

First Quiz: Solutions
Managerial Economics: Eco 685

Question 1 (10 points)

- a. When firms maximize profits, they benefit consumers by producing goods consumers want (as evidenced by their willingness to pay for those goods).
- b. When firms maximize profits, they generate income for stockholders and workers.

Question 2 (10 points)

Notice that:

$$\frac{MP_u}{MP_s} < \frac{P_u}{P_s} \tag{1}$$

Now if we reduce u by one unit and hire $\frac{MRP_u}{MRP_s}$ units of s , then we keep production constant, but costs fall: we can spend $\frac{P_u}{P_s}$ and costs will be constant, but we spent less than that since the left hand side is smaller. So we can increase profits by reducing unskilled labor by one unit and hiring $\frac{MRP_u}{MRP_s}$ skilled workers.

Question 3 (5 points)

As the amount of workers rise, holding for example machines and other capital fixed, eventually there so many workers at each machine that workers just get in each other's way. Thus an additional unit of labor does not increase production very much. As the number of workers rise, coordination problems also increase. For example, in large study groups additional students tend to simply distract other students, preventing work from getting done. Other students will tend to free ride, letting a few students do all the work.

Question 4 (10 points)

- a. Long run average costs are increasing, apparently costs rise if the size of the firm gets to even a few employees.
- b. In class we mentioned regulation, taxes, and expropriation, all of which affect large firms more than small firms. A small firm is difficult to tax and regulate: it can easily move to another country or under-report income. It also has few assets for the government to confiscate or expropriate. Conversely, a large firm, especially one with a lot of capital, is an easy target for an opportunistic government.

Question 5 (5 points)

The \$500,000 spent on the option is a sunk cost and does not affect the decision of which building to buy today. By exercising the option, the firm can obtain a building for \$5M,

which is cheaper than the alternative building, which costs \$5.25M. Thus the firm should exercise the option.

Question 6 (20 points)

a. We have:

$$\pi = \$3 (0.03 + 0.48C + 0.64S - 0.02C^2 - 0.05S^2) - \$0.40C - \$0.30S \quad (2)$$

$$= \$0.09 + 1.44C + 1.92S - 0.06C^2 - 0.15S^2 - \$0.40C - \$0.30S \quad (3)$$

To maximize profits we find where the derivative or slope is equal to zero, for both inputs. Alternatively, I could first find where the marginal rate of substitution was equal to the price ratio first.

$$\frac{\partial \pi}{\partial C} = 1.44 - 0.12C - .40 = 0 \quad (4)$$

Notice that the marginal revenue, the first two terms, equals the marginal expenditure, \$0.40. Thus:

$$C = 8.67 \quad (5)$$

$$\frac{\partial \pi}{\partial S} = 1.92 - 0.3S - .30 = 0 \quad (6)$$

$$S = 5.4 \quad (7)$$

Looking at the numbers, soybean is 25% cheaper than corn. Looking at the marginal products, soybean is more productive than corn, for low values of S and C . However, diminishing returns sets in quicker for Soybeans. Apparently, chickens like soybeans, but get sick of the all soybean diet quickly, and in this case eat less and do not get fat. Taking all these factors into account, it is optimal to have a mix of corn and soybeans, but with more corn. The varied diet apparently keeps the chickens eating.

b. From above, we have:

$$\pi = \$0.09 + 1.44 \cdot 8.67 + 1.92 \cdot 5.4 - 0.06 \cdot 8.67^2 - 0.15 \cdot 5.4^2 - \$0.40 \cdot 8.67 - \$0.30 \cdot 5.4 \quad (8)$$

$$= \$8.97 \quad (9)$$

c. We have:

$$Q = 0.03 + 0.48C + 0.64S - 0.02C^2 - 0.05S^2 \quad (10)$$

$$MP_c = \frac{\partial Q}{\partial C} = 0.48 - 0.04C = 0 \quad (11)$$

$$C = 12 \quad (12)$$

$$MP_s = \frac{\partial Q}{\partial S} = .64 - .1S = 0 \quad (13)$$

$$S = 6.4 \quad (14)$$

Question 7 (20 points)

