SUCCESSIVE PROCESSES OF STATISTICAL OPTIMIZING PROCEDURES

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1. Introduction

The purpose of this paper is to discuss some stochastic aspects of successive processes of controls in connection with optimizing procedures. Various optimizing procedures have been treated by several authors in connection with several different areas belonging to production processes. Thus the response surface analysis aiming to attain an optimal combination of levels of controlled factors was developed by Box, Hunter, and their colleagues [1], [2], and they advocate a certain method for proceeding from some starting point to the optimal point or its neighborhood. The evolutionary operations program introduced by Box [3], [4] has the feature of moving from a routine point of production conditions to a better point in the light of data to be accumulated during the production. The mathematical aspects of response surface analysis and evolutionary operations programs can be formulated more definitely than these authors [1], [2], [3] have done, and indeed we discussed certain mathematical formulations in our two previous papers [21], [22]. It is our viewpoint that, although not all our procedures in these areas can be given in mathematical formulation, there are certainly many situations for which, at least approximately, we can give a rigorous mathematical formulation of our procedure which will lead us to an objective criterion to judge how far our procedures are adequate and efficient.

On the other hand, the recent developments in automatic controls in the production process of plants of various industries are now raising various problems about optimizing procedures which can be defined objectively at least in their main aspects and hence can sometimes be described in mathematical formulations, so far as controlling procedures can be carried out by automatically controlled apparatus. Thus certain rules have been advocated in these areas for changing from a combination of the levels of factors to be controlled to a new combination of them, always aiming to become nearer to an optimal point and to attain it or reach a certain neighborhood of it as fast as possible, that is, with the smallest number of steps needed before realizing its aim. In this connection references can be given to numerous recent works such as Brown [6], Brandon [5], Cosgriff and Emerling [8], Gorn [10], Hooke and van Nice [12], and Lefkowitz and Eckman [25].