

BOOK REVIEW

Foundations of Casualty Actuarial Science: Published by Casualty Actuarial Society, One Penn Plaza, 250 West 34th Street, New York, NY 10119. 584 pages. \$65. — (overseas \$97.50).

From the Preface of *Foundations of Casualty Actuarial Science*:

This landmark book is the first published, complete text containing the fundamentals of casualty actuarial science as practiced in North America. It is intended as an introduction to casualty actuarial concepts and practices. Its target audiences are members and students of the Casualty Actuarial Society, university and college students, plus insurance and general business professionals with a need for basic knowledge on these subjects.

In designing the textbook, the Casualty Actuarial Society concluded that the readership would be best served by having each chapter written by an expert in the topic covered by the chapter. Therefore, each chapter is individually authored and the styles and organization vary somewhat. The chapters reflect the views of the individual authors and the content should not be considered as the official opinion of the Casualty Actuarial Society.

Those two paragraphs in the preface make it clear why reviewing the book *Foundations of Casualty Actuarial Science* is a difficult task for the reviewer as well as the reader. The ambitious specification of its aim, the wideness of its target audience, and the distribution of tasks among nine individual authors, set the book apart from the more usual one-author, one-topic, one-audience textbooks. A separate review of each chapter will be given.

Introduction, by Matthew RODERMUND

In his introduction, the author recounts the history of the Casualty Actuarial Society from its beginnings in 1914. In his presentation, the history of CAS is inextricably interwoven with the development of Credibility Theory in North America. Thus the reader also finds a fascinating survey of the events leading to early applications of credibility theory, and its subsequent study and development. Special attention is given to the work of Albert H. Mowbray, Albert Whitney, Arthur Bailey, Laurence H. Longley-Cook, Allen L. Mayer-son, Charles C. Hewitt; the contributions of several others are also mentioned including, of course, the work of Hans Bühlmann. Surprisingly, the work of William S. Jewell and Charles A. Hachemeister is not mentioned.

Matthew Rodermund takes a rather narrow view of casualty actuarial science, equating it, essentially, to the study of credibility theory. He is critical of risk theory which, in his words, still stands on the shoulders of credibility.

He is also very critical of “classical statistical theory”, as opposed to the Bayesian discipline of credibility.

Ratemaking, by Charles L. McCLENAHAN

The author of this chapter shows how one can perform a review of manual premium rates within the constraints of a given rating structure. Basic terminology is introduced and explained. Different approaches to the derivation of rates are presented, and special attention is given to the calculation of on-level premium (the level of current premium which is equivalent to a certain amount of statistical exposure). The necessity of projecting ultimate losses of immature accident years, and “trending” those to reflect the expected ultimate losses of future periods, is emphasised, and a technique for doing so is illustrated with a simple example. The effect of limits on severity trends is illustrated. The inclusion of loadings for expenses, profits and contingencies is discussed.

After overall rates have been determined, classification relativities must be found. A procedure for doing so is illustrated briefly with an example. Finally, any premium off-balance created by the classification relativities must be corrected for.

A worked-through example of a rate review for a fictitious auto insurance company is given as an appendix. This chapter also has a few pages of questions for discussion.

The author offers no model to explain the relationship between risk exposed and the generation of claims, or the difference in claim propensities between classes. Little guidance is given for the calculation of a class relativity, when the class exposure is small and data credibility is low.

For ratemaking at the overall level, this chapter contains much useful advice for a novice. Especially the emphasis on projecting and trending the ultimate losses of immature years, is timely (unfortunately, there are still insurance companies who base their rate decisions mainly on the loss ratio in last year's income statement).

Individual Risk Rating, by Margaret Wilkinson TILLER

This chapter discusses individual premium rating for large entities, or entities of special character (e.g. a Roller Skating Rink Risk Retention Group). Methods of individual risk rating are classified into Schedule Rating (adjusting a manual rate with discounts or loadings for observed risk factors), Experience Rating (adjusting next year's premium on the basis of previous years' loss experience), composite rating (experience rating using a composite exposure base for large, complex risks), and retrospective rating. Of each rating method, an example from real life is provided. The considerations necessary in designing an individual risk rating scheme, are mentioned and discussed.

Loss Reserving, by Ronald F. WISER

One of the major tasks of any practicing casualty actuary is the determination of loss reserves.

The author starts with giving an overview of accounting concepts and the place of loss reserves in corporate accounting. The tasks of a claims department are described lucidly. An actuarial model for loss development is set forward (I found that model hard to comprehend, but it is not used in what follows). The author then defines the necessary loss reserving terminology. Some questions of data availability and organisation are discussed; the estimation strategy must take the peculiarities of the data into account.

The author then offers a variety of angles from which to view loss development data in a preliminary, exploratory data analysis. Such an analysis is useful for detecting irregularities in respect of certain accident years. As far as I could see, the possibility of irregularities for calendar years is not mentioned. I also missed a formalised analysis of paid (or incurred) losses relative to the risk exposed; the amount of risk exposed is only verbally invoked as an explanatory variable.

The basis of the loss reserving method discussed in the next section is the chain-ladder method. The author explains how the raw, chain-ladder estimates can be adjusted judgementally, to dampen the effect of abnormal years. This method is applied both to paid loss development, and reserve development.

The Bornhuetter-Ferguson method is offered as a way of smoothing the estimated ultimate loss amounts, when data is sparse or very irregular.

The author then discusses the estimation of loss adjustment expenses, the incidence of which can follow a different pattern from paid or incurred losses. The necessity of comparing actual and predicted claims development is mentioned and discussed. Reserve discounting is mentioned only very briefly.

