## Problem Set 6 – Competitive Firms and Markets

1. Draw a graph showing the average total, average variable, and marginal cost curves for a typical firm. Draw in three prices that result in the firm making positive profits, breaking even, and making negative profits that are less than fixed costs.

2. Consider the following diagram where a perfectly competitive firm faces a price of $40.
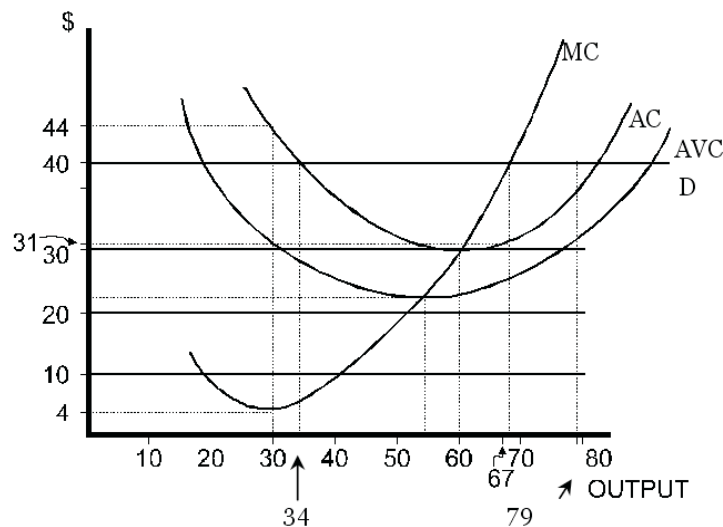
   a) What is the profit- maximizing output?
   b) The firm earns zero profit at what output?
   c) What happens with the profit at 67 units of output?
   d) What is the level of ATC at the profit- maximizing level of output?
   e) What is the level of AVC at the profit- maximizing level of output?
   f) What is the size of total revenue at the profit- maximizing level of output?
   g) What is the size of total profit at the profit- maximizing level of output?
   h) Are the costs minimized at the profit- maximizing level of output?

3. Suppose your firm is in a competitive industry in long-run equilibrium making substantial long-run profits (as in Figure 8.11 in your textbook). State specifically what will occur as the industry moves toward long-run equilibrium.

4. Suppose a perfectly competitive firm has the short-run cost function $C = 125 + q^2$. Use the derivative formula or marginal cost to determine the firm's output level and profit at prices of \$30 and \$20. At what price does the firm reach the shut-down point?

5. Suppose there are 25 firms in the sandals market, in which market demand elasticity is –1.5. The elasticity of supply is 1. A single firm in this industry decides that because there are only 24 competitors, it might be a good idea to increase prices by 1%. How much will quantity demanded fall by? If the number of firms goes up to 100 what happens?

6. Conigan Box Company produces cardboard boxes that are sold in bundles of 1000 boxes. The market is highly competitive, with boxes currently selling for \$100 per thousand. Conigan's total and marginal cost curves are:

$$TC = 3,000,000 + 0.001Q^2$$
$$MC = 0.002Q$$

where Q is measured in thousand box bundles per year.

   a) Calculate Conigan's profit maximizing quantity. Is the firm earning a profit?
   b) Analyze Conigan's position in terms of the shutdown condition. Should Conigan operate or shut down in the short run?

7. Laura's internet services has the following short-run cost curve: $C(q,K) = \dfrac{25q^3}{K^{\frac{2}{3}}} + rK$ where q is Laura's output level, K is the number of servers she leases and r is the lease rate of servers. Laura's short-run marginal cost function is: $MC(q,K) = \dfrac{50q}{K^{\frac{2}{3}}}$. Currently, Laura leases 8 servers, the lease rate of servers is \$15, and Laura can sell all the output she produces for \$500. Find Laura's short-run profit maximizing level of output. Calculate Laura's profits. If the lease rate of internet servers rise to \$20, how does Laura's optimal output and profits change?

8. A competitive market is made up of 100 identical firms. Each firm has a short-run marginal cost function as follows:

$$MC = 5 + 0.5Q,$$

where Q represents units of output per unit of time. The firm's average variable cost curve intersects the marginal cost at a vertical distance of 10 above the horizontal axis. Determine the market short- run supply curve. Calculate the price that would make 2,000 units forthcoming per time period. Note the minimum price at which any quantity would be placed on the market.

9. Irina owns a coffee factory in Edinburgh. Her production function is:

$$F(K,L) = (K-1)^{\frac{1}{4}} L^{\frac{1}{4}}$$

Consider the cost of capital to be r and the wage to be w. Both inputs are variable, and Irina faces no fixed costs.

i) What is the MRTS of labor for capital?
ii) What are Irina's input demands conditional on the quantity (q) she wants to produce? [Hint: Treat w and r as parameters.]
iii) Show that Irina's long run cost function is $C(q) = r + 2(wr)^{0.5} q^2$
iv) What is the supply function of Irina's firm?

Consider now that r = 4, w = 1, and that the market demand for coffee is $Q_d = 20 - P$. There are 7 other companies operating in this market, all with cost structures identical to Irina's company.

v) What is the aggregate supply in this market?
vi) Calculate the equilibrium price, aggregate quantity sold, quantity sold by each firm, and economic profit of each firm.
vii) Can this be a long run equilibrium? Why? How will the supply side of the market adjust in the long run?
viii)   What is going to be the price in the long run? How many firms will be present in this market in the long run? How much will each firm produce?

10. Suppose a firm's cost function is

$$C(q) = \frac{1}{2}q^2 + q$$

and the market demand curve is

$$D(P) = 310 - 10P$$

The government can limit the number of firms in the market by decree. If the government wants the equilibrium price to be $21, how many firms should it let into the market? Do you think the government could achieve this goal?

11. Suppose the government imposes a tax on each unit of output produced of τ. What is the firm's new profit maximizing level of output? Use comparative statics to determine how a change in tax affects output.

12. We have assumed that firms have no market power. That is, no matter how much a firm produces, the price will be the same. What happens to a firm's profit maximizing level of output if the market price is a function of how much an individual firm produces? Try to express it as a function of the price elasticity of demand facing a firm.