Economics & Society
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Practice Set 3 – KEY

Cost, Supply & Competitive Markets

This set contains problems for your own practice. It is highly recommended to work on the problems on your own. Do not just read the provided solutions. Instead, try to solve the problems and use the solutions only when you cannot continue on your own. Reading problems that someone else has solved has the same value for your preparation like watching someone else running a marathon on TV and then expecting to be able to run it, too. If you have questions on this set, please ask your section's teaching assistant.

1. Fill in the following table:

q	TC	VC	FC	MC
0	___	___	60	-
1	___	10	___	___
2	90	___	___	___
3	___	___	___	20
4	___	80	___	___
5	180	___	___	___
6	___	___	___	50

q	TC	VC	FC	MC
0	*60 + 0 = 60*	*0*	60	-
1	*60 + 10 = 70*	10	*60*	*70 – 60 = 10*
2	90	*90 – 60 = 30*	*60*	*90 – 70 = 20*
3	*90 + 20 = 110*	*110 – 60 = 50*	*60*	20
4	*80 + 60 = 140*	80	*60*	*140 – 110 = 30*
5	180	*180 – 60 = 120*	*60*	*180 – 140 = 40*
6	*180 + 50 = 230*	*230 – 60 = 170*	*60*	50

2. A print-shop produces books according to the production function $q = 200 \cdot L \cdot K$, where q is the number of copies of books produced per week, L denotes the number of typesetters (humans) and K denotes the number of printing presses (machines) used in production. The weekly salary of a typesetter is \$2. The weekly leasing cost of a press is \$4.

   (a) Find the number of books we can produce if we use 1 typesetter and 2 presses.

   This will be $q = 200 \cdot 1 \cdot 2 = 400$ *books.*

   (b) Find the number of books we can produce if we use 2 typesetters and 1 press.

   This will be $q = 200 \cdot 2 \cdot 1 = 400$ *books.*

   (c) Can we in general say that "*one can substitute 1 typesetter with 1 press while keeping production constant*"?

   No, we cannot. This does happen in (a) and (b) above but it does not happen in general with this particular production function. For instance, 4 typesetters and 2 presses produce 1,600 books. However, if we substitute a typesetter with a press having 3 typesetters and 3 presses, the production will become 1,800 books.

   (d) A publisher has ordered 2,000 copies of a book. How should the print-shop organize the production? Assume that L and K can only employed in whole units.

We must find the optimal combination of K and L to produce 2,000 books in the most economical way.
0 units of K cannot produce 2,000 books.
1 unit of K requires 10 units of L to produce 2,000 books. This will cost $1 \cdot 4 + 10 \cdot 2 = \$24$.
2 units of K require 5 units of L to produce 2,000 books. This will cost $2 \cdot 4 + 5 \cdot 2 = \$18$.
3 units of K require 4 units of L to produce 2,400 books. This will cost $3 \cdot 4 + 4 \cdot 2 = \$20$.
4 units of K require 3 units of L to produce 2,400 books. This will cost $4 \cdot 4 + 3 \cdot 2 = \$22$.
5 units of K require 2 units of L to produce 2,000 books. This will cost $5 \cdot 4 + 2 \cdot 2 = \$24$.
*The cheapest way to organize the production is by using 2 presses and 5 workers. This is because in this example, labor is on average cheaper than capital.**

**Notice here that although the cost per book when $K = 3$ and $L = 4$ ($\$20/2{,}400 = \$0.0083$) is lower than the cost per book when $K = 2$ and $L = 5$ ($\$18/2{,}000 = \$0.009$), the customer ordered 2,000 books that can be produced with $\$18$ when $K = 2$ and $L = 5$ and with $\$20$ when $K = 3$ and $L = 4$. That is, if the print-shop produces 2,400 books, the total cost will increase by \$2 for producing 400 more books that the customer did not order.*

Assume now that the print-shop leases 3 presses for 6 years.

