Managerial Economics Chapter Three Study Problems

1. a. Fill in the missing numbers below.

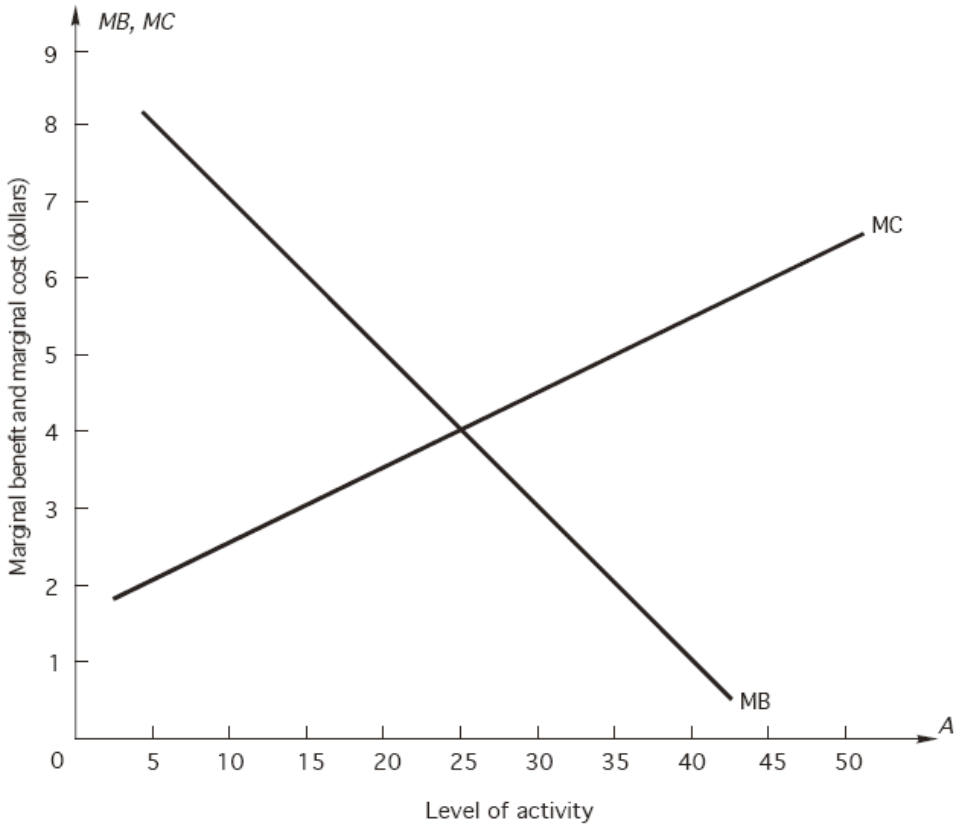
A	*Total Benefit*	*Total Cost*	*Marginal Benefit*	*Marginal Cost*	*Net Benefit*
0	0	_____	xx	xx	0
1	_____	_____	10	_____	8
2	_____	5	9	_____	_____
3	25	_____	_____	4	_____
4	_____	_____	_____	6	15
5	34	22	_____	_____	_____

b. Define "optimal level of activity." In part *a*, what is the optimal level of activity? Why?

c. In part *a*, marginal benefit does not equal marginal cost for any quantity. Does this mean there is no optimal level of activity? Why or why not?

d. At the optimal level of activity, could you increase the level of activity and get an increase in total benefit? If so, why should the manager *not* increase the activity further?

4. Use the figure below to answer the following questions



a. At 15 units of the activity, marginal benefit is $_____ and marginal cost is $_____.

b. Adding the 15th unit of activity causes net benefit to _____ (increase, decrease) by $_____.

c. At 35 units of the activity, marginal benefit is $_____ and marginal cost is $_____.

d. Subtracting the 35th unit of activity causes net benefit to _____ (increase, decrease) by $_____.

e. The optimal level of activity is _____ units, *MB* = $_____ and *MC* = $_____.

f. Can you compute total benefit, total cost, and net benefit for the optimal level of activity? If so, how? If not, why not?

5. Activity A has the following marginal benefit (MB) and marginal cost (MC) functions:

$$MB = 10 - 0.05A \text{ and } \quad MC = 2 + 0.05A$$

where MB and MC are measured in dollars.

a. The 70^{th} unit of activity increases total benefit by \$_____ and increases total cost by \$_____. Since marginal benefit is _____ (greater, less) than marginal cost, adding the 70^{th} unit of the activity _____ (increases, decreases) net benefit by \$_____.

b. The 110^{th} unit of activity increases total benefit by \$_____ and increases total cost by \$_____. Since marginal benefit is _____ (greater, less) than marginal cost, adding the 110^{th} unit of the activity _____ (increases, decreases) net benefit by \$_____.

c. The optimal level of activity is _____ units. At the optimal level of activity, marginal benefit is \$_____ and marginal cost is \$_____.

