

Their usefulness much precedes and exceeds their measurability.

10. Reformulation in terms of Bayesian odds ratios will not rescue standard tail-area testing procedures, I believe. Such odds ratios for lower-dimensional hypotheses are problematic and prior-dependent. And whatever the relation between Bayesian odds ratios and real modeling issues, standard tail-area procedures will have to be transformed beyond recognition to become well articulated to either.

In usual F tests, $1/F$ has a pleasant interpretation as a shrinkage factor, at least in the balanced case, but this doesn't rescue P recognizably or interpret R-squared directly. (This interpretation is well known, I understand. I noticed it while reviewing Mosteller and Wallace (1964) for the Mosteller Festschrift, when working through the simple normal-theory counterpart of the difficult nonnormal shrinkage and discrimination problem that they solve.)

Rejoinder

Harry V. Roberts

I keenly appreciate the contribution of all the discussants. I have very few disagreements to record, and I have been stimulated to offer some extensions of the paper.

Dr. Deming says that the business of statisticians is to transform the company goals, not to help the management to pursue theirs. Thanks in large measure to his efforts, some companies have already transformed their goals, or are at least far along in the transformation. In these companies, statisticians need to ply their trade skillfully in pursuit of company goals, and to train parastatisticians.

Unfortunately, many other companies have not heard about, understood, or believed, the need for transformation. What do statisticians do when the organizational climate is bad, when management's goals are misdirected? (Dr. Deming once wrote me that the statistician may only prolong the life of a sick company.)

Some of my students, discouraged by the contrast between what goes on in their own companies and the advice of the Deming 14 Points, ask the same question. My first impulse is to say that it is a rare statistician in the middle levels of such a company who can do much to transform the organization's goals. But that is not a good enough answer. Since statisticians often have considerable freedom in defining the data and studies on which they work, they can help to educate management. They are free to suggest, for example, that it might be valuable to study quality, lead time and inventories instead of, or at least in addition to, machine utilization, cost variances and quota fulfillments.

George Box expresses my basic view of statistics in one golden sentence and one splendid metaphor. The sentence: "In my view, statistics has no reason for

existence except as the catalyst for investigation and discovery." The metaphor: teaching swimming by theoretical training alone, and the tendency of many statistics teachers to avoid getting wet.

Professor Moore's description of the U.K. situation bears many similarities with that of the United States. For example, what he says about the London Business School could be applied with only minor modification to the business school at which I teach; better use of basic statistics to improve quality and productivity is needed in the United States as well as in the U.K. and Europe; and upward mobility of accountants and lawyers is conspicuous in the United States (where Dr. Deming deplores "creative accounting" and calls litigiousness a "deadly disease").

My purpose in citing management books by Peters and others was not to endorse them in all details but to point out that statistics is but one component of a major management upheaval in many world class companies. By the regression phenomenon alone, it is to be expected that studies confined to successful companies at any one time will be embarrassed by problems encountered later by some of these companies. There's more to it than regression, however. Excellence in quality and productivity is no insurance against major management blunders in other areas, such as unfortunate acquisitions.

The mention of writers on management gives me the opportunity to cite a new book by Richard Schonberger (Schonberger, 1990) that carries the story beyond what I reported in my subsection "Beyond Parastatisticians" at the end of Section 3. The new book, *Building a Chain of Customers*, extends the focus from manufacturing to the entire business firm.

I do believe that work of Raiffa and Schlaifer (and, of course, that of Savage and de Finetti) is seminal.