ECON2103 Microeconomics

Chapter 7 Exercises

Solutions

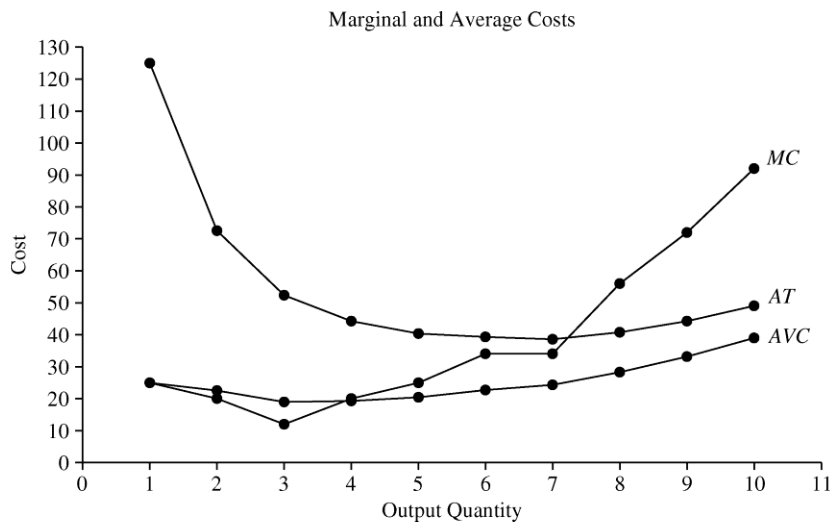
1. The accounting cost includes only the explicit expenses, which are Joe's salary and his other expenses: \$40,000 + 25,000 = \$65,000. Economic cost includes these explicit expenses plus opportunity costs. Therefore, economic cost includes the \$24,000 Joe gave up by not renting the building and an extra \$10,000 because he paid himself a salary \$10,000 below market (\$50,000 – 40,000). Economic cost is then \$40,000 + 25,000 + 24,000 + 10,000 = \$99,000.

2.

a.

Units of Output	Fixed Cost	Variable Cost	Total Cost	Marginal Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost
0	100	0	100	—	—	—	—
1	100	25	125	25	100	25	125
2	100	45	145	20	50	22.50	72.50
3	100	57	157	12	33.33	19.00	52.33
4	100	77	177	20	25.00	19.25	44.25
5	100	102	202	25	20.00	20.40	40.40
6	100	136	236	34	16.67	22.67	39.33
7	100	170	270	34	14.29	24.29	38.57
8	100	226	326	56	12.50	28.25	40.75
9	100	298	398	72	11.11	33.11	44.22
10	100	390	490	92	10.00	39.00	49.00

b. Average total cost is U-shaped and reaches a minimum at an output of about 7. Average variable cost is also U-shaped and reaches a minimum at an output between 3 and 4. Notice that average variable cost is always below average total cost. The difference between the two costs is the average fixed cost. Marginal cost is first diminishing, up to a quantity of 3, and then increases as q increases above 3. Marginal cost should intersect average variable cost and average total cost at their respective minimum points, though this is not accurately reflected in the table or the graph. If specific functions had been given in the problem instead of just a series of numbers, then it would be possible to find the exact point of intersection between marginal and average total cost and marginal and average variable cost. The curves are likely to intersect at a quantity that is not a whole number, and hence are not listed in the table or represented exactly in the cost diagram.



3.

a. The short-run production function is $q = 5(5)L = 25L$, because K is fixed at 5. Thus, for any level of output q, the number of labor teams hired will be $L = \frac{q}{25}$. The total cost function is thus given by the sum of the costs of capital, labor, and raw materials:

$$TC(q) = rK + wL + 2000q = (10{,}000)(5) + (5{,}000)\left(\frac{q}{25}\right) + 2000q$$

$$TC(q) = 50{,}000 + 2200q.$$

The average cost function is then given by:

$$AC(q) = \frac{TC(q)}{q} = \frac{50{,}000 + 2200q}{q}.$$

and the marginal cost function is given by:

$$MC(q) = \frac{dTC}{dq} = 2200.$$

Marginal costs are constant at \$2200 per engine and average costs will decrease as quantity increases because the average fixed cost of capital decreases.

b. To produce $q = 250$ engines we need $L = \frac{q}{25}$, so $L = 10$ labor teams. Average costs are \$2400 as shown below:

$$AC(q = 250) = \frac{50{,}000 + 2200(250)}{250} = 2400.$$

c. You are asked to make recommendations for the design of a new production facility. What capital/labor (K/L) ratio should the new plant accommodate if it wants to minimize the total cost of producing at any level of output q?

