Problems on market structure (chapters 10, 11, 12, and 13)

1. Bada Bing, Ltd., supplies standard 256 MB RAM chips to the U.S. computer and electronics industry. Like the output of its competitors, Bada Bing's chips must meet strict size, shape, and speed specifications. As a result, the chip-supply industry can be regarded as perfectly competitive. The total cost and marginal cost functions for Bada Bing are:

$$TC = \$1,000,000 + \$20Q + \$0.0001Q^2$$

where Q is the number of chips produced.

  a Calculate Bada Bing's optimal output and profits if chip prices are stable at $60 each.

  b Calculate Bada Bing's optimal output and profits if chip prices fall to $30 each.

  c If Bada Bing is typical of firms in the industry, calculate the firm's long-run equilibrium output, price, and economic profit levels.

2. In class we discussed various reasons why a particular store may choose to remain open 24 hours. Consider a rural Wal-Mart and an urban Wal-Mart.

   Rural Wal-Mart

   The rural Wal-Mart earns net revenues (net revenues here are total revenues minus product costs, so the revenue earned on all product sales minus their cost) of $2,000 per day between the hours of 6am and 11pm. It can also earn $100 in net revenues if it is open from 11pm to 6am. Electricity costs $500 per day between 6am and 11pm if the store is open, and $100 per day if the store is closed during those hours. Electricity costs $200 per day between the hours of 11pm and 6am if the store is open, and $40 per day if the store is closed during those hours. If the store is open from 6am-11pm then it must pay $1190 to cashiers and if the store is open from 11pm-6am it must pay another $84 to cashiers. The table below gives the net revenues for the hours of operation as well as the electricity and cashiers cost for these hours.

	Open 6am-11pm	Closed 6am-11pm	Open 11pm-6am	Closed 11pm-6am
Net Revenues	$2000	$0	$100	$0
Electricity	$500	$100	$200	$40
Cashiers	$1190	$0	$84	$0

   Urban Wal-Mart

   The urban Wal-Mart earns net revenues (again, net revenues here are total revenues minus product costs, so the revenue earned on all product sales minus their cost) of $5,000 per day between the hours of 6am and 11pm. It can also earn $700 in net revenues if it is open from 11pm to 6am. Electricity costs $1000 per day between 6am and 11pm if the store is open, and $200 per day if the store is closed during those hours. Electricity costs $400 per day between the hours of 11pm and 6am if the store is open, and $80 per day if the store is closed during those hours. If the store is open from 6am-11pm then it must pay $2380 to cashiers and if the store is open from 11pm-6am it must pay another $168 to cashiers. The table below gives the net revenues for the hours of operation as well as the electricity and cashiers cost for these hours.

	Open 6am-11pm	Closed 6am-11pm	Open 11pm-6am	Closed 11pm-6am
Net Revenues	$5000	$0	$700	$0
Electricity	$1000	$200	$400	$80
Cashiers	$2380	$0	$168	$0

  a What hours should the rural Wal-Mart be open? Explain.

  b What hours should the urban Wal-Mart be open? Explain.

  c The _urban_ Wal-Mart has to pay people (stockers) to stock the shelves. These stockers can either work from 6am-11pm (the day) or from 11pm-6am (the night). If they work during the day then Wal-Mart must pay them $300. However, the stockers also cause some congestion in the

store during the day and the store loses $500 in net revenues during the day. If they work at night Wal-Mart must pay them $500, but no net revenues are lost at night. One other factor to consider is electricity. Whenever the stockers work Wal-Mart must pay full electricity regardless of whether or not the store is actually open (so it must pay $400 in electricity if the stockers work at night even if the store is closed). Assuming this urban Wal-Mart must hire stockers, answer the following questions:

i Will the urban Wal-Mart be making a profit or loss during the night hours if it hires the stockers to work at night and it opens?

ii If the urban Wal-Mart hires the stockers to work at night should they open? Explain.

iii If Wal-Mart is a business intent on maximizing its profits, during which hours should it hire the stockers, and what should the store's hours of business be? Explain, making sure to reference the profit level of your decision as well as the profit level of other decisions that could have been made.

