Due date: April 19, 2000

1. Work Problem 1 from Practice Problems and Questions from Chapter 8 of the study guide.

2. Work Problem 2 from Practice Problems and Questions from Chapter 8 of the study guide.

3. Work Problem 3 from Practice Problems and Questions from Chapter 8 of the study guide (Assuming that all firms in the industry are identical).

4. Work Problem 5 from Practice Problems and Questions from Chapter 8 of the study guide (Assuming that all firms in the industry are identical).

5. Work Problem 6 from Practice Problems and Questions from Chapter 8 of the study guide.

6. Choose 3 of the 10 markets listed below. To what extent do they satisfy the 7 conditions for perfect competition. In each case give reasons for your conclusion.

   1. Market for fresh vegetables in Madison, WI
   2. Market for seed corn in Iowa
   3. Market for delivered pizza in Ames, IA
   4. Market for baseball players
   5. Market for unskilled farm labor in California
   6. World market for wheat
   7. Secondary market for treasury bills (3-month)
   8. Market for combines in the United States
   9. Market for sport utility vehicles
   10. Market for live cattle in western Iowa
   11. Market for running shoes
7. Assume that the manufacturing of biking socks is a perfectly competitive industry. The market demand for biking socks is described by a linear demand function \( Q^D = 400 - 2P \). The inverse demand can easily be worked out, therefore, to be \( P = 200 - \frac{1}{2} Q^D \). There are thirty (30) manufacturers of biking socks. Each manufacturer has the same production costs. These are described by long-run total and marginal cost functions of \( TC(q) = 200 + 10q + 2q^2 \) and \( MC(q) = 10 + 4q \).

a. Show that an individual firm in this industry maximizes profit by producing \( q = \frac{P - 10}{4} = \frac{1}{4} P - 2.5 \).

b. Derive the industry supply curve and show that it is \( Q^S = 7.5P - 75 \).

c. Find the equilibrium market price by setting supply equal to demand. The answer is \( P = 50 \).

d. Find the aggregate quantity traded in equilibrium. The answer is \( Q = 300 \).

e. How much output does each firm produce? The answer is 10.

f. Show that each firm earns zero profit in equilibrium.
8. Consider a firm with the following long run cost function.

\[ cost(y_1) = 36 + 10y_1 + 0.25y_1^2 \]

Assume that the fixed cost of $36, $20 is sunk (at least in the short run), and $16 is avoidable. Assume that in the long run, all costs are avoidable. Marginal cost is given by

\[ MC(y_1) = 10 + 0.5y_1 \]

Average cost reaches its minimum at the point where it is equal to marginal cost.

a. From a long-run perspective, calculate the level of \( y \) at which average cost is minimized.

b. In the long run, how high does the price need to be for the firm to continue operating? To find this plug the answer to a in the marginal cost equation.

c. What is an expression for avoidable cost?

\[ \text{Avoidable cost}(y_1) = 16 + 10y_1 + 0.25y_1^2 \]

d. What is an expression for average avoidable cost?

e. From a short-run perspective, calculate the level of \( y \) at which average avoidable cost is minimized.
f. In the short run, how high does the price need to be for the firm to continue operating? To find this plug the answer to e in the marginal cost equation.

g. What is the supply function for this firm assuming that it chooses to produce? Hint: You get this by setting marginal cost equal to p, and then solving the equation to get $y_1$ on the left hand side and p on the right hand side. Second Hint: The answer is $y_1 = 2p - 20$.

h. What is this firm's long-run supply function? (It will have two parts.)

i. What is this firm's short-run supply function? (It will have two parts.) Remember that the short run supply function is the marginal cost function above the minimum of average avoidable cost.
9. Consider a firm with the following long run cost function.

\[
\text{cost}(y) = 16 + 7y_2 + y_2^2
\]

Assume that of the fixed cost of $16, $7 is sunk (at least in the short run), and $9 is avoidable. Assume that in the long run, all costs are avoidable. Marginal cost is given by

\[
MC(y) = 7 + 2y_2
\]

Average cost reaches its minimum at the point where it is equal to marginal cost.

a. From a long-run perspective, calculate the level of \( y \) at which average cost is minimized.

b. In the long run, how high does the price need to be for the firm to continue operating?

c. What is an expression for avoidable cost?

d. What is an expression for average avoidable cost?

e. From a short-run perspective, calculate the level of \( y \) at which average avoidable cost is minimized.
f. In the short run, how high does the price need to be for the firm to continue operating?

g. What is the supply function for this firm assuming that it chooses to produce?  Hint: You get this by setting marginal cost equal to \( p \), and then solving the equation to get \( y_2 \) on the left hand side and \( p \) on the right hand side.

h. What is this firm's long-run supply function?  (It will have two parts.)

i. What is this firm's short-run supply function?  (It will have two parts.)  Remember that the short run supply function is the marginal cost function above the minimum of average avoidable cost.
10. Consider a firm with the following cost function.

