B.E. International Program

Faculty of Economics, Thammasat University

EE 211 Principle of Microeconomics

Semester 1/2019

Exercise 7 - Answers

(Production in the Short Run and in the Long Run)

1. Consider an agricultural production in which land is the fixed factors and the variable factors are seed, labour, fertilizer, and equipment. Suppose the fixed cost is $30 and the cost of each variable unit (i.e. all variable factors are grouped together) is $10.

    a. Complete the following table.

Units of Variable Factors	TP (or Q)	AP	MP	TC	ATC	MC
0	0	0	-	30	-	-
1	2	2	2	40	20	5
2	5	2.5	3	50	10	3.33
3	7	2.3	2	60	8.57	5
4	8	2	1	70	8.75	10
5	8	1.6	0	80	10	infinity

    b. Graph the TP, AP, and MP curves in figure (i), and the three cost curves (TC, ATC, and MC) in figure 2. Remember that these "marginal" points are plotted at the midpoints of the intervals on the horizontal axis.

Figure (i)

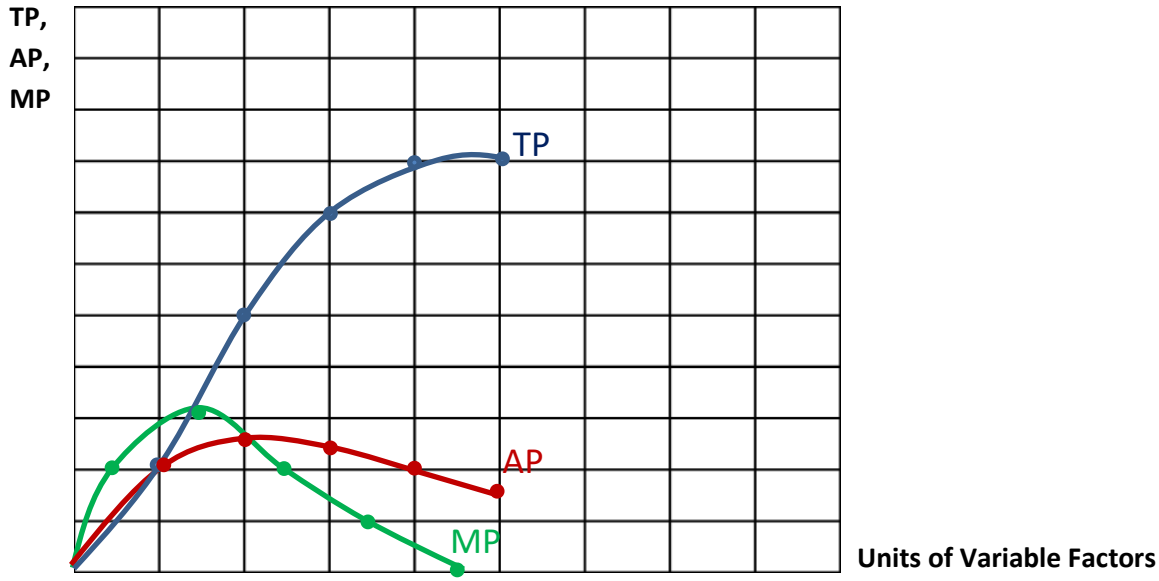
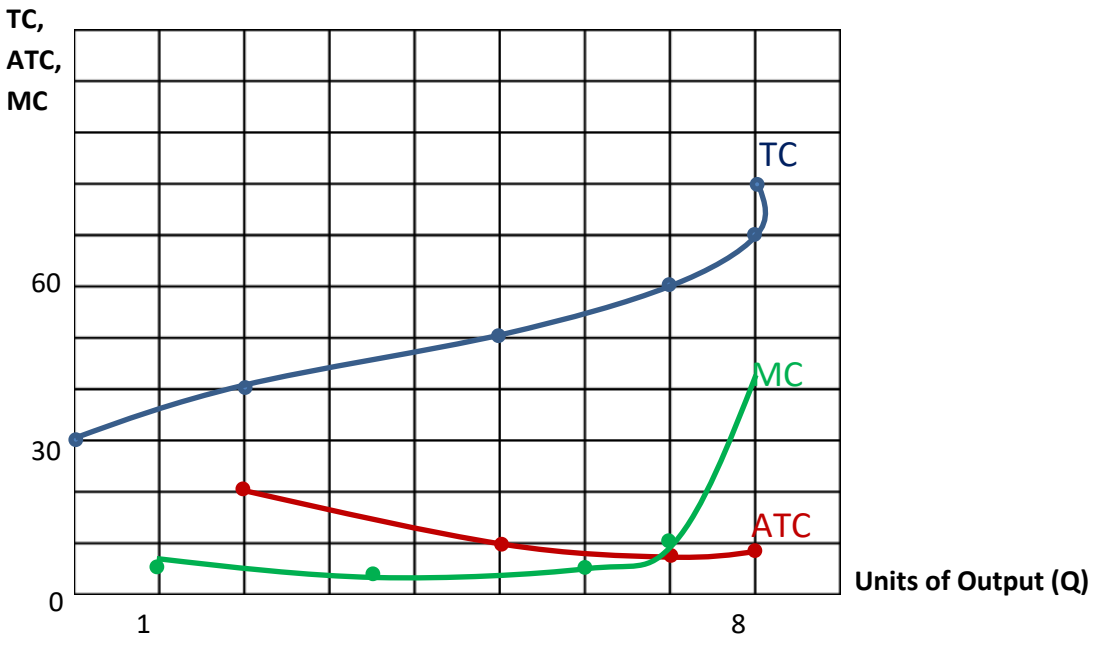
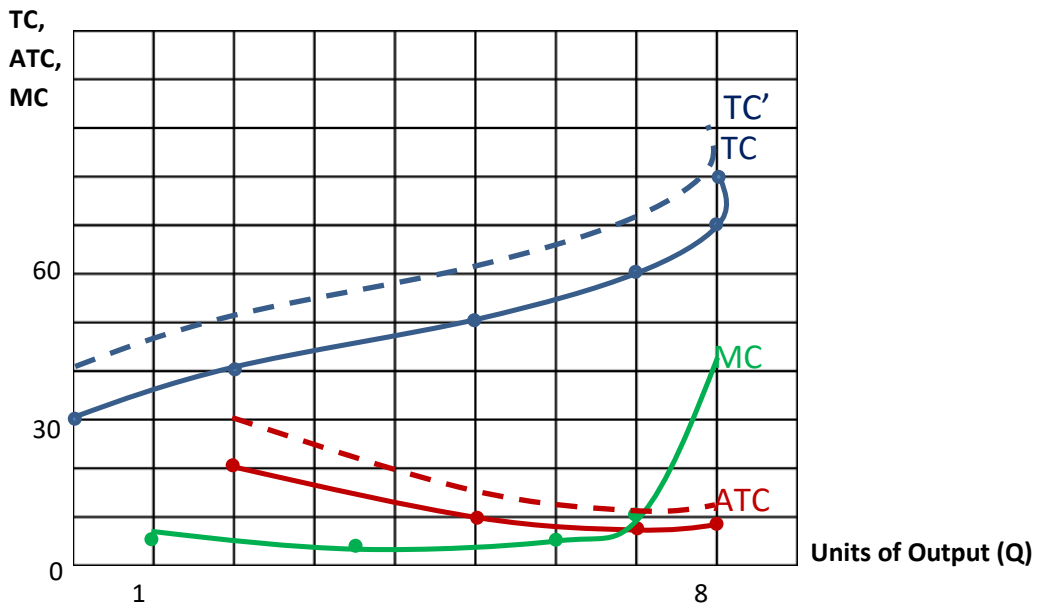


