

MAT540

Week 8 Homework

Chapter 4

1. Betty Malloy, owner of the Eagle Tavern in Pittsburgh, is preparing for Super Bowl Sunday, and she must determine how much beer to stock. Betty stocks three brands of beer- Yodel, Shotz, and Rainwater. The cost per gallon (to the tavern owner) of each brand is as follows:

Brand	Cost/Gallon
Yodel	\$1.50
Shotz	0.90
Rainwater	0.50

The tavern has a budget of \$2,000 for beer for Super Bowl Sunday. Betty sells Yodel at a rate of \$3.00 per gallon, Shotz at \$2.50 per gallon, and Rainwater at \$1.75 per gallon. Based on past football games, Betty has determined the maximum customer demand to be 400 gallons of Yodel, 500 gallons of shotz, and 300 gallons of Rainwater. The tavern has the capacity to stock 1,000 gallons of beer; Betty wants to stock up completely. Betty wants to determine the number of gallons of each brand of beer to order so as to maximize profit.

- a. Formulate a linear programming model for this problem.
 - b. Solve the model by using the computer.
2. As result of a recently passed bill, a congressman's district has been allocated \$3 million for programs and projects. It is up to the congressman to decide how to distribute the money. The congressman has decide to allocate the money to four ongoing programs because of their importance to his district- a job training program, a parks project, a sanitation project, and a mobile library. However, the congressman wants to distribute the money in a manner that will please the most voters, or, in other words, gain him the most votes in the upcoming election. His staff's estimates of the number of votes gained per dollar spent for the various programs are as follows.

Program	Votes/Dollar
Job training	0.03
Parks	0.08
Sanitation	0.05
Mobile library	0.03

In order also to satisfy several local influential citizens who financed his election, he is obligated to observe the following guidelines:

- None of the programs can receive more than 30% of the total allocation
- The amount allocated to parks cannot exceed the total allocated to both the sanitation project and the mobile library.
- The amount allocated to job training must at least equal the amount spent on the sanitation project.

Any money not spent in the district will be returned to the government; therefore, the congressman wants to spend it all. The congressman wants to know the amount to allocate to each program to maximize his votes.

- a. Formulate a linear programming model for this problem.
 - b. Solve the model by using the computer.
3. Anna Broderick is the dietician for the State University football team, and she is attempting to determine a nutritious lunch menu for the team. She has set the following nutritional guidelines for each lunch serving:
- Between 1,300 and 2,100 calories
 - At least 4 mg of iron
 - At least 15 but no more than 55g of fat
 - At least 30g of protein
 - At least 60g of carbohydrates
 - No more than 35 mg of cholesterol

She selects the menu from seven basic food items, as follows, with the nutritional contributions per pound and the cost as given:

	Calories (per lb.)	Iron (mg/lb.)	Protein (g/lb.)	Carbo- hydrates (g/lb.)	Fat (g/lb.)	Cholesterol (mg/lb)	Cost (\$/lb.)
Chicken	500	4.2	17	0	30	180	0.85
Fish	480	3.1	85	0	5	90	3.35
Ground beef	840	0.25	82	0	75	350	2.45
Dried beans	590	3.2	10	30	3	0	0.85
Lettuce	40	0.4	6	0	0	0	0.70
Potatoes	450	2.25	10	70	0	0	0.45
Milk (2%)	220	0.2	16	22	10	20	0.82

The dietician wants to select a menu to meet the nutritional guidelines while minimizing the total cost per serving.

- a. Formulate a linear programming model for this problem and solve.
 - b. If a serving of each of the food items (other than milk) was limited to no more than a half pound, what effect would this have on the solution?
4. Dr. Maureen Becker, the head administrator at Jefferson County Regional Hospital, must determine a schedule for nurses to make sure there are enough of them on duty throughout the day. During the day, the demand for nurses varies. Maureen has broken the day in to twelve 2-hour periods. The slowest time of the day encompasses the three periods from 12:00 A.M. to 6:00 A.M., which beginning at midnight; require a minimum of 30, 20, and 40 nurses, respectively. The demand for nurses steadily increases during the next four daytime periods. Beginning with the 6:00 A.M.- 8:00 A.M. period, a minimum of 50, 60, 80, and 80 nurses are required for these four periods, respectively. After 2:00 P.M. the demand for nurses decreases during the afternoon and evening hours. For the five 2-hour periods beginning at 2:00 P.M. and ending midnight, 70, 70, 60, 50, and 50 nurses are required, respectively. A nurse reports for duty at the beginning of one of the 2-hour periods and works 8 consecutive hours (which is required in the nurses' contract). Dr. Becker wants to determine a nursing schedule that will meet the hospital's minimum requirement throughout the day while using the minimum number of nurses.
 - a. Formulate a linear programming model for this problem.

- b. Solve the model by using the computer.
5. The production manager of Videotechnics Company is attempting to determine the upcoming 5-month production schedule for video recorders. Past production records indicate that 2,000 recorders can be produced per month. An additional 600 recorders can be produced monthly on an overtime basis. Unit cost is \$10 for recorders produced during regular working hours and \$15 for those produced on an overtime basis. Contracted sales per month are as follows:

Month	Contracted Sales (units)
1	1200
2	2100
3	2400
4	3000
5	4000

Inventory carrying costs are \$2 per recorder per month. The manager does not want any inventory carried over past the fifth month. The manager wants to know the monthly production that will minimize total production and inventory costs.

- a. Formulate a linear programming model for this problem.
- b. Solve the model by using the computer.