Homework 3, Solutions

Question 1

a. We have:

$$\text{Markup } = \frac{P - \text{cost}}{\text{cost}}, \tag{1}$$

So for the phone:

$$\text{Markup } = \frac{\$649 - \$225}{\$225} = 1.88 = 188\%. \tag{2}$$

For the extra storage:

$$\text{Markup } = \frac{\$100 - \$4}{\$4} = 24 = 2{,}400\%. \tag{3}$$

b. Apple is upcharging: the idea is that the price sensitive customers will by the phone, and the less price sensitive customers will by the deluxe phone with extra storage. Since the less price sensitive customers are buying the extra storage, Apple can charge a much higher markup.

c. For the price elasticity of the base phone, we can use:

$$P = \frac{1}{1 + \frac{1}{e_p}} MC, \tag{4}$$

$$\$649 = \frac{1}{1 + \frac{1}{e_p}} \$225, \tag{5}$$

$$\frac{\$649}{\$225} = \frac{1}{1 + \frac{1}{e_p}}, \tag{6}$$

$$\frac{\$225}{\$649} = 1 + \frac{1}{e_p}, \tag{7}$$

$$-0.653 = \frac{1}{e_p}, \;\; \rightarrow \;\; e_p = -1.507 \tag{8}$$

d. Now for the upgraded phone we must consider both products purchased together:

$$P = \frac{1}{1 + \frac{1}{e_p}} MC, \tag{9}$$

$$\$649 + \$100 = \frac{1}{1 + \frac{1}{e_p}} (\$225 + \$4), \tag{10}$$

$$\frac{\$749}{\$229} = \frac{1}{1 + \frac{1}{e_p}}, \tag{11}$$

$$\frac{\$229}{\$749} = 1 + \frac{1}{e_p}, \tag{12}$$

$$-0.6943 = \frac{1}{e_p}, \;\; \rightarrow \;\; e_p = -1.44 \tag{13}$$

The upgrade buyers are less price sensitive, although both are fairly price sensitive (even buyers of the base phone are being charged a very healthy markup).

Question 2

a. For the "base" model, with the special software, we have:

$$P = \frac{1}{1 + \frac{1}{e_p}} MC, \tag{14}$$

$$P = \frac{1}{1 + \frac{1}{-2}} \$40{,}000, \tag{15}$$

$$P = \frac{1}{\frac{1}{2}} \$40{,}000, \tag{16}$$

$$P = 2 \cdot \$40{,}000, \;\; \rightarrow \;\; P = \$80{,}000. \tag{17}$$

b. For the "advanced" model, without the special software, the marginal cost is the same. Therefore:

$$P = \frac{1}{1 + \frac{1}{e_p}} MC, \tag{18}$$

$$P = \frac{1}{1 + \frac{2}{-3}} \$40{,}000, \tag{19}$$

$$P = \frac{1}{\frac{1}{3}} \$40{,}000, \tag{20}$$

$$P = 3 \cdot \$40{,}000, \quad \rightarrow \quad P = \$120{,}000. \tag{21}$$

c. Tesla need only charge $80,000 for the base model, and $40,000 to upgrade to the battery without the special software.

d. Tesla is upcharging. Usually goods with the same marginal cost are identical. But here they are in fact different, as one car is essentially damaged intentionally.

Question 3 (REQUIRES TUESDAY'S NOTES)

a. The best responses are:

		Apple	
		Run	Don't
Samsung	Don't	-2,0	1,(3)
	Run	(0),(0)	(3),-6

Table 1: Ad war game.

Samsung has a dominant strategy to run ads: Samsung always runs ads regardless of Apple's decision.

b. From the best responses, both players run ads is the only Nash equilibrium. Both firms earn zero profits in the Nash equilibrium.

c. No. Apple knows Samsung has a dominant strategy to run ads. Therefore, Apple must run ads or face losing customers to Samsung. If Apple runs ads, Apple earns

zero profits: it had to run some expensive ads but at least it didn't lose any customers. Conversely, if Apple does not run ads and fails to compete with Samsung's ads, it will lose customers and earn profits equal to -6.

Question 4 (REQUIRES TUESDAY'S NOTES)

a. Notice that anyone who joins automatically pays 3. Thus if someone joins the union and no one else does, that person earns 7. However, if two or three players join, the joiners pay 3 to the union but get an extra 5 in wages, for a total of 12. If someone does not join, but the others do, that person can free ride. They get the benefit of being in the union (+5 to wages), but don't have to pay the dues. Overall, I get:

Alec Joins

		April: Joins	April: Not
Jack	Joins	12,12,12	12,15,12
	Not	15,12,12	10,10,7

Alec Does not join

		April: Joins	April: Not
Jack	Joins	12,12,15	7,10,10
	Not	10,7,10	10,10,10

Table 2: Union game: payoffs.

b. No dominant strategies exist. Each player wants not to join if 2 other players join (free ride) or if 2 other players don't join (why pay the dues when the union will not happen anyway?). But if only one other player is joining the player wants to join, as the player is pivotal: she must join otherwise the union will not happen.

c. Using the circle method:

Alec Joins

Jack \ April	Joins	Not
Joins	12,12,12	(12),(15),(12)
Not	(15),(12),(12)	10,10,7

Alec Does not join

Jack \ April	Joins	Not
Joins	(12),(12),(15)	7,10,10
Not	10,7,10	(10),(10),(10)

Table 3: Union game: best responses.

