Extra Questions, Second Quiz, Solutions
Managerial Economics: Eco 685

**Textbook chapter 6, 2a-c**

a. For plant A, we have average variable costs of $AVC = \$1.1 + \$0.9 + \$0.5 = \$2.5$. Therefore average total costs are $ATC = \frac{TFC\cdot \text{ number of plants}}{Q} + \$2.5$. Therefore:

$$ATC_{100K} = \frac{300{,}000}{100{,}000} + \$2.5 = \$4.5. \tag{1}$$

$$ATC_{200K} = \frac{300{,}000}{200{,}000} + \$2.5 = \$4. \tag{2}$$

$$ATC_{300K} = \frac{300{,}000 \cdot 2}{300{,}000} + \$2.5 = \$4.5. \tag{3}$$

$$ATC_{400K} = \frac{300{,}000 \cdot 2}{400{,}000} + \$2.5 = \$4. \tag{4}$$

b. For plant B, we have average variable costs of $AVC = \$2.4+\$1.2+\$2.4 = \$6$. Therefore average total costs are $ATC = \frac{TFC\cdot \text{ number of plants}}{Q} + \$6$. Therefore:

$$ATC_{100K} = \frac{75{,}000}{100{,}000} + \$6 = \$6.75. \tag{5}$$

$$ATC_{200K} = \frac{75{,}000 \cdot 2}{200{,}000} + \$6 = \$6.75. \tag{6}$$

$$ATC_{300K} = \frac{75{,}000 \cdot 3}{300{,}000} + \$6 = \$6.75. \tag{7}$$

$$ATC_{400K} = \frac{75{,}000 \cdot 4}{400{,}000} + \$6 = \$6.75. \tag{8}$$

c. For plant B, we have average variable costs of $AVC = \$3.7+\$1.8+\$2 = \$7.5$. Therefore average total costs are $ATC = \frac{TFC \cdot \text{number of plants}}{Q} + \$7.5$. Therefore:

$$ATC_{100K} = \frac{25{,}000 \cdot 2}{100{,}000} + \$6 = \$6.5. \tag{9}$$

$$ATC_{200K} = \frac{25{,}000 \cdot 4}{200{,}000} + \$6 = \$6.5. \tag{10}$$

$$ATC_{300K} = \frac{25{,}000 \cdot 6}{300{,}000} + \$6 = \$6.5. \tag{11}$$

$$ATC_{400K} = \frac{25{,}000 \cdot 8}{400{,}000} + \$6 = \$6.5. \tag{12}$$

d. Clearly plant A is always the cheapest. So the LRAC points are \$4.5, \$4, \$4.5, and \$4 for 100K, 200K, 300K, and 400K, respectively.

**Textbook chapter 8, 8a**

This is entry/exit causing long run economic profits to move to zero. Low prices presumably resulted in negative economic profits. Farmers left the industry. Because production decreased, the price went back up.

**Textbook chapter 8, 12**

a. The optimal markup is:

$$\text{markup} = \frac{-1}{e_p + 1} = \frac{-1}{1 - 2} = 1 = 100\%, \tag{13}$$

over marginal costs. Further, since $MC = AVC$. So the manager is lucky here. First, he happened to set the exact markup that correctly accounts for the competition, and since $MC = AVC$ he effectively did his markup over the correct cost. So the price is optimal.

b. Now the optimal markup is:

$$\text{markup} = \frac{-1}{e_p + 1} = \frac{-1}{1 - 3} = 1 = 50\%, \tag{14}$$

Now cost plus pricing is not correct: the optimal markup is 50% and the manager is using a 100% markup. Cost plus pricing is incorrect because it does not account for the level of competition. The firm is charging too much and will lose many customers in the more competitive environment. Profits will be lower.