The total benefit (TB) and total cost (TC) functions for the activity are

$$TB = 10A - 0.025A^2 \quad \text{and} \quad TC = 2A + 0.025A^2$$

where TB and TC are measured in dollars.

d. For the optimal level of activity in part c, the total benefit is \$_____, the total cost is \$_____, and the net benefit is \$_____.

e. Compute the net benefit for one unit more and one unit less than the level of activity found to be optimal in part c (i.e., compute NB for $A^* + 1$ and $A^* - 1$). Are your results consistent with the definition of "optimal"? Explain.

7. Suppose a manager wishes to find the optimal level of two activities X and Y, which yield the total benefits presented in the table below. The price of X is \$40 per unit, and the price of Y is \$100 per unit.

Level of Activity	*Total Benefit of Activity X (TB_X)*	*Total Benefit of Activity Y (TB_Y)*
0	0	0
1	800	1,000
2	1,440	1,900
3	2,000	2,700
4	2,360	3,400
5	2,680	4,000
6	2,960	4,500
7	3,200	4,900
8	3,400	5,200

a. The manager faces a budget constraint of \$500 for expenditures on activities X and Y. The optimal levels of activities of X and Y when the manager can spend only \$500 are $X^* =$ _____ and $Y^* =$ _____.

b. In part *a*, the total benefit associated with the optimal level of X and Y is \$_____.

c. Now let the budget constraint increase to \$780. The optimal levels of activities of X and Y when the manager can spend \$780 are $X^* =$ _____ and $Y^* =$ _____.

d. In part *c*, the total benefit associated with the optimal level of X and Y is \$_____.

Answers:

1. a.

A	*Total Benefit*	*Total Cost*	*Marginal Benefit*	*Marginal Cost*	*Net Benefit*
0	0	0	*xx*	*xx*	0
1	10	2	10	2	8
2	19	5	9	3	14
3	25	9	6	4	16
4	30	15	5	6	15
5	34	22	4	7	12

b. The level of activity that maximizes the objective function (net benefit) is called the *optimal level of activity*. $A^* = 3$ because at this value, net benefit is maximized.

c. When the choice variable (in this case *A*) is not continuous, the objective function may reach its maximum value at a level of activity where marginal benefit does *not* equal marginal cost. Marginal analysis still leads to the optimal value, however. At a quantity of 3, marginal benefit (= \$6) exceeds marginal cost (= \$4). Clearly, producing the third unit increases profit. For the fourth unit of activity, marginal cost (= \$6) exceeds marginal benefit (= \$5), and net benefit would decrease if it were produced. Thus, 3 units is the optimal level.

d. Because *MB* is positive at the optimal level, *TB* could be further increased by increasing the level of activity. This is not desirable because the increase in *TB* would be accompanied by a decrease in *NB* (since $MB < MC$).

4. a. $MB_{15} = \$6$; $MC_{15} = \$3$ [Note: These numbers are read from the figure.]
   b. increase; \$3
   c. $MB_{35} = \$2$; $MC_{35} = \$5$
   d. increase; \$3
   e. 25; \$4; \$4
   f. No, because you are only given marginal benefit and marginal cost. You cannot compute total benefit, total cost, and net benefit using the information given.

5. a. \$6.50 [= 10 – 0.05(70)]; \$5.50 [= 2 + 0.05(70)]; greater; increases; \$1 (= 6.50 – 5.50)
   b. \$4.50 [= 10 – 0.05(110)]; \$7.50 [= 2 + 0.05(110)]; less; decreases; \$3 (= 7.50 – 4.50)
   c. $A^* = 80$ units (set $MB = MC$ and solve for A^*);
   \$6; \$6 [Note: $MB_{80} = MC_{80} = 10 - 0.05(80) = 2 + 0.05(80) = 6$.]
   d. $TB = \$640$; $TC = \$320$; $NB = \$320$
   e. $A^* + 1 = 81$ and $NB_{81} = \$319.95$;
   $A^* - 1 = 79$ and $NB_{79} = \$319.95$;
   Since NB_{80} (= \$320) exceeds both NB_{79} and NB_{81}, these computations are consistent with *NB* being maximized at 80 units.

7. a. $X^* = 5$; $Y^* = 3$
   b. \$5,380 since $TB_{X=5} = \$2,680$ and $TB_{Y=3} = \$2,700$
   c. $X^* = 7$; $Y^* = 5$
   d. \$7,200 since $TB_{X=7} = \$3,200$ and $TB_{Y=5} = \$4,000$