PART A

(1/1 point)

Excerpted from: Dimitris Bertsimas and John N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, 1997, Exercise 5.8. We thank the authors for permitting us to use this problem.

A pottery manufacturer can make four different types of dining room service sets: English, Currier, Primrose, and Bluetail. Furthermore, Primrose can be made by two different methods, labeled 1 and 2. Each set uses clay, enamel, dry room time, and kiln time, and results in a product shown in the table below. The rows correspond to different products abbreviated as below. [1]

- E: Units English
- C: Units Currier
- P_1: Units Primrose via Method 1
- P_2: Units Primrose via Method 2
- B: Units Bluetail

The resource constraints are on

- Clay
- Enamel

- Dry room usage
- Kiln
- Primrose

Hint: It must be the case that the Primrose created by method 1 and 2 must be equal, and should be reflected in one of the constraints.

Table 1: Resource usage and availability

	E	C	P_1	P_2	B	Total
Clay (lbs)	10	15	10	10	20	130
Enamel (lbs)	1	2	2	1	1	13
Dry room (hours)	3	1	6	6	3	45
Kiln (hours)	2	4	2	5	3	23
Profit	51	102	66	66	89	-

Assuming that the number of dining room service sets of each type can be fractional, formulate the product maximization problem of the manufacturer as an LP. Then click below to reveal the formulation. (This part counts for 0 points.)

Sensitivity report 1

Sensitivity report 2

$$\left.\begin{array}{rr} \textbf{min} & z = 51E + 102C + 66P_1 + 66P_2 + 89B \\ \textbf{s.t.:} & \\ & 10E + 15C + 10P_1 + 10P_2 + 20B \geq 130 \\ . & E + 2C + 2P_1 + P_2 + B \geq 13 \\ & 3E + C + 6P_1 + 6P_2 + 3B \geq 45 \\ & 2E + 4C + 2P_1 + 5P_2 + 3B \geq 23 \\ & P_1 - P_2 = 0 \\ & E, C, P_1, P_2, B \geq 0 \end{array}\right\}$$

$$
\left.
\begin{aligned}
\textbf{max} \quad & z = 51E + 102C + 66P_1 + 66P_2 + 89B \\
\textbf{s.t.:} \quad & \\
& 10E + 15C + 10P_1 + 10P_2 + 20B \leq 130 \\
. \quad & E + 2C + 2P_1 + P_2 + B \geq 13 \\
& 3E + C + 6P_1 + 6P_2 + 3B \leq 45 \\
& 2E + 4C + 2P_1 + 5P_2 + 3B \leq 23 \\
& P_1 - P_2 \leq 0 \\
& E, C, P_1, P_2, B \geq 0
\end{aligned}
\right\}
$$

$$
\left.
\begin{aligned}
\textbf{max} \quad & z = 51E + 102C + 66P_1 + 66P_2 + 89B \\
\textbf{s.t.:} \quad & \\
& 10E + 15C + 10P_1 + 10P_2 + 20B \geq 130 \\
. \quad & E + 2C + 2P_1 + P_2 + B \geq 13 \\
& 3E + C + 6P_1 + 6P_2 + 3B \geq 45 \\
& 2E + 4C + 2P_1 + 5P_2 + 3B \leq 23 \\
& P_1 - P_2 = 0 \\
& E, C, P_1, P_2, B \geq 0
\end{aligned}
\right\}
$$

$$
\begin{aligned}
\textbf{min} \quad & z = 51E + 102C + 66P_1 + 66P_2 + 89B \\
\textbf{s.t.:} \quad & \\
& 10E + 15C + 10P_1 + 10P_2 + 20B \leq 130 \\
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& 2E + 4C + 2P_1 + 5P_2 + 3B \leq 23 \\
& P_1 - P_2 = 0 \\
& E, C, P_1, P_2, B \geq 0
\end{aligned}
$$

$$
\begin{aligned}
\textbf{max} \quad & z = 51E + 102C + 66P_1 + 66P_2 + 89B \\
\textbf{s.t.:} \quad & \\
& 10E + 15C + 10P_1 + 10P_2 + 20B \leq 130 \\
. \quad & E + 2C + 2P_1 + P_2 + B \leq 13 \\
& 3E + C + 6P_1 + 6P_2 + 3B \leq 45 \\
& 2E + 4C + 2P_1 + 5P_2 + 3B \leq 23 \\
& P_1 - P_2 = 0 \\
& E, C, P_1, P_2, B \geq 0
\end{aligned}
$$

You have used 1 of 2 submissions

PART B

(1/1 point)
What is the optimal quantity of each service set, and what is the total profit?

- Total profit: 374
- E Units English: 1
- C Units Currier: 0
- P_1 Units Primrose via Method 1: 1
- P_2 Units Primrose via Method 2: 1
- B Units Bluetail: 1

- Total profit: 374
- E Units English: 5
- C Units Currier: 1
- P_1 Units Primrose via Method 1: 1
- P_2 Units Primrose via Method 2: 0
- B Units Bluetail: 0

- Total profit: 649
- E Units English: 0
- C Units Currier: 2
- P_1 Units Primrose via Method 1: 1
- P_2 Units Primrose via Method 2: 1
- B Units Bluetail: 2

- Total profit: 374
- E Units English: 0
- C Units Currier: 2
- P_1 Units Primrose via Method 1: 0
- P_2 Units Primrose via Method 2: 0
- B Units Bluetail: 1

- Total profit: 649
- E Units English: 0
- C Units Currier: 2
- P_1 Units Primrose via Method 1: 0
- P_2 Units Primrose via Method 2: 0

- B Units Bluetail: 5

✔

You have used 1 of 2 submissions

PART C

(1/1 point)

Should the manufacturer buy an additional 10 lbs. of Clay at $1.1 per pound? That is, will it increase the profit of the manufacturer, assuming that the manufacturer reoptimizes?

- No
- Yes ✔

You have used 1 of 1 submissions

PART D

(1/1 point)

Suppose that the number of hours available in the dry room decreases by 30. Which of the following statements is true?

- The profit stays the same.
- The profit either stays the same or it decreases. ✔
- The profit either stays the same or it increases.

You have used 1 of 2 submissions

PART E

(1/1 point)

In the current model, the number of Primrose produced using method 1 was required to be the same as the number of Primrose produced by method 2. This is modeled using the "Primrose constraint" $P_1 - P_2 = 0$. Consider a revision of the model in which the constraint is replaced by the constraint $P_1 - P_2 \geq 0$. In the revised model, would P_1 strictly exceed P_2?

- No
- Yes ✔

You have used 1 of 2 submissions