15| PRODUCTION AND COST IN THE SHORT-RUN

Purpose: To illustrate the relationship between total product curves and total cost curves. To show the relationship between changes in input prices and a firm's cost of production in the short-run.

Computer file: **tptc198.xls**

Instructions and background information:

You own and operate an apartment cleaning service firm in Detroit. Your business is to clean and repair apartments for landlords whose tenants have recently moved out. The left graph in the computer display shows the total product curve for your firm. The input is the number of workers you hire per day, and the output is the number of apartments cleaned per day.

There are two baseline variables in this problem. One is the wage rate you must pay your workers, and the other is something called "labor efficiency".

Labor efficiency is an index of how efficiently labor services are used to clean apartments, and is an aspect of the technology of production. It doesn't have anything to do with whether you are a good manager, or whether your workers goof off on the job. The relationship between the numbers of employees you hire and the output produced is purely technical. Labor efficiency is .50 in this problem, and you cannot change it -- that is reserved for the next problem set. In the real world, the labor efficiency index might go up if you provide your workers with more equipment -- mops and brooms, for example.

Workers for your business do not come free. In fact, you must hire workers and pay them at a rate of $10 per worker per day. $10/day is the market wage. If you try to pay less than that, workers simply will not work for you.

The data on the total product curve (see the left graph) shows the output you get for any amount of labor input you choose.

The data on the total cost curve show total cost for any output you choose, given the wage rate. You can pick any values you want for output and the wage rate, and the total cost curve on the right displays the results. The table also shows the amount of labor required for the output you choose. The left and right graphs operate independently. The input and output you see in the total product curve can be different from the output and cost you see on the total cost curve.

Here are some things to watch for and learn as you do the problems:

1)   Given the technology of production, you can't get more output without using more labor input.

2)   Given the wage rate and the technology of production, higher output is possible only with increased costs.

3)   Raising the wage rate (the price of a variable input) increases total, average, and marginal costs. An increase in the wage causes total cost to increase more at higher outputs than lower outputs.

4)   In the short-run, fixed costs are the firm's costs when output is zero.

Here are some hints to help you get the answers quicker:

1)   Average cost is total cost divided by output.

2)   Marginal cost is the change in total cost per unit change in output. $\Delta C/\Delta Q$. Marginal cost is the "cost of one more", the extra cost of increasing output by one unit. The marginal cost of the 25th unit of output is the difference in total cost at 25 minus the total cost at 24 units of output.

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MATH MAVEN'S CORNER: The total product curve for the computer problems is $Q = AL^e$, where the exponent e is the efficiency index, and A is a constant. e in this case is also the elasticity of output with respect to changes in L. The marginal product is the derivative of total product with respect to L, or AeL^{e-1}. The total cost curve is $TC = FC + (p_L)(Q/A)^{1/e}$, where p_L is the wage rate, $10.00 a day to start off with.

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Questions

Set all variables to their baseline values, and set labor input to 10.
      1) How many apartments are cleaned per day with this amount of labor?

Set all variables to their baseline values, and set labor input to 20.
      2) How many apartments are cleaned per day with this amount of labor?

Set all variables to their baseline values, and set labor input to 20. Increase the wage rate to $12/day.
      3) With labor at 20, what is the change in output?

Set the wage is $10/day.
      4) If 15 apartments must be cleaned, how many workers must be hired to get the job done?

Make sure the wage is set to $10/day, and set output at 15 apartments per day.
      5) What's the TOTAL COST of cleaning 15 apartments?

Now set the wage to $12/day.
      6) What's the TOTAL COST of cleaning 15 apartments?

      7) When the wage rose from $10 to $12 per day, did total cost INCREASE or DECREASE?

Set all variables to their baseline values and set output at 15 apartments per day.
      8) What's the AVERAGE COST of cleaning 15 apartments?

Now set the wage to $12/day.
      9) What's the AVERAGE COST of cleaning 15 apartments?

      10) When the wage rose from $10 to $12 per day, did average cost INCREASE or DECREASE?

Set the wage back to $10/day, its baseline value.
      11) What's the MARGINAL COST of cleaning the 15th apartment?
          [Hint: What's the total cost of cleaning 15compared to 14?]

Now set the wage to $12 per day.
      12) What's the MARGINAL COST of cleaning the 15th apartment at the higher wage?

13) When the wage rose from $10 to $12 per day, did marginal cost INCREASE or DECREASE?

14) What's the amount of fixed cost for the firm?