Chapter 10: Output and Costs.

I. The firm’s objective and constraints.

   A. maximize economic profits.

   B. constraints

      1. market constraints
         i. demand for product
         ii. supply of inputs

      2. technology constraints
         i. technologically efficient
            a. maximize output for a given set of inputs
         ii. economically efficient
            a. choose production method that minimizes cost of production for the
               output chosen.

      3. short run vs. long run

         i. short run: at least one input is fixed but other inputs can be varied.
         ii. long run: all inputs are variable.

C. Short run production and cost curves .

   1. assume capital is fixed but labor is variable.

   2. total product (TP) = total amount produced

   3. Marginal product (MP) of an input = increase in TP from one more unit of the
      input = change in TP/change in input.

   4. Average product (AP) of an input =average amount produced per unit of the
      input=TP/units of input

   5. Increasing Marginal returns: occurs when the marginal product of an input
      increases as use of the input increases.

   6. Decreasing marginal returns: occurs when the marginal product of an input
      decreases as use of the input increases.

   7. Law of Diminishing Marginal Returns: As the amount of an input increases
      (holding fixed inputs constant) its marginal product will eventually decrease.

   8. The relationship between TP, MP and AP.
      i. TP=sum of Mps
ii. when MP>AP, AP increases as input increases.
iii. when MP<AP, AP decreases as input increases.
iv. graphic representation (MP always intersects AP at its peak).

**D. Short run costs:**

1. total cost (TC)=cost of all productive resources used (including cost of owner's resources).
2. total fixed cost (TFC)=cost of all the firm’s fixed inputs. Independent of level of output. no fixed costs in long run.
3. total variable cost (TVC)=cost of all the firm’s variable inputs. Varies with level of output. all costs are variable in long run.
4. TC=TFC+TVC
5. Marginal cost (MC) = increase in TC from producing one more unit of output.
   i. MC will always eventually increase as output increases.
6. Average Total Cost (ATC)=TC/Q
   i. if MC>ATC, ATC will increase as Q increases.
7. Average variable cost (AVC)=TVC/Q
   i. if MC>AVC, AVC will increase as Q increases.
8. Average fixed cost (AFC) = TFC/Q
   i. AFC always decreases as Q increases.
9. ATC=AVC+AFC
10. Graphic representation of ATC, AVC, MC (AFC is diff between ATC and AVC)
Numerical example:

1. THE PRODUCTION AND COST SCHEDULE FOR A TREE TRIMMING FIRM

All measures are per month. The wage rate is the amount paid per month per worker. Fixed costs represent the monthly payments for the capital equipment (which we assume is leased). These payments are due regardless of whether and trees are trimmed.

Wage rate=$1000 per month; Fixed costs=$1500 per month.

<table>
<thead>
<tr>
<th>L: units of labor</th>
<th>TP: total product</th>
<th>MP\textsubscript{L}: marginal product of labor</th>
<th>AP\textsubscript{L}: avg. product of labor</th>
<th>FC: fixed cost</th>
<th>VC: variable cost</th>
<th>TC: total cost</th>
<th>MC: marginal cost</th>
<th>AVC: avg. variable cost</th>
<th>AFC: avg. fixed cost</th>
<th>ATC: avg. total cost</th>
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<td>--</td>
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<td>1,500</td>
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<td>50</td>
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<td>3,000</td>
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<td>25</td>
<td>12.5</td>
<td>37.5</td>
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<td>4,000</td>
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<td>10.7</td>
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<td>6,500</td>
<td>100</td>
<td>33.3</td>
<td>10</td>
<td>43.3</td>
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</table>

Production Relationships:

1. If MP\textsubscript{L} > AP\textsubscript{L}, the AP\textsubscript{L} will increase as the use of labor rises. If MP\textsubscript{L} < AP\textsubscript{L}, the AP\textsubscript{L} will decrease as the use of labor rises.
2. When labor is the only variable input, MC=W/MP\textsubscript{L}.
3. When labor is the only variable input, AVC=W/AP\textsubscript{L}.
4. AFC always decreases as production (TP) increases.
5. When MC>ATC, ATC increases as production (TP) increases. When MC<ATC, ATC decreases as production increases.
6. When MC>AVC, AVC increases as production (TP) increases. When MC<ATC, ATC decreases as production increases.
Short versus Long Run Cost:

In the short run, at least one input is fixed. Hence, in the short run there are both fixed and variable costs.

In the long run, no inputs are fixed and all costs are variable costs.

Suppose that the tree-trimming firm doubled the amount of capital. Suppose that this additional capital allows labor to produce twice as much for any given number of workers. This would generate the following production/cost table:

<table>
<thead>
<tr>
<th>L</th>
<th>TP</th>
<th>MP_L</th>
<th>AP_L</th>
<th>FC</th>
<th>VC</th>
<th>TC</th>
<th>MC</th>
<th>AVC</th>
<th>AFC</th>
<th>ATC</th>
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<td>26.67</td>
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</tbody>
</table>

Wage rate=$1000 per month; Fixed costs=$3000 per month.

The ATC for the two levels of capital are compared in the diagram below. In the long run, firms will always choose the level of inputs that gives the lowest ATC for a given level of output.
RETURNS TO SCALE.

1. If LRATC falls as Q increases, economies of scale (increasing returns to scale).

2. If LRATC rises as Q increases, diseconomies of scale (decreasing returns to scale).

3. If LRATC is constant as Q increases, constant returns to scale.