

Modeling with linear programming

Reddy Mikks produces both interior and exterior paints from two raw materials, M1 and M2. The following table provides the basic data of the problem:

Tons of raw material per ton			
	exterior paint	Interior paint	Max. daily availability (tons)
Raw material M1	6	4	24
Raw material M2	1	2	6
Profit per ton (\$1000)	5	4	

A market survey indicates that the daily demand for interior paint cannot exceed that for exterior paint by more than 1 ton. Also the maximum daily demand for interior paint is 2 tons.

Reddy Mikks wants to determine the optimum product mix of interior and exterior paints that maximizes the total daily profit.

1. For the Reddy Mikks model, construct each of the following constraints and express it with a linear left hand side and a constant right hand side:
 - (a) The daily demand for interior paint exceeds that of exterior paint by at least 1 ton.
 - (b) The daily usage of raw material M2 in tons is at most 6 and at least 3.
 - (c) The demand for interior paint cannot be less than the demand for exterior paint.
 - (d) The minimum quantity that should be produced of both the interior and the exterior paint is 3 tons.
 - (e) The proportion of interior paint to the total production of both interior and exterior paints must not exceed 0.5.

2. Determine the best feasible solution among the following.

(a) $x_1=1$ $x_2=4$

(b) $x_1=2$ $x_2=2$

(c) $x_1=3$ $x_2=1.5$

(d) $x_1=2$ $x_2=1$

(e) $x_1=2$ $x_2=-1$

3. For the feasible solution $x_1 = 2$, $x_2 = 2$ of the Reddy Mix model, determine the unused amount of raw material M1 and M2.

4. An industrial recycling center uses two scrap aluminum metals A and B to produce a special alloy. Scrap A contains 6% aluminum, 3% silicon and 4% carbon. Scrap B contains 3% aluminum, 6% silicon and 3% carbon. The costs per ton for scraps A and B are \$100 and \$80 respectively. The specification of the special alloy require that the aluminum content must be at least 3% and at most 6%, the silicon content must be at least 3% and at most 5% and the carbon content must be between 3% and 7%. Determine the optimum mix of the scraps that should be used in producing 1000 tons of the alloy.
5. John must work at least 20 hours a week to supplement his income while attending school. He has the opportunity to work in two retail stores. In store 1, he can work between 5 to 12 hours a week and in store 2 he is allowed between 6 to 10 hours. Both stores pay the same hourly wage. In deciding how many hours to work in each store, John wants to base his decision on work stress. Based on interviews with present employees, John estimates that on an ascending scale of 1 to 10, the stress factors are 8 and 6 on stores 1 and 2 respectively. Because stress mounts by the hour, he assumes that the total stress for each store at the end of the week is proportional to the number of hours he works in the store. How many hours should John work in each store?
6. A company produces two products A and B. The sales volume for A is at least 80% of the total sales of both A and B. however, the company cannot sell more than 100 units of A per day. Both product use one raw material of which maximum daily availability is 240 lb. the usage rates of the raw materials are 2 lb per unit of A and 4 lb per unit of B. The profit units for A and B are \$20 and \$50 respectively. Determine the optimal product mix for the company.
7. The Continuing Education Division at the Ozark Community College offers a total of 30 courses each semester. The courses offered are usually of two types: practical and humanistic. To satisfy the demands of the community, at least 10 courses of each type must be offered each semester. The division estimates that the revenues of offering practical and humanistic courses are approximately \$1500 and \$1000 per course respectively. Devise an optimal course offering for the college.