

Chapter 3 Homework Problems

Compiled by Joe Kahlig

Section 3.2: For problems 1–11 set up the linear programming problem. Be sure to define the variables. Do not solve.

- Jack has a casserole and salad dinner. Each serving of casserole contains 250 calories, 3 grams of vitamins, and 9 grams of protein. Each serving of salad contains 30 calories, 6 grams of vitamins, and 1 gram of protein. Jack wants to consume at least 23 grams of vitamins and 28 grams of protein but keep the calories at a minimum. How many servings of each food should he eat?
- Phillip is planning on investing \$3 million dollars in three different projects. He estimates that project A will yield a return on 10%, project B will yield a return of 18%, and project C will yield a return of 24%. Because of the risks involved with investing, Phillip has decided to put not more than 20% of the total investment in project C. He also decided that project B and C should not exceeded 60% of the total investment. Finally, he decided that project A should be at least 60% of the investments in projects B and C. How much should be invested in each project so that the total returns will be maximized?
- The Hi-Fi Record Store is about to place an order for cassette tapes, lps, and compact disks. The distributor from which they order requires that each order must request at least 375 items. The prices that Hi-fi must pay are \$2.75 for each cassette, \$9 for each lp and \$8.25 for each compact disk. The distributor also requires that at least 60% of any order be for compact disks. How many cassettes, lps, and compact disks should Hi-Fi order so that its total ordering costs will be kept to a minimum?
- A firm makes three types of golf bags, A, B, and C. Type A requires 20 minutes to cut, 25 minutes to sew, 25 minutes to trim, and sells for \$75. Type B requires 20 minutes to cut, 15 minutes to sew, 45 minutes to trim, and sells for \$85. Type C requires 25 minutes to cut, 25 minutes to sew, 45 minutes to trim and sells for \$95. The firm has available 70 work-hours for cutting, 80 work-hours for sewing and 110 work-hours for the trimming each day. A contract from a large discount store requires that they make at least 25 bags of type A. How many of each type bag should be produced under these conditions in order to maximize revenue?
- An import company obtains a license to import up to 200 pieces of hand-carved furniture. The importer may import chests, desks, and silverware boxes. The cost, volume, and profit are the following:

	Cost	Profit	Volume (cubic feet)
Chest	\$270	\$180	7
Desk	\$310	\$300	18
Silverware Box	\$90	\$45	1.5

The import company may purchase up to \$5,000 worth of furniture and the furniture must fit into a 1500-cubic-foot shipping container. Find the number of each type of furniture that should be ordered so that the profit is maximum.

- An investment company has two funds, A and B, that you can pick from for your personal investments. Each unit of fund A costs \$15, yields an annual return of 6%, and has a risk index of 2 per unit. Each unit of fund B costs \$12, yields an annual return of 5%, and has a risk index of 1.5 per unit. You have \$42,000 available for investing and want to earn at least \$2,4000 in interest in the coming year. How many units of each fund should you purchase in order to meet your goals and also to minimize the total risk index for your portfolio?
- A real estate developer is planning to build a new apartment complex consisting of one-bedroom units and two- and three-bedroom townhouses. The complex will have at most 192 units and the number of family units (two- and three-bedroom townhouses) will be at least twice the number of one-bedroom units. The developer believes they can rent the one-bedroom units for \$500 and the two- and three-bedroom townhouses for \$800 and \$1200 respectively. How many units of each type will be in the complex if they want to maximize the revenue from renting the apartments.
- A factory produces two models of wire baskets, model A and model B. Each model A basket requires 110 feet of wire and 2 hours of labor; each model B basket requires 90 feet of wire and 3 hours of labor. The factory has 9900 feet of wire and 210 hours of labor available per day. The profit on each model A basket is \$4 and the profit on each model B basket is \$5. How many baskets of each model should be produced to maximize the factory's profit?
- John's Dinner makes home-made pudding, vanilla and chocolate, for its deserts. Each serving of vanilla requires 2 teaspoons of sugar and 34 fluid ounces of mineral water, and each serving of chocolate pudding requires 3 teaspoons of sugar and 19 fluid ounces of mineral water. John has available each day 1,200 teaspoons of sugar and 9840 fluid ounces of mineral water. Also John will not make any more than 200 servings of vanilla pudding, as that is the most they can sell each day. If there is a profit of 11 cents on each serving of vanilla pudding and 6 cents on each serving of chocolate, how many servings of each should be made in order to maximize the profit?
- Steinwelt Piano manufactures pianos in two plants: Plant I and Plant II. The output of plant I is at most 300 per month, where as the maximum output of plant II is 250 per month. The pianos are shipped to two warehouses that serve as distribution centers for the company. To fill current and projected orders, warehouse A requires a minimum of 200 pianos per month and the minimum

