Homework 2: Solutions
Managerial Economics: Eco 685

**Question 1**

Since demand is volatile, if Boeing builds the large hanger and demand is low, the company will incur large fixed costs spread over few units. Average costs would then rise dramatically. Even though costs of the large hanger are lower, it may be better to build a smaller hanger and use more variable inputs like labor. Another strategy might be to develop alterative uses of the hanger in times of low demand. For example, the aerospace-defense industry is less volatile.

**Question 2**

a. The objective is to minimize long run average costs:

$$\min_{Q} LRAC = 3000 - 100Q + Q^2 \tag{1}$$

So we set the derivative equal to zero:

$$-100 + 2Q = 0 \quad \rightarrow \quad Q = 50 \tag{2}$$

b. Since the optimal size is 50, one would expect the 60 passenger ship is cheaper than the 20 passenger ship. But to tell for sure we must compute the Long run average costs (each ship brings in the same amount of revenue per passenger).

$$LRAC\,(Q = 60) = 3000 - 100 \cdot 60 + (60)^2 = \$600 \text{ per passenger} \tag{3}$$

$$LRAC\,(Q = 20) = 3000 - 100 \cdot 20 + (20)^2 = \$1,400 \text{ per passenger} \tag{4}$$

So we should build the 60 seat ship, which has lower costs per passenger.

c. Notice that long run average costs are an average cost, or cost per unit (passenger). Thus profit per passenger is simply revenue per passenger (\$1,000) less costs per passenger:

$$\pi \text{ per person}\,(60) = \$1,000 - \$600 = \$400 \text{ per passenger} \tag{5}$$

$$\pi \text{ per person}\,(20) = \$1,000 - \$1,400 = -\$400 \text{ per passenger} \tag{6}$$

The smaller ship loses money, but by increasing the ship size we can take advantage of increasing returns to scale and lower our average costs. The larger ship thus is able to generate some profits.

**Question 3**

Young adults are not as addicted as older persons. Further, young adults lack the income to buy expensive cigarettes, even if they are addicted.

**Question 4**

a. From the demand function, we see that

$$\frac{\partial Q}{\partial P} = \frac{\partial 9 - 0.7P + 2I}{\partial P} = -0.7 \tag{7}$$

Further we are given a price $P = \$30$ and the quantity is:

$$Q = 9 - 0.7 \cdot 30 + 2 \cdot 27 = 42 \tag{8}$$

Thus the price elasticity is:

$$e_p = \frac{P}{Q}\frac{\partial Q}{\partial P} = \frac{30}{42} \cdot (-0.7) = -\tfrac{1}{2} \tag{9}$$

b. The demand is inelastic, meaning competition is low and the firm has pricing power. The firm can raise prices and lose few customers. Since costs would fall and revenues rise if the firm raised prices, the firm should raise prices to increase profits.

c. A change in income only affects the quantity demanded:

$$Q = 9 - 0.7 \cdot 30 + 2 \cdot 13 = 14 \tag{10}$$

Thus:

$$e_p = \frac{30}{14} \cdot (-0.7) = -\frac{3}{2} \tag{11}$$

The recession has reduced the quantity demanded and lowered the price elasticity into the elastic range. Because consumers have lower incomes, they become more price sensitive, shopping around and looking for bargins. Hence the firm loses pricing power in a recession.

**Question 5**

a. Using the alternative formula:

$$e_p = \frac{\text{percent change in Q}}{\text{percent change in Q}} = \frac{-10\%}{20\%} = -\tfrac{1}{2} \tag{12}$$

For the actual elasticity, we know the quantity is 11, so the price is:

$$P = 17 - 11 = 6 \tag{13}$$

Further, using the demand curve:

$$Q = 17 - P \tag{14}$$

$$\frac{\partial Q}{\partial P} = \frac{\partial 17 - P}{\partial P} = -1 \tag{15}$$

Hence:

$$e_p = \frac{6}{11} \cdot (-1) = -0.55 \tag{16}$$

So the Columbian delegate has a pretty good idea of the price elasticity. But is the 20% price increase the optimal pricing strategy?

b. We maximize profits:

$$\max \pi = TR - TC = PQ - TC = (17 - Q)\, Q - \left(12 + 5Q + Q^2\right) \tag{17}$$

Simplify first:

$$= 17Q - Q^2 - 12 - 5Q - Q^2 = 12Q - 12 - 2Q^2 \tag{18}$$

Now take the derivative and set it equal to zero:

$$12 - 2 \cdot 2Q = 0 \quad \rightarrow \quad Q = 3 \tag{19}$$

$$P = 17 - Q = 17 - 3 = \$14 \tag{20}$$

$$\pi = 12Q - 12 - 2Q^2 = 12 \cdot 3 - 12 - 2\,(3)^2 = \$6 \tag{21}$$

$$e_p = \frac{14}{3}\,(-1) = -4\frac{2}{3} \tag{22}$$

The optimal price increase is very large, equal to a 133% increase (6 to 14). This example shows how competition keeps prices down. By removing competition, say through a cartel like the Brazilian coffee cartel or OPEC, surprisingly large price increases are possible. However, in the long run demand will be more elastic. Consumers will substitute to tea or fuel efficient cars and demand will be more elastic (there is also the problem of cheating among the cartel, which we will examine later in the course). Elastic long run demand may be one reason why the cartel instituted only a small increase in prices.