PREFACE

This thesis entitled "MULTIOBJECTIVE PROGRAMMING IN SOME STATISTICAL PROBLEMS" is submitted to the Aligarh Muslim University, Aligarh, India, to supplicate the degree of Doctor of Philosophy in Operations Research. It consists of the research work carried out by me in the Department of Statistics and Operations Research, Aligarh Muslim University, Aligarh, India.

The development of efficient algorithms for the problems of Multi-objective Programming in diverse fields has been of primary concern of the Operations Researchers for last four decades.

Single objective mathematical programs are commonly used in many Operational decision making processes. But, there are many situations where the decisions depend upon multiple objectives. In such situations, one wants to attain simultaneous goals, some of which conflict with each other. This type of situation in mathematical programming format gives rise to multiobjective programming. There are several conventional optimization based methods available for solving multiobjective programming models, such as Goal programming, Weighted
Some problems of deriving Statistical information on several characteristics of a population based on sample data, can be formulated as multiobjective programming problems in which we wish to minimize the cost of the survey, which is a function of the sample size, size of sampling unit, the sample scheme etc, subject to the restriction that the loss in precision arising out of making decisions on the basis of the sample results is within a certain prescribed limit and vice-versa. Thus we are interested in finding the optimal sample size and the optimal sampling scheme which will enable us to obtain estimates of the population characteristics with prescribed properties.

In stratified sampling the population is first divided into mutually exclusive and exhaustive groups called strata. An important problem in stratified sampling is the determination of optimum sample sizes (allocation) for different strata. They may be found by minimizing the sampling variance of the estimator for a fixed cost or to minimize the total cost of the survey for a desired precision.

In multivariate stratified sampling where more than one population characteristics are under study, the optimum
allocation of the sample sizes to various strata becomes complicated due to the fact that an allocation that is optimal for one characteristic may be far from optimal for other characteristics.

In chapter I of this thesis we give an introduction to multi-objective optimization and discuss the development of the solution methods for it. Several statistical problems are then viewed as multi-objective programming problems. An introductory note on cluster analysis is also presented.

The problem of sample allocation in multivariate stratified sampling is formulated as a multi-objective convex programming problem with a linear constraint in chapter II. We linearize the convex functions arising in the problem at suitable points and then the approximated LPP is solved through fuzzy goal programming approach. A numerical illustration is also presented.

In chapter III, the multivariate allocation problem is solved by using the Fuzzy programming model and also by using the Chebyshev goal programming model through the sequential multiplex approach. A comparison is also made between fuzzy and Chebyshev solutions through a numerical illustration.
In chapter IV, we consider the multivariate allocation problem with upper limits on the available costs for various characters. This problem is formulated as a multi-objective programming problem with several convex objective functions and linear constraints. The convex functions are linearized by using the cutting plane technique and the resulting multi-objective LPP is solved by fuzzy programming approach.

Cluster analysis is a vital and frequently encountered problem across a diverse spectrum of applications. It is concerned with the 'best' assignment of objects, persons, variables, symbols etc. into a smaller number of mutually exclusive groups or clusters so that the members within a group are similar to each other in some sense. The problem of clustering becomes more typical when multiple characters are to be measured on each of the member, as the optimum result for one character may differs from the other. By choosing a suitable clustering criterion a cluster analysis problem may be formulated as a mathematical programming problem.

In chapter V of this thesis we solve the problem of multicharacter cluster analysis by using fuzzy programming approach. A numerical example is also given for illustrating the method.