This supplement will provide two tables of practice to show the "link" between input productivity and costs of output. It will show the intuition that higher marginal productivity of labor (MPL) leads to lower marginal costs (MC) of output. In addition, lower MPL leads to higher MC.

Let's remember the following equations:

$MC = \dfrac{w}{MPL}$, where *w* is the wage rate paid to workers. $MPL = \dfrac{\Delta TP}{\Delta L}$ $APL = \dfrac{TP}{L}$

$TC = TVC + TFC$ $ATC = AVC + AFC$ $MC = \dfrac{\Delta TC}{\Delta Q}$

$ATC = \dfrac{TC}{Q}$ $AFC = \dfrac{TFC}{Q}$ $AVC = \dfrac{TVC}{Q}$

Example 1: Assume that TFC = 0, and that the wage rate is *w* = $60 per worker.

Note that if TFC = 0, then TC = TVC and ATC = AVC.

L	Q	APL	MPL	TC	AVC	MC
0	0	--	--	0	--	--
1	2					
2	6					
3	12					
4	20					
5	30					
6	38					
7	43					
8	45					

a. Fill in the APL column
b. Fill in the MPL column
c. Fill in the TC column
d. Fill in the AVC column
e. Fill in the MC column
f. Note the relationship between MPL and APL, and the relationship between MC and AVC
g. Note the relationship between MPL and MC

Walkthrough:

(a). (b). For parts (a) and (b), it is relatively simple to use the equations:

L	Q	APL	MPL	TC	AVC	MC
0	0	--	--	0	--	--
1	2	2	2			
2	6	3	4			
3	12	4	6			
4	20	5	8			
5	30	6	10			
6	38	6.333333	8			
7	43	6.142857	5			
8	45	5.625	2			

(c). But how do we) and find the TC? We can't really use our quantities or other costs, since we don't have those yet. For quantities, we don't really see a linear pattern we can use. However, we do know the cost of labor is w = \$60, and we know the labor used in the production of the outputs shown. Thus, we can find TC by finding the labor costs associated with the labor inputs that were used to give us the outputs. Each worker costs \$60, so we can multiply 60 by the number of workers to get TC.

L	Q	APL	MPL	TC	AVC	MC
0	0	--	--	0	--	--
1	2	2	2	60		
2	6	3	4	120		
3	12	4	6	180		
4	20	5	8	240		
5	30	6	10	300		
6	38	6.333333	8	360		
7	43	6.142857	5	420		
8	45	5.625	2	480		

Remember: When we graph the TC function, we put Q instead of L on the horizontal. This will give us an upward sloping (but nonlinear) TC function. See the graphs for this example in a couple of pages.

(d). At this point, problem (d) asks us to find AVC, which can be filled in using $AVC = \frac{TVC}{Q}$ and the fact that TFC = 0, so TVC = TC.

L	Q	APL	MPL	TC	AVC	MC
0	0	--	--	0	--	--
1	2	2	2	60	30	
2	6	3	4	120	20	
3	12	4	6	180	15	
4	20	5	8	240	12	
5	30	6	10	300	10	
6	38	6.333333	8	360	9.473684	
7	43	6.142857	5	420	9.767442	
8	45	5.625	2	480	10.66667	

(e). Finally, in part (e), MC can be found one of two ways.

We can either use $MC = \frac{\Delta TC}{\Delta Q}$ or $MC = \frac{w}{MPL}$.

L	Q	APL	MPL	TC	AVC	MC
0	0	--	--	0	--	--
1	2	2	2	60	30	30
2	6	3	4	120	20	15
3	12	4	6	180	15	10
4	20	5	8	240	12	7.5
5	30	6	10	300	10	6
6	38	6.3333	8	360	9.4737	7.5
7	43	6.1429	5	420	9.7674	12
8	45	5.625	2	480	10.667	30

For example, look at L = 4 and Q = 20.

$MC = \frac{\Delta TC}{\Delta Q} = \frac{240-180}{20-12} = \frac{60}{8} = 7.5$ or $MC = \frac{w}{MPL} = \frac{60}{8} = 7.5$

(f). Note that MPL goes up and then down. APL rises when MPL > APL, and APL falls when MPL < APL. The average follows the margin. MC goes down, and then up. AVC falls when MC < AVC, and AVC rises when MC > AVC. The average follows the margin. See the graphs on the next page.

(g). MPL and MC are inversely related. As MPL rises (workers 1 – 5), MC falls. At the MPL max (L = 5), MC is at its minimum (MC = 6 at output Q = 30). Then, due to diminishing marginal product, MPL starts to fall (workers 6 – 8), and MC starts to rise. See the graphs on the next page.