ABSTRACT OF THESIS

Agnes M. Herzberg, Ph. D., On rotatable and cylindrically rotatable designs, University of Saskatchewan, Saskatoon, January, 1966. (Supervisor: N. Shklov)

The relationship between the dependent variable and the independent variables in a process can be analyzed by the technique of fitting a response surface. In order to estimate this relationship, a polynomial is fitted by the method of least squares to the data obtained from the experiments performed according to some experimental design. The subject of response surfaces is introduced by a general discussion. This includes an outline of the method of steepest ascent, the theory of aliases and blocking.

Response surface designs are said to be rotatable, if the variances of the estimated responses at all points equidistant from the origin of the design are equal. Draper gave a method for the construction of a second order rotatable design in k dimensions using a second order rotatable design in (k-1) dimensions. His work is presented along with a more general method for doing this. The two methods are compared and illustrated by examples. Two third order rotatable designs in four dimensions consisting of 72 points each are also presented.

Rotatable designs are rather restrictive and require the performance of a large number of experiments. Designs are developed which while preserving some of the properties of rotatability require the performance of fewer experiments. These designs have been called cylindrically rotatable designs of types 1, 2 and 3. They are such that the variances of the estimated responses at points on the same s-dimensional cylinder in k-dimensional space with certain characteristics are equal. These designs in k dimensions have the same properties as rotatable designs in s dimensions with the added advantage of enabling the experimenter to estimate the coefficients of terms of the polynomial involving the remaining (k-s) factors. Examples are given of each type of cylindrically rotatable design. Blocking of cylindrically rotatable designs is discussed. In order to show how a cylindrically rotatable design can be utilized, an analysis of variance is applied to a cylindrically rotatable design of types 1, 2 and 3, using fictitious data.