(Group 6)
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Problem 3-15 : *Farm Management :* A firm operates four farms of comparable productivity. Each farm has a certain amaunt of usable acreage and supply of labor hours to plant and tend the crops. The data for the upcoming season are shown in the following table.

FARM	USABLE ACREAGE	LABOR HOURS AVAILABLE PER MONTH
1	500	1700
2	900	3000
3	300	900
4	700	2200

The organization is considering three crops for planting. These crops differ primarily in their expected profit per each acre and in the amount of labor they require, as shown in the following table.

CROP	MAXIMUM ACREAGE	MONTHLY LABOR HOURS REQUIRED PER ACRE	EXPECTED PROFIT PER ACRE ($)
A	700	2	500
B	800	4	200
C	300	3	300

Furthermore, the total acreage that can be devoted to any particular crop is limited by the asociated requirements for harvesting equipment.In order to maintain a roughly uniform workload among the farms, management's policy is that the percentage of usable acreageplanted must be the same at each farm. However, any combination of the crops may be grown at any of the farms as long as all constraints are satisfied (including the uniform-workload requirement). Management wishes to know how many acres of each crop should be planted at the respective farms in order to maximize expected profit. Formulate this as a linear programming model and solve it.

Solution of the problem :

We defined th variables as follows:

(*i* refer that which farm crop is planted.)

XA_i : area for the crop A,

XB_i : area for the crop B,

XC_i : area for the crop C.

Then the model is:

Max : $500*(XA_1+ XA_2+ XA_3 + XA_4) +$
$200*(XB_1 + XB_2 + XB_3 + XB_4) +$
$300*(XC_1 + XC_2 + XC_3 + XC_4)$

s.t. $XA_1 + XA_2 + XA_3 + XA_4 \leq 700$ (crop A limit)
$XB_1 + XB_2 + XB_3 + XB_4 \leq 800$ (crop B limit)
$XC_1 + XC_2 + XC_3 + XC_4 \leq 300$ (crop C limit)

$XA_1 + XB_1 + XC_1 \leq 500$ (farm 1 limit)
$XA_2 + XB_2 + XC_2 \leq 900$ (farm 2 limit)
$XA_3 + XB_3 + XC_3 \leq 300$ (farm 3 limit)
$XA_4 + XB_4 + XC_4 \leq 700$ (farm 4 limit)

$2XA_1 + 4XB_1 + 3XC_1 \leq 1700$ (farm 1 workhour limit)
$2XA_2 + 4XB_2 + 3XC_2 \leq 3000$ (farm 2 workhour limit)
$2XA_3 + 4XB_3 + 3XC_3 \leq 900$ (farm 3 workhour limit)
$2XA_4 + 4XB_4 + 3XC_4 \leq 2200$ (farm 4 workhour limit)

$(1/500)*(XA_1 + XB_1 + XC_1) - (1/900)*(XA_2 + XB_2 + XC_2) = 0$
$(1/500)*(XA_1 + XB_1 + XC_1) - (1/300)*(XA_3 + XB_3 + XC_3) = 0$
$(1/500)*(XA_1 + XB_1 + XC_1) - (1/700)*(XA_4 + XB_4 + XC_4) = 0$

$XA_1 , XB_1 , XC_1 \geq 0$

Note: You can see the solution of the problem in group6_prob15.xls excel document by using the solver.