

LINEAR PROGRAMMING PROBLEM CASES

1. The manager of an oil-refinery must decide on the optimal mix of 2 possible Blending processes, of which the input and output per production run are given as follows:

Process	Input (units)		Output (units)	
	Crude 'A'	Crude 'B'	Gasoline X	Gasoline Y
I	5	3	5	8
II	4	5	4	4

The maximum amount available of crude A and B are 200 units and 150 units respectively. Market requirements show that at least 100 units of gasoline X and 80 units of gasoline Y must be produced. The profit per production run from process I and process II are ` 300 and ` 400 respectively. Formulate the above problem as LPP and solve.

2. A city hospital has the following daily requirements of nurses at the minimal level:

Period	Clock Time (24 hours a day)	Minimal no. of nurses required
1	6 a.m. – 10 a.m.	2
2	10 a.m. – 2 p.m.	7
3	2 p.m. – 6 p.m.	15
4	6 p.m. – 10 p.m.	8
5	10 p.m. – 2 a.m.	20
6	2 a.m. – 6 a.m.	6

Nurses report to the hospital at the beginning of each period and work for 8 consecutive hours. The wants to determine minimal number of nurses to be employed, so that there will be sufficient number of nurses available for each period.

Formulate this as LP model by setting up appropriate constraints and objective function and solve

3. The management of Xyz Corporation is currently faced with the problem of determining its product mix for the coming period. Since, the corporation is one of the few suppliers of transformers for laser cover units, only liberal sales ceilings are anticipated. The corporation should not plan on selling transformers more than 200 units of A type, 100 units of B type and 180 units of C type. Contracts call for production of at least 20 units of A type and 70 units of C type. Within these bounds, management is free to establish units production schedules. These are subject to the capacity of the plant to produce without overtime. The production times prevail.

Product	Production Hours per unit				Unit
	Dept. I	Dept. II	Dept. III	Dept. IV	

					Profit (₹)
A	0.10	0.06	0.18	0.13	10
B	0.12	0.05	---	0.10	12
C	0.15	0.09	0.007	0.08	15
Available Hours	36	30	37	38	

Formulate and solve this as an LPP so as to maximize the total profit.

- A small petroleum company owns two refineries. Refinery 1 costs \$20,000 per day to operate, and it can produce 400 barrels of high-grade oil, 300 barrels of medium-grade oil, and 200 barrels of low-grade oil each day. Refinery 2 is newer and more modern. It costs \$25,000 per day to operate, and it can produce 300 barrels of high-grade oil, 400 barrels of medium-grade oil, and 500 barrels of low-grade oil each day. The company has orders totalling 25,000 barrels of high-grade oil, 27,000 barrels of medium-grade oil, and 30,000 barrels of low-grade oil. How many days should it run each refinery to minimize its costs and still refine enough oil to meet its orders?
- A firm can produce 3 types of cloth say A, B and C. Three kinds of wool are required for it say red, green and blue. One unit length of type A cloth needs 2 metres of red wool and 3 metres of blue wool. One unit length of B type cloth needs 3 metres of red wool, 2 metres of green wool and 2 metres of blue wool; and 1 unit length of type C cloth needs 5 metres of green wool and 4 metres of blue wool. The firm has a stock of 8 metres of red wool, 10 metres of green wool and 15 metres of blue wool, it is assumed that the income obtained from one unit length of type A cloth is ₹ 3, of B ₹ 5 and of C ₹ 4. Determine how the firm should use the available material so as to maximize the income from the finished cloth. Formulate the above problem as LPP.
- Suppose a firm produces two products A and B. For producing the each unit of product A, 4 Kg of Raw material and 6 labour hours are required. While, for the production of each unit of product B, 4 kg of raw material and 5 labour hours is required. The total availability of raw material and labour hours is 60 Kg and 90 Hours respectively (per week). The unit price of Product A is Rs 35 and of product, B is Rs 40. Formulate the Problem to maximize the profit and solve the problem by using Simplex procedure to get the optimal value of the function.
- An oil company produces two grades of gasoline P and Q which it sells at Rs. 3 and Rs.4 per litre. The refiner can buy four different crude with the following constituents and costs:

