NOTE ON TECHNIQUES OF EVALUATION OF SINGLE RAIN STIMULATION EXPERIMENTS

JERZY NEYMAN and ELIZABETH L. SCOTT
UNIVERSITY OF CALIFORNIA, BERKELEY

1. Introduction

The formulas used in our paper [1] its appendix and in [2], [3], are all based on the theory given in [4] and particularly in [5]. The deduction of these formulas is straightforward, but the formulas themselves are not familiar. Their description in the text of the three papers [1], [2], and [3] would have tended to disrupt the continuity of discussion of the substantive matters treated therein. Therefore, it was decided to compile the present note assembling all the formulas employed and also some extensions that may be useful.

All the techniques employed in our treatment of rain stimulation experiments are asymptotic techniques. In particular, the normal distributions of the test criteria were obtained under a passage to the limit as the number N of observations is indefinitely increased. As far as the distributions under the hypothesis tested are concerned, no special comments are needed. This is not so for the asymptotic distributions of the test criteria that lead to the approximate evaluation of the power of the tests. Here the passage to the limit, invented in 1936 [6], is somewhat peculiar: in parallel with increasing the number N of observations, the parameter ξ, characterizing the effectiveness of the treatment, is supposed to tend to zero so that the product $\xi N^{1/2}$ remains constant or, at least, tends to a fixed limit different from zero. Thus, in any particular case in which N is large and ξ small, the asymptotic formula for the power is obtained simply by equating the product $\xi N^{1/2}$ to its presumed limit.

As indicated in [5], this double passage to the limit, which is the basis of what we like to call the method of alternatives infinitely close to the hypothesis tested, while being useful in deducing optimal $C(\alpha)$ tests, provides simplifications of formulas for the asymptotic power which, in some cases, are too sweeping. In what follows, formulas obtained under this double passage to the limit will be described as the first approximation to the power of the tests. The method of obtaining the second approximation to the same power is also described in [5]. The passage to the limit used to obtain the second approximation is a more conventional one. It is based on the assumptions that ξ is fixed and that $N \to \infty$.

Prepared with the partial support of the Office of Naval Research (Contract No. N00014-66-C0036-G01; NR 307-303X).