

16/ENG02/062

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QUESTION 1

Linear programming refers to a mathematical modelling technique that deals with the optimization of linear functions or expressions (objective function), example, to minimize or maximize. With given constraints. These constraints are referred to a feasible region or solution space. Example

Maximize $x^5 + y^6$

Where $1 \leq x \leq 15$

And $0 \leq y \leq 10$

The limits of x , and y are referred to as the solution space. Examples of Algorithms include:

1. Criss-Cross algorithm
2. Simplex algorithm

Application of Linear Programming to Engineering

1. Modelling and Designing of system:

Example: Design of Drones Delivery system that takes into consideration the Battery Consumption rate, payload, weather and distance. Amazon Prime Air are currently experimenting with such a system that would be able to deliver parcels to consumers, while minimizing for cost and delivery time. Taking into consideration that the battery is a linear function of the payload, which means that the battery consumption rate depends on how heavy what its carrying is.

Example 2: In the design of cars which is optimized for speed, which various constraints such as Engine type, weights, tire types, etc.

2. Simulation Software:

Example: Modeling and Simulation of Growth and Lipid Accumulation of *Phaeodactylum tricornutum*. To accomplish this, a simulation software is used to optimize for nutrient content while putting a constraints on the light intensity that should hit the produce and also finding the minimum amount of electricity required to carry this out.

QUESTION 2

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$P =$ printers made per week

$K =$ keyboards made per week

iii) maximize:

$$M = 30P + 20K$$

Constraints

$$2P + K \leq 1000$$

$$P + K \leq 800$$

$$\therefore M - 30P - 20K = 0$$

	P	K	s_1	s_2	M	
First Row $\rightarrow T_2$		1	1	0	0	1000
	1	1	0	1	0	800
	30	-20	0	0	1	M

	P	K	s_1	s_2	M	
	1	$\frac{1}{2}$	$\frac{1}{2}$	0	0	500
	1	1	0	1	0	800
	-30	1	0	0	1	0

$$-R_1 + R_2 \rightarrow R_2$$

$$30R_1 + R_3 \rightarrow R_3$$

	P	K	s_1	s_2	M	
	1	$\frac{1}{2}$	$\frac{1}{2}$	0	0	500
	0	$\frac{1}{2}$	$\frac{1}{2}$	1	0	300
	0	-5	15	0	1	5000

$2R_2$	P	K	S_1	S_2	M	
R_1 S_1	1	$1/2$	$1/2$	0	0	500
S_2 K	0	1	-1	2	0	600
R_2	0	-5	15	0	1	15000

$$-1/2 R_2 + R_1$$

$5R_2 + R_3$	R_1	R_2	S_1	S_2	C	
	1	0	1	-1	0	200
	0	1	-1	2	0	600
	0	0	10	10	1	15,000

ΣM (maximum value)

$$\text{Printers} = 200$$

$$\text{Keyboards} = 600$$

$$\therefore C = 30P + 20K$$

$$\therefore 30(200) + 20(600)$$

$$= 15000$$