

1. Ben has three dogs, Uno, Dos, and Tres. Every day Ben feeds them with five types of food: beef, dog food, bread, bones, and chicken. Each type of food is bought in pounds. The price for each type of food is as follows (Table 9.10):

**TABLE 9.10 Food Prices**

Food	Beef	Dog Food	Bread	Bones	Chicken
\$/lb	\$2.50	\$1.00	\$0.80	\$1.20	\$1.60

Ben's wife wants him to find the most cost-effective plan for feeding dogs, subject to the dogs' preferences. Table 9.11 shows the minimum amount of food consumed by each dog each day. Despite this, Dos eats no less than 2.5 lb of chicken plus bread. Uno eats no less than 2.71b of meats (including dog food, chicken, and bones). The total amount of bread and beef fed to Tres cannot be less than 2.61b.

**TABLE 9.11 Minimum Daily Food Consumption**

	Beef	Dog Food	Bread	Bones	Chicken
Uno	0	0	0.5	1.7	1.9
Dos	0	1.5	0.3	0.9	0.1
Tres	1.5	0.9	0.8	0.6	0.2

- Formulate the problem as an LP.
- Solve the problem using Gurobi.
- Estimate the impact on the objective function if the meat consumption of Uno could be reduced to 2.5.

2. Home Grocery is a new company that makes same-day deliveries of groceries to people's homes. The company is launching its business in Metropolis, a large urban area. The marketing department has identified eight neighborhoods in Metropolis where the company should concentrate its business. The logistics manager has identified six locations where the company may locate grocery depots. The following table shows the average time (in minutes) required to travel from each of the six potential depot locations to the center of each of the eight neighborhoods. It also shows the target population (in thousands) for the company's service in each neighborhood. The company wishes to locate two depots so that they maximize the population served within 12 min of average travel time. Formulate the problem as an IP model and solve using Gurobi.

Neighborhoods	Depots						Population
	1	2	3	4	5	6	
1	15	17	27	5	25	22	12
2	10	12	24	4	22	20	8
3	5	6	17	9	21	17	11
4	7	6	8	15	13	10	14
5	14	12	6	23	6	8	22
6	18	17	10	28	9	5	18
7	11	10	5	21	10	9	16
8	24	22	22	33	6	16	20

3. Big Burger is a fast food restaurant with many chain stores all over the states. Customers to Big Burger can be divided into three types: kids, drivers drawn from highways, and workers nearby. Each type has different purchasing preference. The most popular food in Big Burger includes burgers, fries, and soft drinks. They can be purchased individually or as a combo meal, which includes all three items. The maximum price each customer group is willing to pay for each item or the combo, as well as monthly estimated number of customers from each group, is listed in the following table. Determine the price to charge for individual and combo purchases so as to maximize revenue from sales.

Customer Type	Expected Monthly Customers	Maximum Price Customer is Willing to Pay			
		Burger	Fries	Soft Drink	Combo Meal
Kids	300	2.69	1.39	1.09	4.29
Drivers	240	2.99	0.99	1.29	4.89
Workers	600	2.59	0.99	1.19	4.19