

15. Par, Inc., is a small manufacturer of golf equipment and supplies. Par has been convinced by its distributor that there is an existing market for both a medium-priced golf bag, referred to as a standard model, and a high-priced golf bag, referred to as a deluxe model. The distributor is so confident of the market that if Par can make the bags at a competitive price, the distributor has agreed to purchase all the bags that Par can manufacture over the next three months. A careful analysis of the manufacturing requirements resulted in the following table, which shows the production time requirements for the four required manufacturing operations and the accounting department's estimate of the profit contribution per bag:

Product	Production Time (hours)				Profit per Bag
	Cutting and Dyeing	Sewing	Finishing	Inspection and Packaging	
Standard	7/10	1/2	1	1/10	\$10
Deluxe	1	5/6	2/3	1/4	\$ 9

19. Kelson Sporting Equipment, Inc., makes two types of baseball gloves: a regular model and a catcher's model. The firm has 900 hours of production time available in its cutting and sewing department, 300 hours of production time available in its finishing department, and 100 hours of production time available in its packaging and shipping department. The production time requirements and the profit per glove are given below.

Model	Production Time (hours)			Profit/Glove
	Cutting and Sewing	Finishing	Packaging and Shipping	
Regular model	1	1/2	1/8	\$5
Catcher's model	3/2	1/3	1/4	\$8

- Assuming that the company wants to maximize profit, how many gloves of each model should Kelson manufacture?
  - What profit can Kelson earn with the above production quantities?
  - How many hours of production time will be scheduled in each department?
  - What is the slack time in each department?
20. The Erlanger Manufacturing Company makes two products. The profit estimates \$25 for each unit of product 1 sold and \$30 for each unit of product 2 sold. The labor-hour requirements for the products in each of three production departments are summarized below.

	Product 1	Product 2
Department A	1.50	3.00
Department B	2.00	1.00
Department C	0.25	0.25

The production supervisors in the departments have estimated that the following number of labor-hours will be available during the next month: 450 hours in department A, 350 hours in department B, and 50 hours in department C. Assuming that the company is interested in maximizing profits, answer the following:

- What is the linear programming model for this problem?
- Find the optimal solution. How much of each product should be produced, and what is the projected profit?
- What is the scheduled production time and slack time in each department?

27. M&D Chemicals produces two products that are sold as raw materials to companies manufacturing bath soaps, laundry detergents, and other soap products. Based on an analysis of current inventory levels and potential demand for the coming month, M&D's management has specified that the total production for products 1 and 2 combined must be at least 350 gallons. Also, a major customer's order for 125 gallons of product 1 must be satisfied. Product 1 requires 2 hours of processing time per gallon and product 2 requires 1 hour of processing time per gallon; for the coming month, 600 hours of processing time are available. Production costs are \$2 per gallon for product 1 and \$3 per gallon for product 2.
- Determine the production quantities that will satisfy the requirements specified above at minimum cost.
  - What is the total product cost?
  - Identify the amount of any surplus production.

30. Greentree Kennels, Inc., provides overnight lodging for a variety of pets. A particular feature at Greentree's is the quality of care the pets receive, including excellent food. The kennel's dog food is made by mixing two brand-name dog food products to obtain what the kennel calls the "well-balanced dog diet." The data for the two dog foods are as follows:

Dog Food	Cost/ Ounce	Protein (%)	Fat (%)
Bark Bits	\$0.06	30	15
Canine Chow	\$0.05	20	30

If Greentree wants to be sure that the dogs receive at least 5 ounces of protein and at least 3 ounces of fat per day, what is the minimum cost mix of the two dog food products?

- 32.** Car Phones, Inc., sells two models of car telephones: model  $x$  and model  $y$ . Records show that 3 hours of sales time are used for each model  $x$  phone that is sold, and 5 hours of sales time for each model  $y$  phone. A total of 600 hours of sales time is available for the next 4-week period. In addition, management planning policies call for minimum sales goals of 25 units for both model  $x$  and model  $y$ .
- Show the feasible region for the Car Phones, Inc., problem.
  - Assuming the company makes a \$40 profit contribution for each model  $x$  sold and a \$50 profit contribution for each model  $y$  sold, what is the optimal sales goal for the company for the next 4-week period?
  - Develop a constraint and show the feasible region if management adds the restriction that Car Phones must sell at least as many model  $y$  phones as model  $x$  phones.
  - What is the new optimal solution if the constraint in part c is added to the problem?
- 33.** Kats is a new pet food product. Each 16-ounce can of Kats consists of a blend, or mixture, of two pet food ingredients. Let

$x_1$  = the number of ounces of ingredient A in a 16-ounce can

$x_2$  = the number of ounces of ingredient B in a 16-ounce can

Each ounce of ingredient A contains  $\frac{1}{2}$  ounce of protein and  $\frac{1}{8}$  ounce of fat. Each ounce of ingredient B contains  $\frac{1}{10}$  ounce of protein and  $\frac{1}{3}$  ounce of fat. Restrictions are that a 16-ounce can of Kats must have at least 4 ounces of protein and 2.5 ounces of fat. If ingredient A costs \$0.04 per ounce and ingredient B costs \$0.03 per ounce, what is the minimum cost blend of ingredients A and B in each 16-ounce can of Kats? Identify and interpret the values of the surplus variables for the problem.

- 34.** Photo Chemicals produces two types of photographic developing fluids. Both products cost Photo Chemicals \$1 per gallon to produce. Based on an analysis of current inventory levels and outstanding orders for the next month, Photo Chemicals' management has specified that at least 30 gallons of product 1 and at least 20 gallons of product 2 must be produced during the next 2 weeks. Management has also stated that an existing inventory of highly perishable raw material required in the production of both fluids must be used within the next 2 weeks. The current inventory of the perishable raw material is 80 pounds. While more of this raw material can be ordered if necessary, any of the current inventory that is not used within the next 2 weeks will spoil; hence the management requirement that at least 80 pounds be used in the next 2 weeks. Furthermore, it is known that product 1 requires 1 pound of this perishable raw material per gallon and product 2 requires 2 pounds of the raw material per gallon. Since Photo Chemicals' objective is to keep its production costs at the minimum possible level, the firm's management is looking for a minimum cost production plan that uses all the 80 pounds of perishable raw material and provides at least 30 gallons of product 1 and at least 20 gallons of product 2. What is the minimum cost solution?
- 35.** Bryant's Pizza, Inc., is a producer of frozen pizza products. The company makes a profit of \$1.00 for each regular pizza it produces and \$1.50 for each deluxe pizza produced. Each pizza includes a combination of dough mix and topping mix. Currently the firm has 150 pounds of dough mix and 50 pounds of topping mix. Each regular pizza uses 1 pound of dough mix and 4 ounces of topping mix. Each deluxe pizza uses 1 pound of dough mix and 8 ounces of topping mix. Based on past demand Bryant can sell at least 50 regular pizzas and at least 25 deluxe pizzas. How many regular and deluxe pizzas should the company make in order to maximize profits?
- Show the above problem in standard form.
  - What are the values and interpretations of all slack and surplus variables?
  - Which constraints are binding the optimal solution?