PART A

(1/1 point)
Consider the linear program.

$$\begin{array}{rr} \textbf{max} & z = 5x_1 + 4.5x_2 + 6x_3 \\ \textbf{s.t.:} & \\ & 6x_1 + 5x_2 + 8x_3 \leq 60 \\ & 10x_1 + 20x_2 + 10x_3 \leq 150 \\ & x_1 \leq 8 \\ & x_1, x_2, x_3 \geq 0 \end{array}$$

Write a model in Excel for this problem and then solve it using Excel Solver. After solving the problem, select the sensitivity report. (An alternative is to use OpenSolver to obtain the sensitivity report.)

What is the optimal solution?

- $x_1 = -6.4285714, x_2 = -4.2857143, x_3 = 0$
- $x_1 = -6.4285714, x_2 = -4.2857143, x_3 = 0.571428671$

- $x_1 = -6.4285714, x_2 = -4.2857143, x_3 = 0.571428671$
- $x_1 = -6.4285714, x_2 = 4.5, x_3 = 0$
- $x_1 = 6.4285714, x_2 = 4.2857143, x_3 = 0$ ✔

You have used 1 of 2 submissions

PART B

(1/1 point)

Suppose that the first two constraints are changed from linear inequalities into equality constraints. What is the change in the optimal solution value? Try figuring out the correct answer first. You may solve the LP again to verify whether your initial answer was correct.

- [x] The optimum solution value and the optimum solution are both unchanged.
- [ ] The optimum solution value strictly increases.
- [ ] The optimal solution value strictly decreases.
- [ ] The optimal solution value stays the same, but the solution itself changes.

You have used 1 of 2 submissions

PART C

(1/1 point)

Suppose that the first constraint of the original problem is multiplied by two. That is, we modify the first constraint so that it is $12x_1 + 10x_2 + 16x_3 \leq 120$. Which of the following statements is correct? (Try to determine the correct answer first via direct reasoning. Subsequently, you can solve the problem again and generate a new sensitivity report.

- [ ] The optimum solution does not change, and the shadow prices do not change.
- [ ] The optimum solution does not change, and the shadow price of the first constraint is multiplied by 2.
- [x] The optimum solution does not change, and the shadow price of the first constraint is multiplied by 1/2.
- [ ] The optimal solution value increases.
- [ ] The optimal solution value decreases.

You have used 2 of 2 submissions

PART D

(1/1 point)

Let P denote the model from PART B in which we have changed the first two constraints into equality constraints. Let Q denote the model in which we change the second constraint, but keep all other variables and constraints unchanged. In Q, we replace the constraint: $10x_1 + 20x_2 + 10x_3 = 150$ by the constraint $16x_1 + 25x_2 + 18x_3 = 210.$ That is, we replace the second constraint from P by the sum of the first two constraints. Problem Q is equivalent to Problem P in the sense that it has the same optimal solution and the same optimal objective value. However, you will find that the shadow prices for P and Q are different. Let p_1, p_2, p_3 denote the shadow prices for Problem P. Let q_1, q_2, q_3 be the shadow prices Problem Q. Which of the following answers is correct? You may solve Problem Q and generate the sensitivity report to determine your answer. The correct answer will likely be surprising. See if you can reason through why it is correct.

- [ ] $q_1 = p_1; \quad q_2 = p_2; \quad q_3 = p_3$
- [ ] $q_1 = p_1; \quad q_2 = p_1 + p_2; \quad q_3 = p_3$
- [ ] $q_1 = p_1; \quad q_2 = p_1 - p_2; \quad q_3 = p_3$
- [ ] $q_1 = p_1 + p_2; \quad q_2 = p_2; \quad q_3 = p_3$
- [x] $q_1 = p_1 - p_2; \quad q_2 = p_2; \quad q_3 = p_3$

You have used 1 of 2 submissions