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An account by S. Steinberg, C. F. Geffken, and W. K. Herrmann, in TAPPI, volume 46, pages 224-232, April 1963, stating that uncontrolled runs of presses (that is, runs in normal, commercial practice) are superior to controlled runs (statistically designed experiments), contains the basis for an important lesson in the design of experiments. The account must be accepted in two ways: (1) as an observed phenomenon, with an opinion worthy of respect; (2) a criticism of statistical design from an administrative point of view, which to me means that statisticians sometimes get out of their field.

Other examples are only too easy to find. A locomotive was subjected to many tests, and passed them all, only to fail on its first run, in a tunnel, where the grade and haul went beyond any of the ranges specified for the acceptance tests.

It has long been the practice of careful statisticians to obtain from the client (management, engineer, chemist) beforehand, in the design of an experiment, a list of the material subject to test, and a statement of what ranges of pressure, temperature, speeds, voltage, or other stresses the tests are to cover. These specifications are beyond the realm of statistical theory, and a careful statistician will not accept responsibility for them.

He insists, instead, and beforehand, that the client specify these fundamental requirements, as they form the basis of design, and the limitation of the inferences that, in the end, will be possible by use of statistical theory.

If controlled runs are not as good as uncontrolled runs, the fault is not one of statistical theory, but failure of design, chargeable to the negligence of both engineers and statisticians to know their fields and to know where their responsibilities lie. The statistician must depend on the expert in the subject-matter to know his business, just as the expert in the subject-matter must expect the statistician to know his.

Put together as a team, each taking on the responsibilities that he is fitted for, controlled runs will far excel in reliability and economy anything that can come from practice.

The statistician, as architect of the design of an experiment, has an obligation to explain to the people that he works with the advantages and disadvantages of including or excluding certain materials or product, and of extending or contracting the ranges of pressure, temperature, and other stresses that the tests are to cover.

He will explain, for example, that any statistical inference (estimates, tests of significance, charts) based on the results will refer only to the frame — that is, to the material and ranges specified as subject to test. Inferences beyond these ranges are not statistical; they will be the responsibility of the client, not of the statistician.

Incidentally, my use of the word client refers to anyone that the statistician works with. The principles of statistical practice are the same, I believe, whether the statistician is on a salary or is a private consultant.

Trouble and misunderstanding could be avoided, and greater reliability and economy achieved, if statisticians would insist on the above rules, dictated by principles of responsibility, which might, I suppose, be interpreted as principles of management. In my own practice, I have found it helpful to formalize the rules in a code of professional conduct, the aim being to lay a foundation on which the statistician and the expert in the subject-matter, representing the client, may contribute most effectively to a good job.

Editor's Note

Dr. Deming's note is written largely in the setting of an outside statistical consultant and his relation to an industrial organization. But the principles, of what statistics and statisticians can and cannot do, and of how they may best be used in experimentation, are applicable where all are employees of the same organization. Even though a single person may be competent in both statistics and the industrial or scientific area, it is well to keep the two complementary roles clear.

I quote below a few paragraphs from this code, which incidentally governs any engagement.

"(3.) An engagement with a client carries with it certain responsibilities. The reason for stating them explicitly is (i) to enable me to render better service; (ii) to forestall disappointment on the part of the client, who if he fails to exercise his responsibilities in the planning of the survey or experiment, may not realize in the end its fullest possibilities, or may discover too late that certain uses that he intended to make of the results are impossible.

"(4.) In summary, I will depend on the client for knowledge of his own subject-matter or business . . . any assistance that I offer does not involve me in decisions that the client is ultimately and rightfully responsible for, specifically:

"a. The type of statistical information that may be helpful on his problem.

"b. The methods of test, examination, questionnaire, or interview, by which to elicit the information from any unit selected for investigation.

"c. The decision on whether a proposed frame is satisfactory. In general, a frame is satisfactory to the client if it contains the people, areas, establishments, materials, parts, or other units that would satisfy his needs if the whole content were included in the study. The frame must also in some studies specify the levels or ranges of concentration, dosages, pressures, temperatures, speeds, voltages, or other stresses that the client certifies as necessary and sufficient.

"d. The decision on the

classes and areas of tabulation, as these depend on the uses that he intends to make of the data.

"e. The decision on the approximate level of statistical precision or protection that would be desirable in view of the purpose of the investigation, the skills and time available, and the costs of certain operations. I will offer assistance in this decision, to the extent possible, by explaining to him the procedure, predicted precision, advantages and disadvantages of various statistical plans that appear to be feasible (see paragraph 10b).

"(10.) In summary, my responsibility covers the statistical aspects of a study. Specifically, I will:

"a. Assist the client to formulate his problem in statistical terms, in an attempt to enhance the usefulness of the investigation.

"b. Explain to him the procedure, cost, and use of various possible frames, and of various statistical plans of sampling and of experimentation that seem to be feasible. Prediction of the precision that any plan will deliver is usually dependent on the information that the client furnishes in advance concerning the frame, and hence may differ from the actual precision delivered.

"c. Explain to him that the results of any survey or experiment may be impaired if a proposed frame and the experimental conditions specified by him fail to include all the material, methods, levels, types, stresses or ranges thereof concerning which he desires information.

"d. Explain to him that any objective inferences that one may draw by statistical theory

from the results of an investigation can only refer to the material in the frame, including the methods, levels, types, stresses, or ranges thereof presented for study:

that generalizations to other materials, methods, and conditions are substantive, and will be his responsibility.

"(22.) I will not recommend

to the client that he take any specific administrative action or policy as a result of the study. My responsibility ends with the statistical interpretation of the results."