Figure (ii)

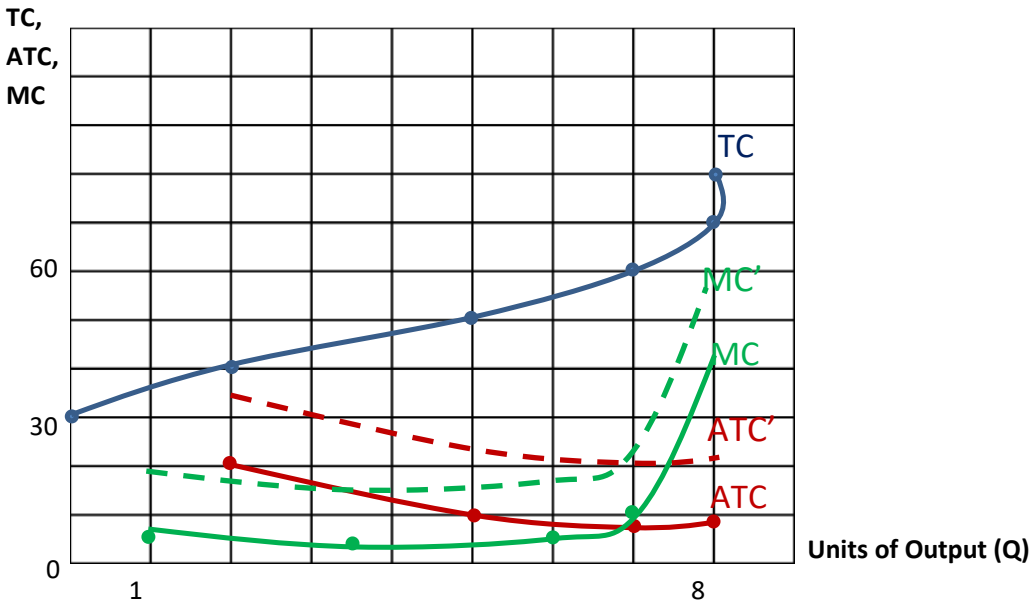


c. Suppose that the fixed cost increases to $40. How would the ATC and MC curves change? Compare the new ATC and MC curves to the ones drawn in part b.
MC remains unchanged.



d. Suppose, instead, that the cost of variable factors increases to $15 per unit. How would the ATC and MC curves change? Compare the new ATC and MC curves to the ones drawn in part b.

Both ATC and MC shift up by $15 for every unit of output.



2. Suppose that the short-run total cost is represented by the following equation:

$$TC = 30 + 3Q + Q^2$$

a. What are total fixed costs equal to?

30

b. What is the equation that represents total variable costs?

$TVC = 3Q + Q^2$

c. Derive the equation for average total costs (ATC).

$ATC = \frac{30}{Q} + 3 + Q$

d. Fill in the blanks in the following table.

Q	TVC	TFC	TC	ATC	MC
0	0	30	30	-	-
1	4	30	34	34.0	4
2	10	30	40	20.0	6
3	18	30	48	16.0	8
4	28	30	58	14.5	10
5	40	30	70	14.0	12
6	54	30	84	14.0	14
7	70	30	100	14.3	16
8	88	30	118	14.8	18
9	108	30	138	15.3	20
10	130	30	160	16.0	22

e. The equation for the MC curve is:

$MC = 3 + 2Q$.

Use the equation for MC to calculate MC at outputs of 5, 5.5, and 6. Compare these answers with the marginal cost you derived in (d).

Q = 5 → MC = 13

Q = 5.5 → MC = 14 (This is the same as the difference in TC between Q= 5 and Q = 6.)

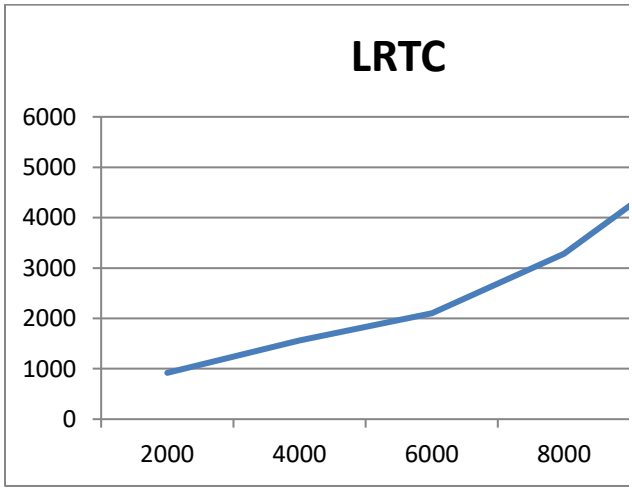
Q = 6 → MC = 15

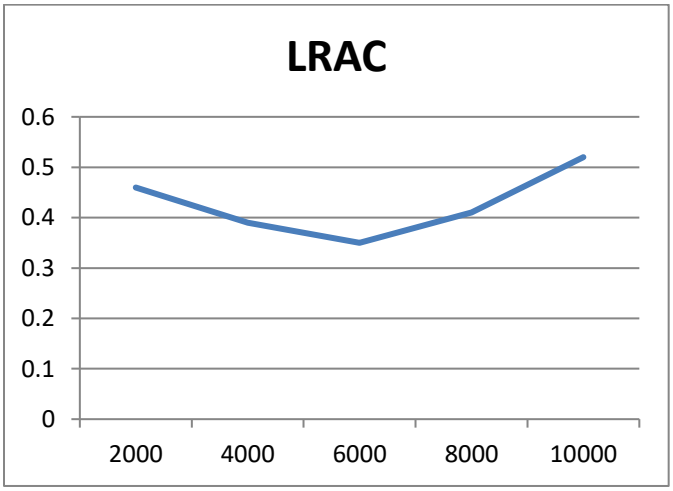
3. The input combinations for the production of wine are given in the following table.