3. Bates Gill is the sole developer of underwater operating systems. His firm is protected by considerable barriers to entry. Gill faces the following inverse demand function for his underwater operating systems:

$$P(Q) = 4320 - 12Q$$

His total cost function is:

$$TC = 4Q^2 + 200,000$$

a Write down Gill's MR function solely as a function of quantity.

b Find Gill's profit-maximizing quantity.

c Find Gill's price at the profit-maximizing quantity.

d What are Gill's profits at the profit-maximizing price and quantity?

Adding the government

The government realizes that Gill is a monopolist and that "considerable" deadweight loss is being created in the underwater operating systems market. Use the functions above to answer these questions.

e Draw a picture (just a rough sketch, not necessarily to scale) that illustrates Gill's profit-maximizing price and quantity as well as the quantity and the price that would be charged if the market were to operate efficiently (with no deadweight loss).

f Find the price and quantity that correspond that will make this market completely efficient (no deadweight loss).

g Suppose that Gill had not yet entered into this market, but was merely planning to enter into the market. If the government were to tell Gill ahead of time that they would regulate his price at the efficient level, would Gill enter this market? Explain.

4. The market for a rare strain of apples is a perfectly competitive market, with 150 identical sellers. The market is a constant cost industry. Each seller has the following costs:

$$
\begin{aligned}
TC &= 4q^2 - 4q + 144 \\
ATC &= 4q - 4 + \frac{144}{q} \\
MC &= 8q - 4
\end{aligned}
$$

The supply and demand conditions in the market are such that the market price is $52 per apple (I told you they were rare).

a Find the profit-maximizing quantity for an individual firm in this market.

b What is the profit-level at the profit-maximizing quantity for an individual firm in this market.

c What is the total MARKET quantity in this industry?

d Using the graphs below, draw a picture of the competitive market and firm in LR equilibrium. Be sure to label your graphs, and to include the firm's ATC, MC, and MR.

e Find the price that would correspond to the apple market being in a LR equilibrium. Remember, the apple market is a constant cost industry.

f Explain why the fact that the apple market is a constant cost industry is a useful assumption in solving part **e**. If the apple market were a decreasing cost industry, how would this affect the resulting LR equilibrium price (would it be higher or lower than the price you found in part **e** and why).

5. To many upscale homeowners, no other flooring offers the warmth, beauty, and value of wood. New technology in stains and finishes call for regular cleaning that takes little more than sweeping and/or vacuuming, with occasional use of a professional wood floor cleaning product. Wood floors are also ecologically friendly because wood is both renewable and recyclable. Buyers looking for traditional oak, rustic pine, trendy mahogany, or bamboo can choose from a wide assortment.

   At the wholesale level, wood flooring is a commodity-like product sold with rigid product specifications. Price competition is ferocious among hundreds of domestic manufacturers and importers. Assume that market supply and demand conditions for mahogany wood flooring are:

$$Q_S = -10 + 2P$$
$$Q_D = 320 - 4P$$

   where Q is output in square yards of floor covering (000), and P is the market price per square yard.

   a Calculate the equilibrium price/output solution before and after imposition of a $9 per unit tax on suppliers.

   b Calculate the deadweight loss to taxation caused by imposition of the $9 per unit tax. How much of this deadweight loss was suffered by consumers versus producers? Explain.

