1. Assume that you are an economic consultant to a firm that has the following Cobb-Douglas production function: \( Q = 10L^{0.5}K^{0.5} \). The current wage rate is $50 per labor unit and the cost per unit of the capital is $80.

a. If the firm wishes to produce 400 units of output, how much of the each input would you tell the managers to use to minimize the cost of producing the 400 units? What would that cost be?

b. Suppose that instead of having a target amount of output, the firm’s managers have told you that they spend $6000 on labor and capital and that they would like to maximize the amount of output produced. Now how many units of labor and capital would you recommend? How many units could they produce?

c. For part a and b, show that the marginal productivity per dollar spent on each input is equal for the values of \( L \) and \( K \) that you suggest.

2. Given the following total cost function for ABE Industries, \( TC = 100 + 200Q - 3Q^2 + 0.02Q^3 \)

a. What is the firm’s fixed cost? What is the algebraic equation for variable cost?

b. Does marginal cost intersect the average variable cost and average cost functions at their minimum points?

3. JVA Foodstuffs cans green beans for two distinct markets. JVA estimates the demand in each market to be

\[
\begin{align*}
\text{Market 1:} & \quad Q_1 = 170 - 1.9P_1 \\
\text{Market 2:} & \quad Q_2 = 65 - 0.45P_1
\end{align*}
\]

The average total cost of producing the green beans is \( ATC = 9 + 0.11Q \) where \( Q \) is the total amount produced.

a. If the markets are such that price discrimination is possible, what will be the price charged in each market?

b. If the markets are such that price discrimination cannot be possible, what will be the price charged in each market?

c. Would the firm earn higher profits with or without price discrimination?

4. The demand for telephones in a mid-size city is given by \( Q = 1000 - 50P \) where \( Q \) is the number of homes buying service (in thousands) and \( P \) is the monthly connect charge (in dollars). Phone system costs are given by \( TC = 500\ln(0.1Q - 20) \) for \( Q > 200 \)
a. Is telephone production a natural monopoly in this city.

b. What output level will an unregulated monopoly produce in this situation? What price will be charged? What will monopoly profits be?

c. If there is active competition for the city franchise, what price will prevail?

5. A monopoly firm has the following total cost and demand functions: $TC = 100 + Q^2$ and $Q = (600 - P)/4$. What quantity of output will the firm produce? What price will it charge for the output? What profit will it earn? If the government limited this monopolist by imposing a $200 price ceiling on the product, how would the firm react? What would be its new price, output and profit?

6. Gray Computer Inc., located in Colorado Springs is a privately held producer of high speed electronic computers with immense storage capacity and computing capability. Although Gray’s market is restricted to industrial users and a few large government agencies, the company has profitably exploited its market niche. The founder of the company has recently announced his retirement, the timing of which will unfortunately coincide with the expiration of several patents covering key aspects of the Gray computer. Your company, a potential entrant into the market for computers has asked you to evaluate the short-run and long-run potential of this market. Based on the data gathered from your company’s engineering department, user surveys, trade associations and other sources, the following market demand and cost information has been developed: $P = 54 - 1.5Q$ and $TC = 200 + 6Q + 0.5Q^2$

a. Calculate output, price and economic profits earned by Gray Company as a monopolist. What is the point price elasticity of demand at this output level?

b. Calculate the range within which a long-run equilibrium price/output combination would be found for individual firms if entry eliminated Gary’s economic profits (Note: high price/low output and low price/high output ranges).

c. Assume that the point price elasticity of demand calculated in part a is a good estimate of the relevant arch price elasticity? What is the potential overall market size for supercomputers?

7. The First National Bank received 3000 inquiries following the latest advertising describing its 30-month IRA accounts in the Boston World, a local newspaper. The most recent as in a similar advertising campaign in Massachusetts Business, a regional business magazine, generated 1000 inquiries. Each magazine ad costs $125.

a. Assuming that additional ads would generate similar response rates, is the bank running an optimal mix of newspaper and magazine adds? Why or why not?

b. Holding all else equal, how many inquiries must a newspaper ad attract for the current advertising mix to be optimal?
8. The I-70 Truck Stop, Inc., sells gasoline to both self-service and full-service customers. Those who pump their own gasoline benefit from the lower self-service price of $1.25 per gallon. Full-service customers enjoy the service of attendant, but they pay a higher price of $1.30 per gallon. The company has observed the following relation between the number of attendants employed per day and full-service output:

<table>
<thead>
<tr>
<th>Number of Attendants per day</th>
<th>Full-Service Output (Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>3800</td>
</tr>
<tr>
<td>3</td>
<td>5400</td>
</tr>
<tr>
<td>4</td>
<td>6800</td>
</tr>
<tr>
<td>5</td>
<td>8000</td>
</tr>
</tbody>
</table>

a. How many attendants (input) would I-70 employ at a daily wage rate of $64? 

b. What is the highest daily wage rate I-70 would pay to hire three attendants per day?