Output (Q)	K	L
2000	10	180
4000	18	300
6000	25	400
8000	34	650
10000	60	1000

a. Suppose that the price of capital is $20, and the price of labour is $4 per unit. Calculate and graph the long-run total cost curve (LRTC) and the long-run average cost curve (LRAC).

Output (Q)	K	L	LRTC	LRAC
2000	10	180	920	0.46
4000	18	300	1560	0.39
6000	25	400	2100	0.35
8000	34	650	3280	0.41
10000	60	1000	5200	0.52





b. At what output level do long-run increasing returns cease?

Q = 6000

4. Suppose that three different firms are able to combine capital (K) and labor (L) in various ways, resulting in pairs of marginal products as shown in the table below. (Note that higher number of combinations substitute more capital for less labor, which decreases MP_K and increases MP_L). For all firms, the price of a unit of capital is \$10, and the price of labor is \$5.

Combination	Firm A		Firm B		Firm C	
	MP_K	MP_L	MP_K	MP_L	MP_K	MP_L
1	10	1	6	3	25	2
2	8	2	5	4	20	4
3	6	3	4	6	14	7
4	4	4	3	8	10	8
5	2	5	2	10	5	10

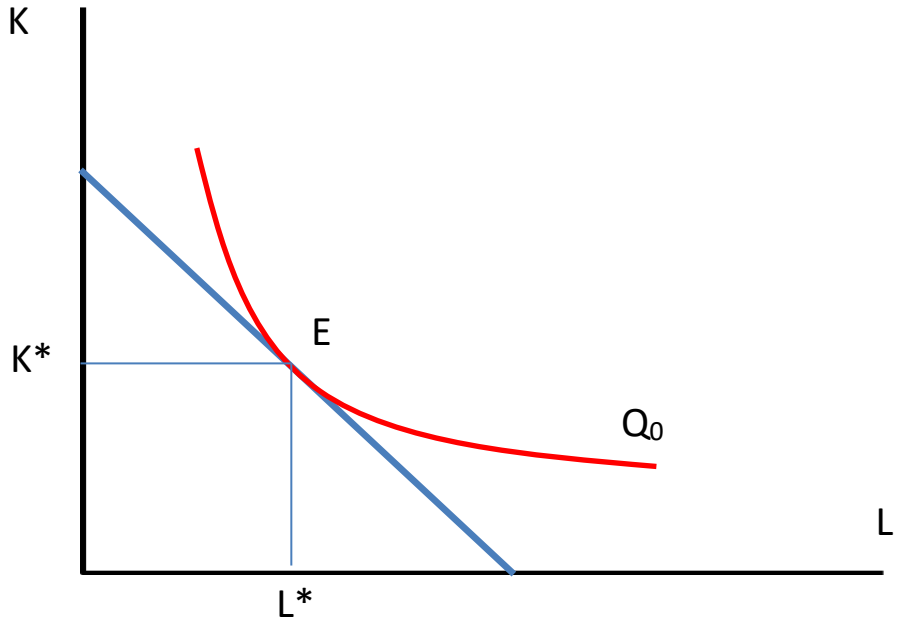
a. Firm A is currently using combination 3, firm B is using combination 2, and firm C is using combination 4. Which firm is minimizing its costs? Explain.

Firm A is minimizing the cost since $\frac{MP_K}{MP_L} = \frac{6}{3} = 2 = \frac{r}{w} = \frac{10}{5}$

b. How would the firms that are not minimizing their costs have to alter their use of capital and labour to do so?

Firm B would move to combination 1, and Firm C would move to combination 3.
For both, they need to use less capital (higher MP_K) and more labor (lower MP_L).

5. Consider a long-run production where the firm chooses labor (L) and capital (K) to minimize total cost given a desired level of output, Q_0. Suppose the wage rate (w) is \$5 per hour and the cost of capital (r) is \$20 per unit.
   a. Draw a diagram to illustrate this firm's optimal choices of L and K. State the conditions that yield the equilibrium.