(e) How much is the FC for the company per week?

Now, K cannot be adjusted for 6 years, and therefore, it becomes the fixed production factor. The fixed cost is the cost of presses. That is, $3 \cdot 4 = \$12$.

(f) Derive the total cost function for the production of books per week.

The total cost will be $TC = 2 \cdot L + 4 \cdot K$. Because $K = 3$, we have that $TC = 2L + 12$. However, TC is a function that relates TC to q, not TC to L. From the production function we have that $q = 200 \cdot L \cdot 3$ or $q = 600L$. We can solve this with respect to L as: $L = q/600$ and substitute it in TC:

$$TC = 2 \cdot \frac{q}{600} + 12 \ \text{ or } \ TC = 12 + \frac{q}{300}.$$

3. A firm's total cost function is given by $TC = 20 + 0.5q + 0.05q^2$.

(a) Calculate the FC and the VC.

The only factor in this cost function that is fixed is the 20. Thus, $FC = 20$. This implies that the rest will be the variable cost. That is, $VC = 0.5q + 0.05q^2$.

(b) Calculate the AC, the AFC and the AVC.

Average costs have to be divided by q. That is, $AC = TC/q$ or $AC = 20/q + 0.5 + 0.05q$. Then, $AFC = FC/q$ or $AFC = 20/q$ and $AVC = VC/Q$ or $AVC = 0.5 + 0.05q$.

(c) For the above TC, the marginal cost is given by $MC = 0.5 + 0.1q$. Find at which quantity AC is minimum.

AC will be minimum at its intersection with MC. That is, when $20/q + 0.5 + 0.05q = 0.5 + 0.1q$ or

$20/q = 0.05q$ or $q^2 = 400$ or $q = 20$.

4. Klara used to be a tutor of Spanish and she was charging 30 euros per hour for lessons. Recently, she started an online store where she sells handmade necklaces. The market for necklaces is perfectly competitive and the price for a necklace is 20 euros. The cost of materials for a necklace starts at 6 euros for the first necklace and keeps increasing by 1 euro per for each next necklace because it becomes harder and harder to find the raw materials in one day. Once she has the materials, it takes Klara 10 minutes to make a necklace.

(a) Write down Klara's marginal cost equation and use it to derive the optimal number of necklaces she should produce per day.

The production of necklaces involves two separate costs. First, the cost of materials, which for the q^{th} necklace is $(5+q)$. This yields the marginal cost of materials in euros 6, 7, 8, 9 etc. for each next necklace. Second, the cost of Klara's time, which is given to be 30 euros per hour or 5 euros per 10 min that the construction of a necklace takes. Thus, cost of time for each extra necklace is 5 euros. So, her marginal cost is $MC = 5 + (5+q)$ or $MC = 10 + q$.

The optimal number of necklaces is when $p = MC$. That is, $20 = 10 + q$ or $q = 10$.

(b) Derive how many necklaces Klara should produce per day by using a table with Klara's MC.

Klara's marginal cost is given in the following table.

Necklaces	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	***10***	*11*	*12*
MC of time	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	***5***	*5*	*5*
MC of materials	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	***15***	*16*	*17*
Total MC	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	***20***	*21*	*22*

Marginal cost becomes equal to the Marginal Revenue (20 euros per necklace) when she supplies 10 necklaces.

(c) How much is the total *economic profit* for Klara's enterprise?

Total economic profit is $\Pi = (20-11) + (20-12) + \cdots + (20-20) = 9 + 8 + \cdots + 0 = 45$ *euros.*

(d) How much is the *total accounting profit* for Klara?

If we do not include her cost of time because it is an opportunity cost (it is not actually paid to anyone), her accounting profit will be $\Pi = (20-6) + (20-7) + \cdots + (20-15) = 14 + 13 + \cdots + 5 = 95$ *euros.*

(e) How much is the *economic profit* that Klara makes from the last necklace she supplies per day?