The author does not discuss the estimation of claims covered, but not incurred, or the idea of a premium deficiency provision. No way of assessing the uncertainty of the estimates is given.

Risk Classification, by Robert J. FINGER

Robert J. Finger discusses criteria for selecting rating variables, taking into account actuarial, operational, social and legal considerations and constraints. The need to classify risks, in order to prevent adverse selection, is thoroughly explained¹.

A detailed description of Motor Vehicle rating structures is given, while rating structures for other lines of business are only sketched. The author then presents a measure of efficiency of a rating structure, in a section which I found hard to comprehend. The estimation of class relativities is briefly discussed. The choice between an additive and a multiplicative rating structure is mentioned.

¹ While lecturing on the same topic, the reviewer was recently asked by a student why insurance companies would want to charge anyone a lower premium... weren't they interested in earning as much money as possible?

The discussion of credibility estimation for classes with small exposure is very general, emphasising the need to find a reliable and appropriate “credibility complement” (i.e., the term following the $(1 - z)$). No model is given to help the actuary in finding a credibility complement.

Reinsurance, by Gary S. PATRIK

In his introduction, the author explains the nature of reinsurance, its objectives, different reinsurance forms, cost considerations to the cedant. A thorough treatment of reinsurance pricing is given. Pricing formulae are derived under the assumption of pareto or lognormal claim size distributions (or their censored counterparts, for loss degrees). The peculiarities of all the common forms of reinsurance are discussed in detail.

Gary Patrik has also included a section on reinsurance loss reserving. The problems encountered in estimating the outstanding losses of a reinsurer, are recounted and explained. A general procedure of attacking the estimation problem is sketched, which begins with partitioning the data into meaningful blocks of reasonably homogeneous contracts. The chain ladder and Bornhuetter-Ferguson methods are given as possible estimation tools.

This chapter is the first one in this book which formally takes stochastic variation into account. The properties of the pareto and lognormal distributions, and the aggregate loss model, are given in an appendix.

In my opinion, Gary Patrik has written an excellent treatise on reinsurance, an area which is notoriously difficult to describe comprehensively, and comprehensibly.

Credibility, by Gary G. VENTER

Charles C. Hewitt has written the prologue and postlogue for Gary Venter's chapter on Credibility. Both are a defense of Bayesian estimation and its linear counterpart, credibility.

Gary Venter, in his introduction, discusses alternative ways of viewing the prior distribution in credibility theory, mentioning both the frequentist and the formal view. He gives a short outline of the history of credibility theory. A review of the necessary probability theory is given, including: several lucid examples of the use of Bayesian inference outside insurance, a discussion of diffuse priors, the NP approximation to the aggregate claims distribution. The limited fluctuation approach to credibility is briefly outlined.

The least squares approach to credibility is then introduced, using the Bühlmann model. Estimation of the structural parameters is discussed within that framework, including the correction needed to make the estimated credibility factor unbiased, and Bayesian estimation of the credibility factor.

The next section is on incorporating risk size, giving the Bühlmann-Straub model. Empirical and Bayesian estimation of the credibility factor is discussed.

The last section is on assessing the linearisation error incurred when the unrestricted Bayes estimator is replaced by a credibility estimator. The author uses the example of a lognormal distribution with a lognormal prior.

A survey of further topics is given. In an appendix, the properties of a great number of distributions are tabulated, including an overview of less well-known pairs of conditional distribution/conjugate prior.

Though this chapter does not pursue credibility theory to its utmost generality, it mentions a number of interesting aspects (e.g., linearisation error), which other textbooks do not address explicitly.

Investment Issues in Property-Liability Insurance, by Stephen P. D'ARCY

The author discusses the role of investment income. He begins with an overview of the common assets (bonds, equities, real estate, others) and their peculiarities. Investment and tax strategies are then discussed. The former are of general interest, while the latter will be of most interest to actuaries practicing in the U.S.A. Different measures of the rate of return of an insurance business are presented, including combined ratio, underwriting profit margin, operating ratio, return on equity, and the effect of discounting losses. The impact (practical and statutory) of investment income on pricing is discussed, including use of the CAPM.

Special Issues, by Stephen P. D'ARCY

The following topics are briefly discussed in this chapter: measurement, allocation and uses of surplus; insurer solvency issues, including NAIC Early Warning tests and other rating systems, and guarantee funds; the risk theory approach to insurer solvency; planning and forecasting; sources of industry data and forecasts.

While not giving any detailed guidance for work in any of these areas, the chapter outlines the considerations which will have to be made.

General Review

For a long time, stochastic modelling was most prominent within casualty insurance. Only recently has the stochastic approach to life insurance been "officially" sanctioned by the publication of the Society of Actuaries' textbook *Actuarial Mathematics*. Even while it was being taught in a deterministic framework, the theory of life insurance offered techniques and equations of wide applicability, explanatory value and considerable elegance.

Casualty actuarial "science", as described in *Foundations of Casualty Actuarial Science*, lags several evolutionary steps behind life actuarial science, as expounded in *Actuarial Mathematics*. Not only is a deterministic view taken throughout most of the book (all but two chapters); it also lacks the unifying theory, model framework and other paradigms, which are the hallmarks of a true science.

On the other hand, the book gives a comprehensive overview of the tasks which may be asked of a practicing casualty actuary, and how one may attack them. It has a great deal of useful advice for the novice. In particular, it explains most of the concepts and the terminology of casualty insurance, and discusses their application. As a source of practical inspiration, the book can be recommended.

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