a. Profits are:

$$\pi = \$50Q - \left(\frac{1}{2}Q^2 + 20Q + 150\right) \quad (15)$$

$$= \$50Q - \frac{1}{2}Q^2 - 20Q - 150 \quad (16)$$

To maximize profits, we set the derivative equal to zero, which is where marginal revenue equals marginal costs:

$$\frac{\partial \pi}{\partial Q} = 50 - Q - 20 = 0 \quad (17)$$

$$50 = Q + 20 \quad (18)$$

so the left hand side is the marginal revenue, which equals the marginal cost, which is the right hand side. Of course, the sunk costs of \$150 do not affect the decision.

$$Q = 30 \quad (19)$$

b. Profits are:

$$\pi = \$50 \cdot 30 - \frac{1}{2}30^2 - 20 \cdot 30 - 150 \quad (20)$$

$$\pi = 300 \tag{21}$$

- c. Enterprise has sunk costs of \$150, these are paid regardless of whether or not the operation is shut down. Thus we can simply compare \$300 we make on the operation (which includes the sunk costs), versus the opportunity cost of $\$500 - \$150 = \$350$. So we sell the factory. Alternatively, not including sunk costs, we have $\$500 > \$300 + \$150 = \450 . Either way the sunk costs do not matter for the decision. Notice I am ignoring the time value of money. If this was real life, as opposed to a one hour exam, one would have to compute the present discounted value of annual payments of \$300 versus \$500 today.

Question 8 (20 points)

Regrettably, I got confused by a student's question, and thought there might be an error. But there was no error and in fact students were confused about something entirely different, how to take the derivative of CS . So I'll give both answers.

- a. Clearly coffee should make students more productive. Therefore, there should be a C somewhere in the marginal product of S . Indeed, if the derivative of $4S$ is 4 (with 4 cups of coffee the marginal product of a student is 4), and the derivative of $3S$ is 3, then the derivative of CS with respect to S must be C .
- b. We have:

$$Q = C \cdot S \tag{22}$$

$$MP_s = \frac{\partial Q}{\partial S} = C \tag{23}$$

$$MP_c = \frac{\partial Q}{\partial C} = S \tag{24}$$

$$\frac{MP_s}{MP_c} = \frac{C}{S} = \frac{P_s}{P_c} = \frac{\$9}{\$3} \tag{25}$$

$$\frac{C}{S} = 3 \tag{26}$$

$$C = 3S \tag{27}$$

So each student should drink 3 cups of coffee.

c. The budget is:

$$\$36 = \$9s + \$3C \quad (28)$$

$$12 = 3S + C \quad (29)$$

Since $C = 3S$,

$$12 = 3S + 3S \rightarrow S = 2 \quad C = 6 \quad (30)$$

With the other production function, only the answers are different.

a. Clearly coffee should make students more productive. Therefore, there should be a C somewhere in the marginal product of S . Indeed, if the derivative of $4S$ is 4 (with 4 cups of coffee the marginal product of a student is 4), and the derivative of $3S$ is 3, then the derivative of CS with respect to S must be C .

b. We have:

$$Q = C \cdot S - \frac{1}{2}S^2 \quad (31)$$

$$MP_s = \frac{\partial Q}{\partial S} = C - S \quad (32)$$

$$MP_c = \frac{\partial Q}{\partial C} = S \quad (33)$$

$$\frac{MP_s}{MP_c} = \frac{C - S}{S} = \frac{P_s}{P_c} = \frac{\$9}{\$3} \quad (34)$$

$$\frac{C - S}{S} = 3 \quad (35)$$

$$C - S = 3S \rightarrow C = 4S \quad (36)$$

So each student should drink 4 cups of coffee.

c. The budget is:

$$\$36 = \$9s + \$3C \tag{37}$$

$$12 = 3S + C \tag{38}$$

Since $C = 4S$,

$$12 = 3S + 4S \rightarrow S = \frac{12}{7} \tag{39}$$

$$C = 4 \cdot \frac{12}{7} = \frac{48}{7} \tag{40}$$