

A General Simplex Method

Highlighted steps below are additions to our previous simplex method!

For the Simplex algorithm to work the problem must be in standard form, which means that:

- i. The objective function is to be maximized.
- ii. All constraints are of the form: *linear expression* $\leq$ *non-negative constant*
- iii. All variable values must be greater than or equal to 0.

If a problem violates one or more of these requirements it can be converted into standard form as follows.

1. **Rearrange the objective function** into an equation equal to a constant (possibly 0). If you are minimizing instead of maximizing negate this equation.
2. **Convert all constraint inequalities** of form *linear expression* $\geq$ *non-negative constant* into the form *linear expression* $\leq$ *non-negative constant* by multiplying by -1 (don't worry for now if the constant is negative).
3. **Introduce slack variables** to convert each constraint inequality into an equality.
4. **Enter the equations into the simplex tableau** (matrix).
5. If a negative number appears in the upper part of the rightmost column, remove it by **pivoting** as follows:
 - a) Select one of the negative values in its row. This value's column will be the **pivot column**.
 - b) The **pivot element** will be the element in the column with the smallest positive ratio with the constant column.

Repeat this procedure until no negative values remain in the upper part of the rightmost column.
6. While there are negative values in the left part of the bottom row pivot the tableau according to these rules:
 - a) **Calculate the pivot column**. It is the column with the most negative entry in the left part of the bottom row.
 - b) **Calculate the pivot element**. Divide each element in the pivot column into the corresponding element in the last column. The pivot element is the one with the smallest non-negative quotient.
 - c) **Pivot** the tableau about this element to get a new tableau.
 - d) In the new tableau **relabel the pivot row** with the pivot column variable.
7. **When** all the values in left part of bottom row are positive, the solution can be read from the tableau.