Optimization is a quantitative approach for selecting the best (minimum or maximum) decision that fits all the constraints. Linear programming is important because firstly, it represents the essence of business decision problem. It helps decision makers to convert verbal descriptions and numerical data into mathematical expressions. Solving the business problems such as labor, material, machine working time etc. to get the maximum or minimum value. Secondly, there will be a sensitivity report provided with Excel Solver, which provides more information to identify the existence of alternate optimal solutions.

Linear programming is the most ubiquitous being used in many industries today. The example that I am going to introduce is in manufacture industry. A small factory produces 2 toys: bicycles and trucks. Each bicycle would profit $16 and each truck profits $14. There are two machines need to be used, lathe could operate 16 hours a day and 2 assemblers would work 24 hours in total. The working hour for each toy is listed below,

A screenshot of a cell phone

Description automatically generated

To solve a linear programming question, we consist of the following 4 steps: define the decision variables, identify the objective function, identify constraints, and write mathematical expressions that fit all constraints. First step, we identify all the decision variables. We wish to find the maximum profits for the factory, so we have x,y to be the number of bicycles and trucks to be made, respectively. Step 2, the objective function would be: 16x + 14y. Step 3, identify constraints. According to data that listed in the above table, the equations would be: 2x + y < 16, 2x +3y < 24. Step 4, plot this two linear equations, we get the solution of x,y as (6,4), the profit is $152.

In order to change the constraint inequalities into equalities, we could use slack variables. The earlier steps are similar. In step 3, when we identify constraints, introduce two slack variables, s1 and s2, so we have:

2x + y + s1 = 16.

2x + 3y + s2 = 24.

In step 4, use simplex tableau and get the same point as earlier graphical solution: (6,4).

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Reference:

<https://mei.org.uk/files/pdf/09conference/2009handoutb4.pdf>