IMPLEMENTATION OF MULTIPLE COMPARISON PROCEDURES IN A GENERALIZED LEAST SQUARES PROGRAM

by

MERVYN G. MARASINGHE
B.Sc., University of Sri Lanka, 1970

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Statistics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1977

Approved by:

Major Professor

TABLE OF CONTENTS

ILLEGIBLE DOCUMENT

THE FOLLOWING DOCUMENT(S) IS OF POOR LEGIBILITY IN THE ORIGINAL

THIS IS THE BEST COPY AVAILABLE

CHAPTER 1

INTRODUCTION

1.1 Statement of the Problem

The LEAST SQUARES ANALYSIS OF VARIANCE Program (LSQRS), which has been in consistent use for analysing designs with unbalanced data, could be more useful to experimenters and researchers if a procedure for multiple separations can be made available. This project has been undertaken to modify LSQRS to provide estimates of the standard errors and LSD's for differences of every pair of means.

There are two basic schools of thought regarding computational techniques to be adopted to analyse General Linear Models not of full rank. The classical way of attacking the problem has been the use of restrictions on the parameters to reparameterize the model to one of full rank, and apply the results of the full rank model. The problem of multiple separations in this case is not easy to handle and the generalization of the computing techniques is complex.

The more modern approach has been to use the results obtained for the General Linear Model of less than full rank directly in the computations. This involves the development of algorithms for the computation of the generalized inverse of matrices and also for conditions of estimability of parameters and testability of hypotheses that are easily computed and used in a program. These techniques are discussed in detail in BENTZ [1]. The method adopted herein is an attempt to use the reparameterized model for obtaining data necessary to use the results available for the model of less than full rank.

1.2 Contents and Goals of This Report

The goal of this report is to develop, program and implement algorithms which carry out multiple separations in the Least Squares program. The program uses restrictions on the parameters to reparameterize a less than full rank model to a full rank model. The proposed algorithm involves the construction of a matrix L, which is used to transform the non-full rank design matrix to the full rank design matrix obtained by the above mentioned restrictions.

The differences of the means, which are actually linear combinations of estimable functions of parameters, and their standard errors can then be estimated in terms of this matrix L and the inverse of the reduced sums of squares and cross-products matrix which is already available. This technique attempts to overcome the need for computing the generalized inverses and still use the results of the linear model of less than full rank.

Computation of estimates of estimable functions of the parameters requires the construction of vectors of constants. The proposed modifications contain routines for developing these vectors for every mean required to be analysed.

Chapter 2 contains a brief statement of the theory of the General Linear Model, in particular, the results which will be used in this report. Chapter 3 contains a description of the Least Squares Program and the reparameterization that is used in the program. The results used in the suggested modifications and how these are implemented in the program will be discussed in Chapter 4 while an example illustrating the computational techniques will be presented in Chapter 5.