From the 10th necklace Klara makes zero dollars of economic profit because $MR = MC$. However, Klara wants to make that last bracelet because she still gets paid the 5 euros for the 10 min she dedicated in producing that necklace. Even though those 5 euros are not economic profit, they are compensation for her work, and thus, income for her.

(f) What will be the effect on the economic profit of Klara's enterprise if she produced one necklace above the optimal number of necklaces?

If she supplies an 11^{th} necklace, it will contribute to her economic profit $20 - 21 = -1$ euros. Klara would completely cover the cost of materials of 16 euros for the extra necklace, sell it for 20 euros, and still receive 4 euros for her 10 min of work. Even though these 4 euros is income for Klara, economically it counts as a loss. This is because the 11^{th} necklace requires 5 euros worth of work, while yielding only 4 euros. Technically, it would be economically optimal for Klara to tutor Spanish during those 10 min as she would make 1 extra euro.

5. *"The PC firm of figure 1 produces quantity q^*. However, if the firm produced at q' it would minimize its cost per unit, and thus, it would achieve a higher profit."* True or false?

The statement is false. If the firm produced quantity q', the cost per unit would be lower than if it produced at q^* (the height difference between B and C). Yet, the sales would also be $q^* - q'$ lower. The benefit from lowering the cost would be exceeded by the revenue loss from sales, and thus, profit would decrease. The PC firm maximizes its profit when $p = MC$, even though per unit cost may not be minimum.

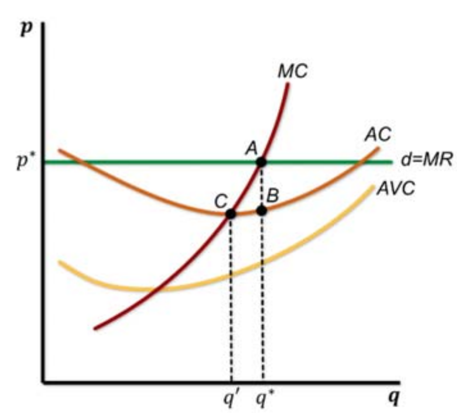

Figure 1

6. Explain why a PC firm will not shut down in the S-R when $AVC < p < AC$.

When $p < AC$, the firm makes loses. However, when $AVC < p < AC$, the firm still covers all variable costs plus some part of the fixed costs for which it is committed to pay even if it shuts down. If the firm shuts down, the owner must cover the entire FC from pocket. Therefore, it is better if the firm continues operation in the S-R. Once the S-R period expires and all costs become variable and avoidable, if $p < LAC$, the firm will shut down.

7. Which of the following formulas would yield the profit of a firm?

(1) $\Pi = R - C$, (2) $\Pi = (p - AC)q$, (3) $\Pi = (p - AVC)q - FC$.

All three formulas equivalently yield the profit of a firm. Formula (1) subtracts the cost (C) from the revenue (R), which is the definition of profit. Formula (2) multiplies the profit per unit $(p - AC)$ with the number of units q. Equation (3) does the same with (2) but subtracts the FC in the end. All 3 formulas are equivalent and you can use the one most convenient for the info you are have available.

8. Explain why when MC is constant, then $AVC = MC$.

A constant MC suggests that each next unit costs as much as every previous. If all units cost the same, the average cost of variable resources (AVC) must also be the same. For instance, if every next unit costs 10 dollars to make, then all units cost 10 dollars each to make; thus, the average cost of variable resources (AVC) will also be 10 dollars. Hence, when MC is constant, $AVC = MC$. Moreover, if there are no fixed costs, $AVC = AC$. Consequently, when MC is constant and $FC = 0$, $AC = AVC = MC$. This is a very useful property in problems, because it may help us figure out AC or AVC when only the MC is given.

You are kindly requested to report any *typos, mistakes* or *proposals* for the improvement of this practice set key at kmarinakis@smu.edu.sg.