OPERATIONAL RESEARCH (LINEAR PROGRAMMING PROBLEM SIMPLEX)

Linear Programming (LP)

- LP is a mathematical modeling technique used to maximise or minimize objective function, with respect to some restrictions called constraints

Applications Linear Programming in Mauritius

- Business & Marketing Company -Vivea Moka
- Medine Group
- Banks (SBM & MCB)
- Farey co ltd Mauritius

LP Model Formulation

- Decision variables
  - mathematical symbols representing levels of activity of an operation
- Objective function
  - a linear relationship reflecting the objective of a given situation

  Note : In most cases one wants to maximize profit of the company by minimizing the salaries of the workers

  - **Note** : Low Input Workers =High output
- Constraint
  - a linear relationship representing a restriction

LP Model Formulation (standard Form)

Max/min $\quad z = c_1x_1 + c_2x_2 + \ldots + c_nx_n$

subject to:

$$
\begin{cases}
a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n \ (\leq, =, \geq) \ b_1 \\
a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n \ (\leq, =, \geq) \ b_2 \\
\vdots \\
a_{m1}x1 + a_{m2}x_2 + \ldots + a_{mn}x_n \ (\leq, =, \geq) \ b_m
\end{cases}
$$

x_j = decision variables
b_i = constraint levels
c_j = objective function coefficients
a_{ij} = constraint coefficients

Linear Programming (LP)

- Wake up question !

What is a feasible solution ?

What is unbounded solution?

Linear Programming (LP)

- A set of real values which x_i satisfies the constraints along with non negativity restrictions and optimizes the objective function is called optimal solution, i.e feasible solution optimizing the objective function is called optimal solution.

A set of real values that satisfies the constraints and optimizes the objection function is called optimal solution

- Note 1 :An LPP can have many optimal solutions.
- Note 2 :If the optimal value of the objective function is infinity, then the LPP is said to have **unbounded solution**.
- Note 3 :A LPP may also not posses any feasible solution.

Example of LPP

A manufacturer produces 2 types of models P_1 and P_2. Each P_1 model requires 4 hours of grinding and 2 hours of polishing whereas each P_2 model requires 2 hours of grinding and 5 hours of polishing. The manufacturer has 2 grinders and 3 polishes. Each grinder works for 140 hours a week and each polisher works for 160 hours a week. Profit on an P_1 model is Rs13 and on an P_2 model is Rs14. Whatever is produced in a week is sold in the market in Quatre-Bornes Mauritius. How should the manufacturer allocate his production capacity to the types of models so that he may make the maximum profit in a week?

LP Formulation: Example on Reformulation

Maximize $Z = \$40\, x_1 + 50\, x_2$

Subject to

$$x_1 + 2x_2 \leq 40 \text{ hr} \quad \text{(soil constraint)}$$
$$4x_1 + 3x_2 \leq 120 \text{ lb} \quad \text{(sand constraint)}$$
$$x_1, x_2 \geq 0$$

Solution is $x_1 = 24$ plate $x_2 = 8$ fork

Revenue = \$1,360

LP Model: Example on Reformulation

	RESOURCE REQUIREMENTS		
PRODUCT	*Soils (lb/unit)*	*Sand (lb/unit)*	*Income ($/unit)*
Plate	1	4	40
Fork	2	3	50

There are 40 pounds of soil and 120 pounds of Sand available each day

Decision variables

x_1 = number of Plate to produce

x_2 = number of Fork to produce

Minimization Problem -Example

CHEMICAL CONTRIBUTION

Brand	*Lithium (lb/bag)*	*Sodium (lb/bag)*
Gro-plus	2	4
Crop-fast	4	3

Minimize $Z = \$6x_1 + \$3x_2$

subject to

$$2x_1 + 4x_2 \geq 16 \text{ lb of Lithium}$$
$$4x_1 + 3x_2 \geq 24 \text{ lb of Sodium}$$
$$x_1, x_2 \geq 0$$