

**Solutions Available Wednesday, October 25**

1. Complete the following table:

Labor	Total Product	Average Product	Marginal Product
0		0	--
1	180		
2			140
3	420		
4		120	

2. The Philadelphia Police Department has 500 police officers to allocate between West Philadelphia and Center City. The average product, total product, and marginal product in each of these two areas is given below, where output is measured as the number of arrests made. Currently, the police department allocates 200 police officers to Center City and 300 to West Philadelphia. If police can be redeployed only in groups of 100, how, if at all, should the police department reallocate its officers to achieve the maximum number of arrests?

<i>West Philadelphia</i>				<i>Center City</i>			
# Police	AP	TP	MP	# Police	AP	TP	MP
0	0	0	--	0	0	0	--
100	40	40	40	100	45	45	45
200	40	80	40	200	40	80	35
300	40	120	40	300	35	105	25
400	40	160	40	400	30	120	15
500	40	200	40	500	25	125	5

3. After graduation, you take a job at Hot Meals, a local non-profit that provides meals for low income families. The organization currently has 10 staff members, each of whom is paid \$20 per hour. The money to pay their salaries comes from a government grant.

The director of Hot Meals would like to expand operations. To do so, it will be necessary to hire 10 additional staff members. Unfortunately, additional grant money is not available, so that the salaries for these workers will be paid for using Hot Meals' money. The director is not worried about this additional cost. He notes that because the current staff are all free (since their wages are paid using government money), the average cost of staff members after the expansion will be just \$10 per hour.

Does the director's analysis make sense? When deciding whether Hot Meals can afford the new staff members, is a cost of \$10 per hour the appropriate cost to use? Why or why not?

4. You are the manager of Lift Up, a local non-profit that provides advising and tutoring to low-income children to help them get into college. Lift Up uses two types of workers: highly-trained professional staff and high school students. The trained staff work quickly, and can work on 15 cases per hour. Because they are well-trained, these workers earn \$30 per hour. High school students are less-skilled and require more supervision. They work on only 5 cases per hour, but are paid less, earning only \$10 per hour.
- Currently, you have 20 professional staff and 40 high school students. Based on the data above, are you minimizing costs? How do you know this? If so, explain why this combination is the best for Lift Up. If Lift Up is not minimizing costs, what changes should you make to the current staff allocation to lower costs?
  - To increase employment of school age children, the government offers a \$5 subsidy for each high school student hired. Assume that Lift Up already meets the demand of all students needing advice on college, so that there is no demand for additional services. How does this subsidy change your answer to part (a)?

5. Smarter Kids is an international NGO that provides schooling in underserved areas of low-income countries. Depending on the location, they can either send teachers to teach in classrooms in local buildings or deliver services on-line. Smarter Kids measures the effectiveness of their services based on observed increases in the test scores of local children on standardized tests. You are given the following information on the costs and effectiveness of each type of service provision:

*On-line instruction:* On-line instruction is less expensive, costing just \$500 per student per year. However, on-line instruction is not as effective as services provided in person. Research shows that a year of on-line instruction raises test scores by just 5 points.

*In-person instruction:* Providing teachers to teach in local classrooms is more effective, as teachers are able to pay more attention to individual children. However, both the cost and effectiveness of doing so varies by location, depending on both the number of student in a classroom and the quality of the facilities available. Below are data on in-person services for four local communities:

<b>Community</b>	<b>Cost per student per year</b>	<b>Test score increase</b>
Apple Hill	\$2,000	10 points
Baskerville	\$5,000	60 points
Canterbury	\$3,000	45 points
Denali	\$6,000	50 points

Smarter Kids has sufficient funding to provide services in each of these four cities. However, they need to decide whether it is more effective to provide services in-person or on-line. Based on the data given above, in which communities should Smarter Kids provide services in-person, rather than on-line? Why?