Exercise 1 [20]: Consider the following total cost function

\[ TC = 200 + 10Q \]

where \( TC \) is total costs, and \( Q \) the output.

1. What is the marginal cost? Give a definition of marginal cost. What is the marginal cost when output is 10? What is the average cost? Give a definition of average cost.

2. Assume a perfectly competitive market. What is the price charged by each firm?

Exercise 2 [20]: There are five firms that produce reaping machines. Suppose their sales in the year 2005 are as follows:

<table>
<thead>
<tr>
<th>Firm</th>
<th>Sales (10 millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>200</td>
</tr>
<tr>
<td>B</td>
<td>120</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
</tr>
<tr>
<td>D</td>
<td>40</td>
</tr>
<tr>
<td>E</td>
<td>40</td>
</tr>
</tbody>
</table>

1. What is the concentration ratio in the industry
   (a) if you use the four-firm concentration ratio;
   (b) if you use the HHI index.

2. Would you regard this industry as oligopolistic? Why or why not?

3. Suppose that firm A merges with firm E. What now will be the concentration ratio in the industry?

4. Suppose that after they merge, firms A and E go out of business. What now will be the concentration ratio in this industry?
Exercise 3 [35]: Two firms, firm 1 and firm 2 produce champagne. The demand curve for champagne is \( P = 100 - \frac{1}{5}Q \) where \( P \) is the price (in dollars) of the champagne, \( Q = Q_1 + Q_2 \) is the total amount of bottles of champagne produced, \( Q_1 \) is the number of bottles produced and sold per month by firm 1, and \( Q_2 \) is the number of bottles produced and sold per month by firm 2. Each firm has the same marginal cost of $60 and fixed cost of zero.

a. If they compete in price (Bertrand competition), what will be the price? What quantities each firm will produce? What will be the profit of each firm?

b. If each of these two firms sets its own output level to maximize its profits, assuming that the other firm holds constant its output level, what will be the output for each firm? (hint: determine the Cournot Equilibrium). What will be the equilibrium price? What will be the profit for each firm?

c. Imagine that the two firms decide to merge and just form one unique firm. What is the monopoly price, output and profit? Represent a graph.

Exercise 4 [25]: Consider the 2 firms of exercise 3. Suppose that a research institute develops a new technology that reduces marginal cost to $35.

1. Is it a drastic or a non drastic innovation in Bertrand or Cournot cases?

2. Calculate the new market equilibrium price, output and profits of the monopolist and each duopolist, given that the innovation is made available to only one firm.

3. How much the monopolist and duopolist each be willing to pay for the innovation?