\[ \text{cost}(y) = 8 + 8y^3 + 0.5y^2 \]

Assume that of the fixed cost of $8, $6 is sunk (at least in the short run), and $2 is avoidable. Assume that in the long run, all costs are avoidable. Marginal cost is given by

\[ MC(y) = 8 + y^3 \]

Average cost reaches its minimum at the point where it is equal to marginal cost.

a. From a long-run perspective, calculate the level of \( y \) at which average cost is minimized.

b. In the long run, how high does the price need to be for the firm to continue operating?

c. What is an expression for avoidable cost?

d. What is an expression for average avoidable cost?

e. From a short-run perspective, calculate the level of \( y \) at which average avoidable cost is minimized.
f. In the short run, how high does the price need to be for the firm to continue operating?


g. What is the supply function for this firm assuming that it chooses to produce? Hint: You get this by setting marginal cost equal to p, and then solving the equation to get y, on the left hand side and p on the right hand side.

h. What is this firm's long-run supply function? (It will have two parts.)

i. What is this firm's short-run supply function? (It will have two parts.) Remember that the short run supply function is the marginal cost function above the minimum of average avoidable cost.
11. Now consider a market containing the first two firms. Assume that they behave competitively (are price takers) even though they could behave in a non-competitive manner. Assume that there is a market demand curve given by  

\[ Q = 36 - p \]

In equilibrium the total supplied by both firms will equal the market demand  

\[ Q = y_1 + y_2 \]

a. Find the long run market supply equation. It will have 3 parts, one for when there is zero output, one for when only firm 2 produces and one for when both firms produce. Write it in the following form

\[
y = \begin{cases} 
0, & p < 15 \\
15, & 15 \leq p < 16 \\
16, & p \geq 16 
\end{cases}
\]

b. Find the market equilibrium price.

c. Find the equilibrium quantity supplied for each firm.

d. What is the profit for firm 1?

e. What is the profit for firm 2?
f. Now consider the situation if the third firm enters the market. What is the long-run market supply function? It will have 4 parts. Write it in the same form as part a.

g. Find the market equilibrium price if all firms participate in the market.

h. Find the equilibrium quantity supplied for each firm.

i. What is the profit for firm 1?

j. What is the profit for firm 2?

k. What is the profit for firm 3?

l. Is this a stable equilibrium for this market? Why?
m. What is the long run equilibrium for this market? How many firms will participate?

n. What is the short-run market supply function for the market will all three firms participating? It will have 4 parts. Write it in the same form as part a.

o. What is the short run equilibrium price in this market?

p. How much does each firm produce?
12. Consider the following market where there are only two firms. Assume that they behave competitively even though they could behave in a non-competitive manner. Assume that there is a market demand curve given by

\[ Q = 200 - p \]

The cost functions for the two firms in the industry are given by

\[ \text{cost}(y_1) = 1000 + 20y_1 + y_1^2 \]
\[ \text{cost}(y_2) = 500 + 20y_2 + .5y_2^2 \]

The marginal cost functions for the two firms in the industry are given by

\[ MC(y_1) = 20 + 2y_1 \]
\[ MC(y_2) = 20 + y_2 \]

In equilibrium the total supplied by both firms will equal the market demand

\[ Q = y_1 + y_2 \]

a. Find an equation representing the market supply of firm 1 as a function of price. (Hint: The answer is \( y_1 = \frac{1}{2} p - 10 \).)

b. Find an equation representing the market supply of firm 2 as a function of price. (Hint: The answer is \( y_2 = p - 20 \).)

c. What is the market supply curve assuming both firms produce? The answer is \( \frac{3}{2} p - 30 \).
d. What is the market equilibrium price assuming both firms produce? The answer is \( P = $92 \).

e. What is the profit for firm 1?

f. What is the profit for firm 2?

g. Will other firms want to enter this industry?
13a. Consider the following production function

\[ y = 20x_1 + 15x_2 - 0.5x_1^2 - 0.5x_2^2 \]

The price of \( x_1 \) is $40 and the price of \( x_2 \) is $20. You are trying to determine which of the following sets of points is the cost minimizing way to produce 250 units of output. For each of the input combinations in question, verify that it will produce 250 units (or close with rounding), compute its cost, find the marginal rate of substitution and the price ratio. Then decide which point is minimum cost.

