

Problem Set 5 - Costs

1. Is it possible for a firm to use a production process that is economically efficient that is NOT technologically efficient?
2. [True or False, explain your answer.] I paid \$25 for the materials to make these flower arrangements, and sold them at the craft fair for \$25, so I just broke even."
3. Suppose a firm employs labor as its only variable input. All workers are paid \$20 per day. Output per day and variable cost are shown in Table 1. Complete the table, showing labor, average variable cost, and marginal cost for the first eight units of output. Draw a graph showing average and marginal cost.
4. Suppose a firm's average cost curve is described by the equation $AC = 2q^2 - 16q + 90$. At what output level does the marginal cost curve cross the average cost curve?
5. Suppose the cost of production milkshakes is $C = 0.333Q^3 - 3Q^2 + 15Q + 50$. What is the equation for marginal cost? At what point is marginal cost minimized?
6. Some questions about short-term and long-term costs:
 - i) What is the relationship between the long-run average cost curve and the short-run average cost curve? Please show graphically.
 - ii) What algebraic condition describes a firm that is at an output level that maximizes its profits, given its capital in the short-term?
 - iii) What two algebraic conditions describe a firm that is at a capital level that minimizes its costs in the long-term?
 - iv) If a firm is characterized by short-run marginal cost that is greater than long-run marginal cost and short-run average cost greater than long-run average cost, how should it change its capital level in the long-run to minimize costs?
7. If input prices are $w = 4$, and $r = 1$, and $q = 4K^{0.5}L^{0.5}$, what is the least cost input combination required to produce 40 units of output? Suppose instead that capital was fixed at 16 units. What would be the implications
8. If input prices are $w = 3$, and $r = 2$, and $q = 10KL$, what is the least cost input combination required to produce 60 units of output? How would input usage change if output is increased to 240 units? Sketch the solutions on a graph.

9. Suppose you can produce two goods, ice cream and steel. There are diseconomies of scope in the production of these two goods. What does the production possibilities frontier look like?
10. Two firms currently produce the goods q_1 and q_2 separately. Their cost functions are $C(q_1) = 25 + q_1$, and $C(q_2) = 35 + 2q_2$. By merging, they can produce the two goods jointly with costs described by the function $C(q_1, q_2) = 45 + q_1 + q_2$. Are there scope economies in this case that would justify the merger?
11. Ricardo produces widgets, using as inputs labor (L) and machines (K). His production function is given by the following equation:

$$q = 10K^{\frac{2}{3}} + L^{\frac{1}{2}}$$

- i) What type of returns to scale (increasing/constant/decreasing) does Ricardo's production function exhibit?

At the end of last year, Ricardo bought his only machine for \$1,000. He will use this machine for 5 years, after which the machine will have no value. Ricardo will calculate depreciation linearly (depreciation will be 20% of the total value of the machine per year). This machine has no other use besides Ricardo's production of widgets, and, at this moment, Ricardo cannot buy any more machines.

- ii) What is Ricardo's annual fixed cost of production? Is the fixed cost sunk or not? Explain.
- iii) What is Ricardo's demand for labor as a function of the quantity he wants to produce annually?
- iv) Assuming that wage equals 1, what is Ricardo's annual total cost function?

12. Suppose a firm has two factories and wishes to produce q units of output. The cost functions for each factory are slightly different. In general, how can the firm decide how to allocate production between the two plants?

13. A firm's marginal cost function is as follows

$$MC = 3q^2 - q$$

What is the firm's average variable cost of producing 10 units of output?