SIT718 Real World Analytics

School of Information Technology
Deakin University

Prac. 7 Problems

PROBLEM 6: FARMER DAVE'S DECISION PROBLEM

To feed his stock, Dave the farmer can purchase two types of feed. He has decided that each day his herd requires at least 60, 84, and 72 units of nutritional elements A, B, and C, respectively. The contents and costs of a pound of each of the two feed are given in the following table.

	Nutritional elements (units/lb)			Cost (cents/lb)
	A	B	C	
Feed 1	3	7	3	10
Feed 2	2	2	6	3

Formulate an LP model to minimize the total cost of feed, and use the graphical method to solve the LP.
And, for what values of the cost coefficient for Feed 1 will the current solution remain optimal?

Problem 2: Farmer Vicky's decision problem

[Example modified from Taha]
Vicky's Farm uses at least 800 kg of "magic" feed daily by mixing corn and soybean with their composition detailed as below.

Feedstuff	Quantity (in kg) in per kg of raw ingredient		Cost ($/Kg)
	Protein	Fibre	
Corn	0.09	0.02	0.3
Soybean	0.6	0.06	0.9

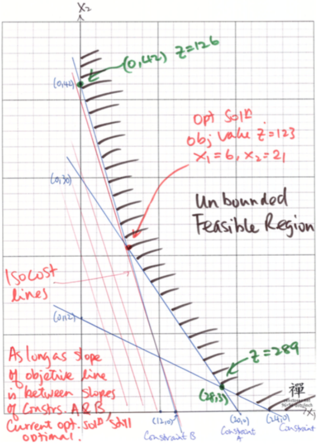
The dietary requirements for Magic Feed is that there should be at least 30% protein and at most 5% fibre. Use LP to help Vicky decide how much Corn and Soybean (in kg) she needs to purchase in order to minimize the cost, but having all the dietary requirements satisfied.

Farmer Dave's Decision Problem

Let x_1 be the number of pounds of Feed 1 to purchase and x_2 the number of pounds of Feed 2 to purchase. The LP model to minimize the total cost of feeds is given by:

$$
\begin{array}{lrcrcll}
\min & 10x_1 & + & 3x_2 & & & \\
\text{s.t.} & 3x_1 & + & 2x_2 & \geq & 60 & \quad \text{Constraint A} \\
 & 7x_1 & + & 2x_2 & \geq & 84 & \quad \text{Constraint B} \\
 & 3x_1 & + & 6x_2 & \geq & 72 & \quad \text{Constraint C} \\
 & x_1 & , & x_2 & \geq & 0. &
\end{array}
$$

Farmer Dave's Decision Problem



Farmer Dave's Decision Problem

From the solution of the graphical method, it is clear that the optimal solution occurs at the intersection of lines A and B, at point (6,21), with an objective value of $z = 123$.

Farmer Vicky's Decision Problem

Let x_1 be the number of kgs of corn to purchase; and x_2 the number of kgs of soybean purchase. We have $x_1, x_2 \geq 0$.

The objective is to minimize the cost, hence we have:

$$\min z = \quad 0.3x_1 + 0.9x_2$$

Daily requirement constraint

$$x_1 + x_2 \geq 800$$

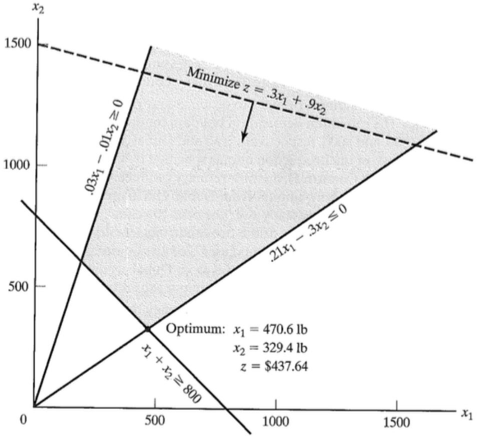
At least 30% protein constraint:

$$\frac{0.09x_1 + 0.6x_2}{x_1 + x_2} \geq 0.3 \quad \Longrightarrow \quad 0.09x_1 + 0.6x_2 \geq 0.3(x_1 + x_2)$$

At most 5% fibre constraint:

$$0.02x_1 + 0.06x_2 \leq 0.05(x_1 + x_2)$$

Farmer Vicky's Decision Problem



Optimal Solution: $x_1 = 470.6$, $x_2 = 329.4$, and $z = 437.647$.