GROUP SCREENING DESIGNS WITH MORE THAN TWO STAGES

By

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SUMMARY OF CONTENTS

The problem of finding a few defective or effective factors out of a large population consisting of defective and non-defective factors is not new. Designs used in this kind of investigation are known as factor screening designs. Several authors have made contributions in this area. Connor [1], Watson [27], Patel [12], [13], [14], and Ottieno [11] have approached this problem from the point of view of designs of experiments and have called these designs "Group-Screening Designs". This thesis which is an extension of Patel's paper [13] and Ottieno's thesis [11], will be along similar lines.

Chapter I gives basic ideas in group-screening designs and describes briefly some relevant work that has been done by various authors. The chapter also sets out the basic assumptions which are used in subsequent development of the theory in later chapters. These assumptions are similar to those made by the above authors. Lastly, some applications of group-screening designs are briefly discussed.

In Chapter II, the three-stage group-screening design has been discussed, as an extension of Patel's and Ottieno's results. Section 2.1 of the chapter considers the case when all factors are assumed to be defective with same prior probability. Section 2.2 discusses the case when different factors are defective with different prior probabilities. In fact, it has been proved that under quite general conditions, the expected number of runs needed to screen defective factors from non-defective ones in the case of screening with unequal prior probabilities is considerably smaller than that required in the case where all factors have the same prior probability of being defective. Through out the chapter it has been assumed that there are no errors in decisions.

In Chapter III, the three-stage group-screening design in which different factors are defective with different prior probabilities has been extended to the multi-stage design. Only the case when there are no errors in decisions has been discussed. It has been proved that any group-screening design with unequal prior probabilities will generally require a smaller number of runs than a corresponding design in which all factors are defective with the same prior probability.

Chapter IV discusses the three-stage group-screening design when there are errors in decisions. Section 4.1 of the chapter considers the case when all factors have the same prior probability of being defective. Section 4.2 discusses the case when different factors have unequal prior probabilities of being defective. In both sections the optimum group sizes have been determined by minimizing the expected total number of runs only, without considering the expected number of incorrect decisions.

Finally, in Chapter V, the optimum group-sizes have been determined taking into account both the expected number of runs and the expected number of incorrect decisions. Only the three-stage group-screening design in which every factor has the same prior probability of being defective has been discussed. A linear cost function in terms of the expected number of runs and the expected number of incorrect decisions has also been defined. This cost function has been optimized by proper choices of the group sizes.

Every group-screening design derived has been illustrated by a set of screening plans, which have been included in the thesis as appendices.

Most of the problems in this thesis have been solved using the ordinary calculus methods and numerical techniques such as differentiation, matrix algebra, Newton-Raphson iterative method etc.