**Extra Problem 1**

a. Here are the answers:

| $Q$ | Price | TC | Total Variable Cost | Total Fixed Costs | Marginal Cost | Total Revenue | Marginal Revenue | Price Elasticity |
|---|---|---|---|---|---|---|---|---|
| 80 | 340 | 5610 | 5600 | 10 | NA | 27200 | NA | NA |
| 90 | 320 | 6410 | 6400 | 10 | 80 | 28800 | 160 | $-\frac{16}{9}$ |
| 95 | 310 | 7010 | 7000 | 10 | 120 | 29450 | 130 | $-\frac{31}{19}$ |
| 100 | 300 | 7510 | 7500 | 10 | 100 | 30000 | 110 | $-\frac{3}{2}$ |
| 110 | 280 | 8510 | 8500 | 10 | 100 | 30800 | 80 | $-\frac{14}{11}$ |

Table 1: Cost/Revenue table.

b. We set $MR = MC$. This occurs between 100 and 110 units, with a price between 300 and 280.

**Extra Problem 2**

a. We use the $MR = MC$ formula. First, we find marginal revenues:

$$TR = P \cdot Q. \tag{15}$$

We must find how the price changes with $Q$. Using the demand curve:

$$Q = 160 - 2P, \tag{16}$$

$$2P = 160 - Q, \tag{17}$$

$$P = 80 - \frac{1}{2}Q. \tag{18}$$

Now, plug the price into the total revenues formula:

$$TR = P \cdot Q = \left(80 - \frac{1}{2}Q\right) Q. \tag{19}$$

$$TR = 80Q - \frac{1}{2}Q^2, \tag{20}$$

$$MR = \frac{dTR}{dQ} = 80 - Q. \tag{21}$$

Now we need marginal costs:

$$TC = 40 + 5Q + 2Q^2, \tag{22}$$

$$\frac{dTC}{dQ} = 5 + 4Q. \tag{23}$$

Now we can find the maximum via:

$$MR = MC, \tag{24}$$

$$80 - Q = 5 + 4Q, \tag{25}$$

$$75 = 5Q, \ \rightarrow \ Q = 15. \tag{26}$$

So the firm should build a building with 15 condos.

b. To find the price, we plug the quantity into the pricing equation (18):

$$P = 80 - \frac{1}{2}Q, \tag{27}$$

$$P = 80 - \frac{1}{2}15, \ \rightarrow \ P = 72.5 \tag{28}$$

For the price elasticity, we use the formula:

$$e_P = \frac{P}{Q}\frac{dQ}{dP}. \tag{29}$$

The derivative we get from the demand curve, equation (16):

$$Q = 160 - 2P, \tag{30}$$

$$\frac{dQ}{dP} = -2. \tag{31}$$

So plugging into the formula:

$$e_P = \frac{P}{Q}\frac{dQ}{dP} = \frac{72.5}{15} \cdot (-2) = -9.67. \tag{32}$$

The elasticity is negative and in the elastic range.

c. Total profits are:

$$\pi = TR - TC = P \cdot Q - \left(40 + 5Q + 2Q^2\right), \tag{33}$$

$$= 72.5 \cdot 15 - \left(40 + 5 \cdot 15 + 2 \cdot 15^2\right) = 522.5. \tag{34}$$

d. The new demand curve and total cost curves are:

$$TC = 40 + 8Q + 2Q^2, \tag{35}$$

$$Q = 196 - 2P, \tag{36}$$

Notice that we are adding $3Q$ to the total cost, because the cost is 3 per unit.

