STUDIES IN INTEGER PROGRAMMING: NEW DIRECTIONS AND SOLUTION METHODS

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BSc. (Hons) and MSc.

A Thesis Submitted to the

DEPARTMENT OF APPLIED MATHEMATICS
FACULTY OF APPLIED SCIENCES
NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

In Fulfillment of the Requirements for the Degree

of

DOCTOR OF PHILOSOPHY IN OPERATIONS RESEARCH

ABSTRACT

The thesis presents studies in pure integer programming *(PIP)* models so as to come up with new directions and solution methods. The first solution method is a descending path algorithm for solving the general *PIP* model. This is a method that follows a descending path from the linear program (*LP*) optimal solution to its optimal integer point and is controlled by a characteristic equation developed from the *LP* solution. A binary integer programming *(BIP)* model is a special case *PIP* and a descending path algorithm for *BIP* models with special features is also presented. The second approach is the ordered branch technique that is used to solve the characteristic equation. An ordered branch is used to construct an ordered tree and the optimal integer solution is obtained from the smallest feasible node in the ordered tree, which is traced from the path that comes from the root node to the smallest feasible node. Other strategies within the ordered branch approach that can improve efficiency for solving the characteristic equation are also considered. The third method is a technique for significantly improving the efficiency of the branch and bound method for solving *PIP* models. In this approach, Gomory cuts are used to generate an alternative *PIP* model, which is relatively simpler and easier to solve. This alternative *PIP* model has many features that make it easier to solve when compared to the original *PIP* model. The fourth approach is the primal-dual concept used in solving transportation problems. The concept is also extended to the transshipment model and the advantage is that a primal-dual feasible solution does not have to be subjected to any test of optimality. The last solution method is an efficient technique to determine free floats associated with the non-critical activities and optimal crash limits for various critical activities in a critical path network method. The new critical path and new associated floats can be computed without analyzing the complete network all over again. The computational efforts of these new ideas were found to be more effective when compared to some of the existing methods using standard benchmark problems. Suggested directions for further work with regard to software development and testing are also discussed.