

to the general public. Many Blue Cross—Blue Shield plans are issued to the employees of individual organizations and this study is concerned with modifying the rates charged to the employees of an individual organization to reflect the experience of such employees.

*Addresses and Reports*

This volume of the Proceedings contains the following addresses and reports:

Accreditation of Actuaries	Reinhard A. Hohaus
A Casualty Actuary in Europe	Paul Johansen
ASTIN Colloquium at Rättvik	Norton E. Masterson
Committee to Cooperate with the International Cooperation Adminis- tration	Frank Harwayne

L. H. Longley-Cook

*The Causation of Bus Driver Accidents* by W. L. CRESSWELL and P. FROGGATT, Oxford University Press, 1963.

Ever since Greenwood and Woods presented their paper on the incidence of industrial accidents (ref. 1) the interpretation of accident statistics has been a topic of controversy amongst those concerned with the interpretation of the data and those concerned with administration of the environment in which the accidents arose. In particular the pattern of accidents among drivers of motor vehicles has been an ever growing topic of argument, whether from those concerned with the determination of premiums and management of portfolios of motor insurance or from legislators concerned with road safety and the welfare of the population.

Much of this argument has been developed from the fact that one model which gives rise to the commonly occurring negative binomial distribution for the distribution of accidents is a combination of a gamma distribution (for the distribution of "accident proneness" in the population) and a Poisson distribution (for the distribution of accidents). The finding of a negative binomial has been accepted as evidence of accident proneness and it has been all too readily assumed that the population can be divided according to such a characteristic.

Unfortunately, despite many efforts, most careful investigators have failed in their search to find features which correlate with the so-called accident proneness. In recent years the study by Hakkinen (ref. 2) on public service vehicle drivers in Helsinki provides one of the best reviews of the problems involved, the results of which can be broadly (and perhaps a little unfairly) summarised by observing that correlations of accident experience with experimental tests only become significant when the tests become as complex as the environment of the accident!

Nevertheless the question is important for motor insurers, and some of the discussions on the principles of no claim bonus have involved the assumption of a proneness concept when heterogeneity was a sufficient concept

for the purpose in view. Thus a rating structure, to be commercially convenient will only take care of some of the risk variation. The classification groups will almost inevitably be heterogenous in regard to some aspect of the exposure to risk (e.g. mileage) and it is therefore not surprising that observations of the accidents arising from the group are described by a compound Poisson rather than a simple Poisson distribution. The question whether the no claim bonus system is fair i.e. the extent to which it penalises the bad driver as distinct from the unlucky driver, is another question, equally productive of marked differences of opinion.

The appearance of another record of carefully controlled experiments in the accident experience of public service vehicle drivers, this time in Northern Ireland, shows that the topic is still very real and anyone interested in the subject should read this new book, which provides some extensive new numerical data, an excellent and critical study of a great deal of the earlier important work as well as some new ideas on the genesis of accidents. References include papers published up to 1962 and the coverage is thus very much up to date.

The raw material of this study consists of accidents occurring when the drivers concerned were in charge of the vehicles, and excluded those to passengers and those occurring to a stationary untended bus. Broadly speaking the driver population was those in continuous employment throughout the period of the study (1952-5). The data was carefully analysed according to various external factors e.g. routes covered and then according to age and experience. This latter investigation leads the authors to comment ". . . both age and experience had independent effects on the accident rate of the drivers studied. Without a cohort study or a planned prospective investigation it would be imprudent to draw firm conclusions, although it would appear reasonable to postulate these factors as influencing the accident rate *throughout* life and acting additionally to produce a U-shaped curve of the accident rate through time".

Having thus set the stage the authors then introduce the various models with which they analyse the data. These consist of the Poisson and the compound Poisson (negative binomial) and two distributions which the authors describe as the Long and the Short. The model for the Long distribution, which they show is equivalent to the Neyman type A is derived by postulating that every driver is liable to "spells" and that no accident can occur outside a spell. The spells are assumed to be rare events, occurring at random, with equal probabilities for all drivers. The chance of an accident occurring within a spell is assumed to be constant. In the Short distribution it is additionally assumed that there is at all times a constant probability of "chance" accidents. For the data concerned the Long distribution shows a slightly better fit than the negative binomial, and the Short distribution slightly worse, all three being satisfactory when tested by  $X^2$ . Mathematical properties are described in an appendix.

The authors then deal with the question of correlation between accidents in successive periods. These are small and positive and are rightly treated with considerable reserve. A short chapter on the time interval between successive accidents leads to some thoughts on repeaters which are summarised by the authors in the words:—

"If the straight choice lies between reckoning

1. that any individual incurring, say, six accidents was indeed liable to have six accidents in *that environment and at that time* or
  2. that an individual incurring six accidents implies that he is inordinately subject to a particular degree of accident proneness
- then on the evidence the correct choice is more likely to be the former”.

Attempts were made to try and find physical or psychological factors with which the accident experience of the drivers could be correlated. The results of the various experiments can be briefly described as inconclusive.

The numerical fitting of the “short model” leads to estimates of the chances of accidents arising within “spells” and of those occurring at any time. It is shown that the “spells” accidents which might be considered as “personal” showed a constancy over the different groups comprising the Northern Ireland experiments but figures derived from the Helsinki data were also of a similar magnitude. The “chance” accidents, which might be looked upon as environmental, showed variations which are reasonable compared with the known facts. Whether this interpretation is the true one or not remains to be seen, but the hypothesis is interesting and suggestive of possible lines for future studies.

The authors find that the evidence for “accident prone” drivers in their study is slight and their final words, after suggestions for further research are “Tendency to accident is a hazard of living”.

Altogether an interesting and stimulating book, with some new ideas and much material for experimental studies.

- ref. 1. Greenwood, M., and Woods, H. M. (1919). A report on the Incidence of Industrial Accidents upon Individuals with Special Reference to Multiple Accidents. Rep. Industr. Fat. Res. Bd. London, No. 4.
- ref. 2. Hakkinen, S. (1958). Traffic Accidents and Driver Characteristics. A Statistical and Psychological Study. Helsinki: Finland's Institute of Technology, Scientific Researches, No. 13.

R. E. Beard

*Sul calcolo dei premi nell'assicurazione danni* by BRUNO TEDESCHI, *Giornale dell'Istituto Italiano degli attuari*, Rome 1960

The author first derives the basic formula for insurance of property damage  $\left(\int_0^{\infty}\right)$  and then derives the excess loss reinsurance premium by first introducing an upper limit  $M \left(\int_0^M\right)$  and then choosing a net retention  $\lambda \left(\int_{\lambda}^M\right)$ . He then proceeds to show that the reinsurance premium  $\left(\int_{\lambda}^M\right)$  depends to a large extent on the procedure followed in grouping the statistical data for a claim distribution, whereas the basic premium  $\left(\int_0^{\infty}\right)$  is not so dependent.