BOOK REVIEWS

M. J. GOOVAERTS and W. J. HOOGSTAD (1987). *Credibility Theory.* Surveys of Actuarial Studies 4. Nationale-Nederlanden N. V., Rotterdam. 114 pages + 1 diskette.

With the present book, the series Surveys of Actuarial Studies has reached its fourth issue, and the subject this time is credibility theory.

The book starts with some historical remarks and general ideas of credibility theory. As in earlier issues of the series, a nice diagram of the presented material gives the reader a lucid guideline to the book and credibility theory.

In Chapters 1 and 3 the classical model of Bühlmann is presented. Chapter 3 treats exact credibility. Chapters 4–9 are concerned with the Bühlmann–Straub model, the regression models of Hachemeister and De Vylder, semi-linear credibility, and hierarchical credibility. In Chapter 10 loss reserving and treatment of large claims are presented as applications of credibility theory. Finally, Chapter 11 is concerned with credibility for loaded premiums.

It is obvious that a survey like the present one cannot include every model and method of credibility theory, and a choice has to be made. However, when coming to the actual choice, every author and reviewer presumably has his own preferences. The present reviewer would have preferred the chapters on semi-linear credibility and the section on Esscher premiums replaced with chapters on Bayesian (i.e. subjectivistic) credibility and evolutionary models. Optimal semi-linear credibility seems to be of mainly theoretical interest. In the Esscher premium section one applies a loss function that does not seem to be appropriate, cf. Zehnwirth (1981). It would also have been better to drop the presentation of Zehnwirth's representation of the linear credibility model which seems more confusing than clarifying.

As to Bayesian theory, actuarial science is an area where pure and empirical Bayes philosophy should live together. In some mass branches an empirical approach is natural; in other branches the available information is so scarce that one has to rely on subjective judgement. Thus Bayesian credibility should be considered as an important part of actuarial science.

Evolutionary models allow for the intuitively reasonable idea that new data are more relevant than old, and such models should therefore be applicable in practical insurance.

The authors have aimed at giving the different models a uniform presentation, but the Bühlmann model is given a more extensive treatment to illustrate underlying principles. In most cases the authors have chosen to concentrate on the homogeneous version of the credibility adjusted estimators. For pedagogical reasons the reviewer would have preferred the inhomogeneous version as you then see more clearly the two-step nature of empirical credibility estimation. First you develop a linear Bayes method utilizing observations related to the relevant realizations of structure variables. As a second step you utilize collateral data to estimate the unknown structural parameters.

For most of the models, the data set from Hachemeister (1975) is used for numerical illustrations. The authors argue that using the same data set for all models makes a comparison useful. However, by using the same data, one ignores the fact that the model assumptions are different. The authors state that the Bühlmann model "can be recommended in case deflated claim amounts or loss ratios are used which do not exhibit a trend", but a few pages later they apply it on data showing a clear trend.

For the hierarchical model one divides the data set into two parts to be able to illustrate the model. However, it seems questionable to estimate structural parameters on a purely empirical basis with only two realizations of a structure variable; this would have been an excellent opportunity to illustrate Bayesian credibility.

Unfortunately, the authors often use confusing terminology. The term "credibility adjusted estimator" is applied for both homogeneous and inhomogeneous estimators. In the mentioned diagram, a column is called "structural parameters", but it contains *estimators* for structural parameters. Furthermore, the use of the term "model" is somewhat confusing. This is perhaps most lucid in the title of Chapter 8, "The De Vylder optimal semi-linear model"; it is the *method* that is semi-linear and optimal, not the *model*. In a survey paper, a clear and logical presentation is essential.

Unfortunately, no general definition is given of a "credibility adjusted estimator". Thus it is not clear why the credibility adjusted estimator M_{pj}^a in the hierarchical model does not have the usual form with N_p^a instead of X_{pjw}. A general definition combined with a presentation of the normal equations would have helped the readers to understand the special cases.

In several places the presentation seems too uncritical and unbalanced. In this review, we have already mentioned Zehnwirth's criticism of credibility premiums with the Esscher principle; this is not touched in the book. Gerber's "unbayesed" approaches have been referred to without mentioning the severe criticisms that have been raised against these approaches. It can be argued that broad discussions would be beyond the scope of the survey, but then it would have been better to have dropped the disputable material, which cannot be considered as central.

Estimation of structural parameters is discussed for most of the models presented. It could have been mentioned that some of the estimators can produce negative estimates of variances. The reviewer is somewhat sceptical when the authors talk about unbiased pseudo-estimators; that $Ef(X, a) = a$ for a random vector X and a parameter a, does not necessarily imply that a^* satisfying $a^* = f(X, a^*)$ is an unbiased estimator of a. Analogously, a statement about minimum variance of a pseudo-estimator seems questionable.

The book is supplemented with a diskette with PC programs for the presented methods. The programs are given in both IBM APL, Version 1.0 and STSC APL, Version 6.0. To include the diskette is an excellent idea, but it would have been even better if the algorithms had been programmed in a compiled language. As it is, one needs an appropriate APL interpreter to run the programs. The

reviewer's competence in APL is fairly vague, and he will therefore abstain from comments on the programs.

The reviewer has enjoyed reading earlier Surveys of Actuarial Studies, and he was very much looking forward to the present one as credibility theory is one of his favourite topics. However, this time he was disappointed. He has chosen to go so much in detail in this review as he finds that some of his comments might be of interest beyond the evaluation of the book. Several other questions of principal nature could be discussed on the basis of it, but that would be beyond the scope of a review. In this respect the reviewer has benefited from reading the book. However he would not recommend it as an introduction for a novice to the subject.

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REFERENCES

HACHEMEISTER, C. A. (1975). Credibility for the regression model with application to trend. In *Credibility: Theory and Applications* (ed. P. M. Kahn), pp. 129–163. Academic Press, New York.
ZEHNWIRTH, B. (1981). The Esscher premium principle: A criticism. *ASTIN Bulletin*, **12**, 77–78.

S. T. PRITCHETT and R. P. WILDER (1986). *Stock Life Insurance Company Profitability and Workable Competition*. Huebner Foundation Monograph No. 14, IX. S. S. Huebner Foundation for Insurance Education, University of Pennsylvania. 77 pages, $17.95.

The central theme of this monograph is the workability of competition in the U.S. life insurance industry. In order to clarify this issue S. T. Pritchett and R. P. Wilder analyze the market structure, industry conduct and industry performance. They argue that barriers to entry are relatively low and that the degree of concentration has decreased continuously during the last thirty years. On the other hand, the authors point out that price competition may be hampered by the fact that individuals are hardly able to compare complex policies. Finally, the profitability of the U.S. life insurance industry is analyzed in detail. S. T. Pritchett and R. P. Wilder conclude that the profitability of stock life insurers is similar to the level of profits in other industries. According to the authors there is strong evidence of workable competition but no conclusion is possible with respect to production efficiency.

This study can be recommended to everybody who is interested in a financial analysis of the U.S. life insurance industry. In addition, profitability data, institutional facts and a detailed list of references are highly informative.

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