COLLEGE OF COMPUTING AND INFORMATION SCIENCES
LINEAR PROGRAMMING COURSEWORK

MTH 3107

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QUESTIONS

Dalaus is a soft drinks company produces 3 juices A, B and C using fresh Mangoes, Passions and Pineapples. The daily supply is limited to 200 tons of mangoes, 90 tons of passions and 150 tons pineapples. The cost per ton of mangoes, passions and pineapples is 210,000, 110,000 and 100,000 UGX respectively. Each ton makes 1500liters of mango juice, 1200 liters of passion juice and 1000liters of pineapple juice. The drink mixes are in proportions below

NB $0 \leq \lambda, \gamma(\mu) \leq 1(0.5)$
All drinks are canned in 1 liter bottles and the price per bottle is 1,150, 1,250 and 1,200 for A,B,C respectively. Dalaus wants to maximize profits. The company wants to maximize the profit.

Drink	mango	passion	pineapple
A	λ	$1-\lambda$	
B	μ	μ	$1-2\mu$
C		γ	$1-\gamma$

i. Model their problem as an LP problem. The constants should be part of the LP formulated problem

ii. Develop a program in any language of your choice that will solve the LP problem formulated above when provided with the values of λ, γ and μ. The program should give appropriate error messages in case wrong parameters are provided.

Solution to part (i)

Let the $\mathbf{x_1}$ be for mangoes, $\mathbf{x_2}$ for passion and $\mathbf{x_3}$ be for pineapples.
Which implies;

	mangoes	passions	pineapples
	$\mathbf{x_1}$	$\mathbf{x_2}$	$\mathbf{x_3}$
constraints:	$x_1 \leq 200$	$x_2 \leq 90$	$x_3 \leq 150$

$x_1, x_2, x_3 \geq 0$
$0 \leq \lambda, \gamma \leq 1, \mu \leq 0.5$

Let the total cost be, T

$T = 210000\ x_1 + 110000 x_2 + 100000\ x_3$

The quantity in 1 litre of mangoes passions and pineapple are;

mangoes	passions	pineapples
1500 $\mathbf{x_1}$	1200 $\mathbf{x_2}$	1000 $\mathbf{x_3}$

Total Litres in Fruit **A** would be;
$(1500\ \mathbf{x_1}\lambda + (1-\lambda) * 1200\ \mathbf{x_2})$ Litres

Similarly in Fruit **B** would be ;
$(1500\ \mathbf{x_1}\ \mu + 1200\ \mathbf{x_2}\mu + (1-2\mu) * 1000\ \mathbf{x_3})$ Litres

similarly in Fruit **C** would be**;**
$(1200\ \mathbf{x_2}\gamma + (1-\gamma) * 1000\ \mathbf{x_3})$ Litres.

Let the total sales of Fruit A be $\mathbf{S_1}$, fruit B be $\mathbf{S_2}$ and Fruit C be $\mathbf{S_3}$
Therefore total sales in;

1. A is;
   $\mathbf{S_1} = 1150 * [(1500\ \mathbf{x_1}\lambda + (1-\lambda) * 1200\ \mathbf{x_2})]$
2. B is;
   $\mathbf{S_2} = 1250 * [(1500\ \mathbf{x_1}\ \mu + 1200\ \mathbf{x_2}\mu + (1-2\mu) * 1000\ \mathbf{x_3})]$
3. C is;
   $\mathbf{S_3} = 1200 * [(1200\ \mathbf{x_2}\gamma + (1-\gamma) * 1000\ \mathbf{x_3})]$

Therefor, the total sales, **S** is the sum of sales of A + sales of B + sales of C

$\mathbf{S = S_1 + S_2 + S_3}$

$\mathbf{S} = 1150 * [(1500\ \mathbf{x_1}\lambda + (1-\lambda) * 1200\ \mathbf{x_2})] + 1250 * [(1500\ \mathbf{x_1}\ \mu + 1200\ \mathbf{x_2}\mu + (1-2\mu) * 1000\ \mathbf{x_3})] + 1200 * [(1200\ \mathbf{x_2}\gamma + (1-\gamma) * 1000\ \mathbf{x_3})]$

$\mathbf{S} = [1725000\mathbf{x_1}\lambda + 1380000\mathbf{x_2} - 1380000\mathbf{x_2}\lambda] + [1875000\mathbf{x_1}\ \mu + 1500000\mathbf{x_2}\mu + 1250000\ \mathbf{x_3} - 2500000\ x_3\mu] + [140000x_2\gamma + 1200000x_3 - 1200000\mathbf{x_3}\gamma]$

Profits, P = Total Sales,S -Total Cost, T
P = S – T

p = { [1725000$\mathbf{x_1}$λ + 1380000$\mathbf{x_2}$ - 1380000$\mathbf{x_2}$λ] + [1875000$\mathbf{x_1}$ μ + 1500000$\mathbf{x_2}$μ + 1250000 $\mathbf{x_3}$ - 2500000 x_3μ] + [140000x_2ɣ + 1200000x_3 - 1200000$\mathbf{x_3}$ɣ] } - {[210000 x_1 + 110000x_2 + 100000 x_3]}

P = { [1725000$\mathbf{x_1}$λ + 1380000$\mathbf{x_2}$ - 1380000$\mathbf{x_2}$λ] + [1875000$\mathbf{x_1}$μ + 1500000$\mathbf{x_2}$μ + 1250000 $\mathbf{x_3}$ - 2500000 x_3μ] + [140000x_2ɣ + 1200000x_3 - 1200000$\mathbf{x_3}$ɣ] } - 210000 x_1 -110000x_2 - 100000 x_3]

p = {1725000$\mathbf{x_1}$λ + 1875000$\mathbf{x_1}$μ -210000 x_1} + {1380000$\mathbf{x_2}$ - 1380000$\mathbf{x_2}$λ + 1500000$\mathbf{x_2}$μ + 140000x_2ɣ- 110000x_2} + {1250000 $\mathbf{x_3}$ - 2500000 x_3μ + 1200000x_3 - 1200000$\mathbf{x_3}$ɣ}

on factorization we have,
P = x_1[1725000 λ + 1875000 μ -210000] + $\mathbf{x_2}$ [1380000 -1380000 λ + 1500000 μ + 140000ɣ- 110000] + x_3[1250000 - 2500000μ + 1200000 - 1200000ɣ]

On simplifying we shall have,
x_1[1725000 λ + 1875000 μ -210000] + x_2[1270000-1380000 λ + 1500000 μ + 140000ɣ] + x_3[1370000 - 2500000μ – 1200000ɣ].

Therefore, the Profit P would be;
P = x_1[1725000 λ + 1875000 μ -210000] + x_2[1270000-1380000 λ + 1500000 μ + 140000ɣ] + x_3[1370000 - 2500000μ – 1200000ɣ]