

PROBLEMS

Problem 10-1

Solve the following linear programming problems:

1.

$$\text{Maximize } y = 2x_1 + 3x_2 + 5x_3$$

Subject to the following constraints:

$$2x_1 + 2x_2 + 2x_3 \leq 3$$

$$5x_1 - x_2 + 2x_3 \leq 5$$

$$x_1 + 3x_2 - 2x_3 \leq 2$$

2.

$$\text{Minimize } y = 8 - 4x_1 - 1.5x_2$$

Subject to the following constraints

$$x_2 - x_1 + 2x_3 \leq 5$$

$$x_1 + x_2 \leq 10$$

$$x_1 - x_2 \leq 5$$

Problem 10-2

Consider a refinery that has the choice of processing four different cruds. The yield and the availability of each crude is given in Table P10-2a. Table P10-2b shows the total processing cost, wholesale price and maximum market demand for each fuel (gasoline, heating oil, jet fuel and lube oil). Formulate the refinery problem into a linear programming problem and solve it.

Table P10-2a

Crude	1	2	3	4
Gasoline yield	0.15	0.55	0.32	0.20
Heating oil yield	0.25	0.25	0.28	0.30
Jet fuel yield	0.22	0.10	0.25	0.24
Lube fuel yield	0.23	0.01	0.03	0.16
Loss	0.15	0.05	0.12	0.10
Availability 1000 Barrels/day	23	22	32	33

Table P10-2b

Product	Total cost of processing (SR/Barrel)	Wholesale Prices (SR/Barrel)	Maximum demand 1000 Barrel/Day
Gasoline	200	220	32
Heating oil	188	200	23
Jet Fuel	216	240	20
Lube oil	228	260	9

Problem 10-3

You are required to produce an alloy that has at least 28% Pb and at least 35% Zn by mixing a number of available Pb-Zn-Sn alloys given in Table P10-3. Find the cheapest blend.

Table P10-3

Available Alloy	Pb (%)	Zn (%)	Sn (%)	Cost(SR/lb)
1	20	20	60	24
2	10	40	50	26
3	42	50	8	30
4	48	30	22	33

Problem 10-4

A city requires water at the rate of at least $5\text{ m}^3/\text{sec}$. The water should not contain dissolved salts more than 500 ppm. Water is available from two sources:

- Water from desalination plant containing 50 ppm of dissolved salt at a cost of 10 SR/ m^3 .
- Ground water containing 1500 ppm salt at a cost of 1 SR/ m^3 .

Calculate the production rate of both sources of water for a minimum cost.

Problem 10-5

The manager of an oil refinery must decide on the optimum mix of two possible blending processes, of which the inputs and outputs per production run are given in Table P10-5. The maximum amounts available of crude *A* and *B* are 200 units and 150 units respectively. Market requirement shows that at least 100 units of gasoline *X* and 80 units of gasoline *Y* must be produced. The profits per production run from process 1 and 2 are 3 and 4 SR per unit produced.

1. Formulate the linear programming problem to maximize the profit.
2. Solve the problem using both the Simplex tableau and the graphical method.

Table P10-5

Process	Input (A)	Input (B)	Gasoline output (X)	Gasoline output (Y)
1	5	3	5	8
2	4	5	4	4

Problem 10.6

A burner requires that the blend of the fuel it burns contain no more than 0.5. How should the fuels be mixed in order meet the above constraints and also achieve the minimum cost for the burner.

Table XI-5

Fuel	%Sulfur	%Nitrogen	%metals	Cost SR/ton
1	0.2	0.05	0.01	200
2	1.0	0.02	0.1	120
3	0.1	0.10	0.05	150
4	0.7	0.05	0.03	140

