TFA 39 (1984-1986) 421-425

REVIEWS

Loss Distributions

by

ROBERT V. HOGG and STUART A. KLUGMAN

(John Wiley and Sons)

This book is concerned with individual losses from insured events such as motor accidents or thefts from private dwellings. As such it is clearly related to risk theory but whereas classical texts on risk theory assume at the start that both the distribution of the number of insured events in a specified time interval and the distribution of the amounts of individual losses are known and then go on to develop the mathematics of the subject, Loss Distributions by Hogg and Klugman deals with the preliminary statistical problem of fitting probability distributions to the data on individual loss amounts.

In many practical situations a considerable amount of such data will be available but the authors argue strongly in favour of fitting a distribution to the data rather than using the raw data itself and even go so far as to say on page 12, "The actuary . . . is urged not to fall victim to the deadly trap that "raw" data are most expressive of the true loss process." (The authors do concede on page 157 that ". . . in many cases we have a large number of small losses, but little information about the tail. In such cases it may be reasonable to use the empirical distribution as is for the small losses and then to fit a . . . model in the tail.") The principal argument used by the authors to support the fitting of distributions appears in the following two paragraphs on pages 11 and 12:

"The settlement process with respect to indeterminate and partial losses tends to produce a clustering of values about particular numbers. For example, claims adjusters have authority to settle losses up to and including $1,000; above that amount they must refer the matter to a supervisor. This situation often results in a clustering of loss values at or just below the maximum authorization point — in this case $1,000. The reverse side of this is the relative absence of loss amounts just above the point of maximum authorization. Also, human nature tends to think in terms of round numbers. An insured is much more likely to settle a loss for $500 than $494.67 — and so is the individual claims adjuster!

"Policies with deductibles or limits tend to be susceptible to this type of distortion. In automobile collision claims it is not uncommon for the repair bill to be escalated as the amount approaches the deductible amount from below. However, there are contraphenomena. Insureds may be reluctant to report or press claims when the amount recoverable after application of a deductible is small ... At the other end of the size-of-loss spectrum adjusters frequently are willing to settle at or just below policy limits when it is clear that a claim if pressed to adjudication might substantially exceed those limits."

The authors then claim that where the raw data are distorted in these ways, the effects of, for example, inflation and or changes in deductibles or policy limits are better assessed using a fitted distribution.

Chapter 1 is an introductory discussion, on a very practical level, of the subject matter of the book. Chapters 2 and 3, which together represent one half of the book in terms of the number of pages, contain the theoretical material to be used in the later chapters. The reader is warned in the Preface that a reasonable prerequisite for the understanding of this work is a substantial undergraduate course in mathematical statistics and this warning should be taken seriously.

The most important chapter in the book is Chapter 4 where distributions are fitted to five sets of "real" insurance loss data. These sets of data relate to:

(i) damage due to hurricanes
(ii) fire and theft claims under home owners policies
(iii) sickness insurance
(iv) automobile bodily injury
(v) hospital malpractice cases.

These examples illustrate problems due to clustering of values, the grouping of data and the censoring of data by not recording losses above or below certain amounts. In most cases preliminary estimates of the parameters of the chosen distribution are made using the method of moments or percentile matching and then the distribution is fitted by the more sophisticated methods of minimum distance, minimum chi-square or maximum likelihood. Considerable detail is provided about the fitting of the distribution even to the extent of giving the addresses of the institutes who supplied the computer routines used by the authors.

Chapter 5 extends the examples studied in Chapter 4 by showing how the fitted distributions could be useful in practice.

In particular it gives examples relating to the effects of inflation and the effects of changing policy deductibles and policy limits or, equivalently, of changing reinsurance limits.

Few if any books of this type are free of minor misprints and this book contains one in the first line of page 202 (a factor z has been omitted from the integral). However, this minor error is a little unfortunate since it induces the authors to make the false statement (in the middle of page 202) "... raising the (policy) limit to "keep up" with inflation produces a new pure premium ... which is strictly less than the old pure premium increased by the inflation rate." This statement implies that if X is a positive random variable representing an individual loss from an insured event, if u is a positive number representing the maximum amount the insurer will pay on any one loss (so that the insurer will actually pay min (X, u)), if r is a rate of inflation so that a loss in the coming year can be represented by $(1+r)$X, then

$$\mathrm{E}[\min((1+r)\mathrm{X}, (1+r)u)] < (1+r)\mathrm{E}[\min(\mathrm{X}, u)].$$

However it is easily seen that the two sides of the above inequality are always equal to each other.

This book is primarily aimed at people working in non-life insurance and it will undoubtedly be of interest to such people. More generally it should be of interest to anyone interested in applying statistical techniques to insurance problems; it is worth noting that the third example in Chapter 4 would normally be regarded as belonging to life rather than non-life insurance. It is also worth noting that The Report of the Committee to Review the Structure for Education and Training (the Kennedy Report) published by the Faculty of Actuaries and the Institute of Actuaries in June 1984 refers on pages 39 and 51 to the possibility that statistics subjects in the actuarial examination syllabus could be restructured to include more advanced and specialised techniques. Loss Distributions by Hogg and Klugman could be a useful source of material for any person or group of people involved in designing such a syllabus.

H.R.W.

Actuarial Mathematics

by

N. L. BOWERS, H. U. GERBER, J. C. HICKMAN, D. A. JONES and C. J. NESBITT

(Society of Actuaries, Itasca, Illinois, USA)

The actuarial profession in North America originally relied on the textbooks published in the United Kingdom, and the Society of Actuaries reading on Life Contingencies included King and then Spurgeon. In 1952 however the Society published their own text, Life Contingencies by C. W. Jordan, thus replacing Spurgeon at about the same time that Hooker and Longley-Cook became the reading for the Faculty and Institute.

The new Society textbook, which is the subject of this review and whose title is perhaps less explicit than is desirable, has not yet been published as a whole but the text of what is to be Volume I and some of Volume II is available in the form of three paperback typescript study notes. One of the notes (Chapters 3 to 10) covers much the same ground as some of Jordan (or our current textbook, Neill) with other notes covering an introduction to the subject using the probabilistic rather than the deterministic approach — Chapter 1 introducing utility theory, and Chapter 2 discussing individual short term risk models. It is explained in Chapter 0 (the preface) that this different approach is being used because some concepts used in building the original foundation of actuarial science are now part of a general mathematical education so that it is necessary to recast basic models in the language of contemporary mathematics. The differences in approach, however, do not seem particularly significant in the main part of the text although it is probably as well to remind the student that it is better to think of the "answer" as the expected result of a probabilistic model rather than the result of a deterministic model. The method of approach has probably been influenced by the academic background of the authors, most of whom are professors in various university actuarial departments and given the likely differing views on what should be included and emphasised it is probably quite a feat that a text has resulted at all! However it is noteworthy that it is only the death risk of other contingencies which are treated in a probabilistic way when it is the interest function which in practice is probably more variable.

It is also interesting that despite the extraordinary growth in

computer methods even since the most recent UK textbook was published that commutation functions are still to be part of the actuary's techniques and in fact no computer programs or exercises specifically requiring such are included.

With expense considerations and with profit contracts (which in the American context means dividend systems) to be covered in Volume II there is perhaps nothing particularly Transatlantic in the material that will be published in Volume I and could be interesting for a student with sufficient time for further reading, although the solved examples and exercises for practice, of which there are a valuable number, are perhaps orientated towards the Society's multiple choice approach rather than the style of questions in our domestic examinations.

A.N.