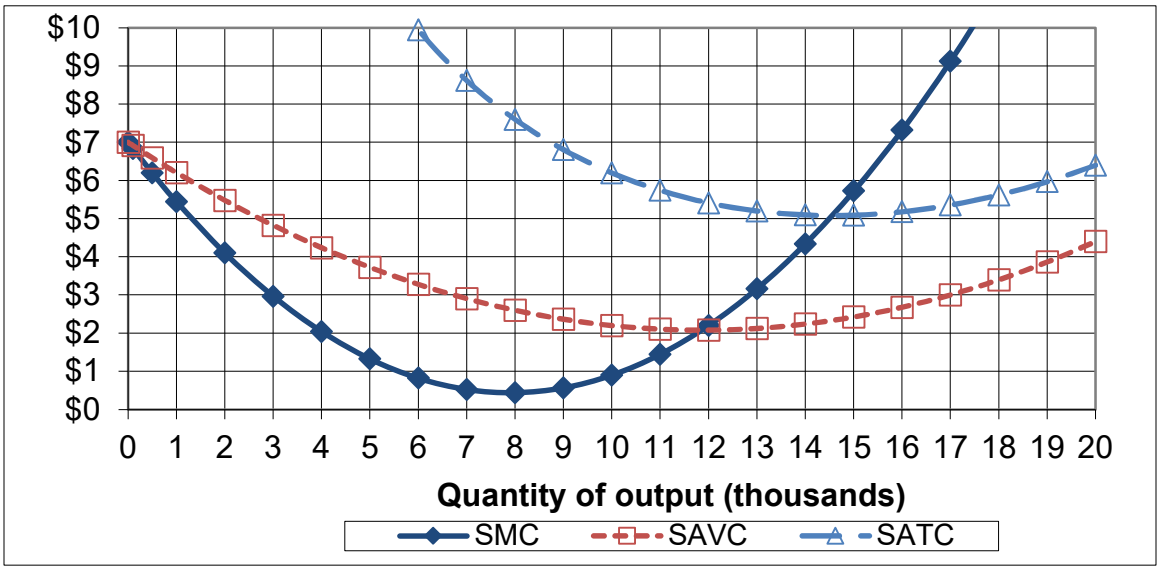
g. What quantity of output will you produce? [Hint: Recall the rule that SMC must equal price, with the qualification that SMC must intersect the price line from below--that is, SMC must be upward-sloping. Here you must solve a quadratic equation. There are two solutions, but only one lies on the upward-sloping part of the MC curve.]
h. Compute the amount of United's profits (or losses) at this price. [Hint: United will make losses. The amount is not an integer—sorry!]
i. The stockholders are angry that United is making losses and accuse you of incompetence. How do you justify your choice of output level? Why don't you just shut down United's operations? Comment.

(11.5) [Short-run cost curves and supply] Micro Technologies Company makes computer parts. It is a small firm in a big market, and therefore takes its output price as given. In the short run, the company faces daily cost curves as shown in the following diagram. Here, SMC denotes short-run marginal cost, SAVC denotes short-run average variable cost, and SATC denotes short-run average total cost.



a. What is the company's break-even price--that is, the lowest price at which the company can avoid losses? (Give an answer to the nearest dollar.)
b. What is the company's shut-down price--that is, the lowest price at which it will remain in operation in the short run? (Give an answer to the nearest dollar.)
c. What output level will the firm choose if the market price is $13? Will the firm make a profit or a loss at that price?
d. What output level will the firm choose if the market price is $5? Will the firm make a profit or a loss at that price?
e. What output level will the firm choose if the market price is $3? Will the firm make a profit or a loss at that price?

(11.6) [Short-run cost curves and supply] Macro Technologies Company makes fasteners for ships. It is a small firm in a big market, and therefore takes its output price as given. In the short run, the company faces daily cost curves as shown in the following diagram. Here, SMC denotes short-run marginal cost, SAVC denotes short-run average variable cost, and SATC denotes short-run average total cost.



a. What is the company's break-even price--that is, the lowest price at which the company can avoid losses? (Give an answer to the nearest dollar.)
b. What is the company's shut-down price--that is, the lowest price at which it will remain in operation in the short run? (Give an answer to the nearest dollar.)
c. What output level will the firm choose if the market price is $1? Give an answer to the nearest thousand. Will the firm make a profit or a loss at that price?
d. What output level will the firm choose if the market price is $3? Give an answer to the nearest thousand. Will the firm make a profit or a loss at that price?
e. What output level will the firm choose if the market price is $9? Give an answer to the nearest thousand. Will the firm make a profit or a loss at that price?

(11.7) [Cost minimization across firms] Firm A and Firm B must together produce a total of 200 units of output at *minimum total cost*. Firm A's marginal cost is given by $MC_A = 3 + (q_A/20)$, where q_A denotes Firm A's output level. Firm #B's marginal cost is given by $MC_B = 1 + (q_B/10)$, where q_B denotes Firm B's output level.

a. What output level q_A should be produced by Firm A?
b. What output level q_B should be produced by Firm B?
c. Suppose Firm A and Firm B are competitive firms, taking price as given. What market price would motivate Firm A and Firm B to produce these output levels?

(11.8) [Cost minimization across firms] Two firms each produce radios. Firm A has daily total cost function $TC_A = 5q_A + 0.01\ q_A^2$ Firm B has daily total cost function $TC_B = q_B + 0.07\ q_B^2$

a. Find the marginal cost function for Firm A: $MC_A(q_A)$.
b. Find the marginal cost function for Firm B: $MC_B(q_B)$.
c. Suppose each firm produces 100 radios per day. Find the total cost at each firm, and the combined total cost.

First suppose these firms are owned by the government and you have been appointed to administer them. You are charged with lowering combined total cost as much as possible, while still producing a combined total of 200 radios per day.

d. How many radios will you order Firm A to produce?
e. How many radios will you order Firm B to produce?
f. Find the total cost at each firm, and the combined total cost under your production scheme.

Now suppose these firms have been privatized. Each seeks to maximize its own profit, given a market price of radios of $8.

g. How many radios will Firm A produce?
h. How many radios will Firm B produce?

(11.9) [Long-run competitive equilibrium] In a perfectly competitive market, two conditions hold in the long run:

(i) Price = marginal cost for each firm.
(ii) Price = average cost for each firm.

a. Which condition is *desired* by each firm? Why?
b. Which condition is *forced* on each firm by market forces outside its control? Why?

[end of problem set]