monthly requirement at the other warehouse is 150 pianos. The shipping cost, for each piano, from the plants to the warehouses is shown in the table.

	Plant I	Plant II
warehouse A	60	80
warehouse B	70	50

What shipping schedule will enable the company to meet the warehouses' requirements while keeping shipping costs to a minimum?

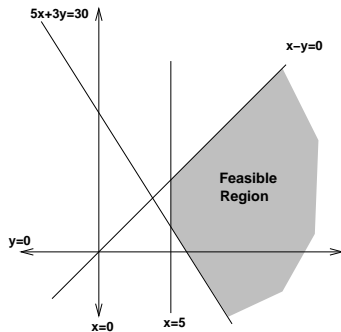
11. A major coffee supplier has warehouses in Seattle and San Jose. The coffee supplier receives orders from coffee retailers in Salt Lake City and Reno. The retailer in Salt Lake City needs a minimum of 400 pounds of coffee, and the retailer in Reno needs no less than 350 pounds of coffee. The Seattle warehouse has 700 pounds available, and the warehouse in San Jose has 500 pounds available. The cost of shipping (in dollars per pound) from the different warehouses to the different retailers can be found in the table.

	Seattle	San Jose
Salt Lake City	2.5	4
Reno	3	2

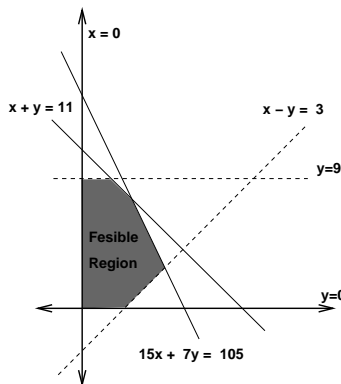
Find the number of pounds to be shipped from each warehouse to each retailer to minimize the cost.

Section 3.1 and 3.3

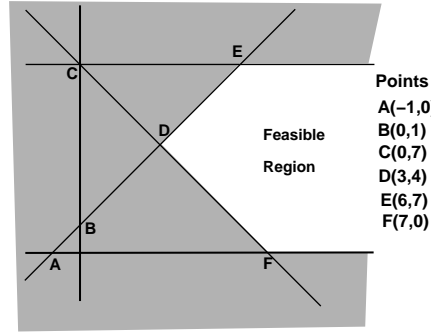
12. Write the system of inequalities that will give the following feasible region.



13. Write the system of inequalities that will give the following feasible region.



14. Write the system of inequalities that will give the following feasible region.



For problems 15–23, graph the feasible region either by reverse shading or regular shading and label this region with an F.R. Label all lines and find the coordinates of the corner points. Is the above feasible region bounded or unbounded?

15. $3x - y > 0$
 $2x + y < 12$
16. $3x + 8y < 24$
 $6x + 5y < 30$
17. $4x + 5y \leq 20$
 $4x - 5y \leq 10$
 $x \geq 1$
18. $x + 2y \leq 16$
 $3x + 2y \geq 24$
 $0 \leq x \leq 13$
 $y \geq 0$
19. $x - y \leq -6$
 $x + 3y \geq 30$
 $2x + y \leq 36$
 $x \geq 0$
 $y \geq 0$
20. $2x + 3y \geq 12$
 $3x + 2y \geq 15$
 $4x + y \geq 10$
 $x, y \geq 0$
21. $y - 3x \leq 3$
 $x - 2y \leq 2$
 $x + y \leq 11$
 $y \geq 0$
22. $x + 2y \geq 16$
 $3x + 2y \geq 24$
 $0 \leq x \leq 13$
 $y \geq 0$
23. $2x + y \geq 36$
 $x + 3y \geq 30$
 $x - y \geq -6$
 $x, y \geq 0$

