SHORT THEORY INTRODUCTION

**Introduction**

Simplex algorithm (also called simplex method), discovered by George B. Dantzig in 1947, is a way of solving linear optimization problems.

**Linear Optimization**

Before we jump right into the simplex method itself, let us go through a brief explanation, what linear optimization (also called linear programming) actually is. The procedure itself is based around maximizing / minimizing the outcome of various mathematical scenarios, represented by linear relationships.

Suitable examples might be:   
- maximizing profit of production  
- maximizing (and hence optimizing) resource usage  
- minimizing costs (production, delivery, etc.)

The mathematical scenarios, which are to be solved via linear optimization, have important aspects worth explaining:  
  
1. Constraints – limits or boundaries of the given scenario  
 - e.g. amount of resources, amount of time, etc.  
 - represented via linear equations or inequalities  
 - are used to determine the feasible region

2. Feasible Region – a set of all possible values, that satisfy all given constraints  
 - represented by a convex polytope  
 - flat-sided n-dimensional geometric shape  
 - no internal angle is greater than 180°  
 - no line connecting any points inside goes outside the region

Of course Simplex is not the only algorithm known to be used for linear programming, other notable ones are: criss-cross algorithm, ellipsoid algorithm, projective algorithm and path-following algorithm.

**Simplex Method**

As was already mentioned, the simplex method is used for linear optimization and is claimed to be among the most popular algorithms available. This might be due to the following aspects:  
  
PRO:

* Relatively easy to implement
* Easy to use
* Practice efficiency  
  - in areas such as Production Management, Distribution, Finance

CONTRA:

* Worst case complexity almost never occurs  
  - but would lead to exponential compute time
* Calculation – heavy  
  - only regarding manual calculations
* Only specific scenario limitations

Nevertheless, let us proceed to the actual process of using the Simplex Algorithm in practice:

1. What needs to be done first, is the setting of the constraints
2. After the first necessary step, we begin shaping the Standard form  
   - creation is only allowed by setting constraints
3. Followed by creating the Extended Standard Form  
   - formed via introduction of Slack/Surplus variables  
   - represented by fulfilling the following rules:  
    1. Non-negative constraints of all variables  
    2. All remaining constraints expressed as equalities  
    3. RHS vector being non-negative
4. Forming the Canonic “Simplex” Tableau
5. Performing pivot operations  
   - choosing the pivot column (via most negative number in the bottom row)  
   - choosing the pivot row (via dividing RHS by the row value and choosing the lowest result)  
   - making these two into the pivot (or pivoting point) and turning its value to 1  
   - making every value “above” and “below” to 0  
   - repeating this cycle until there are no negative numbers in the bottom row

The graphical documentation with step-by-step explanations and tutorials to the manual usage of the simplex method, excel / other SW implementation are to be found in other divisions of the webpage.