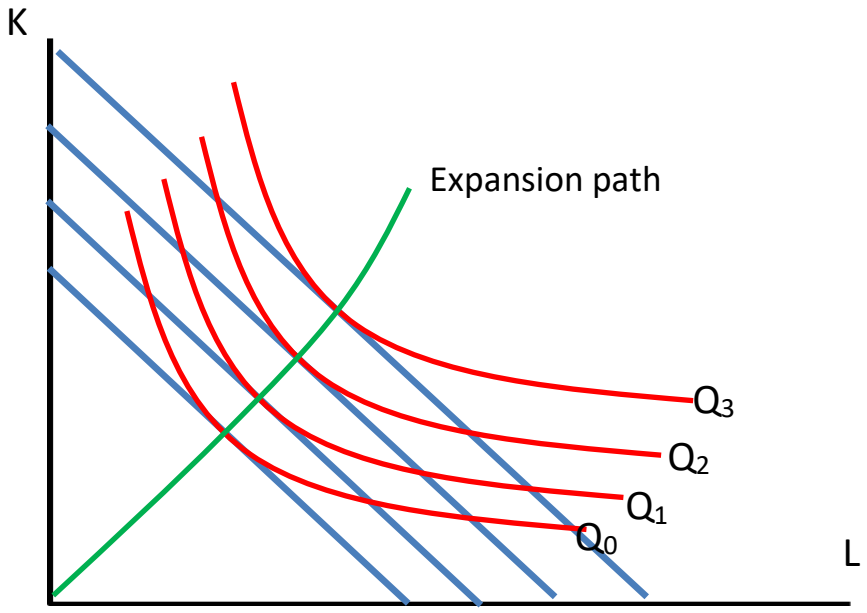
Conditions for equilibrium:

1. $f(L^*,K^*)= Q_0$.
2. $\frac{MP_L(L^*,K^*)}{MP_K(L^*,K^*)} = \frac{w}{r}$

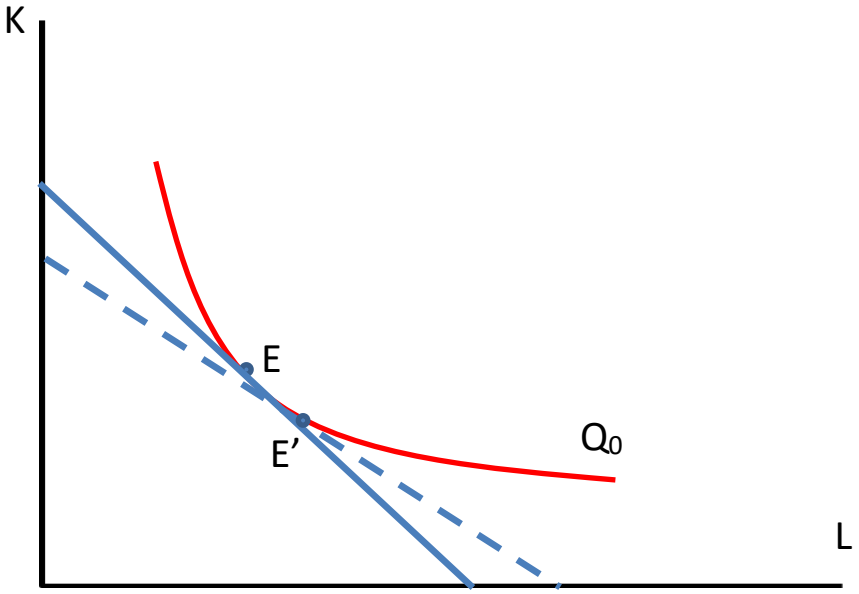
b. Calculate the marginal rate of technical substitution (MRTS) at this equilibrium point.

$MRTS_{LK} = \frac{MP_L(L^*,K^*)}{MP_K(L^*,K^*)} = 0.25$. To maintain the same output level, 0.25 unit of K must be reduced in order to use one more unit of L.

c. Suppose that there are many levels of desired output, Q_1, Q_2, and Q_3, where $Q_0 < Q_1 < Q_2 < Q_3$. Draw the corresponding expansion path.



d. Suppose that *r* increases to 25, everything else constant. Show how the isocost curve and the equilibrium change. What is the new MRTS?



New MRTS = 0.2.

e. Suppose instead that both *w* and *r* increases by 10%, everything else constant.
   i. How would your answers in (d) change?
   The isocost would shift parallelly. The equilibrium will be on a higher isoquant.

ii. Will the expansion path drawn in (c) change? Explain with support of a diagram.
No, because the input-price ratio remains the same.

iii. How will the LRTC, LRAC, and LRMC change? Explain with support of a diagram.
The LRTC, LRAC, and LRMC will shift up but not in parallel manner.