We follow the same procedure as above, finding $MR$ then setting $MR = MC$. Step one is to find the price using the new demand curve:

$$Q = 196 - 2P, \tag{37}$$

$$2P = 196 - Q, \tag{38}$$

$$P = 98 - \frac{1}{2}Q. \tag{39}$$

Next we find total revenue:

$$TR = P \cdot Q = \left(98 - \frac{1}{2}Q\right) Q = 98Q - \frac{1}{2}Q^2. \tag{40}$$

So marginal revenue is:

$$MR = \frac{dTR}{dQ} = 98 - Q. \tag{41}$$

The new marginal cost is:

$$MC = \frac{dTC}{dQ} = 8 + 4Q. \tag{42}$$

Thus:

$$MR = MC, \tag{43}$$

$$98 - Q = 8 + 4Q, \;\; \rightarrow \;\; Q = 18. \tag{44}$$

To maximize profits, set the slope or derivative equal to zero:

$$\frac{d\pi}{dQ} = 90 - 5Q = 0, \tag{45}$$

$$5Q = 90, \;\; \rightarrow \;\; Q = 18. \tag{46}$$

e. The price is:

$$P = 98 - \frac{1}{2}Q = 98 - \frac{1}{2} \cdot 18 = 89. \tag{47}$$

f. Profits are:

$$\pi = TR - TC = P \cdot Q - TC. \tag{48}$$

$$\pi = P \cdot Q - \left(40 + 8Q + 2Q^2\right). \tag{49}$$

$$\pi = 89 \cdot 18 - \left(40 + 8 \cdot 18 + 218^2\right) = 770. \tag{50}$$

g. Yes, the builder's profits go up when granite is added. Demand is much stronger. The cost is an extra \$3 thousand per unit. However, the strong demand allows the builder to raise the price from 72.5 to 89 per unit, more than enough to compensate for the increase in costs. In addition the builder can take advantage of the higher demand and build more units (15 to 18), which also adds to profits.

**Extra Problem 3**

a. We have:

$$Q^{break-even} = \frac{TFC}{P - AVC} = \frac{2400}{120 - 100} = 120. \tag{51}$$

We break even at 120 units.

b. We have:

$$\text{mark-up} = \frac{price - cost}{cost} = \frac{120 - 100}{100} = 0.2. \tag{52}$$

A 20% mark-up.

c. We have:

$$P = \frac{MC}{1 + \frac{1}{e_P}} = \frac{100}{1 - \frac{1}{5}} = \$125. \tag{53}$$

d. The prices differ because the optimal price accounts for the competition using the price elasticity. The firm could in fact raise prices by \$5. A few customers would be lost, but the firm would more than make up for it through the higher price to existing customers.

**Extra Problem 4**

a. The problem asks to maximize profits with imperfect competition. Therefore we need to set $MR = MC$. To calculate marginal revenue, we start with the price. From the demand curve:

$$Q = 25 - P, \tag{54}$$

$$P = 25 - Q. \tag{55}$$

So total revenues are:

$$TR = P \cdot Q = (25 - Q)\, Q = 25Q - Q^2. \tag{56}$$

So marginal revenues are:

$$MR = \frac{dTR}{dQ} = 25 - 2Q. \tag{57}$$

Next we need marginal costs:

$$TC = 25 + Q + 5Q^2, \tag{58}$$

$$MC = \frac{dTC}{dQ} = 1 + 10Q. \tag{59}$$

Finally:

$$MR = MC, \tag{60}$$

$$25 - 2Q = 1 + 10Q, \tag{61}$$

$$24 = 12Q, \ \ \rightarrow \ \ Q = 2. \tag{62}$$

To maximize profits, produce 2 units.

b. We can get the price from price equation (55):

$$P = 25 - Q = 25 - 2 = 23. \tag{63}$$

For the price elasticity, we have:

$$e_P = \frac{P}{Q}\frac{dQ}{dP}. \tag{64}$$

We can get the derivative from the demand curve:

$$Q = 25 - P, \tag{65}$$

$$\frac{dQ}{dP} = -1. \tag{66}$$

So

$$e_P = \frac{P}{Q}\frac{dQ}{dP} = \frac{23}{2} \cdot (-1) = -11.5, \tag{67}$$

which is in the elastic range as expected.

c. Profits are:

$$\pi = TR - TC = P \cdot Q - \left(25 + Q + 5Q^2\right), \tag{68}$$

$$\pi = 23 \cdot 2 - \left(25 + 2 + 5 \cdot \left(2^2\right)\right) = 46 - 47 = -1. \tag{69}$$

The firm is losing money because of the fixed costs.

d. No, economic profits are negative, so other options are more profitable.

