

Answers to Homework # 4

1) The following table represents an annual production function for corn. The first column indicates the amount of land used (acres per year) and the first row indicates the amount of labor used (number of workers per year).

	1	2	3	4	5	6
1	50	150	275	375	450	500
2	150	370	550	700	825	900
3	240	500	740	940	1080	1160
4	300	660	920	1060	1190	1270
5	330	790	1050	1160	1250	1320
6	340	900	1050	1250	1300	1330

a. Using the above production function, calculate total output, the average physical product of labor (APP_L), and the marginal physical product of labor (MPP_L) when the amount of land is fixed at 3 acres.

To answer this question, recall that average physical product = total output/input quantity; and marginal physical product = change in total output when the input is increased by 1 unit.

Acres	Workers	Total Output	APP_L	MPP_L
3	1	240	240	240
3	2	500	250	260
3	3	740	246.7	240
3	4	940	235	200
3	5	1080	216	140
3	6	1160	193.3	80

b. Suppose the farmer uses 1 worker and 1 acre of land. Over time, he expands production by increasing the use of both inputs proportionately. Does the farmer experience increasing, constant, or decreasing returns to scale as he expands?

Both inputs are increasing proportionately along the diagonal. Returns to scale increase then decrease in this production function. Decreasing returns to scale set in after 4 workers and 4 acres are hired. When both inputs are increased from 4 to 5 units, input usage has increased by 25%, yet output increased by only 18%.

c. If the amount of land is held fixed at 3 acres, when do diminishing marginal returns for labor set in?

Diminishing marginal returns set in after the second worker is hired.

2) You are currently going to college. Consider yourself to be a "firm" utilizing inputs to produce an output. What is the output? What are the inputs you use to produce the output? Describe a situation when diminishing marginal returns applies.

Output could be defined as knowledge gained by going to college or by the diploma. Inputs include the faculty, classrooms, paper, books, the library, computers, land the college is on, as well as you. Diminishing marginal returns would apply whenever you try to increase your rate of output without increasing all inputs proportionately. For example, attending class more frequently while holding the number of hours spent studying constant.

3) Starbucks finds that as it increases the number of workers it hires, the number of mochas produced weekly changes as follows:

Workers	Mochas	MPP _L	MRP _L (P = \$3)	MRPL (P = \$4)
1	100	100	300	400
2	300	200	600	800
3	600	300	900	1200
4	1000	400	1200	1600
5	1350	350	1050	1400
6	1650	300	900	1200
7	1900	250	750	1000
8	2100	200	600	800
9	2250	150	450	600
10	2350	100	300	400
11	2400	50	150	200
12	2400	0	0	0
13	2350	-50	-150	-200

a. The price of mochas can be \$3 or \$4 each. For each number of workers, calculate the marginal physical product of labor (MPP_L) and the two marginal revenue products of labor (MRP_L) corresponding to the two mocha prices.

Recall that $MRP_L = \text{Product price} \times MPP_L$. The answers are provided in the table above.

b. Plot the MPP_L curve and indicate the phases of increasing returns to labor, diminishing returns, and negative returns.

MPP_L rises from 1 to 4 workers; falls from 4 to 12 workers; and becomes negative once the 13th worker is hired.

c. Assume the price of mochas is \$3. If the wage rate of labor is \$600 a week, how many workers will Starbucks hire? Note: there are 2 employment levels at which the wage equals the MRP_L . Explain why you picked one and not the other.

Wage = MRP_L at 2 and 8 workers. Profits are maximized by hiring 8 workers. The firm's profits are lower if only 2 workers are hired. Each worker from 3 to 7 generates additional profits, because revenues (MRP_L) exceed the cost of labor (wage). Note: the 2nd and 8th workers are hired even though the firm earns zero profits from these workers. Both workers are worth (MRP_L) their wage to the firm. Also, the firm loses money by hiring the 1st worker ($MRP_L < \text{wage}$) yet, does so, in order to hire the next 7 workers.

d. When the wage falls to \$400, what will the new employment level be? Carefully explain why the next worker is not hired.

Starbucks will hire 9 workers where the $MRP_L > \text{wage}$. The 10th worker is not hired, because the \$400 cost of hiring the worker exceeds the \$300 in revenue that is generated by the worker. Starbucks would lose \$100 by hiring the 10th worker.

e. How does the employment change when the price of mochas rises from \$3 to \$4, if the wage rate remains at \$400?

The increased product price raises the MRP_L and thereby raises the demand for labor. Starbucks will now hire 10 workers instead of 9.