So we have 4 Nash equilibria. Three are essentially the same: 2 join and the other free rides. In the fourth, no one joins.

d. To get the highest social benefit, we add all three payoffs. The highest social benefit occurs when 2 join and one free rides ($15+12+12=39$). The workers get the benefit of the union, while paying the union the minimum amount necessary, which is 6. For the rest of the numbers:

Alec Joins

Jack \ April	Joins	Not
Joins	SB =36	SB =39
Not	SB =39	SB =27

Alec Does not join

Jack \ April	Joins	Not
Joins	SB =39	SB =27
Not	SB =27	SB =30

Table 4: Union game: social benefits.

Three of the Nash correspond to the highest benefit. Although free riding exists, the problem is not a prisoner's dilemma. If only one of the two other players has joined, the remaining player cannot free ride and instead must join the union which benefits everyone. Further, there is no incentive to cheat from any agreement where 2 players join. Each player knows that if he cheats and doesn't join the union, then the union will dissolve and she will lose the benefits of the higher negotiated salary.

e. Any equilibrium where two players join the union. If none join, there is always an incentive for 2 players to agree to join. They can get the benefits of the union and improve their payoffs.

f. For the case where 3 must join to get the benefits of the union:

- We have:

Alec Joins

Jack \ April	Joins	Not
Joins	(12),(12),(12)	7,10,7
Not	10,7,7	(10),(10),7

Alec Does not join

Jack \ April	Joins	Not
Joins	7,7,10	7,(10),(10)
Not	(10),7,(10)	(10),(10),(10)

Table 5: Union game.

- No dominant strategies exist. All players do not want to join unless all other players join. So the decision depend on what the other players do.
- From table 5, 2 Nash equilibria exist. No free riding is possible here, because all players must join to get the benefits.

Question 5 (REQUIRES TUESDAY'S NOTES)

a. The best responses are:

MasterCard \ Visa	High, more	Medium, more	Low, more	High, less	Low, less
High, more	(9),8	6,(9)	5,8	4,8	(12),3
Medium, more	(9),6	(8),(7)	5,6	3,(7)	10,4
Low, more	8,5	5,(6)	4,5	(7),(6)	10,(6)
High, less	7,4	5,5	3,4	6,(6)	11,(6)
Low, less	3,(12)	4,10	(6),10	6,11	10,10

Table 6: Profits of Visa and MasterCard.

Two Nash equilibria exist: in one, both Visa and Mastercard play medium advertising and high cash back, and in the other, Mastercard plays low ads and more cash back, whereas Visa plays High ads and Less cash back.

For the first, if Mastercard predicts Visa will adopt an aggressive strategy of medium ads and more cash back, then Mastercard must match this aggression, otherwise Mastercard will lose customers to Visa and get lower profits (all other choices have profits less than 8 in the second column). Given that Mastercard is aggressive, however, Visa must respond by being aggressive for the same reason (all profits for Visa are lower than 7 in the second row). Thus the prediction that Mastercard adopts the aggressive strategy is correct.

For the second equilibrium, if Visa predicts Mastercard adopts a strategy of low ads but more cash back, then it is optimal for Visa to compete in the opposite way: more ads but less cash back. In this way, Visa can attract the consumers who are swayed by ads, whereas Mastercard will get the customers swayed by cash back. Given Visa adopts a strategy of high ads and low cash back, Mastercard responds with low ads and high cash back. Thus the prediction by Visa is correct.

b. For collusion, we choose the highest social benefit. Adding the two numbers in each cell, we see that if both players adopt low ads and low cash back, we get the highest social benefit of $10 + 10 = 20$. This makes sense, both firms save money by limiting ads and cash back. Competing with ads or cash back just tends to cancel out the ads and cash back offers from the other player.

c. No, both players have an incentive to cheat, and offer more ads.

d. Both players prefer the Nash equilibrium where they adopt the more aggressive strategy.

Question 6

No Firms use price-matching to reduce the incentive for the opposing firms to cut prices. Both firms will offer a high price, and offer to match competitors prices. However, since the competitors both are offering a high price, the consumer is unable to take advantage of the match and has only high prices to choose from.