We no longer assume that K is fixed at 5. We need to find the combination of K and L that minimizes cost at any level of output q. The cost-minimization rule is given by

$$\frac{MP_K}{r} = \frac{MP_L}{w}.$$

To find the marginal product of capital, observe that increasing K by 1 unit increases q by $5L$, so $MP_K = 5L$. Similarly, observe that increasing L by 1 unit increases q by $5K$, so $MP_L = 5K$. Mathematically,

$$MP_K = \frac{\partial q}{\partial K} = 5L \text{ and } MP_L = \frac{\partial q}{\partial L} = 5K.$$

Using these formulas in the cost-minimization rule, we obtain:

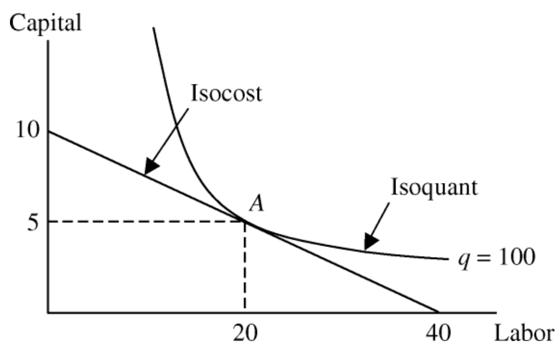
$$\frac{5L}{r} = \frac{5K}{w} \Rightarrow \frac{K}{L} = \frac{w}{r} = \frac{5000}{10{,}000} = \frac{1}{2}.$$

The new plant should accommodate a capital to labor ratio of 1 to 2, and this is the same regardless of the number of units produced.

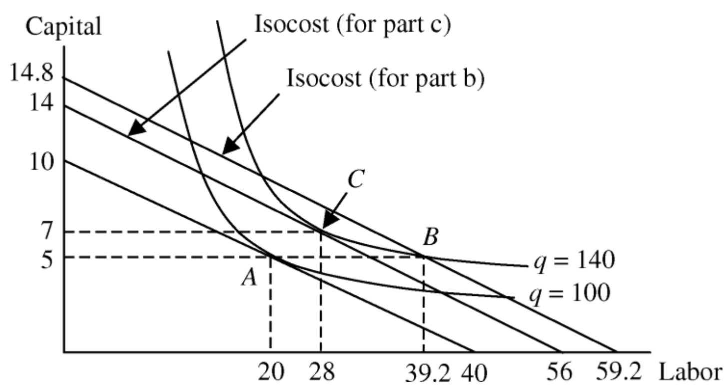
4.

a. To graph the isoquant, set $q = 100$ in the production function and solve it for K. Solving for K:

$K^{1/2} = \dfrac{q}{10L^{1/2}}$ Substitute 100 for q and square both sides. The isoquant is $K = 100/L$. Choose various combinations of L and K and plot them. The isoquant is convex. The optimal quantities of labor and capital are given by the point where the isocost line is tangent to the isoquant. The isocost line has a slope of –1/4, given labor is on the horizontal axis. The total cost is $TC = (\$20)(20) + (\$80)(5) = \$800$, so the isocost line has the equation $20L + 80K = 800$, or $K = 10 - 0.25L$, with intercepts $K = 10$ and $L = 40$. The optimal point is labeled A on the graph.



b. The new level of labor is 39.2. To find this, use the production function $q = 10L^{\frac{1}{2}}K^{\frac{1}{2}}$ and substitute 140 for output and 5 for capital; then solve for L. The new cost is $TC = (\$20)(39.2) + (\$80)(5) = \$1184$. The new isoquant for an output of 140 is above and to the right of the original isoquant. Since capital is fixed in the short run, the firm will move out horizontally to the new isoquant and new level of labor. This is point B on the graph below. This is not the long-run cost-minimizing point, but it is the best the firm can do in the short run with K fixed at 5. You can tell that this is not the long-run optimum because the isocost is not tangent to the isoquant at point B. Also there are points on the new ($q = 140$) isoquant that are below the new isocost (for part b) line. These points all involve hiring more capital and less labor.



c. This is point C on the graph above. When the firm is at point B it is not minimizing cost. The firm will find it optimal to hire more capital and less labor and move to the new lower isocost (for part c) line that is tangent to the $q = 140$ isoquant. Note that all three isocost lines are parallel and have the same slope.

d. Set the marginal rate of technical substitution equal to the ratio of the input costs so that $\frac{K}{L} = \frac{20}{80} \Rightarrow K = \frac{L}{4}$. Now substitute this into the production function for K, set q equal to 140, and solve for L: $140 = 10L^{\frac{1}{2}}\left(\frac{L}{4}\right)^{\frac{1}{2}} \Rightarrow L = 28,\ K = 7.$ This is point C on the graph. The new cost is TC = (\$20)(28) + (\$80)(7) = \$1120, which is less than in the short run (part b), because the firm can adjust all its inputs in the long run.