

4. Hilltop Coffee manufactures a coffee product by blending three types of coffee beans. The cost per pound and the available pounds of each bean are as follows:

Bean	Cost per pound	Available pounds
1	\$0.50	500
2	\$0.70	600
3	\$0.45	400

Consumer tests with coffee products were used to provide ratings on a scale of 0–100, with higher ratings indicating higher quality. Product quality standards for the blended coffee require a consumer rating for aroma to be at least 75 and a consumer rating for taste to be at least 80. The individual ratings of the aroma and taste for coffee made from 100% of each bean are as follows.

Bean	Aroma rating	Taste rating
1	75	86
2	85	88
3	60	75

Assume that the aroma and taste attributes of the coffee blend will be a weighted average of the attributes of the beans used in the blend.

- What is the minimum-cost blend that will meet the quality standards and provide 1000 pounds of the blended coffee product?
- What is the cost per pound for the coffee blend?
- Determine the aroma and taste ratings for the coffee blend.
- If additional coffee were to be produced, what would be the expected cost per pound?

7. As part of the settlement for a class action lawsuit, Hoxworth Corporation must provide sufficient cash to make the following annual payments (in thousands of dollars).

Year	1	2	3	4	5	6
payment	190	215	240	285	315	460

The annual payments must be made at the beginning of each year. The judge will approve an amount that, along with earnings on its investment, will cover the annual payments. Investment of

the funds will be limited to savings (at 4% annually) and government securities, at prices and rates currently quoted in The Wall Street Journal.

Hoxworth wants to develop a plan for making the annual payments by investing in the following securities (par value \$1000). Funds not invested in these securities will be placed in savings.

Security	Current price	rate (%)	Years to Maturity
1	\$1055	6.750	3
2	\$1000	5.125	4

Assume that interest is paid annually. The plan will be submitted to the judge and, if approved, Hoxworth will be required to pay a trustee the amount that will be required to fund the plan.

a. Use linear programming to find the minimum cash settlement necessary to fund the annual payments.

b. Use the dual value to determine how much more Hoxworth should be willing to pay now to reduce the payment at the beginning of year 6 to \$400,000.

c. Use the dual value to determine how much more Hoxworth should be willing to pay to reduce the year 1 payment to \$150,000.

d. Suppose that the annual payments are to be made at the end of each year. Reformulate the model to accommodate this change. How much would Hoxworth save if this change could be negotiated?

8. The Clark County Sheriff's Department schedules police officers for 8-hour shifts. The beginning times for the shifts are 8:00 a.m., noon, 4:00 p.m., 8:00 p.m., midnight, and 4:00 a.m. An officer beginning a shift at one of these times works for the next 8 hours. During normal weekday operations, the number of officers needed varies depending on the time of day. The department staffing guidelines require the following minimum number of officers on duty:

	Minimum Officers
Time of day	on duty

8:00 a.m.–Noon	5
Noon–4:00 p.m.	6
4:00 p.m.–8:00 p.m.	10
8:00 p.m.–Midnight	7
Midnight–4:00 a.m.	4
4:00 a.m.–8:00 a.m.	6

Determine the number of police officers that should be scheduled to begin the 8-hour shifts at each of the six times (8:00 a.m., noon, 4:00 p.m., 8:00 p.m., midnight, and 4:00 a.m.) to minimize the total number of officers required. (Hint: Let x_1 be the number of officers beginning work at 8:00 a.m., x_2 be the number of officers beginning work at noon, and so on.)

15. Seastrand Oil Company produces two grades of gasoline: regular and high octane. Both gasolines are produced by blending two types of crude oil. Although both types of crude oil contain the two important ingredients required to produce both gasolines, the percentage of important ingredients in each type of crude oil differs, as does the cost per gallon. The percentage of ingredients A and B in each type of crude oil and the cost per gallon are shown.

Crude Oil	Cost l	ngredient A	Ingredient B
1	\$0.10	20%	60% (Crude oil 1 is 60% ingredient B)
2	\$0.15	50%	30%

Each gallon of regular gasoline must contain at least 40% of ingredient A, whereas each gallon of high octane can contain at most 50% of ingredient B. Daily demand for regular and high-octane gasoline is 800,000 and 500,000 gallons, respectively. How many gallons of each type of crude oil should be used in the two gasolines to satisfy daily demand at a minimum cost?