6. Each year, about 9 billion bushels of corn are harvested in the United States. The average market price of corn is a little over $2 per bushel, but costs farmers about $3 per bushel. Tax payers make up the difference. Under the 2002 $190 billion, 10-year farm bill, American taxpayers will pay farmers $4 billion a year to grow even more corn, despite the fact that every year the United States is faced with a corn surplus. Growing surplus corn also has unmeasured environmental costs. The production of corn requires more nitrogen fertilizer and pesticides than any other agricultural crop. Runoff from these chemicals seeps down into the groundwater supply, and into rivers and streams. Ag chemicals have been blamed for a 12,000-square-mile dead zone in the Gulf of Mexico. Overproduction of corn also increases U.S. reliance on foreign oil.

   To illustrate some of the cost in social welfare from agricultural price supports, assume the following market supply and demand conditions for corn:

$$Q_S = -5,000 + 5,000P$$
$$Q_D = 10,000 - 2,500P$$

   where Q is output in bushels of corn (in millions), and P is the market price per bushel.

   a Calculate the equilibrium price/output solution.

   b Calculate the amount of surplus production the government will be forced to buy if it imposes a price floor of $2.50 per bushel.

7. Calvin's Barber Shops, Inc. has a monopoly on barbershop services provided on the south side of Chicago because of restrictive licensing requirements, and not because of superior operating efficiency. As a monopoly, Calvin's provides all industry output. Assume $TC = 20Q$.

Assume that:

$$P = \$80 - \$0.0008Q$$

Where P is price per unit and Q is total firm output (haircuts).

a Calculate the monopoly profit maximizing price/output combination, as well as profits for the monopolist.

b What is the competitive market long-run equilibrium (price and quantity of haircuts)?

c Discuss the "monopoly problem" from a social perspective in this instance.

8. Consider a simultaneous quantity choice (Cournot) game between 2 firms. Each firm chooses a quantity, q_1 and q_2 respectively. The inverse market demand function is given by $P(Q) = 1434 - 2*Q$, where $Q = q_1 + q_2$. Firm 1 has total cost function $TC(q_1) = 3*(q_1)^2$ and Firm 2 has total cost function $TC(q_2) = 12*(q_2)^2 - 12*q_2$. Each firm wishes to maximize profit.

a Set up the profit function for Firm 1 and Firm 2. Remember, this is a quantity choice game.

b Find the best response functions for Firms 1 and 2.

c Find the equilibrium to this game.

d Find the (1) total market quantity, (2) price, and (3) profit for each firm.

e Assume Firm 1 is the only producer in the market now. Find Firm 1's monopoly (1) quantity, (2) price, and (3) profit.

9. Consider two firms who compete by simultaneously choosing prices (a Bertrand game). If firms 1 and 2 choose prices p_1 and p_2, respectively, the quantity that consumers demand from firm i is

$$q_i(p_i, p_j) = a - p_i + bp_j, \text{ with } 0 < b < 2.$$

Assume that there are no fixed costs and that marginal cost is constant and equal to c, where $a > c > 0$. Prices must be nonnegative ($p_1 \geq 0$, $p_2 \geq 0$) and firms wish to maximize profit.

a Find the best response functions for firms 1 and 2.

b Find the equilibrium to this game.

c Explain why $b < 2$.

10. Consider a simultaneous quantity choice game between 2 firms. Each firm chooses a quantity, q_1 and q_2 respectively. The inverse market demand function is given by $P(Q) = 1980 - 6Q$, where $Q = q_1 + q_2$. Firm 1 has total cost function $TC(q_1) = 24q_1 + 624$ and Firm 2 has total cost function $TC(q_2) = 18(q_2)^2 + 12q_2 + 16$. The profit functions for each firm are:

$$\begin{aligned} \Pi_1 &= (1980 - 6q_1 - 6q_2)q_1 - (24q_1 + 624) \\ \Pi_2 &= (1980 - 6q_1 - 6q_2)q_2 - \left(18(q_2)^2 + 12q_2 + 16\right) \end{aligned}$$

a Find the best response functions for Firms 1 and 2.

b Find the equilibrium to this game.

c Find (1) the total market quantity, (2) the market price, and (3) each firm's profit.