**Extra Problem 5**

a. We have:

$$P = \frac{MC}{1 + \frac{1}{e_P}} = \frac{2}{1 - \frac{1}{3}} = 3. \tag{70}$$

b. We have:

$$P = \frac{MC}{1 + \frac{1}{e_P}}, \tag{71}$$

$$16 = \frac{4}{1 + \frac{1}{e_P}}, \tag{72}$$

$$1 + \frac{1}{e_P} = \frac{1}{4}, \tag{73}$$

$$\frac{1}{e_P} = -\frac{3}{4}, \;\; \rightarrow \;\; e_P = -\frac{4}{3}. \tag{74}$$

**Extra Problem 6**

a. The optimal size is found by minimizing the LRAC:

$$LRAC = 1290 - 100Q + 2Q^2, \tag{75}$$

$$\frac{dLRAC}{dQ} = -100 + 4Q = 0, \ \rightarrow \ Q = 25 \tag{76}$$

The ideal sized firm produces 25 barrels.

b. We have:

$$P = LRAC = 1290 - 100Q + 2Q^2 = 1290 - 100 \cdot 25 + 2 \cdot \left(25^2\right), \tag{77}$$

$$P = 40. \tag{78}$$

The long run price is \$40 per barrel.

c. Average economic profits are positive since $P = 60 > 40$ (average profits are zero at \$40). This industry is better than alternatives. Firms will enter.

d. Economic profits are negative since $P = 30 < 40$. Firms will exit.

e. We need to calculate average profits to see if it is better to be bigger than ideal size or smaller.

$$\frac{\pi}{Q} = P - LRAC = P - \left(1290 - 100Q + 2Q^2\right), \tag{79}$$

$$\frac{\pi}{Q} = 40 - \left(1290 - 100 \cdot 30 + 2\left(30^2\right)\right), \tag{80}$$

$$\frac{\pi}{Q} = -50. \tag{81}$$

Apart, the firms each make:

$$\frac{\pi}{Q} = P - \left(1290 - 100Q + 2Q^2\right), \tag{82}$$

$$\frac{\pi}{Q} = 40 - \left(1290 - 100 \cdot 15 + 2\,(15)^2\right), \tag{83}$$

$$\frac{\pi}{Q} = -200. \tag{84}$$

The firms are better of merging, to get closer to ideal size.

f. These two firms should merge as combined they move closer to ideal size.

**Extra Problem 7**

First, let us calculate the prices we would like to charge. For the price sensitive customers:

$$P = \frac{1}{1 + \frac{1}{e_p}} MC, \tag{85}$$

$$P = \frac{1}{1 - \frac{1}{4}} \$400, \tag{86}$$

$$P = \frac{1}{\frac{3}{4}} \$400, \tag{87}$$

$$P = \frac{4}{3} \$400 = \$1600/3 = \$533.33, \tag{88}$$

For the less price sensitive customers:

$$P = \frac{1}{1 - \frac{1}{2}} \$400, \tag{89}$$

$$P = \frac{1}{\frac{1}{2}} \$400, \tag{90}$$

$$P = 2 \cdot \$400 = \$800, \tag{91}$$

Now to implement these prices, we charge \$800, with a mail in rebate of $\$800 - \$533.33 =$

\$266.67.

**Extra Problem 8**

No, as discussed in the notes, price discrimination does not work in competitive markets. Any customer (regardless of how much time they have) can buy scrap metal from a large number of firms at $MC$. Since scrap metal is a commodity, customers will not pay a price above $MC$ which the competition is offering.