\[
\begin{array}{ccccccccc}
  x_1 & x_2 & y & \text{Cost} & \text{MPP}_1 & \text{MPP}_2 & \text{MRS}_{12} & -\frac{w_2}{w_1} \\
 12.190 & 7.000 & 250.000 & 627.59 & 7.810 & 8.000 & \\
 2.000 & 8.000 & 126.000 & 18.000 & 7.000 & 6.000 & \\
 10.566 & 9.000 & 250.000 & 9.434 & 6.000 & & \\
 10.000 & 10.000 & & 10.000 & 5.000 & -0.500 & \\
 9.560 & 11.000 & & 602.3877 & 10.440 & 4.000 & -0.383 & \\
 9.230 & 12.000 & & 609.1868 & 10.770 & 3.000 & -0.279 & \\
 9.000 & 13.000 & & 250.000 & 11.000 & 2.000 & -0.182 & \\
 0.500 & 14.000 & & 121.875 & 19.500 & 1.000 & -0.051 & \\
\end{array}
\]

13b. Consider the following production function

\[ y = 20x_1 + 15x_2 - 0.5x_1^2 - 0.5x_2^2 \]

The price of \( x_1 \) is $40 and the price of \( x_2 \) is $20. You are trying to determine which of the following sets of points is the cost minimizing way to produce 272.5 units of output. For each of the input combinations in question, verify that it will produce 272.5 units (or close with rounding), compute its cost, find the marginal rate of substitution and the price ratio. Then decide which point is minimum cost.

\[
\begin{array}{ccccccccc}
  x_1 & x_2 & \text{Cost} & y & \text{MPP}_1 & \text{MPP}_2 & \text{MRS}_{12} & -\frac{w_2}{w_1} \\
 14.432 & 8.000 & 737.2894 & 5.568 & 7.000 & -1.257 & \\
 13.000 & 9.000 & 700 & 7.000 & 6.000 & -0.857 & \\
 12.584 & 10.000 & 703.3521 & 272.500 & 7.416 & 5.000 & -0.674 & \\
 12.000 & 11.000 & 272.500 & 8.000 & 4.000 & -0.500 & \\
 11.574 & 12.000 & 272.500 & 8.426 & 3.000 & -0.356 & -0.500 & \\
 11.282 & 13.000 & 711.2881 & 272.500 & 8.718 & 2.000 & -0.229 & -0.500 & \\
 11.112 & 14.000 & 724.4722 & 272.500 & 8.888 & 1.000 & -0.500 & \\
 11.056 & 15.000 & 742.2291 & 8.944 & 0.000 & -0.500 & \\
 11.000 & 16.000 & 760 & 9.000 & -1.000 & 0.111 & -0.500 & \\
\end{array}
\]
13c. Consider the following production function
\[ y = 20x_1 + 15x_2 - 0.5x_1^2 - 0.5x_2^2 \]

The price of \( x_1 \) is $40 and the price of \( x_2 \) is $20. You are trying to which of the following sets of points is the cost minimizing way to produce 296.875 units of output. For each of the input combinations in question, verify that it will produce 296.875 units (or close with rounding), compute its cost, find the marginal rate of substitution and the price ratio. Then decide which point is minimum cost.

<table>
<thead>
<tr>
<th>( x_1 )</th>
<th>( x_2 )</th>
<th>Cost</th>
<th>( y )</th>
<th>( \text{MPP}_1 )</th>
<th>( \text{MPP}_2 )</th>
<th>MRS</th>
<th>( \frac{-w_2}{w_1} )</th>
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<td>-0.500</td>
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</tr>
</tbody>
</table>

13d. Consider the following production function
\[ y = 20x_1 + 15x_2 - 0.5x_1^2 - 0.5x_2^2 \]

The price of \( x_1 \) is $40 and the price of \( x_2 \) is $20. You are trying to which of the following sets of points is the cost minimizing way to produce 302.5 units of output. For each of the input combinations in question, verify that it will produce 302.5 units (or close with rounding), compute its cost, find the marginal rate of substitution and the price ratio. Then decide which point is minimum cost.

<table>
<thead>
<tr>
<th>( x_1 )</th>
<th>( x_2 )</th>
<th>Cost</th>
<th>( y )</th>
<th>( \text{MPP}_1 )</th>
<th>( \text{MPP}_2 )</th>
<th>MRS</th>
<th>( \frac{-w_2}{w_1} )</th>
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14. Consider the following production function

\[ y = 20x_1 + 15x_2 - 0.5x_1^2 - 0.5x_2^2 \]

The price of \( x_1 \) is $40 and the price of \( x_2 \) is $20. The following table contains the minimum cost ways to produce various levels of \( y \) along with their marginal cost.

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<th>( w_1 )</th>
<th>( w_2 )</th>
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a. If the price of output is $4.00, how much should the firm produce?

b. If the price of output is $5.00, how much should the firm produce?

c. If the price of output is $4.63739, how much should the firm produce?

d. If the price of output is $8.00, how much should the firm produce?

e. If the price of output is $10.00, how much should the firm produce?

f. If the price of output is $20.00, how much should the firm produce?

g. Explain why input levels in part a and 13a are the same?

h. Explain why input levels in part b and 13b are the same?

i. Explain why input levels in part d and 13c are the same?

j. Explain why input levels in part e and 13d are the same?