Preparing a Problem Definition for LPP for Windows.

Let us consider a typical problem definition on a smaller scale and prepare a model for it. It is hoped that this illustration will educate the user enough to formulate any other problem.

Example Problem.

Cola Products is a company engaged in producing soft drinks since 1970. The company has the following three products in the market :

1 - COLA
2 - LEMONADE
3 - SODA

Due to sharp competition in the market the company has to maintain certain price level to set their share of the market. However, there has been a sharp rise in the production costs and the profit margin has reduced drastically. An appraisal of the production process has revealed that obsolete equipment is responsible for this rise in costs.

As a policy decision, Cola Products has decided to liquidate its present equipment and install a new cost-effective production system. This new system would be divided into two distinct lines one for COLA and the other for LEMONADE and SODA.

The contribution figures for each of the products are as below :

COLA	: $ 250 per unit
LEMONADE	: $ 190 per unit
SODA	: $ 175 per unit

A technical report mentions the capacity of the new system as below :

COLA Production Line	7,000 litres/day
LEMONADE/SODA Production Line	
- If devoted exclusively to LEMONADE	40,000 litres/day
- If devoted exclusively to SODA	80,000 litres/day

In other words LEMONADE takes 50% longer time than SODA.

The Company has man-hours of labor available per day. The technical report further states that the labor requirement for each of the products are as below :

COLA	: 2 man-hours for 1,000 litres
LEMONADE	: 1 man-hours for 1,000 litres
SODA	: 1 man-hours for 2,000 litres

In addition to the above constraint, the Marketing Department requires minimum 20,000 litres of SODA per day to maintain the market share.

Fomulating the Problem.

Before proceeding to formulation, we have to identify the following :

- The Objective of the exercise
- The Decision Variables contributing to this objective.
- The Objective Function, the contribution of each decision variable to the objective.
- The Constraint guiding the objective.
- The Relation between the Constraints and Decision Variables.

Let us proceed step by step and define each of the above.

OBJECTIVE : To MAXIMIZE contribution arising from sale of the products.

DECISION VARIABLES : The variables contributing to the above objectives are the products viz. COLA, LEMONADE, SODA. We are going to decide how much of each, and hence they are called Decision Variables.
There are, therefore 3 Decision Variables :
A - Units of COLA to be produced
B - Units of LEMONADE to be produced
C - Units of SODA to be produced

OBJECTIVE FUNCTION : The contribution of each Decision Variable to the Objective Function is known :
- COLA : $ 250 per unit
- LEMONADE : $ 190 per unit
- SODA : $ 175 per unit
Our Objective , therefore can now be stated as :
MAXIMIZE - 250 x A + 190 x B + 175 x C

CONSTRAINTS : We have three types of constraints to tackle viz. Production line, Labour and Marketing demand.
Let us consider all these constraints one at a time.

First Constraint : COLA Production capacity which is Maximum 7,000 litres/day.
Second Constraint : LEMONADE + SODA Production capacity which is Maximum 80,000 litres/day.
Third Constraint : Labor availability which is Maximum 70 hrs/day.
Fourth Constraint : Minimum SODA Production required which is Minimum 20,000 litres/day.

We can now restate the constraints as :

COLA Production	<= 7,000
LEMONADE & SODA	<= 80,000
Labour Availability	<= 70
SODA Production	>= 20,000

Further if we change the unit of product to 1,000 litres,

COLA Production	<= 7
LEMONADE & SODA	<= 80
Labour Availability	<= 70
SODA Production	>= 20

In the constraint definition above, you will see that the *Constraint Limits* are written on the Right Hand Side, hence they are termed as *Constraint RHS* by LPP for Windows.

Defining Relation Between Constraints & Decision Variables

Here we define how these constraints affect the decision variables and consequently the objective function. Let us go one constraint at a time.

1. COLA PRODUCTION.
   Maximum units of COLA that is (A) can be produced <= 7

2. LEMONADE & SODA PRODUCTION
   The LEMONADE & SODA Production can be expressed as **1.5 x B + C**
   Since LEMONADE (B) takes 50% longer than SODA (C) on that line.
   The relation is therefore : **1.5 x B + C <= 80**

3. LABOR AVAILABILITY
   Considering the Labor requirements for the various products we can define it as :
   2 x A + B + 0.5 x C <= 70

4. MINIMUM SODA PRODUCTION.
   Minimum SODA that is (C) to be produced >= 20
   C >= 20

The Matrix of Coefficients
The definition of relation between Constraints and Decision Variables is called the MATRIX OF COEFFICIENTS. The factors used with the Decision Variables in the above inequalities are called Coefficients.

Example : **2 x A + B + 0.5 x C = 70**
Here the coefficients are 2, 1 and 0.5 for A, B and C respectively.

The problem is now formulated.
This sample problem definition comes along with LPP for Windows.
Open sample.lpp *to work on this problem.*