AN EXAMINATION OF CREDIBILITY CONCEPTS

STEPHEN W. PHILBRICK

VOLUME LXVIII

DISCUSSION BY THOMAS N. HERZOG

I would like to congratulate the author for his valuable contribution to our knowledge of credibility. The expanded discussion of the Hewitt examples and the figures in the first part of the paper are instructive and easy to understand.

The purpose of my discussion is to expand upon some of the ideas raised in Mr. Philbrick's paper. None of my ideas are new. Yet, because of their overriding importance in insurance ratemaking, I believe it is worthwhile to present them here.

My remarks are intended to reinforce and extend Mr. Philbrick's remarks as well as to clarify a few of his ideas that might benefit from being expressed in another fashion. I will begin with a few general remarks about Bayesian statistics and credibility.

Bayesian statistics enables us to combine our prior experience with our current observations in a unified and formal framework and forces us to make explicit our model as well as the underlying assumptions. This makes it easier to describe ratemaking procedures to other technicians, if not to those with less technical backgrounds.

The basic concept of Bayesian inference is that the prior knowledge (i.e., distribution) is modified by the current observations to produce the posterior distribution. For insurance ratemaking this means that the prior distribution of the rate (or pure premium) for each existing insurance policy is modified by the current (i.e., most recently available) experience to produce the posterior distribution of the insurance rate so that the new rate may be determined. The precision of the new rate can be estimated by examining its posterior distribution. For example, a posterior normal distribution with mean 10 and variance 4 leads to more precise estimates than does a posterior normal distribution with mean 10 and variance 25. (I do not think Mr. Philbrick makes this point quite as

clearly as he might.) Currently, the risk loading in an insurance premium often is chosen to be proportional to the variance of the loss severity distribution (i.e., the probability distribution of the amount of loss on an individual claim). It may be preferable in the future to make the risk loading proportional to the variance of the posterior distribution of the pure premium since this relates to total losses during a policy period and incorporates the number as well as the amount of losses.

While Mayerson (1964) and Jewell (1976) show that, under certain conditions, the credibility formulas are exact Bayesian solutions (i.e., they are Bayesian conditional means), in other instances these formulas are just rough approximations. In addition, the concepts of full and zero credibilities are, of course, also just approximations, intended to make the life of the practicing actuary easier. When the actuary says the data are fully credible, he means that for practical purposes there is no reason to use a prior distribution because the weight to be given to the prior distribution would be almost zero. On the other hand, the actuary may have so little current data that he decides to give all the weight to the prior distribution and thereby avoids making computations having little or no impact on the result. We should add here that the Bayesian's focus is on the posterior distribution and this obviates the need for confidence intervals. In fact, Hogg and Craig (1970; Section 6.5) show how ill-conceived the notion of a confidence interval can be under certain circumstances. I don't know why Mr. Philbrick gets tangled up with confidence intervals rather than focusing on the posterior distribution.

Ideally, the actuary/Bayesian statistician should perform a full Bayesian analysis each time he calculates rates. There are, unfortunately, two potentially serious problems with this.

1. The construction of the posterior distribution may require calculations which are, for all practical purposes, impossible to carry out. For example, the composition of the appropriate (conjugate) prior distribution with the distribution of the observed data (i.e., the likelihood) may be a computational nightmare.
2. If the rate calculations (such as those in workers' compensation insurance) are to be understood and/or performed by a large number of nontechnical or semi-technical people, it may be completely unreasonable to expect them to follow the Bayesian procedure instead of the relatively simple credibility-based procedures now in existence.

While the potential problems listed above pertain currently, they may be of less consequence in the future. As the cost of computing continues to drop and as more people have immediate and easy access to high-powered computers, almost anyone may be able to input a few numbers, call a sophisticated computer program, and obtain rates in a few minutes or less. Thus, a complicated underlying procedure should be feasible.

Finally, I recommend that anyone with a serious interest in credibility read "A Survey of Credibility Theory" by Professor Jewell (1976). Of particular interest is his extension of the concept of credibility to "multidimensional credibility." I believe that this procedure, or something similar to it, has great potential for use in ratemaking. While the application of such procedures may be quite involved, the actuary must realize that he is dealing with difficult problems whose solutions may require a lot of careful thought. This is a challenge that actuaries must meet.

REFERENCES

1. R. V. Hogg, and A. T. Craig, *Introduction to Mathematical Statistics,* Third Edition, The Macmillan Company, New York, 1970.

2. A. L. Mayerson, "A Bayesian View of Credibility," *PCAS* LI, 1964.

3. W. S. Jewell, "A Survey of Credibility Theory," Operations Research Center #76-31, University of California, Berkeley, October 1976.