EE211 Section 1
Homework 3 Answers

1. Draw a production function that exhibits diminishing marginal product of labor. Draw the associated total cost curve (in both cases, be sure to label the axes.) Explain the shapes of the two curves you have drawn. (See lecture note)
2. Define total cost, average total cost, and marginal cost. How are they related? (See lecture note)
3. How and why does a firm's average-total-cost curve in the short run differ from its average-total-cost curve in the long run? (See lecture note)
4. Define economies of scale and explain why they might arise? (See lecture note)
5. Define diseconomies of scale and explain why they might arise? (See lecture note)

6. Nimbus, Inc. makes brooms and sells them door-to-door. Here is the relationship between the number of workers and Nimbus's output during a given day.

Workers	Output	Marginal Product	Total Cost	Average Total Cost	Marginal Cost
0	0	---	$200	---	---
1	20	20	300	$15.00	$5.00
2	50	30	400	8.00	3.33
3	90	40	500	5.56	2.50
4	120	30	600	5.00	3.33
5	140	20	700	5.00	5.00
6	150	10	800	5.33	10.00
7	155	5	900	5.81	20.00

a. See the table for marginal product. Marginal product rises at first, then declines because of diminishing marginal product.
b. See the table for total cost.
c. See the table for average total cost. Average total cost is U-shaped. When quantity is low, average total cost declines as quantity rises; when quantity is high, average total cost rises as quantity rises.
d. See the table for marginal cost. Marginal cost is also U-shaped, but rises steeply as output increases. This is due to diminishing marginal product.
e. When marginal product is rising, marginal cost is falling, and vice versa.
f. When marginal cost is less than average total cost, average total cost is falling; the cost of the last unit produced pulls the average down. When marginal cost is greater than average total cost, average total cost is rising; the cost of the last unit produced pushes the average up.

7. Consider the following cost information for a pizzeria:

   a. The fixed cost is $300, because fixed cost equals total cost minus variable cost. At an output of zero, the only costs are fixed cost.

   b.

Quantity	Total Cost	Variable Cost	Marginal Cost (using total cost)	Marginal Cost (using variable cost)
0	$300	$0	---	---
1	350	50	$50	$50
2	390	90	40	40
3	420	120	30	30
4	450	150	30	30
5	490	190	40	40
6	540	240	50	50

Marginal cost equals the change in total cost for each additional unit of output. It is also equal to the change in variable cost for each additional unit of output. This relationship occurs because total cost equals the sum of variable cost and fixed cost and fixed cost does not change as the quantity changes. Thus, as quantity increases, the increase in total cost equals the increase in variable cost.

8. Consider the following table of long-run total costs for three different firms:

	Firm A		Firm B		Firm C	
Quantity	*TC*	*ATC*	*TC*	*ATC*	*TC*	*ATC*
1	$60.00	$60.00	$11.00	$11.00	$21.00	$21.00
2	70.00	35.00	24.00	12.00	34.00	17.00
3	80.00	26.67	39.00	13.00	49.00	16.33
4	90.00	22.50	56.00	14.00	66.00	16.50
5	100.00	20.00	75.00	15.00	85.00	17.00
6	110.00	18.33	96.00	16.00	106.00	17.67
7	120.00	17.14	119.00	17.00	129.00	18.43

Firm A has economies of scale because average total cost declines as output increases. Firm B has diseconomies of scale because average total cost rises as output rises. Firm C has economies of scale from one to three units of output and diseconomies of scale for levels of output beyond three units.