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COE 512

1) Linear Programming can be defined as an optimization technique for a system of linear constraints and a linear objective function. All of the quantifiable relationships in the problem are linear. The values of variables are constrained in some way. The goal is to find values of the variables that will maximize some quantity.

APPLICATIONS OF LINEAR PROGRAMMING IN ENGINEERING

- Engineers use linear programming to help solve design and manufacturing problems. For example, in airfoil meshes, engineers seek aerodynamic shape optimization. This allows for the reduction of the drag coefficient of the airfoil. Constraints may include lift coefficient, relative maximum thickness, nose radius and trailing edge angle. Shape optimization seeks to make a shock-free airfoil with a feasible shape. Linear programming therefore provides engineers with an essential tool in shape optimization.

b) Professional Engineering

Engineers including architects, Surveyors and a variety of engineers in fields such as biomedical, electrical, chemical etc use linear equations to calculate measurements for both solids and liquids. An electrical engineer for example uses linear equations to solve problems involving Voltage, Current and resistance.

c) Computer Programmers also use Linear Equations.

It is used within software applications on websites and security settings which must be programmed by a Computer Engineer. It can also be used to troubleshoot software and networking issues. Eg a programmer might use linear equations to calculate the time needed to update a large database of information.

QUESTION 2

Contribution margins of printers and keyboard.

$$W = 30x_1 + 20x_2 \rightarrow \text{Objective function}$$

Subject to;

$$2x_1 + x_2 \leq 1000$$

$$x_1 + x_2 \leq 800$$

$$\text{where } x_1 \geq 0, x_2 \geq 0$$

Constraints

Applying Simplex method.

	x_1	x_2	S_1	S_2	b	
R_1	(2)	1	1	0	1000	$S_1 \leq 500$
R_3	1	1	0	1	800	$S_2 \leq 800$

Divide R_1 through by 2

	x_1	x_2	S_1	S_2	b	
R_1	1	$\frac{1}{2}$	$\frac{1}{2}$	0	500	x_1
R_2	1	1	0	1	800	S_2
R_3	-30	-20	0	0	0	

$$-R_1 + R_2 \rightarrow R_2$$

$$30R_1 + R_3 \rightarrow R_3$$

	x_1	x_2	S_1	S_2	b	
R_1	1	$\frac{1}{2}$	$\frac{1}{2}$	0	500	x_1
R_2	0	$\frac{1}{2}$	$\frac{1}{2}$	1	300	S_2
R_3	0	-5	15	0	1500	

↑
Pivot element

Divide R_2 through by $\frac{1}{2}$

	x_1	x_2	S_1	S_2	b	
R_1	1	$\frac{1}{2}$	$\frac{1}{2}$	0	500	x_1
R_2	0	1	1	2	600	x_2
R_3	0	-5	15	0	1500	

0 ≤ 1500

$$-\frac{1}{2} R_2 + R_1 \rightarrow R_1$$

$$5R_2 + R_3 \rightarrow R_3$$

	x_1	x_2	S_1	S_2	b	
R_1	1	0	0	-1	200	x_1
R_2	0	1	1	2	600	x_2
R_3	0	0	20	10	18000	

From the Simplex Table, we see that
the minimum value = 18,000 hrs

Hence to maximize Contribution margin,
Total working hours = 18,000 hours.

$$x_1 = 20, x_2 = 10$$