

NOTES

This section is devoted to brief research and expository articles, notes on methodology and other short items.

THE DETECTION OF DEFECTIVE MEMBERS OF LARGE POPULATIONS

By ROBERT DORFMAN

Washington, D. C.

The inspection of the individual members of a large population is an expensive and tedious process. Often in testing the results of manufacture the work can be reduced greatly by examining only a sample of the population and rejecting the whole if the proportion of defectives in the sample is unduly large. In many inspections, however, the objective is to eliminate all the defective members of the population. This situation arises in manufacturing processes where the defect being tested for can result in disastrous failures. It also arises in certain inspections of human populations. Where the objective is to weed out individual defective units, a sample inspection will clearly not suffice. It will be shown in this paper that a different statistical approach can, under certain conditions, yield significant savings in effort and expense when a complete elimination of defective units is desired.

It should be noted at the outset that when large populations are being inspected the objective of eliminating all units with a particular defect can never be fully attained. Mechanical and chemical failures and, especially, man-failures make it inevitable that mistakes will occur when many units are being examined. Although the procedure described in this paper does not directly attack the problem of technical and psychological fallibility, it may contribute to its partial solution by reducing the tediousness of the work and by making more elaborate and more sensitive inspections economically feasible. In the following discussion no attention will be paid to the possibility of technical failure or operators' error.

The method will be described by showing its application to a large-scale project on which the United States Public Health Service and the Selective Service System are now engaged. The object of the program is to weed out all syphilitic men called up for induction. Under this program each prospective inductee is subjected to a "Wasserman-type" blood test. The test may be divided conveniently into two parts:

1. A sample of blood is drawn from the man,
2. The blood sample is subjected to a laboratory analysis which reveals the presence or absence of "syphilitic antigen." The presence of syphilitic antigen is a good indication of infection.

When this procedure is used, N chemical analyses are required in order to detect all infected members of a population of size N .

The germ of the proposed technique is revealed by the following possibility. Suppose that after the individual blood sera are drawn they are pooled in groups