

# LETTER

## Reply to Comments of D. C. Crocker

Sir:

A complete, point by point discussion of Mr. Crocker's reaction to our two articles is neither desirable nor necessary. Insofar as his criticisms remain objective, we appreciate his comments [I&EC, 62 (6), 5 (1970)].

Our articles were written from the viewpoint of the chemist or chemical engineer with the practical need to make decisions based on the interpretation of his data. Our first article, "Would You Believe 99.996% Explained?" was based on an actual case history in which some of the follies of a proposed statistical analysis were illustrated by using randomly drawn numbers in the suggested scheme. Our second paper, "Pitfalls of Stepwise Regression" illustrates, also with numbers "drawn from a hat," the interrelationships among various common methods of statistical analysis. These articles were both written to help bridge the communications gap between the practicing chemist or chemical engineer and the statistician. It seems apparent that this effort was not 100% successful.

One or two specific points may deserve comment. With regard to the criticism of "picking the tallest person . . .," it should be pointed out that this is common practice when using this analysis, as implied by the name, *stepwise regression*. This is one of our principal objections to the procedure.

Further, we would paraphrase Mr. Crocker's statement about 99% of the problems being outside the pale of laboratory control by asserting that seldom can the solutions to real problems in the chemical industry be found by gathering up old data from the daily logs of the plant and running regressions on them. The EVOP techniques proposed by Box (1) represent an alternate (and orthogonal) method for determining

cause and effect relationships in a production plant.

We are grateful for the insight provided in the elucidation of the  $\alpha$  and  $\beta$  probabilities and we hope that other "statistical novices" will benefit as well.

One point should be made clear to our readers. If the "experiment" from the Pitfalls article had been presented as "real," dealing with such variables as temperature, pressure, catalyst concentration, etc., no fault would be found with the interpretation that the  $D$  variable showed an effect at the 95% confidence level while the other variables and interactions showed considerably less significant effects. There is no suggestion in the "data" themselves that they were not obtained from "real" experiments. Except for our assertion that the "data" resulted from random drawing, there is no basis for labeling the acceptance (or rejection) of the null hypothesis as correct or incorrect.

Thus, the dilemma of the experimentalist remains unsolved, in spite of Mr. Crocker's criticisms. On the other hand, we suggest again, perhaps still naively, that one can gain insight into the nature of a proposed analysis technique by making a "blank" run in the manner described.

### REFERENCE

- (1) Box, G. E. P., "Evolutionary Operation: A Method for Increasing Industrial Productivity," *Appl. Statist.*, **VI** (2), 1-23 (1957).

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Robert L. Gorring and Vern W. Weekman of the Systems Research Division of Mobil Oil Corporation and co-chairmen of the symposium, contributed the introduction. Chapter titles and the authors appear below:

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