ABSTRACT

Revised simplex algorithm is a proven, well founded and established procedure to solve linear programming problems. It is essentially a univariate search technique and exhibits slow convergence properties. Researchers of the past succeeded only marginally in their attempts to bring more than one variable at a time into the basis and this was not pursued seriously because of the discouraging note put up by the earlier researchers. The conclusion of that study was that univariate search technique is still the best to solve linear programming problems. Though multivariate search techniques possess rapid converging properties, the main obstacle in employing it was, the selection of a set of linearly independent vectors to form a starting or intermediate basis. This was overcome recently by the development of a multiplex algorithm. Multiplex algorithm makes a search in the direction of the steepest ascent/descent of the objective function.

In this thesis the extension of multiplex algorithm's capabilities are further explored and multiplex and dual multiplex algorithms have been developed using data structure concepts to solve LP problems. A matrix of intercepts (referred to as "θ" matrix) of the promising
variables is constructed to select more than one variable to enter the basis and similarly another intercept matrix is constructed to select more than one variable to leave the basis. These matrices enable to select a set of linearly independent vectors to enter and leave the basis. In the multiplex and dual multiplex algorithms with data structure concept, only non-zero entries of the constraint coefficient matrix and the other required matrices are stored using linked list representation. This algorithm reduces the number of iterations and consequently the computational efforts considerably.

The proposed algorithm arrests variables popping in and out of the basis. In otherwords, it attempts to bring into the basis only such variables which when once entered, do not leave the basis until the optimal solution is obtained. This property has significantly contributed to the computational efficiency. The number of iterations and computations required for this algorithm is less compared to the revised simplex algorithm.

Especially this algorithm is more effective in handling linear programming problems which have constraint matrix of high sparsity. This algorithm is extended to solve problems amenable to solution by the decomposition principle. The multiplex and dual multiplex algorithms are applied to
seek quickly the optimal solution in the sensitivity study of LP solutions. The proposed method can be easily extended to solve integer programming problems. It has been observed that the multiplex and dual multiplex algorithms with data structure concepts are efficient over the simplex method.

Programs have been developed in PASCAL using the following four methods:

i. Revised simplex method
ii. Revised simplex method with data structure
iii. Multiplex and dual multiplex algorithms and
iv. Multiplex and dual multiplex algorithms with data structure.

The above four algorithms are modified for solving problems amenable to solution by the decomposition principle and seeking optimal solution in the sensitivity study of LP solutions. A number of linear programming problems was run on VAX 11/780 system and the results are compared.

The algorithms proposed in this thesis have vast scope and potential to handle problems having high sparsity in the constraint matrix. In the light of the vast potential, it may be challenging to explore and exploit further avenues to improve the computational efficiency.