Problem 31(Algorithmic)

Hart Manufacturing makes three products. Each product requires manufacturing operations in three departments: A, B, and C. The labor-hour requirements, by department, are as follows:

Department Product 1 Product 2 Product 3

A 1.5 3 2

B 2 1 2.5

C 0.25 0.25 0.25

During the next production period, the labor-hours available are 450 in department A, 350 in department B, and 50 in department C. The profit contributions per unit are $25 for product 1, $28 for product 2, and $30 for product 3.

(a) Formulate a linear programming model for maximizing total profit contribution.

If required, round your answers to two decimal places. For those boxes in which you must enter subtractive or negative numbers use a minus sign. (Example: -300)

Let Pi = units of product i produced

Max P1 + P2 + P3

s.t.

P1 + P2 + 2P3 ≤

2P1 + P2 + P3 ≤

P1 + 0.25P2 + P3 ≤

P1, P2, P3 ≥ 0

(b) Solve the linear program formulated in part (a). How much of each product should be produced, and what is the projected total profit contribution?

P1 =

P2 =

P3 =

Profit = $

(c) After evaluating the solution obtained in part (b), one of the production supervisors noted that production setup costs had not been taken into account. She noted that setup costs are $400 for product 1, $550 for product 2, and $600 for product 3. If the solution developed in part (b) is to be used, what is the total profit contribution after taking into account the setup costs?

Profit = $

(d) Management realized that the optimal product mix, taking setup costs into account, might be different from the one recommended in part (b). Formulate a mixed-integer linear program that takes setup costs into account. Management also stated that we should not consider making more than 175 units of product 1, 150 units of product 2, or 140 units of product 3.

If required, round your answers to two decimal places. For those boxes in which you must enter subtractive or negative numbers use a minus sign. (Example: -300)

Here introduce a 0-1 variable yi that is one if any quantity of product i is produced and zero otherwise.

Max P1 + P2 + P3 + y1 + y2 + y3

s.t.

P1 + P2 + 2P3 ≤

2P1 + P2 + P3 ≤

P1 + 0.25P2 + P3 ≤

P1 + y1 ≤

P2 + y2 ≤

P3 + y3 ≤

P1, P2, P3 ≥ 0; y1, y2, y3 = 0, 1

(e) Solve the mixed-integer linear program formulated in part (d). How much of each product should be produced, and what is the projected total profit contribution? Compare this profit contribution to that obtained in part (c).

P1 =

P2 =

P3 =

Profit = $

The profit is - Select your answer –increased/decreased Item 46 by $ 0.00