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This trend seems likely to persist and intensify and so there will be an increasing number of investigations undertaken for which composite (or "response surface") designs will be most appropriate.

We suspect that there is also a trend to incorporate a greater number of factors in response experiments. If this is so, composite designs, because of their (economic and statistical) efficiency in dealing with several factors⁶, will come increasingly into prominence. By focusing attention on two-factor designs, Williams and Baker have circumnavigated the economists' major reason for advocating use of composite designs in agricultural research, namely that as the number of factors considered becomes large, composite designs provide the most economical and probably only feasible way of investigating response processes.

⁶ J. L. Dillon, *The Analysis of Response in Crop and Livestock Production* (Oxford: Pergamon Press, 1968), pp. 107-8.

REPLY

R. J. Williams and J. R. Baker

In their comments on our paper comparing factorial and response surface designs, Anderson and Dillon claim that the statement: "the best statistical analysis and the most reliable predictions will make use of as many techniques as are sensibly available" is both ambiguous and erroneous and is merely a matter of opinion. To us, this statement is neither ambiguous nor erroneous and is certainly not merely a matter of opinion, as any competent biometrician will verify. Anderson and Dillon's restatement is wrong in terminology in that they must surely mean "designs" rather than "models".

Anderson and Dillon claim that there are many potential research projects in which the most appropriate technique of statistical analysis will be regression analysis. This statement is irrelevant to the discussion in that they have completely ignored the fact that factorial analysis is done by regression analysis, and that factorial designs permit a "regression analysis" of the desired form. They claim that high-order effects are very seldom of any economic significance; however, surely any substantial 2-factor (and perhaps even 3-factor) interactions, whether statistically significant or not, are of vital economic importance.

The whole section "Flexibility of Analysis" in no way refutes any arguments we put forward—the simple, *non-arguable* fact is that factorials do allow a more flexible analysis and if we considered this (flexibility) *alone* we would *always* choose a factorial.

We have no quarrel with Anderson and Dillon's statements that all designs concentrate information in some region of the design, and that this means that an agricultural researcher must decide where to centre his design, etc. But we believe these statements are better expressed in more detail and in context in our discussion of "Information Contours" and in our "Conclusions".

In their Conclusion, Anderson and Dillon state that "it is clear from studies published . . . that there is a distinct trend . . . to the extended use of composite designs in agricultural research". If there is such a trend it reflects the situation two or three years ago. It is equally "clear" to us that if any such trend did exist then there is little sign of it now (for example, National Soil Fertility Project supervised by CSIRO and also research carried out by A.C.F. and Shirleys Fertilizers in Queensland).

Anderson and Dillon *suspect* that there is a trend to incorporate a greater number of factors in response experiments. Surely "suspicion" is no basis for argument. Statements such as "it is clear", "we suspect" should be collaborated by facts.

In their final paragraph it is claimed that we have circumnavigated the economist's major reason for advocating use of composite designs in agricultural research by focusing attention on two-factor designs. The two-factor example was used to illustrate as simply as possible the methods for comparison of statistical designs and was in no way intended to circumnavigate any arguments put forward by economists. One thing which particularly concerned us at the time of writing the paper was the recommendation by Dillon¹ of the use of a composite 3-factor design of 15 plots in place of a 3³ factorial of 27 plots. Surely no practising agricultural researcher would contemplate using only 15 plots in an experiment designed to investigate the response to 3 input variables.

¹ J. L. Dillon, "Economic Considerations in the Design and Analysis of Agricultural Experiments", this *Review*, Volume 34, No. 2 (June, 1966), pp. 64-75.