

	Maximum Monthly Production*		Profit per Unit Produced	
	Regular Time	Overtime	Regular Time	Overtime
Power saws	3,000	2,000	\$150	\$50
Power drills	5,000	3,000	100	75

* Assuming adequate supplies of materials from the company's vendors.

vendor who supplies a key part for the gear assemblies will only be able to provide 15,000 for November (4,000 more than for other months). Each power saw requires two of these parts and each power drill requires one.

Mr. Jensen now wants to determine how many power saws and how many power drills to produce in November to maximize the company's total profit.

- E* *a.* Draw the profit graph for each of these two products.
b. Use separable programming to formulate a linear programming model on a spreadsheet for this problem. Then solve the model. What does this say about how many power saws and how many power drills to produce in November?

8.11.* The Dorwyn Company has two new products (special kinds of doors and windows) that will compete with the two new products for the Wyndor Glass Co. (described in Section 2.1). Using units of hundreds of dollars for the objective function, the linear programming model in algebraic form shown below has been formulated to determine the most profitable product mix.

$$\text{Maximize Profit} = 4D + 6W$$

subject to

$$D + 3W \leq 8$$

$$5D + 2W \leq 14$$

and

$$D \geq 0 \quad W \geq 0$$

However, because of the strong competition from Wyndor, Dorwyn management now realizes that the company will need to make a strong marketing effort to generate substantial sales of these products. In particular, it is estimated that achieving a production and sales rate of D doors per week will require weekly marketing costs of D^3 hundred dollars (so \$100 for $D = 1$, \$800 for $D = 2$, \$2,700 for $D = 3$, etc.). The corresponding marketing costs for windows are estimated to be $2W^2$ hundred dollars. Thus, the objective function in the model should be

$$\text{Profit} = 4D + 6W - D^3 - 2W^2$$

Dorwyn management now would like to use the revised model to determine the most profitable product mix.

- E* *a.* Formulate and solve this nonlinear programming model on a spreadsheet.
b. Construct tables to show the profit data for each product when the production rate is 0, 1, 2, 3.
c. Draw a figure that plots the weekly profit points for each product when the production rate is 0, 1, 2, 3. Connect the pairs of consecutive points with (dashed) line segments.
d. Use separable programming based on this figure to formulate an approximate linear programming

model on a spreadsheet for this problem. Then solve the model. What does this say to Dorwyn management about which product mix to use?

- e.* Compare the solution based on a separable programming approximation in part *d* with the solution obtained in part *a* for the exact nonlinear programming model.

8.12. The MFG Corporation is planning to produce and market three different products. Let x_1 , x_2 , and x_3 denote the number of units of the three respective products to be produced. The preliminary estimates of their potential profitability are as follows.

For the first 15 units produced of Product 1, the unit profit would be approximately \$360. The unit profit would be only \$30 for any additional units of Product 1. For the first 20 units produced of Product 2, the unit profit is estimated at \$240. The unit profit would be \$120 for each of the next 20 units and \$90 for any additional units. For the first 10 units of Product 3, the unit profit would be \$450. The unit profit would be \$300 for each of the next 5 units and \$180 for any additional units.

Certain limitations on the use of needed resources impose the following constraints on the production of the three products:

$$x_1 + x_2 + x_3 \leq 60$$

$$3x_1 + 2x_2 \leq 200$$

$$x_1 + 2x_3 \leq 70$$

Management wants to know what values of x_1 , x_2 , and x_3 should be chosen to maximize the total profit.

- a.* Plot the profit graph for each of the three products.
 E* *b.* Use separable programming to formulate a linear programming model on a spreadsheet for this problem. Then solve the model. What is the resulting recommendation to management about the values of x_1 , x_2 , and x_3 to use?

8.13. Suppose that separable programming has been applied to a certain problem (the "original problem") to convert it to the following equivalent linear programming model in algebraic form:

$$\text{Maximize Profit} = 5x_{11} + 4x_{12} + 2x_{13} + 4x_{21} + x_{22}$$

subject to

$$3x_{11} + 3x_{12} + 3x_{13} + 2x_{21} + 2x_{22} \leq 25$$

$$2x_{11} + 2x_{12} + 2x_{13} - x_{21} - x_{22} \leq 10$$

and

$$0 \leq x_{11} \leq 2 \quad 0 \leq x_{21} \leq 3$$

$$0 \leq x_{12} \leq 3 \quad 0 \leq x_{22} \leq 1$$

$$0 \leq x_{13}$$

What was the mathematical model for the original problem? Answer this by plotting the profit graph for each of the original activities and then writing the constraints for the original problem in terms of the original decision variables.