Crude	Constituents			Price/litre
	A	B	C	
1	0.75	0.15	0.10	Rs. 2.00
2	0.20	0.30	0.50	Rs. 2.25
3	0.70	0.10	0.20	Rs. 2.50

4	0.40	0.60	0.50	Rs. 2.75
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The Rs. 3 grade must have at least 55 percent of A and not more than 40% percent of C. The Rs. 4 grade must not have more than 25 percent of C. Determine how the crude should be used so as to maximize profit.

8. A person wants to decide the constituents of a diet which will fulfill his daily requirements of proteins, fats and carbohydrates at the minimum cost. The choice is to be made from four different types of foods. The yields per unit of these foods are given below.

Food type	Yield per unit			Cost per unit
	Proteins	Fats	Carbohydrates	
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	4	65
Minimum requirement	800	200	700	

Formulate linear programming model for the problem.

9. The Apex Television Company has to decide on the number of 27- and 20-inch sets to be produced at one of its factories. Market research indicates that at most 40 of the 27-inch sets and 10 of the 20-inch sets can be sold per month. The maximum number of work-hours available is 500 per month. A 27-inch set requires 20 work-hours and a 20-inch set requires 10 work-hours. Each 27-inch set sold produces a profit of \$120 and each 20-inch set produces a profit of \$80. A wholesaler has agreed to purchase all the television sets produced if the numbers do not exceed the maxima indicated by the market research. Formulate a linear programming model for this problem and solve by using a computer software
10. Dwight is an elementary school teacher who also raises pigs for supplemental income. He is trying to decide what to feed his pigs. He is considering using a combination of pig feeds available from local suppliers. He would like to feed the pigs at minimum cost while also making sure each pig receives an adequate supply of calories and vitamins. The cost, calorie content, and vitamin content of each feed are given in the table below.

Contents	Feed Type A	Feed Type B
Calories (per pound)	800	1,000

Vitamins (per pound)	140 units	70 units
Cost (per pound)	\$0.40	\$0.80

Each pig requires at least 8,000 calories per day and at least 700 units of vitamins. A further constraint is that no more than one-third of the diet (by weight) can consist of Feed Type A, since it contains an ingredient which is toxic if consumed in too large a quantity. Formulate a linear programming model for this problem.

11. Diet problem: A Nutritionist is planning a menu that includes food A and food B as its main samples. Suppose that each ounce of food A contains 2 units of protein, 1 unit of iron and 1 unit of thiamine; each ounce of food B contains 1 unit of iron and 3 units of thiamine. Suppose that each ounce of A costs 30 cents, while each ounce of B costs 40 cents. The Nutritionist wants the meal to provide at least 12 units of protein, at least 9 units of iron, and at least 15 units of thiamine. How many ounces of each food should be used to minimize the cost of the meal?

12. A Dietician has to develop a special diet using two foods P and Q. Each packet of food P contains 12 units of calcium, 4 units of iron, 6 units of Cholesterol and 6 units of Vitamin A. Each packet of same quantity food contains 3 units of calcium, 20 units of iron, 4 units of Cholesterol and 3 units of vitamin A. The diet requires at least 240 units of calcium, at least 460 units of Iron and at most 300 units of cholesterol. How many packets of each food should be used to minimise the amount of Vitamin A in the diet? What is the minimum amount of the vitamin A?

	Foods		Requirement
	P	Q	
Calcium	12 Units	3 Units	At least 240 Units
Iron	4 Units	20 Units	At least 460 Units
Cholesterol	6 Units	4 Units	At most 300 Units
Vitamin A	6 Units	3 Units	