The Simplex Method for Standard Maximization Problems

Given a standard maximization problem with objective function \( P = ax + by + cz + \ldots \) and a set of constraints, the simplex method is as follows:

1. **Write the initial tableau:**
   
   (a) Rewrite the constraints using slack variables. *(These should be equalities!)*
   
   (b) Rewrite the objective function so that all of the variables are on the left, as follows:
   \[
   -ax - by - cz - \ldots + P = 0
   \]
   
   (c) Put all of the equations into an augmented matrix, with the objective function in the bottom row below a horizontal line.

2. **Decide if the optimal solution has been reached:**
   
   Examine all of the entries in the last row of the matrix that are to the left of the vertical bar.
   
   (a) If all of the entries are non-negative, then the solution has been found. **Skip to step 4.**
   
   (b) If there are negative entries, go on to step 3.

3. **Perform a pivot operation:**
   
   (a) Choose the pivot element.
   
   i. Locate the most negative element in the last row to the left of the vertical bar. The corresponding column is the pivot column. *(If there is more than one such column, choose any one.)*
   
   ii. Divide each positive entry in the pivot column above the horizontal line into the corresponding number in the last column. The row with the smallest ratio is the pivot row. *(If there is more than one such entry, choose any one.)*
   
   iii. The element where the pivot column and the pivot row intersect is the pivot element.
   
   (b) Convert the pivot element to a 1.
   
   (c) Use row operations to transform the pivot column into a unit column \( \Rightarrow \) all zeros except pivot element.
   
   **** For (b) AND (c), use SMPLX program. ****
   
   (d) Return to step 2.

4. **Determine the solution:**
   
   (a) Set all non-basic variables equal to zero.
   
   (b) Set all basic variables equal to the corresponding element in the last column.