A FRESH LOOK AT THE BASIC PRINCIPLES OF THE DESIGN AND ANALYSIS OF EXPERIMENTS

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1. Introduction

When Professor Neyman invited me to attend the Fifth Berkeley Symposium, and give a paper on the basic principles of the design and analysis of experiments, I was a little hesitant. I felt certain that all those here must be thoroughly conversant with these basic principles, and that to mull over them again would be of little interest.

This, however, is the first symposium to be held since Sir Ronald Fisher's death, and it does therefore seem apposite that a paper discussing some aspect of his work should be given. If so, what could be better than the design and analysis of experiments, which in its modern form he created?

I do not propose today to give a history of the development of the subject. This I did in a paper presented in 1963 to the Seventh International Biometrics Congress [14]. Instead I want to take a fresh look at the logical principles Fisher laid down, and the action that flows from them; also briefly to consider certain modern trends, and see how far they are really of value.

2. General principles

Fisher, in his first formal exposition of experimental design [4] laid down three basic principles: replication; randomization; local control.

Replication and local control (for example, arrangement in blocks or rows and columns of a square) were not new, but the idea of assigning the treatments at random (subject to the restrictions imposed by the local control) was novel, and proved to be a most fruitful contribution. Its essential function was to provide a sound basis for the assumption (which is always implied in one form or another) that the deviations used for the estimation of error are independent and contain all those components of error to which the treatment effects are subject, and only those components. When a randomized design is used and correctly analyzed disturbances such as those arising from real or imagined fertility gradients in agricultural field trials, and the fact that neighboring plots are likely to be more similar than widely separated plots, can be ignored in the interpretation of the