ABSTRACT

The simplex algorithm used to solve LP Problems is essentially an edge directed search technique and suffers from the drawback of slow convergence. Researchers of the past failed in their attempts to bring more than one variable at a time into the basis, with a view to accelerating the rate of convergence. The conclusion of that study was that univariate search technique is still the best to solve linear programming problems. Though multivariate search technique (such as the gradient method) possesses rapid converging properties the main obstacle in employing it was, how to select a set of linearly independent vectors to form a starting or intermediate basis. This obstacle was recently overcome by the development of a multiplex algorithm.

The construction of the intercept matrix has been suitably modified in this work to improve the computational efficiency.

The modification suggested in the multiplex algorithm, is capable of cutting across the constraint set and finding optimal solution in a single pass. The multiplex algorithm works 15 to 20 times faster than the simplex even for medium size problems. The savings come from two fronts. On one hand this algorithm does not compute the relative contribution/cost coefficient for each
variable as many times as the simplex and on the other hand it suppresses the tendency of variables popping in and out of the basis.

A very significant and conclusive finding from the computational experience is that the non-preservation of feasibility property has considerably accelerated the rate of convergence. However, a revised multiplex algorithm was developed to maintain the feasibility of solution and to study its effect on the rate of convergence. In the course of this investigation a new range of basic solutions which, hitherto was not of much interest to researchers was hit.

The range of solution has been divided into two regions in one of which the multiplex algorithm is employed to accelerate the rate of convergence and in the other, the dual multiplex algorithm is used to remove infeasibility from the solution in as few passes as possible. These two algorithms, each employed at appropriate times improve the rate of convergence very significantly.

The preservation of the feasibility property acts only as a drag on the rate of convergence and this explains why the simplex algorithm is painfully slow compared to the multiplex and its derivatives. Some of the examples reveal that the saving in computational effort is independent of the preservation or otherwise of the feasibility property and in some others its preservation worsens.
the computational efficiency.

The modified multiplex algorithm was extended to solve bounded variable problems and very encouraging results were achieved. A dual multiplex algorithm has been developed to remove a set of infeasible variable from the basis at a time. This algorithm is found to work more or less the same way as the dual simplex for small problems but was found to be quite efficient for medium and large size problems.

Extension of multiplex algorithm with suitable modifications to solve quadratic programming problems has also been attempted. It is found from computational experience that multiplex algorithm works equally efficiently in solving quadratic programming problems also.

The multiplex algorithm proposed in this thesis have vast scope and potential to handle problems having high sparsity in the constraint matrix. It could be easily extended to solve problems amenable to solution by the decomposition principle.

In the light of the vast potential, the multiplex algorithms seem to possess, it may be challenging to explore and exploit further avenues to improve the computational efficiency.