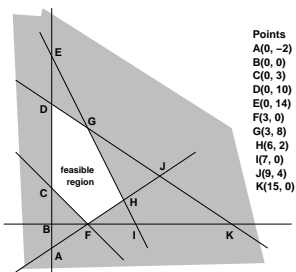
For problems 24–25, solve the following problems using the method of corners: Graph the feasible region (as discussed in class); Label the lines; and label (find) the corner points. Then tell what the solution is for the problem.

24. Minimize: $Z = 3x + y$
 $x + y \geq 6$
 $2x - y \geq 0$
 $0 \leq y \leq 6$
 $x \geq 0$

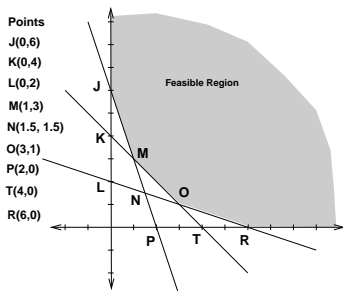
25. Maximize: $Z = 4x + 2y$
 $x + y \geq 6$
 $2x - y \geq 0$
 $0 \leq y \leq 6$
 $x \geq 0$

For problems 26–31, use the given feasible region and objective function to find the optimal solution, both the value and the location(s). If not solutions is possible, then be sure to indicate that.

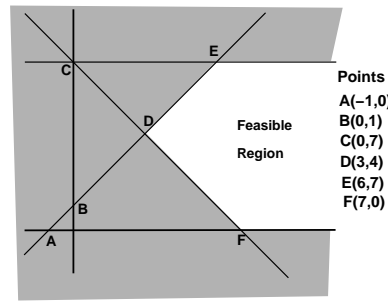
26. (a) Minimize $f = 4x + 6y$
 (b) Maximize $g = 4x + 6y$



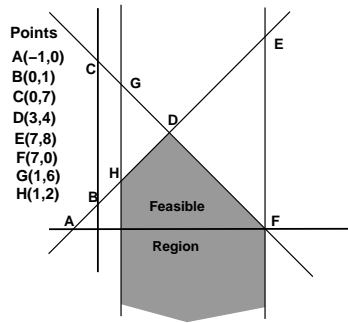
27. (a) Minimize: $f = 2x + 7y$
 (b) Minimize: $g = 6x + 2y$
 (c) Maximize: $h = 5x - 4y$



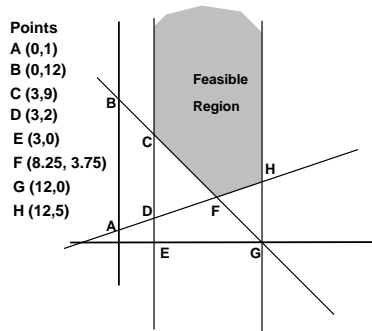
28. (a) Maximize: $f = -x + 3y$
 (b) Minimize: $g = -x + 2y$



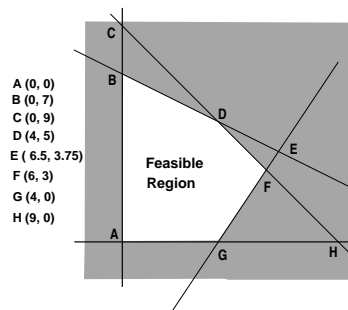
29. Maximize: $f = 5x - y$



30. Minimize: $f = 4x - y$



31. Maximize: $f = x + y$



32. Solve problem # 8. How many baskets of each model should be produced to maximize the factory's profit?

33. Solve problem # 9. How many servings of each brand of puddings should the company make in order to maximize the profit?