Requirements for Solution of Linear Programming

Marie Tomšová

Department of Mathematics, Faculty of Electrical Engineering and Communication
University of Technology Brno, Technická 8, 616 00 Brno, Czech Republic,
e-mail: tomsova@feec.vutbr.cz

This paper shows a method for solution of optimizing problems which is different from the usually used *Simplex method*. The simplex method is considered one of the basic models from which many linear programming techniques are directly and indirectly derived. The simplex method is an iterative process which approaches, step by step, an optimum solution in such a way that an objective function of maximization or minimization is fully reached. Each iteration in this process consists of shortening the distance (mathematically and also graphically) from the objective function to the intercepted vertex of a convex set determined by the inequalities which describe the problem.

The number of iterations to be applied is not fixed and cannot be predicted with a high degree of accuracy. Experience indicates that the most frequent number of iterations is equal to the number of inequalities in a given set. This does not always hold true, but nonetheless it gives a rough and approximate idea of the number of iterations.

The simplex method has a very wide span of utilization. Its use is a matter of routine; in fact, it can be advantageously applied by using punched card equipment or computers. When each iteration is completed, the results are automatically checked and if the required objective has not yet been reached, another complete cycle is repeated by computing the data obtained from the previous iteration.

The objective function can be satisfied by maximizing certain functions such as profit, margin, returns, utilization, capacities, occupancy, time, or minimizing such functions as cost, scrap, distance, weight, and time. The problem must be described by mathematical notation, and all restrictions or constraints which confine the solution into a well-bounded area must also be presented in the form of inequalities with nonnegative variables.

The problem to be solved should be described in appropriate form in such way that restrictions, constraints, confines and all other possible conditions limiting the problem are not overlooked. These requisites can be summarized as follows:

1. A well-defined objective must be clearly stated and expressed by a function.
2. All data entered in the description of the problem must be expressed in quantitative form.
3. An alternative choice among factors must be feasible, such as the possibility of choosing machine work or manual work, machines and processes.
4. Only linear functions expressing contraints and restrictions may be used.
5. The problem must be completely described by mathematical notation. For the fourth requirement above, all equations are linear, i.e. of the first degree. Higher powers are not admissible in the computation.

When all these requirements are fulfilled, the simplex method can be applied. No computation more complex than the four elementary operations (addition, subtraction, multiplication, and division) is used in the simplex method.

The simplex method requires that the problem be described by mathematical formulation. Generally the unknowns are $x_1,\ x_2,\ x_3,\ \dots\ , x_n$, which also are the values indicating the solution to the problem. The input-output coefficients rep[resenting the conditions of the restrictions for each inequality are

$a_{11},\ a_{12},\ ...\ , a_{mn}$ and the known values (or constants) that need not be exceeded by the solution are $b_1,\ b_2,\ ...\ b_m$
The simplex method is not the only technique known and used for solving linear programming problems. Other methods are more useful for the pedagogical expediency, see e.g. R. Dorfman, P.A.Samuelson, and R.M.Solov, *Linear Programming and Economic Analysis*, New. York: McGraw-Hill Book Comp. Inc., 1958. I introduce a method different from the simplex method. This method is based on the principal of graphical method of optimization of linear problems for two variables, but my method is generalized for n variables and arbitrary finite number of inequalities descibing the problem.

References

[1] CHURCHMAN, CH.W., ACKOFF R.L., ARNOFF L. : *Introduction to Operation Research.* New York, John Wiley & Sons. Inc. 1957.

[2] KLAPKA J., DVOŘÁK J., POPELA P.: *Metody operačního výzkumu.* Brno, VUTIUM, 2001

[3] RAIS K.: *Vybrané kapitoly z operační analýzy.* Brno PGS 1985.

[4] VACULÍK J., ZAPLETAL J.: *Podpůrné metody rozhodovacích procesů* . Masarykova univerzita, Brno 1998.

[5] WALTER J. a kol.: *Operační výzkum.* Praha SNTL,1973.

[6] ZAPLETAL J.: *Operační analýza.* Kunovice Skriptorium VOŠ 1995